NURSING PROCEDURES AND INTERVENTIONS

TEXTBOOK FOR BACHELOR'S AND MASTER'S DEGREE PROGRAMMES

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1. INTRODUCTION

Dear Students,

You are now in possession of this comprehensive textbook on nursing procedures and interventions for the Bachelor Study of Nursing and the Master's General Medicine study programme.

An integral part of the training required for both study programmes is the teaching of practical skills required for further study and for the subsequent profession of a doctor or a nurse. The theoretical, preclinical preparation addressed in this textbook should create the conditions for the effective practice of nursing procedures and interventions under laboratory conditions and subsequently in clinical practice, while also reducing the risk of inappropriate or improper nursing procedures and patient interventions during further study. In addition to the practical exercises under laboratory conditions, the study of this textbook should contribute to the smooth transfer of nursing procedures and interventions from preclinical preparation through to clinical practice while internalizing the key skills required for the healthcare profession and general nursing.

The textbook contains descriptions of over 40 basic nursing procedures and interventions, supplemented by extensive photographic and tabular material. The majority of the chapters have a set structure. The introduction addresses the purpose of the procedure / intervention with the conditions for administering these. This is followed by a description of the procedure, post-surgery patient information and post-surgical equipment care. Further on in the chapter, are descriptions of post procedural complications and risks and methods for prevention. The end of each chapter or subchapter is dedicated to check questions, which will enable you to independently verify the level of your knowledge of the subject studied.

It is very difficult to put together a textbook of this type. The publication does not only contain a statistical summary of findings, as is customary in traditional textbooks, but also primarily describes the dynamic activities required for administering individual nursing procedures and interventions. For this reason, the book is accompanied by further electronic study materials with multimedia features, including video recordings of the majority of the nursing procedures and interventions, published on the educational portal of the Czech and Slovak Faculties of Medicine, MEFANET.

The publication is the result of professional literary and journal resources and our own medical service. Each nursing procedure (or intervention) was assessed by field professionals, doctors and nurses, and its feasibility was tested in practice. We would like to thank all the assessors from the University Hospital Motol for their valuable advice and input to the text prepared by us. We would also like to thank doc. PhDr. Lada Cetlová, PhD and PhDr. Jana Haluzíková, PhD for their kind assessments and reviews of this book.

Finally, we hope that our textbook will become appropriate study material and be used in the preparation of nursing examinations and that it will become your resource for further study and subsequent practice.

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2. HYGIENE REQUIREMENTS FOR THE OPERATION OF HEALTHCARE FACILITIES

Chapter objectives:
After studying this chapter, you should be able to:

- Explain the term "hospital infection";
- Describe the negative consequences of hospital infections;
- Describe the process of the spread of hospital infections;
- List the most common sources of hospital infections;
- Explain the difference between an endogenous and exogenous hospital infection;
- Name the main causes of hospital infections and risky procedures that can lead to hospital infections;
- Name the main principles for prevention of the occurrence and spread of hospital infections in connection with the admission and treatment of patients in a healthcare facility;
- Describe the basic requirements for hand care by healthcare workers;
- Describe the main principles for handling different types of laundry in the healthcare sector;
- Name the hygienic requirements for cleaning in healthcare facilities;
- Describe the correct procedure in the event of biological surface contamination;
- Describe the method used to handle sharp and biologically contaminated waste;
- Define the term "disinfection";
- List and briefly describe various methods of disinfection;
- Define high level disinfection, stage 2 disinfection and give examples of use;
- Define the term "sterilization";
- List and briefly describe various stages of sterilization;
- List and briefly describe the various physical procedures and the parameters of sterilization and chemical sterilization;
- Separate sterilization packaging according to the type of packaging material and determine the expiration date for material stored loosely or in a protected area using the applied method of sterilization.

2.1 Nosocomial infection

This chapter is dedicated to the hygiene requirements for the operation of health and social care facilities. Compliance with the rules, largely set by applicable legislation, can help prevent the spread of hospital infections, protect patients, shorten the length of treatment, and thus reduce healthcare costs associated with in patient and outpatient medical facilities and sanatoriums.

A hospital infection is an infection of internal (endogenous) or external (exogenous) origin, caused in direct relation to hospitalization or procedures administered in the health or social care facility within the corresponding incubation period. To classify a hospital infection, it is not crucial when and possibly where the symptoms occur, but rather the place and time when the disease was transferred to the patient. Hospital infection (also known as nosocomial infection) symptoms can develop in a patient within several days or sometimes even weeks after their stay in a healthcare facility or following a surgical procedure.

For example, as Göpfertová (2005) points out, nosocomial infection affects *"on average 5 – 10% of patients, i.e. every 10 – 20 patients. The infection worsens the underlying illness and*

can result in permanent damage or death. Nosocomial infections have great societal importance due to the adverse economic consequences. They represent significant financial costs associated with treatment and prolonged hospital stays". (Göpfertová, 2005, p. 204) In addition, the mass occurrence of a hospital infection also damages the reputation of the affected medical facility.

Diseases that occur in medical facilities and affect medical personnel in connection with the provision of healthcare are not considered to be a nosocomial infection – these are classed as occupational diseases.

Although methods for slowing down the decay of animal tissues, including human tissue (see e.g. mummification techniques in ancient Egypt) were quite well known, the first modern and efficient approaches to the prevention of hospital infections were only in use from the 19th century onwards.

One of the pioneers in this field was **Ignaz Philipp Semmelweis** who worked at Vienna General Hospital from 1841 to 1850.

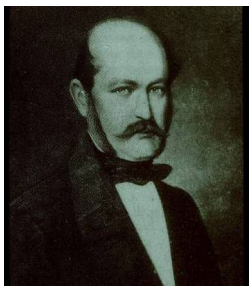


Fig. 2-1: Ignaz Philipp Semmelweis

In 1847 Semmelweis expressed the view that puerperal fever was caused by doctors and medical students who entered the delivery room directly from the autopsy room. He introduced washing and disinfection of hands in a chlorine solution. This simple measure helped him to reduce maternal mortality by 35%.

With regard to the prevention and treatment of hospital infections, it is also important to remember the British nurse **Florence Nightingale** (1820 – 1910), who during the Crimean War (1853 – 1856), introduced simple hygiene measures into the field hospitals regarding the surroundings, food and bandages. Her efforts helped to reduce the mortality rates for injured and sick British soldiers from 42% to just 2%.

Fig. 2-2: Florence Nightingale

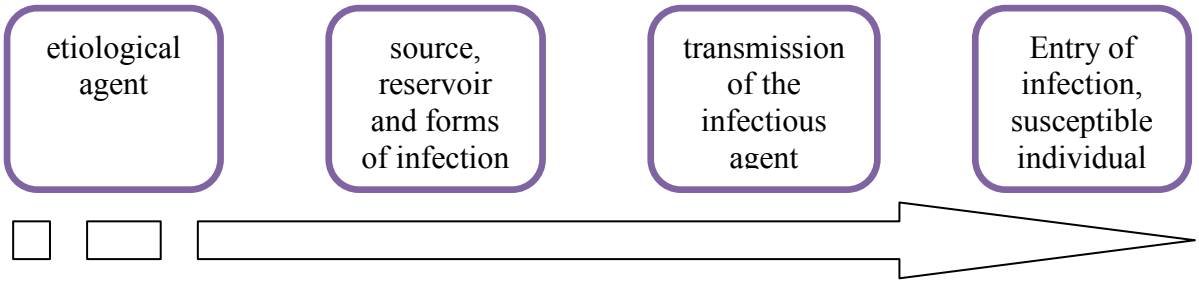
In the second half of the 19th century**, Louis Pasteur's** work on microorganisms, laid the scientific basis for the prevention of the origination and spread of hospital infections. In 1867, **Joseph Lister** introduced the method of actively killing germs in a wound – by attaching compresses containing carbolic acid (more commonly known as phenol) to the wound and

cleaning surgical wounds with this chemical throughout the course of the surgical procedure. At the end of the 19th century, **Ernst von Bergmann** introduced a rule that the wounds can only treated using sterile instruments and sterile bandages. Rubber gloves were first worn to treat patients in 1896 by **William Stewart Halsted**.

The spread of hospital infections

A necessary prerequisite for the spread of the disease is the existence of the disease causative agent. The actual dissemination process has three basic parts:

- Source of infection;
- Transmission path;
- Susceptible individual.



It follows that conditions generally applied to the spread of a disease also apply to hospital infections. In addition to direct contact, transfer often occurs in a variety of invasive therapeutic and diagnostic procedures, e.g. in cannulation of central or peripheral vessels, bladder catheterization, and also during patient intubation, when administering injections etc. Basically, this applies in all cases where the normal physiological barrier of the organism is disrupted and there is a risk of introducing an instrumental cause of nosocomial infection. Susceptible individuals within the hospital environment all weakened individuals, predisposed by underlying diseases, especially by diseases leading to tissue hypoxia, metabolic disorders or immunity disorders.

Sources of hospital infections:

Sources of an exogenous hospital infection can be:

- Patient with an overt disease;
- Patient – carrier without overt signs of a disease;
- Doctor, nurse or another member of the healthcare staff;
- Visitor;
- Technical equipment in the hospital (e.g. air conditioning units or other air conditioning equipment containing Legionella, water containers contaminated with listeria etc.).

The source of an endogenous infection is the patient themselves. It is possible it could be a case of immunosuppression, where the catalyst for the infection is the bodies own microorganisms normally present in the body or as a result of the medical treatment when they are introduced into other organs and tissues, where they subsequently cause inflammation. For example, the inadequate disinfection of a urethral meatus for a female patient can lead during bladder catheterization of the urinary tract, to the introduction of

enterococci, a bacteria normally present in the colon. The second option is the transfer of the infection into the body through blood or lymphatic vessels.

The main types of agents and risk factors for nosocomial infections

The main types of agents and risk factors for nosocomial infections according to Göpfertová (2005) are listed in the following tabular overview:

Type of infection	Etiolological agents	Risk Factors
Wound infection	Staphylococcus aureus Gram-negative rods Anaerobic bacteria	Staphylococci carrier Length of pre-surgery hospitalization Surgery duration Wound drainage Primary contamination of the wound Inadequate prophylaxis Obesity Age
Urinary infection	Gram-negative rods Enterococci Pseudomonas Proteus	Catheterization (80 – 100%) Interstitial colonization of potential pathogens
Bloodstream infection	Pl. coag. negative staphylococci Staphylococcus aureus Enterococci	Transfusion of blood and blood derivatives Vascular catheterization Hemodialysis Numerous IV applications
Pneumonia	Staphylococcus aureus Gram-negative rods Anaerobic bacteria Pseudomonas Legionella	Reintubations Respiratory failure Mechanical ventilation Bilateral pulmonary diseases Inadequate antibiotic treatment

Table 2-1: The main types of agents and risk factors for nosocomial infections
Source: Göpfertová, 2005, p. 211

Essentially all patients whose underlying disease reduces their immunity, such as patients with metabolic disorders, cardiovascular diseases, cancer, multiple trauma, burns, pressure ulcers or those receiving broad-spectrum antibiotics are at risk of nosocomial infections. Also endangered are preterm newborns and infants with low birth weight or by contrast, elderly and obese adults.

Prevention of nosocomial infections

Prevention of nosocomial infections includes the full set of measures listed in Act No.258/2000 Coll., on the protection of public health and amending related acts, as amended, and in Sec. No. 306/2012 Coll., on the terms of the prevention of and the spread of infectious diseases and on hygiene requirements for the operation of health and social care facilities. The summary of these measures can be found in chapter 2.2.

2.2. Hygiene requirements for the operation of healthcare facilities

Methods of reporting hospital infection

A mass outbreak of a hospital infection, which can result in severe injury or death, must be reported without delay, by telephone, fax or e-mail to the local public health protection authority (usually to the regional or Capital City of Prague hygiene departments). The following cases are subject to the reporting of hospital infections:

- Severe injury, as a result of hospital infection caused by one of the following situations:
  - Corrective surgery;
  - Re-hospitalisation;
  - Transfer of the patient to an acute inpatient intensive care unit;
  - Initiation of intensive volumotherapy, antibiotic therapy or circulatory support;
- A mass outbreak of more than one hospital infection in number as per the severity of infection, which is related in terms of the time and place of the hospital stay, and are caused by the same infectious agent, or there are similar clinical symptoms;
- An infection that led to the death of a patient. A serious infection was present in the patient at the time of death. The infection resulted in intensive antibiotic therapy, volumotherapy or circulatory support.

Principles for collecting and testing biological material and the request form

When collecting biological material for testing, the following hygiene requirements must be followed:

- Biological material can be collected in a room or areas designated for handling biological material that meet the basic hygiene requirements for the collection of biological material;
- Biological material is collected with sterile medical aids, including disposable gloves, always for one treated person, and the permeability of the gloves must match the use and the level of the risk from the biological agent;
- Biological material is usually collected before starting treatment with chemotherapeutic or antimicrobial agents;
- Biological material in infectious diseases is collected in regard to the pathogenesis of the infection. In order to determine the diagnosis, the material is usually collected during the acute stage of infection; in the case of serological testing, a second sample is collected two to three weeks after collection of the first sample, or as appropriate;
- Biological material must be stored in standard containers, and in decontaminated containers, excluding any risk of contamination of the requisite forms;
- Biological material is transported to avoid degradation by physical elements and to avoid posing a risk to humans.

The requisite form for the examination of biological material must include the name or names, surname, birth number, address of the person examined in the Czech Republic, the identification number and address of the healthcare provider, signature and telephone number of the doctor requesting the examination of biological material, numerical code of the health insurance company of the examined patient, type of material, date and time of collection, date

of first symptoms of infection, type of antibiotic therapy and date it started, clinical diagnosis and the required type of examination.

Laboratory findings are immediately reported to the healthcare provider that sent the biological material for examination. The laboratory finding that confirms the etiological agent of infection is reported by the laboratory to the locally competent public health protection authority in the area where the patient is hospitalised at the time of sampling the biological material.

Admission and treatment in medical and social care facilities

Hygiene requirements for the admission and treatment of patients at medical inpatient facilities, day care and outpatient care facilities are set out in the operating rules of each healthcare provider, and always take into consideration the nature and scope of activity, and the type of healthcare provided.

The receiving doctor at the healthcare facility such as an inpatient facility, day care or social care facility, records anamnesis information that is significant in terms of the potential occurrence of hospital infection, including travel and epidemiological anamnesis, or conducts an examination of the overall health of the individual. For children, this also includes recording information regarding any infectious diseases and vaccinations.

The doctor conducts clinical and serological tests for syphilis using specific and non-specific responses in

- All pregnant women in the third and seven month of pregnancy;
- The umbilical cord of every newborn;
- Every woman prior to having an abortion;
- All people aged 15 to 65 who are admitted to a hospital's venereological department for the first time, People aged 15 to 65 years admitted to other than the venereological department, if considered appropriate by the doctor.

All drug-dependent people admitted to the inpatient medical facility for detoxification must be tested for basic markers of viral hepatitis.

If patient admission is required due to the medical condition, despite a suspected infectious disease, isolation and barrier nursing measures must be put into place, or the receiving doctor must arrange a transfer to the appropriate department. Similar obligations apply to general practitioners, specialists and doctors at the outpatient healthcare facility.

Patients are placed under the care of a healthcare provider such as an inpatient medical facility primarily depending on the medical condition and the method or extent of the required healthcare, while considering and implementing epidemiological aspects, especially the risk of infection, colonization of multiresistant microorganisms, pathogenic microorganism carriers or in the event of being present in the centre of an outbreak.

The following rules apply to the treatment of patients in health and social care facilities:

- Clothing and footwear of patients placed in the care of a healthcare provider, such as an inpatient health or social care facility with the exception of an acute inpatient intensive care facility, are stored in a central dressing room, in a closet in the room or in closets in designated areas;

- Medical staff employed by the healthcare provider in outpatient or inpatient facilities, including laboratory staff must wear clean personal protective clothing allocated by their own department. Allocated footwear for work can also be used in other workplaces of a similar nature. When working in another workplace, staff must use the personal protective items required for that particular workplace. A healthcare worker is not allowed to leave the premises of the healthcare provider wearing personal protective clothing. Healthcare staff working in outpatient care facilities must use the appropriate protective items, taking into account the nature of their activity.
- Healthcare staff must not wear any jewellery on their hands in workplaces requiring surgical or hygienic disinfection of the hands. Healthcare staff in operating theatres must not wear watches on their wrists. Nail treatment must not jeopardize the health of the patient, especially with regard to the potential spread of a hospital infection and must not interfere with the overall provision of healthcare. Natural nails must be manicured, kept short and clean;
- Healthcare staff performing surgery must wear sterile protective clothing and sterile gloves, mask, cap (protective face mask and cap must be used to cover hair, beard, chin, nose and mouth), footwear allocated only for the workplace; jewellery, watches or other personal items must not be left in the operating theatres and mobile phones may only be used in designated areas of operating theatres;
- In terms of other procedures, where the skin and mucous membranes are violated or come into contact with bodily fluids, or there is non-physiological entry into the body, the protective equipment is selected in relation to the procedure and the risk to the patient. Protective items must be used individually for each patient and disposed off immediately after the procedure.
- Healthcare staff can proceed with examination and treatment after washing hands; hygienic hand disinfection must always take place after contact with infectious material, after each medical treatment of a patient, always before treating a patient, always after handling biological material, items and equipment contaminated by the biological material including used laundry and dangerous waste, and prior to each parenteral treatment, and always when applying barrier treatment mode to prevent occurrence of a hospital infection; hands must be wiped clean using disposable material stored in covered containers.
- When treating patients, healthcare staff must use barrier nursing techniques in all workplaces; only decontaminated equipment must be used; worktops in all workplaces in healthcare facilities must be allocated according to the type of activity it is used for. The barrier nursing technique must also be used when transporting patients and when administering treatment in joint examination and treatment workplaces;
- Detection of infection or the colonization of multiresistant microorganisms are to be entered in the patient's medical record and in the discharge report. Patient colonization by multiresistant microorganisms is not a reason to refuse hospitalization of the patient or admission to a social care facility;
- Healthcare staff must only use sterile medical equipment for parenteral interventions, including drainage of wounds and body cavities, insertion of urinary catheters and comply with aseptic practice in every parenteral treatment; when replacing the collection bags, the closed system of levying and collecting fluids secured against any reflux must be applied;

- Endoscopes and other optical instruments used in sterile body cavities must undergo a higher level of disinfection; digestive, flexible and rigid endoscopes (excluding surgical) and laryngoscopes must be subjected to two-stage disinfection.
- For each patient, a separate and sterile needle and syringe must be used; for insulin pens, the manufacturer's instructions are to be followed;
- Dental sets and other instruments must always be treated according to the manufacturer's instructions;
- Sterile fluids must be used when examining sterile body cavities, if such use is indicated;
- Forceps for handling sterile materials must be stored in a preservative or disinfectant solution intended for this purpose and changed not less than 24 hours later;
- Reusable medical equipment is to be disinfected, cleaned and sterilized according to the manufacturer's instructions. Disposable equipment must never be reused, even after sterilization;
- Instruments and equipment contaminated with biological material must not be cleaned manually by healthcare staff without prior decontamination using disinfectant products with virucidal activity;
- Disposable syringes and needles should be disposed of without manually separating; the needle must only be separated from the syringe using a special tool or device. Recapping a used needle is unacceptable with the exception of an insulin pen;
- The correct personal hygiene measures must be observed for all patients placed in a healthcare inpatient or social care facility; this applies to pre and post medical treatment and surgery.
- The stay and movement of patients in healthcare inpatient and social care facilities must be epidemiologically secured by separating patients according to the risk of occurrence or transmission of infectious diseases;
- Patient visits should be controlled with regard to the operation, specialization of the healthcare unit and the patient's medical condition determined by doctor. Visitors must wear protective clothing when entering acute inpatient intensive care units;
- The acute inpatient intensive care units and surgical units forbid the placement of flowers or other plants.

Handling linen

The patient's clothes and bedding in healthcare facilities are changed as required, but at least once a week, and always after contamination and after surgery, or after re-bandaging and always after a patient is discharged or transferred.

In social care facilities, the bedding is replaced accordingly and always after contamination by biological material; the frequency of replacement is determined by the operating rules of the facility.

When replacing the bedding after release or the death of a patient, the bed and the mattress are disinfected. Stained, heavily soiled and damaged mattresses and bedding are taken out of use.

Used linen is immediately sorted in the designated room with natural or artificial ventilation and subsequently deposited into dedicated containers. Personal protective items are used when sorting soiled linen.

After disinfection, the bedding is replaced and then covered with a clean sheet or covered until the arrival of the next patient.

Washing of personal protective equipment is provided with regard to the nature of the healthcare facility operation and with regard to the risk of the transmission of infectious disease.

Healthcare facilities use disposable material to cover examination tables and beds that come into contact with the exposed parts of the patient's body and this is changed after each patient.

Linen has a similar character to medical material intended for reuse. The washing procedures must ensure that the linen is free of chemical and bacterial contamination. Materials that come into direct contact with a surgical wound must not be classified as linen.

In terms of the health risk, linen is sorted as follows:

- Infectious – this is linen contaminated with biological material and linen used in the contagious diseases ward, TB ward and in all laboratory operations (excluding dental laboratories);
- Surgery – this is linen from operating theatres, gynaecological and obstetric theatres, neonatal wards, ICU and CHIP,
- Other linen.

Linen contaminated with emitters (radionuclides) and by cytostatics, classified as chemical carcinogens, is subject to a different regime.

Treatment of used contagious and surgical linen:

The healthcare provider and the laundry contractually agree on a system for classifying and labelling containers according to the content (e.g. in colour or numerical) and the procedure in terms of the quantity, deadlines and handling is documented.

Linen is sorted at the place of use but it is not counted. The linen is not to be shaken before placing into the containers in the ward. It is sorted into bags according to the degree of soiling, type of material and colour.

Used linen is stored in containers that prevent contamination of the surrounding environment. The containers must be suitable for washing and disinfection or are solely for single use. The used linen in the protective containers is stored in a designated and ventilated area. The floor and the walls up to 150 cm of the linen store must be designed to allow washing and disinfection.

Staff handling used linen must wear protective clothing, gloves and facemasks and observe the principles of hygiene. When handling linen by the patient’s bed, only basic protective equipment, i.e. protective clothing and gloves are used. Hands must be hygienically disinfected after the work is finished.

Linen that has been in contact with body parasites is treated with suitable insecticide and passed to the laundry room after 24 hours. The linen can also be treated in the disinfection chamber.

Used linen is transported to the laundry room in containers or in vehicles with an enclosed loading area. The inside of the container (vehicle loading area) must be easy to wash, clean and disinfect after each transport of the used linen and always before use for another purpose.

Clean linen is protected against contamination and cross-contamination by suitable packaging prior to transportation. Protective packaging can be either washable or disposable. Linen is transported in metal shipping containers or in cage containers. Containers and trays are cleaned and disinfected before use at least once a day. Linen is transported so as to avoid damage to the packaging and mixing of clean and dirty operation. Clean linen is stored in clean and regularly disinfected cabinets or on shelves in closed storage rooms for clean laundry.

Hygienic requirements for cleaning

All healthcare and social care facilities are wet cleaned daily and even more frequently if necessary. According to the nature of the operation, the floor must be suitable for this method of cleaning. In operating theatres using invasive procedures, cleaning is carried out both pre and post surgery for each patient. Intensive care units and the rooms for collecting biological material are cleaned three times a day. The frequency of cleaning in other workplaces corresponds to the nature of the operation. In the event of cleaning by a subject other than the healthcare or social care facility provider, the designated worker must proceed according to the contract and the disinfecting or cleaning rules.

Standard cleaning products can be used for cleaning acute inpatient care facilities. Standard cleaning products and antivirus disinfectants are used to clean the intensive care units, operating and intervention theatres, surgical and infection units, laboratories and rooms for collecting biological material and invasive procedures, toilets, bathrooms and other workplaces as defined by the operational rules.

Each workplace has its own cleaning supplies or cleaning machines allocated depending on use, except the same types of standard outpatient and inpatient facilities.

In the event of surface contamination by biological material, there is immediate decontamination of the stained area by covering the area with cellulose wadding, wiping with a disposable paper towel damped in antivirus disinfectant or the use of absorbent granules with disinfectant. Contaminated areas are cleaned in the usual way. Used linen and mattresses are disinfected either in the room by washing with disinfectant or in the central bed treatment room after each patient discharge.

The waste is sorted in the place of origin. Hazardous waste is stored in labelled, separate, covered, lockable, waterproof and mechanically resistant packaging, by combustible type that does not require further waste handling. Sharp waste is stored in labelled, combustible, strong, puncture resistant and watertight packaging.

Hazardous waste, especially if including sharp objects, is not stored in paper packaging. Hazardous waste generated in patient's beds is removed immediately; the remaining workplaces remove such waste at least every 24 hours. Hazardous waste is stored prior to final removal in a designated, confined area for a maximum of three days. Hazardous waste (anatomical and infectious) can be stored for one month in a freezer or a refrigerated area at a temperature of up to 8°C. Highly infectious waste must be immediately decontaminated using certified technological equipment.

The rooms in healthcare facilities are painted depending on their use; the intervention and operating theatres, acute inpatient intensive care units, collection rooms, laboratories,

infectious diseases ward, children's and neonatal wards are all painted once a year, others every two years, with the exception of facilities which are not used for the provision of healthcare. The rooms in healthcare facilities are always painted if there is a contamination of the walls and ceilings by biological material. Antibacterial paints are used according to the manufacturer's instructions.

2.3 Decontamination and disinfection

Decontamination procedures include mechanical cleaning, which removes impurities and reduces the presence of microorganisms. In the event of contamination by biological material, it is necessary to include mechanical cleaning before the disinfection process. Detergents with a disinfectant effect are applied manually or by washing and cleaning machines, pressure guns, ultrasonic devices, etc. All tools and equipment must be kept clean. Cleaning machines and other equipment are used in accordance with the manufacturer's instructions, including checks of the cleaning process.

Disinfection

Disinfection is a set of measures applied in order to eliminate microorganisms by physical, chemical or combined methods in order to interrupt the transmission path from the source to the susceptible individual.

The selected method of disinfection is based on knowledge of the path and mechanisms of infection transmission and on the possibility of influencing outside environmental factors and resistance of microorganisms.

Methods of disinfection

Physical disinfection

- Boiling under atmospheric pressure for at least 30 minutes.
- Boiling in pressurized containers for at least 20 minutes.
- Disinfection in equipment at a temperature determined by parameter A. The equipment must guarantee to reduce living microorganisms on the disinfected object at a given temperature to a predetermined level suitable for further use.
- Low-temperature disinfection in disinfection equipment is carried out according to the manufacturer's instructions.
- Ultraviolet radiation is used according to the manufacturer's instructions.
- Filtration, calcination, combustion.
- Pasteurization (heating to 62.5 °C for 30 minutes).

Chemical disinfection

Chemicals are diluted and used in accordance with the manufacturer's instructions. Chemical disinfection is carried out with reported biocides or disinfectants certified for use in medical preparation or products registered as drugs for medical use.

The following basic principles must be followed regarding chemical disinfection:

- Disinfecting solutions are prepared by dissolving a measured (weighed) disinfectant in water. The solutions are freshly prepared for each shift (8 or 12 hours), and depending on the degree of biological material present, then maybe more frequently. Disinfectants for multiple daily use can only be applied for two-level disinfection and a higher level of disinfection in accordance with the manufacturer's instructions.
- Preparation of disinfectant solution is based on the fact that the product is well renowned and 100% trusted.
- When the disinfectant dispenser is empty, it is washed, refilled with disinfectant solution and marked with the date of refill and expiration and the name of the disinfectant product.
- Items and surfaces contaminated with biological material are cleaned with an antivirus disinfectant. When using disinfectants with washing and cleaning properties, the cleaning stage and disinfecting stage can be merged.
- To prevent selection or resistance of microorganisms to the product when used on a long-term basis, it is necessary to alternate the disinfectant products with a different active agent.
- When working with disinfectants, the principles of health and safety at work must be observed, including the use of personal protective equipment. Workers are instructed in the principles of first aid.
- Objects that come into contact with food must be thoroughly disinfected and rinsed with drinking water;
- Ongoing monitoring of parameters and verification of the effectiveness of the washing and sanitizing process in washing and disinfecting equipment is documented regularly, at least once every three months via a record of the actual equipment or via physical or chemical indicators or biomarkers. The parameters of the washing and sanitizing equipment are decisive for selection of the test; the user ensures that the selection of the type of washing and disinfecting equipment, operating cycle, the quality of the operation materials and chemicals are in accordance with the respective batch. Methods of parameter control and the effectiveness of the washing and disinfecting process in the washing and sanitizing equipment must document that the cleaning and disinfecting process will ensure a reduction of viable microorganisms on the disinfected object to a predetermined level suitable for further processing or use.

Physical and chemical disinfection

- Paraformaledehyde chamber – used to disinfect textiles, plastic products, wool, leather and fur at 45 to 75 °C.
- Washing and cleaning equipment - disinfection takes place at 60 °C temperature with the addition of chemical disinfectants. The time parameter is observed in accordance with the manufacturer’s instructions.

Disinfection control

The following methods are used in disinfection control:

- Chemical – qualitative and quantitative method to determine the content of active substances in the disinfecting solution,
- Microbiological – determination of the effectiveness of disinfectant solutions or microbial contamination of already disinfected surfaces (smears, fingerprints, rinses etc.)

Documentation of disinfection

Documentation of the disinfection control process for invasive and non-invasive medical devices is by automatic printing of the values from the relevant equipment or by physical or chemical indicators or bio-indicators. All types of these devices are classed by the manufacture as IIb medical equipment.

Documentation of the pasteurization process is supported by a statement or by a record of the physical parameters.

Written, respectively electronic documentation, of washing and disinfecting equipment is archived for a minimum of five years from inspection.

High level disinfection, two-level disinfection

High level disinfection includes procedures for killing bacteria, viruses, microscopic fungi and some bacterial spores, but do not guarantee the killing of other microorganisms (e.g. highly resistant spores) and the development stages of medically significant worms and eggs.

High level disinfection is intended for medical equipment that cannot be sterilized using available methods and is used in procedures and examinations of microbial physiologically unpopulated body cavities (e.g. surgical and examining endoscopes other than gastrointestinal). The instruments are cleaned (mechanically or manually) and dried prior to higher level of disinfection.

If they are contaminated with biological material, the disinfection stage with antivirus product precedes the cleaning stage. The method of wiping the endoscope is not considered to be first level disinfection. Dry medical instruments are fully, i.e. to fill all hollow parts, submerged into a disinfectant solution for high level disinfection (broad spectrum disinfectant, always with a sporicidal and tuberculocidal effect). Disinfectants are diluted and used in accordance with the manufacturer's instructions. In high level disinfection, the instruments must subsequently be rinsed with sterile water to remove chemical residue.

Two-level disinfection with the application of broad spectrum disinfectant (at least bactericidal, virucidal and microscopic filamentous fungi) with subsequent rinsing in purified water is required for medical equipment used to examine physiologically and microbially populated parts of the body (digestive, flexible and rigid endoscopes) that cannot be sterilized.

Disinfecting solutions should be stored in closed and labelled containers with the date of the application of the solution. The frequency of overnight disinfectant solution replacement is according to the instructions for the use of each product.

Medical equipment that was subject to high level disinfection is intended for immediate use or is stored for a short period of 8 hours, covered with a sterile cloth in enclosed and labelled boxes or special cabinets. Medical equipment subject to two-level disinfection is stored in the same way. After expiration, the last level of disinfection is carried out.

The success of high level disinfection is recorded in a diary of the high level disinfection for each medical device that can be sterilized using conventional methods. The high level disinfection diary contains the date of preparation of disinfection solution, name, surname of the patient, name of the disinfectant, concentration, exposure, name and signature of the medical staff, identification number of the medical device used.

Disinfectant products used for two-level disinfection are recorded in the diary with the date of preparation of the working solution, name of the employee, concentration and exposure and the identification number of the medical device used. Written or electronic documentation is archived for a minimum of five years from conducting the high level disinfection.

2.4 Sterilization

Sterilization is the process that results in the killing of all microorganisms capable of reproduction, including spores, and to the irreversible inactivation of viruses and to killing medically significant worms and eggs.

Medical equipment and items intended for sterilization and pre-sterilization preparation are used in accordance with the manufacturer's instructions.

For sterilization of medical equipment, the healthcare provider will create, document, implement and maintain a certified quality assurance system of sterilization, including the controlled release of the medical equipment.

Pre-sterilization preparation is an integral part of the sterilization which includes checks on the sterilization process and the sterilized material, monitoring and recording of the parameters set for the indication and registration of equipment built into the sterilizer and the efficiency of the sterilization using non-biological and biological indicators. Each sterilization cycle is documented.

Commissioning of the sterilization equipment into operation, repairs and periodic service can only be carried out by authorized service personnel. Technical checks on the sterilization equipment are carried out in the range specified by the manufacturer, and once a year on devices without technical documentation. The healthcare provider is responsible for the quality of sterilization mediums required by the equipment manufacturer, and for the accuracy and monitoring of the sterilization process, training of healthcare workers performing sterilization, control of sterilization by trained workers and testing the sterilizers.

Sterilization is carried out by trained healthcare professionals. Central sterilization in terms of operation and quality is the responsibility of the qualified professional who has completed specialized training or a certified course or another professional medical qualification.

The sterilization of pharmaceuticals and excipients is governed by the Czech Pharmacopoeia.

Sterilization preparation

Sterilization preparation is a set of activities, consisting of disinfection, mechanical cleansing, drying, set compiling and packaging that results in clean, dry, functional and packed medical

equipment ready for sterilization. The same procedure is applied for flash sterilization with the exception of the requirement for packaging the medical equipment.

Products and procedures for disinfection and cleaning are selected so as not to damage the treated material.

All instruments and equipment used are considered contaminated, and if intended for repeated use then they must be decontaminated immediately after each use.

Methods of decontamination:

- Decontamination using washing and disinfecting equipment involves thermal or thermo chemical methods at a temperature which ensures the reduction of the number of viable microorganisms on the disinfected object to a predetermined level, which is crucial for future use.
- Ongoing parameter monitoring of the washing and disinfection process in the washing equipment is maintained on a regular basis using physical or chemical tests or biomarkers, at least once a week, and in sterilization centres and during the daily preparation of medical equipment for sterilization centres. Washing equipment operatives check the indicators to ensure that the washing and disinfection cycle runs according to the selected programme,
- Control of the disinfection and washing process is evidenced by a statement of temperatures, by a chemical test or by a biological indicator. The parameters of the washing and disinfection equipment are decisive for test selection. In the manual cleaning process, the effect of high level disinfection and two-level disinfection is controlled by a method which guarantees a minimum level of the active ingredient for the successful disinfection of the medical equipment.
- Written or electronic documentation for washing and disinfecting equipment is archived for a minimum of five years from inspection.
- All types of washing and disinfecting equipment belong to class IIb; supported with a certificate. The disinfection process is validated in the sterilization centre at least once a year.

Fig. 2.4-1 Automatic disinfection and washing machine, separators

- After hand hygiene instruments and equipment and disinfecting in a virucidal product, subsequent rinsing with water to remove any residues of the substances used is required.

Ultrasonic cleaning is used in addition to prior manual or mechanical washing and disinfection.

The medical equipment is thoroughly dried after decontamination, inspected and any damaged items are discarded. Proper drying is an important precondition for the desired effect of each

sterilization method. The last phase of the pre-sterilization process is the insertion of the instruments intended for sterilization in suitable containers (except for flash sterilization), to protect against microbial contamination after sterilization. The instruments are placed in the sterilization chamber in such a way to enable the easiest possible penetration of the sterilization medium. The chamber is filled up to 3/4 of the volume and material is placed inside so it does not touch the walls. The method of filling the chamber is identical for all types of sterilization. The instruments used in the operating theatres must be decontaminated in a separate area.

Actual sterilization:

Medical equipment can only be sterilized under set conditions in the sterilization equipment. Sterilization includes physical or chemical methods or a combination of the two.

The sterilization unit (STU) is a rectangular container that holds 54 litres.

The pressure (kPa bar) means absolute pressure, relative to a vacuum (normal atmospheric pressure is 100 kPA, 1 bar).

Saturated steam is water vapour, with the temperature and pressure corresponding to the steam saturation curve.

The sterility assurance level /SAL/ <= 10-6 the probability of more than one non-sterile object in one million sterilized.

Sterilization methods:

Physical sterilization uses moist heat, circulating hot air, plasma or additionally another means of sterilization.

Sterilization with moist heat (saturated water vapour) in steam devices is suitable for medical equipment made of metal, glass, porcelain, ceramics, textiles, rubber plastics and other materials resistant to the sterilization parameters listed in Fig 2-4:

Nominal sterilizing temperature (temperature of saturated water vapour)	Pressure (rounded)		Excess pressure (rounded)		Time of sterilization exposure	Note
°C	kPa	bar	kPa	bar	min	
121	205	2.05	105	1.05	20	Compulsory BD test and potential vacuum test.
134	304	3.04	204	2.04	4	Only for loose metal instruments ready for use Sterilized in devices with vacuum and BD testing and that at the venting pressure stage reach at least 13 kPa - flash sterilization, Not used in CS and SC.
134	304	3.04	204	2.04	7	Only in devices with vacuum and BD testing and that in the pressure venting stage reach at least 13 kPa.
134	304	3.04	204	2.04	10	Compulsory RD test and potential vacuum test.
134	304	3.04	204	3.04	60	For the inactivation of prions in conjunction with an alkaline washing. +

+ Tools that have been in contact with patient tissues with established CJD diseases must be destroyed, they cannot be re-sterilized, sterilization is only intended for instruments used on patients with suspected diseases.

Explanatory notes:
CS – Central Sterilization – provides comprehensive pre-sterilization preparation and sterilization of equipment
SC – Sterilization Centre – provides only sterilization of medical equipment
BD – Bowie-Dick test or an alternative test

Fig 2.4-1: Sterilization parameters using saturated water vapour

By applying the given parameters, the moist heat sterilization must ensure safe medical equipment free from all viable agents, or in the specified/prescribed type of packaging that ensures a sterile barrier.

The healthcare provider is responsible for the correct choice of sterilization equipment for the sterilization programme and the corresponding test object in conducting a daily Bowie-Dick test.

Steam sterilizers must be fitted with an antibacterial filter. An exception can be made for small desktop sterilizers fitted with N type sterilization cycles. The filter is regularly changed according to the manufacturer's instructions.

Fig. 2.4-2: Steam sterilizer

The deviation of the actual temperature in the sterilization area from the set temperature ranges during sterilization exposure in a device with one sterilization unit, between 0°C and +4°C, and in devices with more than one sterilization unit, between 0°C and + 3°C.

A flash sterilization cycle must not be used for medical equipment with cavities.

Sterilization with circulating (streaming) hot air is intended for medical equipment made of metal, glass, porcelain, ceramic and stone. Hot air sterilization is carried out in devices with forced air circulation at the parameters stated in the manufacturer's instructions:

Temperature (°C)	Time (min.)
160	60
170	30
180	20

Fig 2.4-2: Hot air sterilization parameters

The deviation in the actual temperature in the sterilization area from the set temperature ranges during exposure from -1 °C to +5 °C.

Plasma sterilization – uses plasma generated in a high frequency or high voltage electromagnetic field which impacts the hydrogen peroxide vapour or other chemicals in accordance with the manufacturer's instructions.

Fig. 2.4-3: Sterrad plasma sterilizers

Radiation sterilization must ensure by applying the given parameters for gamma radiation, safe medical equipment free from all viable agents, or is in the specified/prescribed type of packaging that ensures a sterile barrier. It is used in manufacturing sterile medical equipment, or for sterilizing expired medical supplies originally sterilized using the same method.

Chemical sterilization is intended for material which cannot be sterilized using the physical method. Sterilizing medium are gases of the prescribed composition and concentration. Sterilization takes place in fixed pressure or vacuum devices at temperatures of up to 80 °C. If the device operates in a vacuum, the chamber aeration is through an antibacterial filter at the end of the sterilization cycle.

After sterilization with ethylene oxide, the material is ventilated in special cabinets (aerators) or as a minimum, in a designated, well ventilated area. The ventilation period depends on the time and quality of the rinsing stage after sterilization exposure, the type of sterilization medium for the sterilized equipment, the temperature and the technical equipment in the ventilation area, while the impermeability must be checked prior to each sterilization cycle.

Forms of sterilization based on the sterilization medium used:

- ***Formaldehyde sterilization***
- ***Ethylene oxide sterilization***
- ***Sterilization systems using chemical substances (such as peracid)***

The medium and method of sterilization used must ensure safe medical equipment, free from viable agents in the designated (specified) type of packaging that ensures a sterile barrier.

Sterilization packaging

Packaging protects the sterilized objects against secondary contaminations until use. Each package represents a sterile barrier for the implementation of specific functions required from the medical packaging. This must allow for the sterilization process, provide a microbial barrier and aseptic handling.

Disposable paper, polyamide, polypropylene, mixed paper-foil and other forms of packaging supplied with the procedural test are sealed with an 8 mm weld or with a 3 x 3 mm weld, if the distance between the welds is not greater than 5 mm, or with the original glued weld on the packaging. Material to be cut is to be packaged in a standard manner and sealed with tape with the process test. Medical equipment wrapped in paper or non-woven fabric in an envelope manner in double packaging is taped over with adhesive tape with the process indicator.

Fig. 2.4-4: Disposable sterilization packaging (paper/foil)

Hardwearing reusable sterilization packaging includes boxes and containers that are labelled by the manufacturer as medical equipment. Hardwearing sterilization packaging must indicate the process test; the containers are to be used according to the manufacturer's instructions.

Fig. 2.4-4: Hardwearing sterilization packaging (sterilization container)

Packaging with sterilized material is labelled with the sterilization date, expiration date of the sterilized material according to the storage method. In the central sterilization and sterilization centre the packaging is labelled with the code of the employee responsible for the integrity of the packaging and controlling the process test and the sterilization batch. We distinguish between the following types of packaging:

Primary packaging (unit) – sealed or closed system consisting of a microbial barrier that seals the medical equipment, and is also fitted with a process indicator.

Secondary packaging – contains one or more item of medical equipment, each of which is also packed in its primary packaging.

Transport packaging (transport) – packaging containing one or more primary units and/or secondary packaging, designed to protect the material during transport and storage.

Protected sterilized material is stored in a way as to avoid it getting wet, dusty or mechanically damaged.

Expiration of sterile material

Expiration is derived by the sterilization methods and the type of packaging. Expiration dates are listed in Fig 2.4-3:

Type of package	Sterilization method					Material expiration	
	PS 1)	HS 2	PLS 3)	FS 4)	ES 5	Loosely stored	Protected
Box	-	+	-	-	-	24 hrs.	49 hrs.
Container	+	+*	+**	-	-	6 days	12 weeks
Paper/ blank #	+	-	-	-	-	6 days	12 weeks
Paper - foil	+	-	-	+	+	6 days	12 weeks
Polyamide	-	+	-	-	-	6 days	12 weeks
Polypropylene	-	+	+	-	-	6 days	12 weeks
Tyvek	-	-	+	+	+	6 days	12 weeks
Non-woven fabric	+	-	-	***	***	6 days	12 weeks
Double packaging # #						12 weeks	6 months
Double packaging and storage case						1 year	1 year

Notes:
* container with filter for thermo stable material
** special container recommended by the sterilizer manufacturer
*** according to the manufacturers recommendation
# always double pack to cut
close with by weld or glue on both sides
Explanatory notes:
1) = moist heat sterilization
2) = flowing hot air sterilization
3) = plasma sterilization

Fig 2.4-3: Expiration dates are derived by the sterilization methods and the type of packaging

Storage and transport of sterilized material

Packages with sterilized material are stored in central sterilization and in sterilization centres in an aseptic environment, preferably in closed cabinets. When storing in medical departments, the material is stored either loosely with a short expiration time or with a longer expiration time protected from dust in a closed cabinet, storage container, and drawer or in additional packaging. For long term expiration, double packaging is used and stored after sterilization in an airtight storage container.

Packaging with sterilized material is transported in dedicated closed containers or cabinets to protect against damage and contamination.

Sterilization audit

A sterilization audit involves monitoring the sterilization cycle, controlling the efficiency of the sterilization equipment and checking the sterility of the sterilized material. A sterilization audit is conducted by a medical professional or an authorized person (public health authorities, health institutions, holders of authorization).

A sterilization audit is recorded in the sterilization process documentation which includes records of the object subject to the sterilization process. The documentation process consists of recording every sterilization (type of material sterilized, parameters, date, name surname and signature of the person performing the sterilization, including a written evaluation of non-biological systems).

Sterilization documentation

Monitoring of the sterilization cycle:

The person responsible for sterilization

- Uses the integrated measuring systems to monitor that sterilization cycle progresses according to the selected programme; in order to comply with this condition, sterilization cannot be performed outside of working hours, i.e. when staff are not present,
- Monitors recorded and evaluate the values after the sterilization cycle has finished, if the sterilizer is fitted with a recorder and a printer.

Successful sterilization is evidenced by:

- A record in the sterilization diary or a signed record for the registration device or
- By the signed printed output,
- Dated written evaluation of the chemical sterilization indicator in each batch,
- By a dated written daily evaluation of the Bowie-Dick test, if included in the device hardware and by filing the test with the documentation, with the exception of outpatient healthcare facilities with individual doctors (does not include surgical disciplines), where the steam penetration test is conducted once a week, including documentation,
- By dated written evaluation of the daily vacuum test, if included in the device programme.

Written sterilization documentation is archived for a minimum of five years from the sterilization cycle.

Audit of sterilization equipment effectiveness

Checking the efficiency of the sterilization equipment is the responsibility of the healthcare provider.

Audits are conducted using biological, non-biological and physical systems. All systems must ensure control of the sterilization cycle effectiveness, the achieved sterility of the sterilized medical equipment and thus their safety during use.

Biological systems regulate the requirements for sterilization of medical equipment and provide specific requirements for test organisms, suspensions in the required quality, biological indicators and methods of biomarker cultivation for use in evaluating the effectiveness of sterilization process, using various sterilization mediums.

Test systems and biological indicators are used according to the manufacturer's instructions.

The procedure for testing the efficiency of steam, hot air and gas sterilizers, using biological indicators without a test object, is governed by standard methodology for porous and solid medical equipment as per Annex AHEM No.2/1994. The procedure in plasma sterilizers is the same as with the gas sterilizers. In medical equipment with cavities, tests must be conducted using a test object, which makes it difficult for the sterilization medium to reach the cavity in the equipment.

The proof of sterilization efficiency, using class 4 multi-parameter test systems or biological indicators is always evidenced while monitoring the physical and chemical parameters of sterilization. If any parameter is outside the specified limit, the sterilization cycle is always regarded as failed, regardless of the results of the test system process or biological indicators.

Frequency of use of biological indicators:

- In new devices and equipment following repair or relocation, prior to being put back into operation,
- Immediately if there is any doubt about the effectiveness of the sterilization device,
- Once a month – for sterilizers located in central sterilization departments or sterilization centres, operating theatres, surgical departments and workplaces that sterilize material for other workplaces,
- In all other sterilizers, not more than 10 years after the date of manufacture, after no more than 200 sterilization cycles, at least once a year, and in sterilizers older than 10 years then after a maximum of 100 sterilization cycles, at least once every six months.

Non-biological systems regulate the requirements for the sterilization of medical equipment. The general requirements and test methods of the chemical indicator process via physical and/or chemical changes in substances in the sterilization process are used to monitor the achievement of one or more variable parameters required for the sterilization cycle. The function does not depend on the presence or absence of living organisms.

They are used in accordance with the manufacturer's instructions. The parameters must match the selected programme. In medical equipment with cavities, tests must be conducted using a test object, which makes it difficult for the sterilization medium to reach the cavity in the equipment.

Applied tests:

- Bowie-Dick test – test for the correct ventilation and steam penetration. The test is conducted before the first sterilization cycle, i.e. during the sterilization cycle without a batch. For sterilizing medical equipment with cavities, the test must be conducted using a test object according to a specified standard, and which makes it difficult for the sterilization medium to reach the cavity in the equipment.
- Chemical process tests – a colour change in response to the presence of the sterilization medium. Used to differentiate material awaiting sterilization from that already sterilized. This test is used to identify each packaging unit.
- Chemical sterilization tests – intended to prove compliance with all parameters of the sterilization cycle. In steam sterilizers for 1 STJ at least one such test is used for each batch, for 2 to 5 STJ at least 2 tests, for 6 to 10 STJ at least 3 tests and for more than 10 STJ at least 4 tests, which are stored in the places with the worst penetration of the sterilization medium. In gas and plasma sterilizers, one chemical sterilization test is used for every 10 packs. In hot air sterilizers 1 test is used for a 60 litre chamber, two tests for an over 60 litre chamber and 3 tests for an over 120 litre chamber.
- Physical systems.
- A daily vacuum test is conducted to check the tightness of the equipment; this is built

into the software.

- Indicating and recording apparatus measure the temperature. These have sensors with resistance thermometers, thermistors or thermocouples and (or) pressure sensors or electronic systems and are used to continually measure the quantities during the sterilization cycle or to control the built-in measuring devices.

In the event of a repeatedly unsatisfactory sterilization efficiency check, regardless of the type of sterilization medium, a technical inspection of the equipment is conducted within the range of acceptance tests to confirm or disprove the operational capacity.

Validation

The term validation means to combine individual stages of the sterilization cycle, the documentation and confirmation, and that the correct operation guarantees the reproducibility of the sterilization cycle.

Validation of the sterilization process must ensure that each sterilization cycle will provide adequate means for healthcare according to the predetermined specifications.

Frequency of validation is at least once a year for the sterilization equipment located in the central sterilization workplace, the sterilization centre or at the sterilization workplace for more than one organization.

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Vyhl. č. 306/2012 Sb., o podmínkách předcházení vzniku a šíření infekčních onemocnění a o hygienických požadavcích na provoz zdravotnických zařízení a ústavů sociální péče, ve znění platném ke dni 01.10. 2012

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Act No. 258/2000 Coll., on the protection of public health and amendments to related legislation, as amended at 31.08. 2012

Control questions:

- Explain the term "hospital infection".
- Describe the negative consequences of hospital infections.
- Describe the process of spreading hospital infections.
- Name the most common sources of hospital infections.
- Explain the difference between endogenous and exogenous hospital infection.
- Name the main causes of hospital infections and risky procedures for the development of hospital infections.
- Name the main principles for prevention of the occurrence and spread of hospital infections in connection with the admission and treatment of patients in a healthcare facility.
- Describe the basic requirements for hand care by healthcare workers.
- Describe the main principles of handling different types of linen in the healthcare sector.
- Name all the hygienic requirements for cleaning in healthcare facilities.
- Describe the correct procedure in the event of biological surface contamination.
- Describe the method for handling sharp and biologically contaminated waste.
- Define the term "disinfection".
- Name and briefly describe the different methods of disinfection.
- Define higher level disinfection and two-level disinfection and give examples of use.
- Define the term "sterilization"; name and briefly describe the individual stages of sterilization.
- Name and briefly describe the various physical and chemical sterilization procedures and parameters.
- Classify the sterilization packaging according to the type and packaging material and according to the method of sterilization; determine the expiration date for material stored loosely or in a protected area.

List of figures:

List of tables:

Keywords:

Hospital infection

Hygiene in healthcare facilities

Decontamination

Disinfection

Sterilization

3. HAND HYGIENE

Chapter objectives:

After studying this chapter, you should be able to:

- Define the basic terms related to hand hygiene in healthcare;
- Name the basic indications for hygienic hand disinfection;
- Describe and demonstrate the correct hand hygiene procedure according to the ČSN EN 1499 standard;
- Describe the correct procedure for hygienic hand disinfection;
- Describe surgical hand hygiene and surgical hand disinfection and list the equipment required;
- List the types of gloves and indications for use;
- Describe the main principles for using gloves;
- Describe the rules for hand and nail treatment in the provision of healthcare.

Hand hygiene in healthcare is governed by Methodological Directive No.4 of the Journal of the CR Ministry of Health, section 5/2012, and is based on the regulation issued by the World Health Organization – "Hand Hygiene in Healthcare, First Global Patient Safety Challenge". The next part of this chapter cites the above Methodological Directive issued by the CR Ministry of Health.

Terms, definitions

Alcohol based hand disinfectants: Form: Liquid, gel or foam, for applying to hands, contains alcohol as an active ingredient for the inactivation of microorganisms and/or temporary suppression of growth.

Antiseptic: An antimicrobial substance that inactivates microorganisms or inhibits growth; used for skin and mucous membrane treatments.

Biocidal product: A biocidal product is an active substance or preparation, containing one or more active substances intended to kill, deter, render harmless and prevent the effect or achieve another regulatory effect on any harmful organism by chemical or biological methods; only disinfectants notified for the purpose of this directive are used.

Compliance – monitoring of correct hand hygiene in healthcare: Compliance with individual indications and procedures in accordance with ČSN EN, ISO and national standards and proven recommendations for the practical provision of hand hygiene.

Detergent: Surface active substance with a **cleaning effect**.

Hand disinfection: Application of hand disinfectant to restrict or suppress the growth of microorganisms without the need for water, rinsing and drying of hands.

Hand hygiene: A general term for any activity associated with hand cleaning.

Hygienic hand disinfection: Reducing the amount of transient micro flora from the skin on the hands without the necessary impact on the resident micro flora of the skin, with the objective to interrupt microorganism transmission routes.

Hand hygiene: Using washing detergent to remove impurities and reduce transient micro flora without the necessary impact on the resident micro flora of the skin.

Surgical hand disinfection: Reducing the amount of transient and resident micro flora on the skin on the hands and forearms.

Hand washing: Washing hands with soap – mechanical removal of visible impurities and partially transient micro flora on the skin on the hands.

Place for the provision of healthcare: A term associated with the definition of key situations for hand hygiene. Corresponds to the place where three elements occur together: A patient, healthcare worker and activity involving patient contact (in the patient's zone) The disinfectant (alcohol hand disinfectant) needs to be readily at hand, without the need to leave the patient zone.

Soap: Detergent which does not contain any substances with an antibacterial effect.

Hand washing prior to surgical hand disinfection / surgical hand washing: Refers to surgical hand preparation / **pre-surgical hand preparation** / with soap and water. The aim is to mechanically remove impurities and transient micro flora from the skin on the hands and forearms before surgical disinfection.

Hospital environment: Includes all surfaces in the healthcare facility which are outside the patient zone. It includes other patients and their zones and the entire hospital environment. It is described as an environment containing a variety of microorganisms, including multiresistant organisms.

Medical waste (waste type code 180103): This concerns waste collection and disposal which is subject to special requirements to prevent infection.

Hand care: Activity reducing the risk of damage or skin irritation.

Use of gloves – Personal protective equipment: Gloves are classed in the personal protective equipment category.

Resident (permanent) micro flora on the skin: Microorganisms occurring in the deeper layers of the epidermis, in the sebaceous glands, around the nails and on the skin surface.

Transient (temporary) micro flora on the skin: Microorganisms colonizing the surface of the skin on the hands; the quantity and ratio reflects the microbial load of the environment and the nature of the work.

Patient zone: Includes the actual patient in their immediate surroundings. Specifically includes: Patient's intact skin, all inanimate objects touched by the patient or in direct physical contact with the patient (e.g. barriers, table, bedding, chair, infusion sets, monitors, controls and other medical equipment).

Abbreviations

ČSN – Czech State Standard

EN - European Standard

WHO – World Health Organization

Indication for hand hygiene

Washing hands with soap and water whenever visibly dirty and after using the toilet etc. Washing hands with soap is the only way of decontaminating suspected or confirmed potential spore-forming pathogens, including epidemics caused by *Clostridum difficile*.

Hygienic hand disinfection is indicated for all the following clinical situations:

- Before and after patient contact;
- Before handling invasive instruments, regardless of wearing gloves or not;
- After accidental contact with bodily fluids, excretions, mucous membranes, broken skin or bandages;
- In the case of contaminated parts of the body treatment and the subsequent transition to a different part of the body during patient treatment;
- After contact with inanimate surfaces and objects (including medical equipment) located in the immediate vicinity of the patient;
- After removing sterile or non-sterile gloves;
- During the barrier nursing technique.

Alcohol disinfectant is the most appropriate preparation for hand disinfection, free of visible contamination. If alcohol disinfectant is not suitable, then the hands are washed with soap and water.

Alcohol hand disinfectant (or soap, if indicated) hygiene is always carried out before handling medication and before food preparation. Soap and alcohol hand disinfectant should not be used simultaneously. Alcohol based products are always applied to dry hands.

Techniques for hand hygiene

Hand washing, hygienic hand washing

Preparations and equipment:

- Liquid detergent from a dispenser, liquid soap, etc.;
- Running drinking water and hot water;
- Disposable towels stored in a closed container.

Hand washing procedure - ČSN EN 1499

- Rinse hands with water.
- Apply enough soap to cover the entire surface of the hands, using a small amount of water to create the foam.
- Wash hands for at least 30 seconds.
- Rinse hands under the running water.
- Carefully dry the hands with a disposable towel.

- Avoid using hot water; repeated skin exposure to hot water can increase the risk of damage to the skin.

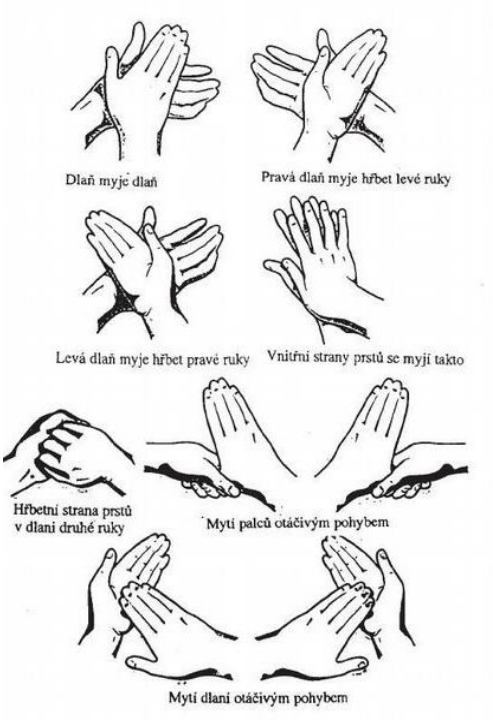

Fig. 3-1: Figure of correct hand washing procedure

Hygienic hand disinfection:

Preparation and equipment:

- Alcohol disinfectant for hygienic hand disinfection;
- Disinfectant in the dispenser with a description of the preparation, filling date and expiration date (on the wall, on the bed frame, on the patients bedside table);
- Disinfectants in individual (pocket) packaging.

If necessary (e.g. allergy), alcohol disinfecting products can be substituted by products containing another active substance. The procedure for alcohol hand disinfection with application of aqueous solutions significantly differs, i.e. the hands must be submerged for

the period specified by the manufacturer, usually for one minute. Individual procedures cannot be combined.

Procedure for hygienic hand disinfection – ČSN EN 1500

- Alcohol disinfectant is rubbed into dry skin in an amount of approx. 3 ml for at least 20 seconds in accordance with the national regulation.
- Throughout the procedure the hands should be sufficiently moist.
- The preparation is applied to the dry skin on the hands and allowed to dry completely.
- Do not rinse or dry your hands.
- When done correctly, hygienic hand disinfection is, within normal nursing contact with individual patients, considered to be more effective and better tolerated than hand washing.

Hand washing before surgical hand disinfection

Preparation and equipment:

- Liquid soap in a dispenser;
- Running hot water, while the water taps do not require direct finger contact;
- Disposable brush – if necessary for cleaning nails - the first surgical washing;
- Towels / disposable face masks are stored in a closed container.

Hand washing procedure before surgical hand disinfection

The procedure is identical to the procedure for hand washing for one minute with the additional washing of forearms. A disposable brush is used to clean nails; nail tips and nail ridges need only to be cleaned in the case of visible contamination.

Surgical hand disinfection

Hand disinfection is always performed before starting a surgical program, between individual surgeries, and in the case of damaged gloves or if replacing gloves during surgery and in outpatient healthcare facilities prior to an invasive procedure.

Preparation and equipment

Liquid alcohol or a suitable disinfectant intended for surgical hand disinfection in a dispenser with a description of the preparation, filling date and expiration date.

Procedure for surgical hand disinfection – ČSN EN 12791

- Approximately 10 ml of alcohol disinfectant is rubbed into the hands for the period specified by the manufacturer or by the national regulation.

- The disinfectant is repeatedly rubbed into the dry skin on the hands and forearms (away from the fingertips to the elbows, from the fingertips to the mid-forearms and from the fingertips to the wrists), and left to dry completely.
- The hands must remain moist throughout the exposure time.
- Do not rinse or dry your hands.

Preparations for hand washing and disinfection

Disinfectants must be effective, gentle, contain moisturizing and skin care/regeneration ingredients, and be easy to apply. Washing and disinfecting hand products must comply with all the requirements of the relevant ČSN EN standard.

Hand washing products containing only detergent without disinfectant do not reduce the required number of bacteria and viruses.

Personal protective equipment – gloves

Gloves are classed as personal protective equipment and provide a mechanical barrier to:

- Reduce the risk of microorganisms in the hospital environment and the risk of infection transfer by healthcare staff onto patients and vice versa;
- Reduce the risk of hand contamination in healthcare personnel with biological material.

Using gloves:

- Gloves can be put on after the disinfectant has completely dried.
- A pair of gloves cannot be used in the care of more than one patient.
- Gloves are to be used only when indicated, otherwise they become a significant risk for transmission of microorganisms.
- Disposable gloves are taken off immediately after the activity for which they were used.
- Used gloves should be disposed of as hazardous waste from the healthcare facility.
- Damaged gloves must not be used again.
- Gloves do not provide complete protection against hand contamination, so hand washing or hygienic hand disinfection according to the indications must be done immediately after removing the gloves.
- Use of gloves does not replace the need to perform hand hygiene.

Types of gloves:

- Examination gloves (non-sterile or sterile).
- Sterile surgical gloves with specific properties (thickness, elasticity, strength).
- Gloves used for working in other than biologically risky environments (chemotherapy, anti-radiation), gloves used when working with instruments contaminated by

biological material.

The choice of gloves depends on the nature of the work.

Procedures and indications for the use of gloves

If the work requires the use of gloves, the gloves must protect against any associated risks. Damaged gloves must not be used again.

***Indications for the use of gloves during care** (according to the type of gloves)*

- *Indications for the use of examination gloves:* E.g. Examination of physiologically non-sterile cavities (for tasks without the risk of disruption membrane integrity), contact with blood, secretions and excretions, mucous membranes and non-intact skin; potential presence of highly infectious, dangerous or multidrug-resistant microorganisms; introduction and removal of peripheral venous catheters; taking blood and other biological material; disconnecting sets; vaginal examination; endotracheal suction catheter; bathing the patient in the bed. *Contact with the patient environment:* Emptying vomit bowls; handling and cleaning used instruments; waste handling; changing bedding; cleaning bodily fluid spills.
- *Indication for use of sterile gloves:* e.g. Performance of surgical procedures; invasive radiological procedures; provision of central vascular access (e.g. central venous catheterization); procedures concerning cavities (with the exception of naturally non-sterile body cavities); preparation of parenteral nutrition and chemotherapy.
- *Gloves are not indicated for:* e.g. Situations where there is no presumption of exposure to blood and bodily fluids or to a contaminated environment. Patient contact: Taking blood pressure and pulse; dressing the patient; transporting the patient, care of eyes and ears (without secretion). *Workplace contact:* Telephone use; documentation records; giving oral medication; distribution and collection of food; non-invasive oxygen-therapy; moving furniture.

Other aspects of hand hygiene

Wearing jewellery on hands

Wearing rings and bracelets on the hands is not permitted in all activities associated with direct patient care (i.e. in situations where surgical and hygienic hand disinfection is performed). Healthcare staff in operating theatres must not wear watches on their wrists.

Nail treatment

Natural nails must be manicured, kept short and clean. Nail treatment must not jeopardize the health of the patient, especially with regard to the potential spread of a hospital infection and must not interfere with the overall provision of healthcare. This applies to all healthcare workers who administer patient care. Thus the maintained hands allow for effective hand sanitation.

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Control questions:

- Define the basic concept of hand hygiene in healthcare,
- Name the basic indications for hygienic hand disinfection;
- Describe and demonstrate the correct hand washing procedure according to the ČSN EN 1499 standard;
- Describe the correct procedure for hygienic hand disinfection;
- Describe surgical hand washing and surgical hand disinfection and list the equipment required;
- List the types of gloves and indications for use;
- Describe the main principles for using gloves;
- Describe the rules for hand and nail treatment when administering healthcare.

List of Figures:

Keywords:

Hygienic hand washing

Surgical hand washing

Hygienic hand disinfection

Indication

Gloves – use

4. PATIENT ADMISSION, TRANSFER AND DISCHARGE

Objectives:

After studying this chapter, you should be able to:

- Define the term "hospitalization";
- Describe, and during clinical nursing practice, subsequently implement the correct procedure for admitting a patient to inpatient healthcare facility by a nurse;
- List the types of patient admission according to priority;
- Correctly prepare medical documents for patient admission to the inpatient healthcare facility;
- Explain the effect of hospitalization on the mental state of both adult and child patients;
- Apply the principles that contribute to better adaptation of the patient to hospitalization;
- Describe the correct procedure for patient transfer;
- Describe, and subsequently implement during clinical practice, the correct procedure for discharging a patient to home care.

Theoretical notes

Patients are admitted to an inpatient healthcare facility if their health condition requires continuous healthcare for more than 24 hours.

The term "hospitalization" means admitting the patient to an inpatient healthcare facility. Inpatient healthcare can be administered in various facilities such as *hospitals, sanatoriums, hospices or nursing care homes.*

Forms of healthcare:

- Outpatient care; General, specialized;
- Institutional care;
- Pharmaceutical service.

4.1 Patient admission to healthcare facility

Patient admission, hospital stays and discharges follow an established procedure, i.e. planned nursing activities. For patients requiring long-term care and repeated hospitalization, the activities must be coordinated so that the nursing care is continuous.

The specific medical treatment prescribed by the doctor, and the nursing regime followed by the nurse, are administered by the nurse in order to meet patient needs. The nurse monitors patient responses throughout the stay.

Types of patient admission according to priority:

Planned admission – the patient has been previously booked for hospitalization, examination or surgery and it is expected that the patient will remain in hospital for the required period. The hospitalization period starts after initial examinations in the outpatient facility.

Emergency admission – the patient is admitted without referral from a doctor in the case of a life-threatening condition.

Patients can be admitted using:

- Healthcare clinics
- Patient admission centres
- Accident and Emergency departments

Usually, a patient is scheduled for hospitalization based on the recommendation of the attending doctor (general practitioner or specialist). To verify the identity of the patient, an insurance card and an identification card or other proof of identity must be presented. If the patient has been previously examined, the records are included in the new documentation file. The admission includes full identification of the patient. Some healthcare facilities provide the patient with an identification bracelet upon admission.

The patient is informed by the attending nurse of the purpose, nature, consequences and risks of the care and the proposed procedural options and the risks should the patient refuse care.

If the patient is a dependent child, the nurse informs the legal guardian or the person who is fostering the child. The nurse is required to inform the patient in a clear and considered manner.

Informed consent is deemed as verifiable consent by the patient for the provision of healthcare, such as surgery. Everyone has the right to refuse the treatment – the refusal must be recorded in writing and signed by the patient, doctor and nurse.

Legal aspects of patient admission

- Providing information about the patient to family members and to the next of kin is governed by applicable legislation;
- In the case of acutely ill patients who cannot express consent with hospitalization (e.g. unconscious, following strokes, etc.) a detention procedure or the "procedure concerning patient admission and detention by a healthcare facility" is put into place. The healthcare provider reports the patient admission without their consent to the court;
- Under emergency hospitalization, the court will appoint a guardian to represent the patient during detention.

Patient documentation

Prior to patient admission to hospital, the forms that will be filed as part of the general medical records must be completed. Medical records are usually filed in a washable folder.

Medical documentation consists of the following:

Pre-hospitalization documentation (not always included).

- For example, this consists of: The transfer medical and nursing report; application for admission to the after-care facility etc.

Initial documentation

- Contains for example: Initial medical examination report, including the care plan; nursing anamnesis etc.

Daily records (medical records, daily report; daily recording of nursing care; records of evaluation techniques (e.g. educational sheet, record of ulcer care and skin defects, nutritional score, record of pain assessment).

Special care records – nutritionist report, physiotherapy and occupational therapy progress records, social health record, psychotherapy record, speech therapy record etc.

Informed consent forms (including those from other facilities), *court report* (clothes and valuables, proof of deposit, including advice)

Discharge summary report (including the care plan).

Complement, Consilium (laboratory test results, imaging, EEG, MMSE, consilium, including one time psychological record and other examinations).

Ancillary documentation (e.g. extended hospitalization, police reports, copy of the document for patient placement in a social care facility, shelter home, voucher for the provision of home healthcare, copy of the previous discharge or transfer report, statements from other documentation etc.).

Forms completed at the place of admission:

- Case history
- Daily report

Forms completed on the ward:

- Informed consent
- Nursing anamnesis
- Nursing plan
- Request for additional diet allowances
- House rules, code of ethics for patient rights
- Cloakroom ticket, record of valuables deposited
- Operational documents, e.g.: Cloakroom ticket, record of valuables deposited

Patient admission to ward

After the patient arrives to the ward, the on duty nurse greets the patient, introduces herself, and takes over the documentation, papers and any identification labels. In accordance with standards the nurse completes the patient documentation, informs the patient of the rules of stay, provides basic information on orientation in the ward, and performs all patient admission tasks. The nurse will accompany the patient to the room, show them their bed and other room facilities that the patient may need during hospitalization, and introduce the patient to other patients.

Clothing and other personal items are usually stored in the patients room (in wardrobes, bedside tables), or in the institutional locker room. If the patient has any valuables, the items must be accurately described and stored according to the internal regulation of the healthcare facility. The accuracy and completeness of the list is confirmed by the patient's signature.

If the patient is able to perceive further information, the nurse may show the patient the alarm to call for help and any other equipment in the care unit. At the same time, the patient is instructed in the house rules of the ward, in the patient's rights and obligations – these are usually displayed in a visible place in the patient's room or in the corridor.

Accident and Emergency department admission

Unlike planned admission, a patient suffering acute illness or injury is brought to the hospital's accident and emergency department admission (see Figs 4-1, 4-2). The care of a patient whose life is at risk (pre-hospital and hospital care) and subsequent admission to institutional care is more demanding in terms of speed, decisiveness and the foresight of the nurse.

Transport of the patient is through:

- Emergency service
- Individually

Fig. 4-1, 4-2: Room for emergency patient admission (Clinic of Anaesthesiology and Resuscitation of the 2nd Faculty of Medicine of Charles University and Motol University Hospital)

Patient medical documentation during hospitalization

The type of medical documentation varies according to the nature of each ward. During hospitalization, the nurse monitors the patient's condition and records such information. Medical documentation is available in printed and electronic form.

Medical documentation contains, in addition to the medical record, which includes a daily report and other documents (see above) – the patient's consent with the procedure, the patient's consent to consult the documentation, the temperature table, nursing documentation including evaluation scales, e.g. regarding the risk of bedsores, the risk of falling, pain monitoring, self-sufficiency – Barthel test, nutritional screening form, etc.

Complications at patient admission and prevention

The patient may encounter many disturbing moments during admission to hospital. For example, unpleasant long waiting times, lack of fresh air, smells, lack of privacy, lack of information, intolerant behaviour of the staff etc.

Preventive measures

Well marked corridors, orientation signs, suitable spatial arrangement of the rooms, surgeries, and waiting rooms can all contribute to better adaptation of the patient to hospitalization. Other contributing factors may be clean and pleasant surroundings, sufficient information (leaflets), comfortable furniture, professional staff, and good work organization.

Special requirements during child admission to hospital

When admitting a child to hospital the procedure is similar as for an adult patient. The documentation is similar, but the consent with the procedure is signed by the parents or guardians of a child under 18 years old. A child under 6 years old can be hospitalized together with an adult (mother, father, adult sibling, grandparents). Admitting a child with a family member for hospitalization is the best way to prevent a negative reaction to hospitalization by the child. The parents can help the child overcome the fear of the procedure, help with adaptation to hospitalization, increase the sense of security in an unfamiliar environment. The parent knows the child's habits and interests, and can help the staff to communicate with the child during nursing procedures.

Admitting a child patient to hospital can be through the clinic in the relevant department, through the patient admission centre or through accident and emergency department admission.

If the child is hospitalized alone, the medical staff will try to find out:

- The child's habits, e.g. eating, toilet, hygiene habits, bedtime rituals, communication, ability to adapt to the new environment,
- How the child is addressed at home (most frequently, what does the child prefer),
- Child's favourite toy or game,
- The child's personality,
- Any previous hospitalization,
- The child's relationships with other children,

- Handling school duties (during school term), which is related to studying in hospital. The parents will bring the child's workbooks and textbooks, to allow study to continue during hospitalization.

Upon child admission (under sanitary filter procedure), the nurse carefully checks the skin, hair and nails of the child. If deformities, lacerations, haematomas, bruising or other abnormalities are detected, the nurse records it in the documentation and informs the doctor. The result of the nurse's examination is signed by the parents or guardians. The child is dressed in their own or in hospital clothes. Clothing and shoes are usually given back to the parents, who accompany the child to the hospital ward.

Other procedures for child admission to a hospital ward include:

- Informing parents or guardians of visiting hours, telephone contact to the ward
- Familiarization with the charter rights for the hospitalized child

The child is taken to the ward, introduced to other children in the room, put to bed. The child is also made aware of the house rules, according to their age and health condition, and given a tour of the ward for better orientation.

The admission to hospital is easier if the child is:

- Accompanied during hospitalization,
- Given a tour of the ward,
- Given understandable, clear and accurate information,
- Met with peaceful, pleasant surroundings (colourful decoration) and friendly staff.

The course of a child's hospitalization is affected by:

- The method and regularity of education,
- Activation of a sick child of school age; game therapist activity - involvement of the child in the game,
- Family involvement in education, frequency of visits,
- Method of communication with the family.

4.2 Patient transfer

The patient is usually hospitalized in the same department from which they are discharged. The health condition changes in some patients so much that they are transferred and treated by another department or another treatment unit of the same or different department or in the same or another healthcare facility.

The patient can be transferred to:

- Another treatment unit,
- Another ward or a clinic within the same hospital,
- Another facility / hospital.

The transfer of the patient to another treatment unit is based on the decision of the doctor, who will inform the patient, usually during their ward round, of the reason for the transfer. It is also important to inform the relatives of the patient, should the patient give their consent. In order to transfer the patient, the nurse will prepare the medical records together with the transfer report and the doctor will record the patient discharge summary report in the daily report.

If necessary, the nurse oversees the packing of the patient's personal items or helps with the packing and arranges transport by ambulance. The valuables from the safe are transported with the patient. It is appropriate for the staff to say goodbye and a nurse will accompany the patient to the new ward. In such a situation the patient may have a fear of the unknown or change so the nurse will try to ease patient fears by answering their questions. The transfer of the patient to another ward or clinic within the same hospital or to another medical facility is the responsibility of the attending doctor. The patient is deleted from the list of admitted patients and the catering list.

If the patient is transferred to another healthcare facility, the transfer procedure is the same as for discharge. The patient is re-admitted by the new healthcare facility.

4.3 Patient discharge

If the patient's condition improves so that treatment can be continued through an outpatient facility or at home, then the patient is discharged. The patient may also be discharged at their own request, known as DAMA, i.e. a declaration that they are leaving on their own request. The release is decided by the attending doctor after consultation with the senior consultant. After that the patient deals with the necessary matters, such as transportation from the hospital and notifies their relatives. If the patient is not collected by relatives, the nurse will book an ambulance if the patient's health condition requires it.

The nurse will give the patient the necessary medical documentation, such as the report from the attending doctor and the forms for work incapacity for their general practitioner. A nurse will ensure the patients clothes are released from the central locker room. A mobile patient is comfortably seated by the nurse on a chair, either in the room or in the communal room. The patient is considered to be a patient of the treatment unit until they physically leave the ward. If the patient is on long-term medication, the nurse will provide them with fixed doses (usually three days) until their general practitioner prescribes the next dose. The patient must pay the regulatory fee for a hospital stay before departure.

After the patient leaves, all the used equipment is properly washed, disinfected or sterilized. The bed and bedside table are washed and disinfected so as to be ready for the next patient (the bedding is changed and adjusted).

Administrative procedure upon leaving: The nurse will delete the patient from the admission list and the catering list. All nameplates with patient information are removed. The completed patient documentation is saved in the hospital archive. The nurse will record the patient's departure in the report.

Auxiliary task

Find out if there is anything unusual when admitting the child to hospital

Find out if the consent of both parents is required for examination or treatment.

Educate yourself during your professional practice with regard to patient medical documentation in various treatment units (standard ward, Department of Anaesthesiology and Resuscitation, Long term illness ward, Paediatric ward, Gynaecology ward etc.)

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Control questions:

- Explain the term “hospitalization”.
- What are the types of patient admission according to priority?
- Which workplaces can admit patients for hospitalization?
- What preventive measures contribute to better adaptation of the patient to hospitalization?
- What forms does a nurse need to prepare for admission, transfer and discharge of a patient?
- What is different when admitting a child to hospital than when admitting an adult?
- Describe the individual parts of medical documentation.

List of Figures:

Keywords:

Hospitalization

Patient admission

Patient transfer

Patient discharge

Institutional care

5. HOSPITAL BED AND FUNCTIONS

5.1 Hospital bed and parts

Chapter objectives:

After studying this chapter, you should be able to:

- Explain the requirements for a hospital bed in relation to the needs of the patient and staff;
- Correctly use the bed equipment and describe the functions;
- Properly manipulate various types of beds and auxiliary equipment in the model classroom, and subsequently during your clinical practice.

Purpose

The bed is the basic and essential equipment intended for a patient. It is the only private place for a recumbent patient in the room. The bed is also instrumental during various examinations, medical, nursing and rehabilitation procedures.

Theoretical notes

The recumbent patient uses the bed for all daily activities, eating, washing, sleeping, bowel movements, and often receives visits.

Bed requirements and properties with regard to:

- *The patients needs*, e.g. the bed includes safety equipment; the bed height should be adjusted for getting out of bed after surgery to the patient's height; also included should be the bed aids to increase self-care;
- *The staff needs*, e.g. the bed should allow for easy positioning and transport of the patient; the mattress height should be adjustable relative to the intensity of patient care; the bed should allow access to the treated part of the patient's body; an additional requirement is the easy maintenance of the bed and the floor underneath.

The bed should be mobile, fitted with wheels and brakes. Some beds have wheels with brakes that lock themselves, if the bed has been stationary for a while. This is important for reducing the risk of falls by patients with reduced orientation.

The bed area must be adjustable and sufficiently firm. It is essential that the hospital bed is always well made, clean and dry with stretched bedding.

The basic bed bedding includes a foam mattress covered by a washable and impermeable layer, pillow, blanket, bed linen. The bed may also include a one off bed cover (as protection for the linen bed cover, e.g. for incontinent patients) or a cross cover for easier handling of a less mobile patient (see the preventive positioning topic).

Beds in a standard ward should be accessible from at least *three sides*; this requirement is particularly important when treating a less mobile patient (see Fig 5.1-1). The distance

between beds should be at least 75 cm in order to reduce the risk of transmitting nosocomial infections and for easy handling of the patient. Each bed must also have good lighting.

Fig. 5.1-1: Hospital bed - accessible from three sides

Types of hospital beds:

- *Standard bed*
- *Special bed*

Standard bed for adults is mobile; the metal bed frame has standard dimensions of 200 x 80 (width) x 60 cm (height). The bed area is fixed and includes positioning of the back part, controlled *mechanically* or *electronically*.

Modern electric beds are adjustable, their dimensions are 200 (210) x 80-90 cm with adjustable height (e.g. in order to prevent the patient falling from the bed). There is a large variety of beds available on the market, depending on requirements. The bed area is divided into one to three segments; both the head part and the feet part can be easily manipulated. This is useful when handling stationary patients, as well as for patients who can control the bed themselves.

The electronically adjustable beds enable to:

- Lift the head – this enables the patient to sit upright, e.g. Fowler's position, which eases breathing and increases cardiac output.
- Lifting the feet allows passive movement of the hips, the knees and leg muscles. Raising the feet prevents sliding of the patient so supports blood circulation in the lower limbs (helps to reduce edema, reduces the risk of thrombosis);
- Raising and lowering both bed parts creates a chair position, and the subsequent positioning of the upper and lower body. This position affects the equilibrium system, improves intestinal peristalsis and secretion due to gravity.

Adjustable beds can also have an electronic *adjustable tilt.* The option of a lateral tilting bed is used for recumbent patients at risk of pressure ulcers. When laying the patient in the treatment position – the Trendelenburg or Anti-Trendelenburg positions – the bed can be tilted so that the head section is lower than the feet or vice versa (see topic 6.1 Patient positions).

Hospital beds for children

Paediatric wards use *standard beds for children* of the relevant age category and *special beds for intensive care.* Children's beds are always mobile with lockable wheels; some are also adjustable.

- *Neonatal beds* have a metal construction and the side rails cannot be dropped. The sleeping area for newborns can be plastic or metal. The neonatal bed usually has a height adjustable tilting transparent tray (see Fig. 5.1-2).
- Standard *beds for infants and toddlers* have high sides, which can be lowered. The bed is mobile with a height-adjustable sleeping area and mechanical positioning. Some beds can be tilted – Trendelenburg or Anti-Trendelenburg positions and the sides have three-level positioning.
- *Beds for preschool children* have lower sides, which can be lowered.
- *Adolescent and school-age children* have the same as beds as adults.

Fig. 5.1-2: Neonatal bed

Fig. 5.1-3: Bed for infants and toddlers

Special beds for children

There are currently other *special beds for children* available on the market.

An *incubator* is a special enclosed bed for the care of premature newborns and infants. The air in the incubator is heated and humidified with accurate regulation of the oxygen concentration. The premature newborns are accessed via closing openings (doors) from the side of the incubator.

A *heated bed* is a special bed for standard care and basic treatment of a newborn in the delivery room, it stabilizes body temperature in heat-sensitive infants via a thermal heater and heated mattress. A heated bed is used in phototherapy treatment, infusion and transfusion and other procedures used in intensive neonatal care (see Fig. *5.1-4*). Special plastic guards may also be included.

Fig. 5.1-4: Heated bed for newborns

Special beds

Special beds for Anaesthesiology, Resuscitation and Intensive Care units enable to electronically set basic treatment positions, some with a lateral tilt. They are fitted with side rails, which should be removable, so the bed can be accessed from all sides (see Fig. 5.1-5). Some beds are fitted with a scale to enable X-ray examinations and various invasive procedures monitored by the C-arm (e.g. introduction of temporary external cardio stimulation, etc.). The bed is easily controlled via a driver, which significantly reduces the effort required. The special beds in the intensive care units facilitate vital functions. The bed allows a suitable position for cardiac patients, which supports natural ventilation of the lungs and pulmonary venous return.

Fig. 5.1-5: Adjustable bed for anaesthesiology, resuscitation and intensive care units

A Stryker bed (sandwich) is a turnable, adjustable bed intended for patients with spinal and spinal cord injuries. The position of the patient on the abdomen can be varied with the position on the back by turning the bed 180° without the need to move the patient requiring minimal physical effort from the staff.

A fluidized bed is a special bed with a waterproof construction, filled with very fine Silica sand. The air that passes through the cartridge floats the patient, which ensures minimum pressure on the parts of the body. The air bed is used in the treatment of severely burned or paraplegic patients.

A nursing bed is easily adjustable, and is similar to a domestic bed. It is fitted with side rails and other aids to increase the self-sufficiency and mobility of the patient. It is often used in long-term care, nursing homes, social care facilities and in home care.

A gynaecological examination and *obstetrical bed* is used in the department of gynaecology and obstetrics. *A gynaecological examination bed* is a special, short bed, fitted with footrests and a waste collection container. It is suitable for gynaecological examination. The *obstetrical bed* also includes a removable foot panel, which is usually replaced during childbirth with foot rests, and other accessories.

The *chair for cardiac patients* is also classed as a special bed. It is used to ensure the orthopneic position during the day, for resting cardiac patients and patients with breathing difficulties, and it is adjustable (see Fig. 5.1-6 and 5.1-7).

Fig. 5.1-6 and 5.1-7: Chair for cardiac patients – adjustable

Mobile shower (washing) bed (mobile bath, aquarel) is a special bed for washing the patient in the bathroom. The bed can be washed and disinfected (see chapter 7. Hygiene patient care). The bed has wheels for easy transport and a hydraulic system for easy control of the bed height.

Supplementary bed aids

Supplementary bed aids make the patient's life in bed more pleasant and often improve patient self-sufficiency and safety.

The *Bedside table* is designed to store the personal belongings of the patient, so it must be easily accessible. It should be on the side of bed that suits the patient best or is important for the patient from medical reasons. The table top is usually used for the pill box, glass and other items. The current bedside tables have a built in side desk, which can be positioned and adjusted as a dining table or a writing pad (see Fig. 5.1-8). The *dining table* can also be detached; it is mobile and height adjustable. Some dining tables can be used as a work surface or as a writing pad.

Fig. 5.1-8: Adjustable dining table built into the bedside table

The *chair* is usually located very close to the bed. It is used to seat the patient or visitors or it is used during discussions between staff and the patient.

A very important aid is the *signalling device,* which must be positioned so that it can be reached by the patient if they need to call a nurse. The healthcare facilities usually encounter two types of nurse call systems - single and duplex.

The single call system allows the patient to call the nurse, who must come to the patient and see what is needed. The duplex call system enables communication between the nurse and the patient using headsets.

Both systems include a call panel with numbered buttons showing the patients bed in the room. If the patient calls, the room and bed number light up on the signalling panel located in the nurse's room. At the same time, the light in the hallways by the relevant room will also come on. Examples of modern nurse call systems are shown in Figs. 5.1-9 and 5.1-10.

Fig. 5.1-9: Headset – one part of the duplex nurse call system

Fig. 5.1-10: Duplex system display

The signalling button can be placed on the trapeze bar that the patient uses to facilitate movement on the bed (see below - auxiliary bed aids). The screens are usually used to ensure privacy between beds. Curtains are hung from the ceiling rail or alternatively it vertical blinds or a metal frame with stretched fabric can be used. Metal frames with stretched fabric can also be mobile. *Artificial lighting* provides plenty of light, which is important for both patient and staff orientation.

Auxiliary bed aids

The bed can be fitted with auxiliary aids, which if necessary can become part of the bed, sometimes as a removable part. The aids are used by the patient during hospitalization. They are distinguished according to their use, e.g. to facilitate movement of the patient on the bed, to reduce pressure on different parts of the body, to maintain therapeutic positioning, to protect the patient from falling, or to place equipment and instruments by the bed.

Equipment to facilitate movement

The most commonly used aid to facilitate movement on the bed is the *bed trapeze* (see Fig. 5.1-11). The trapeze is hung on a fixed or swivel attachment, is usually plastic, and is suspended on a metal structure with a rigid strap or a plastic winding handle. The patient uses it to move on the bed, to pull themselves into a sitting position, for lifting, moving etc.

Fig. 5.1-11: Trapeze

The patient can also be assisted with other aids – *lifting bridle*, although these are rarely used nowadays.

Aids to sustain the position and to relieve pressure on individual parts of the body

The most frequently used aids to move the patient into a treatment position (e.g. Fowler's position) are the *adjustable panels* under the head, which can be controlled mechanically (with a handle) or electronically using a special control with simple operation. Using the electronic control, the patient can be easily moved to an elevated position or the feet can be raised or lowered. There are a large number of aids available on the market, which help to sustain the patient in an appropriate position or which reduce pressure on parts of the body (reduce the risk of pressure ulcers). They are filled with polystyrene beads (bead positioning aids) or with foam. The cover is made of leatherette or waterproof material for easy disinfection. They have different shapes, e.g. cylinder or rectangle shapes, pillows, wedges, "rolls", rings, heels and elbow protection, splints, derotation shoes, boxes, long sacks - "snakes" (see Fig. 5.1-12).

The modern beds also include other positioning equipment, such as stopper, which works as a box in the foot of the bed to keep the patient in Fowler's (elevated) position.

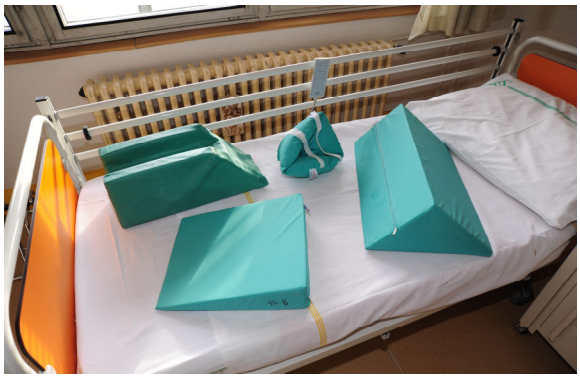

Fig. 5.1-12: Aids to sustain the patient in the appropriate position

Aids relieving pressure on particular parts of the body may be in the form of relief mattresses or pads. Also included are bead, foam and gel aids with or without an opening for the affected part (see above).

Also well known are pads from synthetic material, similar to lambs wool or fur. These can be slightly irritating, so it is not recommended to cover them with canvas.

Equipment for patient safety

The *side rails* are the most commonly used equipment in order to reduce the risk of falling. Older types are removable side rails, although side rails that are part of the bed are more frequently used. Side rails can be lowered. Procedure for lowering side rails: First, press the small tab on the side of the rails, then the round button and hold the rails with your other hand while lowering them (see Fig. 5.1-13). Staff must be very attentive with immobile patients – i.e. check the position of the parts of the body (e.g. hands) when lowering the side rails to avoid injury. For confused patients, a protective foam pad can be inserted between the bed and the side rail.

Fig. 5.1-13: Button for lowering the side rails

In patients who may endanger themselves or others, *straps (courts) and protective restraining vests* may be used in extreme cases. Aids which restrict the movement of the patient are indicated by a doctor. Restricted movement of the patient must be recorded in detail in the medical documentation.

Other auxiliary bed equipment

Other equipment that will make the patient hospitalization more pleasant include a variety of holders, e.g. for crutches, urine bottle, towels, urine collection bag, compressors, integrated infusion stands, orthopaedic extensions, etc.

Care of equipment after use

Bed, auxiliary aids and other bed equipment are kept clean. In terms of maintenance, the recommendations of the manufacture must be followed. Washable aids are regularly treated with disinfectants according to the hospital plan for disinfection, or they can be sent to the institutional laundry for washing. Equipment is used on an *individual basis*, i.e. it is not used for another patient without proper decontamination, which will help to prevent nosocomial infection.

Clean and dry equipment is stored in the designated area (storage) in the ventilated room. Electrical bed accessories are protected from water and other liquids.

Control questions:

- What are the usual dimensions of a standard bed?
- What types of standard bed are there?
- What auxiliary bed equipment is used to regulate the patient's position?
- What auxiliary bed equipment is there to facilitate the movement of the patient?
- What types of children's hospital beds are there?
- Which aids can be used with the bed?

5. 2. Adjusting the bed with the patient

Chapter objectives:

After studying this chapter, you should be able to:

- Describe, list and explain the principles of care for the patient in the bed;
- Adjust the bed for an adult patient and child under standard and emergency care;
- Adjust the bed with the patient in the bed;
- Assess the risk of incorrect bed adjustment for adults and children;
- Care and manage the daily activities of long-term bed stay patients.

Theoretical notes

There can be many reasons for which the patient is bedridden. It is usually the medical condition that prevents the patient from getting out of the bed.

During a treatment regime, at particular stage where strict bed rest is necessary (e.g. in a suspected cervical spinal cord injury), the patient must not get up.

The nurse must get the patient to cooperate and explain the reasons why they must lie in the bed.

The bed must meet the quality and safety criteria.

The nurse adjusts the bed in several ways:

The bed is adjusted after the patients morning hygiene, before bedtime, or if necessary throughout the day, i.e. always when necessary. The bed is adjusted in an open or closed manner.

Preparation by the nurse

Nursing methodology

The nurse:

- Organizes activities according to a predetermined plan: At the time it is necessary to adjust all the beds on the ward (e.g. morning, evening), the nurse allocates a due time for adjustments, works at a reasonable pace, avoids any unnecessary leaving of the ward and interruptions to the bed adjustment; pays attention to the adjustment of the bed base, blanket, pillow, proceed from the top to the bottom, sensibly adjust one side of the bed then proceed to the other side; adjust the bed from start to finish without interruption;
- Handle the clean linen, so that clean sheets do not come into contact with dirty linen, handle the bed linen so as to prevent contamination of work clothes, scalp and hair, and the lower limbs (hold used linen away from the body), etc. The used linen must not be shaken in order to prevent scattering the microorganisms contained in the laundry, or releasing solids (food scraps, dressings etc.). Used linen is immediately placed in the designated textile or plastic bags, which are usually on a special trolley. The linen must never be laid on the floor and after handling linen then the hands must be washed and disinfected to prevent the spread of hospital infections;
- Assess the patient's condition, that all the information is available in terms of adjusting the bed with or without the patient. The patient is prepared for the adjustment in advance (e.g. provision of a chair, airing the room etc.) and the nurse must respect the patients privacy and try and prevent any feeling of embarrassment or dependence on others by the patient;
- When adjusting the bed, the nurse must pay attention to the unevenness of the base of the bed, and to the technical condition (positioning controls, signalling device etc.) and to the bedding. Clean and dry bedding is required for compliance with the principles for the prevention of intertrigo in bedridden patients and for preventing the spread of nosocomial infections.

Patient preparation

- The treatment procedure is explained to the patient, so the patient knows what is expected of them and how to cooperate;
- The recumbent patient takes the position as instructed by the nurse, and according to their capability; they understand the instructions on how to move either on their own or with the assistance of the nurse;
- A completely immobile patient takes the position with the assistance of the nurse or other healthcare worker;
- A child is under the permanent supervision of the nurse throughout the procedure and all risk factors must be removed.

Bed adjustment

The bed can be adjusted either without a change of linen or with fresh linen. The nurse must assess the patient's ability to cooperate during the procedure. If it can be assumed that the

patient will not remember the instructions, or lacks ability and strength or does not want to cooperate, the nurse must choose a different approach. Bed adjustment is often performed with someone assisting.

Changing the bed sheet lengthwise to the bed

The patient is made aware of the procedure and is asked to actively cooperate. Communication with the patient is at a level so they can understand every word. The voice level and fluency of the guidelines is individually adjusted to the specific patient. The work must be done quickly to limit the time the patient is in a non-standard position. Using two nurses to adjust the bed is less strenuous and safer for the patient. The patient is positioned gently, sensitively and safely. When adjusting the patient's position, the nurse minimizes any discomfort by applying a suitable, gentle and sensitive procedure to prevent damage to the skin. The natural position for the patient is the lying down position. Where possible, considering the patient's medical condition, the bed is adjusted in the horizontal position.

Aids

- Clean bed linen;
- Disposable pads;
- Aids for incontinent patients;
- Bag or trolley for used linen;
- Plastic bag for heavily soiled linen.

Working procedure

- Wash and disinfect hands if necessary (e.g. soiled patient); the nurse must use protective clothing and aids;
- A rolled up sheet can be pre-prepared and placed near the patient (on the chair, on the lower part of the bed);
- Auxiliary bed equipment is removed (unless fixed to the bed), pillow, blanket (on a chair put by the bed);
- The nurse holds the mattress and slides it out towards the headboard, the patient is asked to lift themselves using the trapeze, and the moment the mattress is moved upwards, the patient is turned on their side, or gently put into position with the assistance of the nurse – only in the case where the mattress is significantly moved to the foot of the bed;
- The bed sheet on the free side is released and rolled up, including the pad, lengthwise up to the patient's body;
- A clean bed sheet is placed on the free part of the mattress and rolled up halfway; for it to be used on the second part of the bed, all the way to the patient's body, the corners are adjusted and the sheet is tucked under the mattress;
- A clean pad is laid in the middle of the bed and adjusted like the bed sheet (as normally done or the pad can be folded in half);

- The patient is turned on to the clean sheet on the bed, over the rolled up sheet and the folded pad in the middle of the bed;
- Used bedding is rolled up and placed in a basket or a bag for dirty laundry;
- The remaining part of the sheet is rolled out from the middle of the bed and stretched across the entire mattress; the corners are tightly adjusted and tucked underneath;
- The pad is stretched from the middle of the bed and also inserted under the mattress;
- If necessary, the quilt and pillow sheets are also changed;
- The nurse will help the patient to get into position on the bed, making sure the patient is comfortable;
- The pillow is placed under the patient's head;
- The quilt is also adjusted according to the patient's needs;
- The bed is refitted with the auxiliary equipment, which was removed prior to bed adjustment;
- Before leaving the bedside, the side rails are adjusted as well as the position of the head of the bed;
- The patient is asked if they are comfortable and if they need anything;
- The nurse records any important findings, prepares the nursing intervention plan and depending on the nature of the finding, informs the doctor.

Changing the bed sheet widthwise to the bed

If the patient cannot turn on their side, the bed sheet is replaced widthwise to the bed. This is preferably done by two nurses.

Aids

See the above text

Working procedure

- Wash and disinfect hands if necessary (e.g. soiled patient); the nurse must use protective clothing and aids;
- A rolled up sheet (alternatively a pad) can be pre-prepared widthwise and placed near the patient (on the chair, on the lower part of the bed…), a bin or a bag for used laundry is put by the bed;
- The quilt, pillow and auxiliary bed equipment are also removed;
- The patient is gently moved closer to the bottom of the bed (using the loose pad on the bed);
- The used sheet is rolled in the direction from the head to feet;
- A clean sheet (pre-prepared pad) is rolled out on the bed in the same direction while the patient is lifted using one hand;

- The clean sheet is moved under the patient (if in a lying position) by gradually lifting their head, chest, pelvis and lower limbs;
- The base of the bed is adjusted by stretching the sheet and pad and inserting it under the mattress;
- The quilt and pillow are also adjusted;
- The bed is refitted with the auxiliary equipment, which was removed prior to bed adjustment;
- Before leaving the bedside, the side rails are adjusted as well as the position of the head of the bed;
- The patient is asked if they are comfortable and if they need anything;
- The nurse records any important findings, prepares the nursing intervention plan and depending on the nature of the finding, informs the doctor.

Post surgery patient care

See above text - Working procedure

Care of equipment after use

A trolley or bag with the used linen is stored in a designated room and transport to the laundry is ordered. Clean linen is stored in the designated area.

Control questions:

(one answer is correct)

1. The bed is adjusted:

- Once a week
- Twice a week
- Once a day
- After morning hygiene, before bedtime
- After the patients morning hygiene, before bedtime, or if necessary throughout the day, i.e. always when necessary.

2. Getting the patient ready for procedure:

- The process is explained to the patient, so they know what is expected of them, and how to cooperate
- The procedure is explained to the patient
- The patient has undergone their morning hygiene
- The patient knows what is expected of them
- The patient knows how to cooperate

3. Before the procedure, the nurse:

- Assesses the patient's condition, has all the information available in terms of adjusting the bed with or without the patient. The patient is prepared for the adjustment in advance (e.g. provision of a chair, airing of the room etc.) and the nurse respects the patients privacy and tries to prevent the feeling of embarrassment or dependence on others;
- Assesses the patient's condition, has all the information available in terms of adjusting the bed with or without the patient. The patient is prepared for the adjustment in advance (e.g. provision of a chair, airing of the room etc.)
- Assesses the patient's condition, has all the information available in terms of adjusting of the bed with or without the patient.
- Complies with the principles for the prevention of intertrigo in a bedridden patient and in terms of preventing the spread of nosocomial infection.
- Assesses the patient's condition, has all the information available in terms of adjusting the bed with or without the patient. The patient is prepared for the adjustment in advance (e.g. provision of a chair, airing of the room etc.) and the nurse respects the patients privacy and tries to prevent the feeling of embarrassment or dependence on others, complies with the principles for the prevention of intertrigo in bedridden patients and in preventing the spread of nosocomial infection.

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List of Figures:

Keywords:

Bed
Hospital bed for children
Special bed
Standard bed
Bed equipment

6. MOBILITY AND IMMOBILITY

Objectives:

After studying this chapter, you should be able to:

- Define the terms: Mobility, immobility, disability, paresis, plegia, spasticity.
- Briefly explain the purpose of patient mobilization.
- Explain the terms: Passive movement, assisted movement, active movement.
- Implement position changes in the patient in the model classroom and subsequently in clinical practice.
- Correctly verticalize the patient in the model classroom and subsequently in clinical practice (e.g. from a lying to a sitting position).
- Use the appropriate means to facilitate the movement of the patient.

Purpose of mobilization

- Use of all available means to regain the highest level of functional abilities in a patient;
- Prevent the development of complications, e.g. from inactivity;
- Maintain patient self-sufficiency.

Theoretical notes

Movement is a fundamental (physiological) human need, and is typical in all living organisms. Physical activity in a human increases the performance of the organs, improves health and protects against disease.

Mobility (physical activity) enables humans to:

- Acquire motor skills and movement patterns
- Navigate the environment
- Effectively respond to situations in their surroundings
- Affects human self-esteem by supporting a sense of independence, usefulness and need.

The optimal body posture supports lung ventilation, gut motility, renal function and the circulatory system. The upright position is also an expression of confidence, physical fitness, attractiveness and a form of non-verbal communication. The purpose of correct movement is the upright position, muscle tension and body balance. Mobility is also associated with highly specialized expressions such as speech, writing, gesticulation, laughter, crying etc.

Disability is impaired ability, often defined as invalidity (handicap) in the area of mobility (motor), sensory perception (sensors) or thinking (cognitive). It is the inability of a person to undertake daily activities or work activities to the extent that is considered normal.

Paresis is a partial loss of active voluntary movement (palsy). This is caused by multiple failure at various levels of the nervous system (brain, spinal cord, peripheral nerve, neuromuscular transmission, muscle).

Plegia is the complete inability of active voluntary movement, paralysis.

Paraparesis/paraplegia means partial/complete paralysis of the body, usually in both lower limbs.

Hemiparesis/hemiplegia means partial/complete paralysis of the right or left side of the body.

Quadriparesis/quadriplegia means partial/complete paralysis of all four limbs.

Spasticity is increased muscle tension in the internal organs and particularly in the limb muscles. (Vokurka et al., 2007)

The *term* ***immobility*** means the inability of physical activity. The *main causes* of immobility include severe pain, skeletal or neuromuscular system disorders, infectious processes, psychosocial dysfunction, etc.

After 36 hours, complete bed rest triggers changes in the musculoskeletal and circulatory systems followed by changes in other organ systems (respiratory, nervous, digestive, skin and urinary). Distinct pathological changes develop from 7 – 10 days (see the below immobilization syndrome - Chapter Patient positioning, preventive positioning).

Immobility levels:

- *Complete immobility* – e.g. patient in a coma
- *Partial immobility* – e.g. patients with lower limb fractures
- *Limited activity* associated with disease – e.g. patients with bronchial asthma

Mobility and immobility problems are addressed by rehabilitation, which extends to physiotherapy knowledge and practical skills. The job of the physiotherapist and as prescribed by a doctor, is to practice movement, deep breathing using breathing techniques etc. with the patient. The nurse, in collaboration with the patient, continues with the exercise and in maintaining mobility throughout the day and checks the functioning of the patient's proper position, while the position of immobile patients is adjusted at regular intervals. Mobilization in terms of physical rehabilitation is defined as e.g. early sitting up of the patient and other procedures that allow the patient to leave the hospital bed as soon as possible (Vokurka et al., 2007). A balanced nutritional diet for the patient plays an important part in improving mobility.

Methods of mobilizing the patient include passive movement, assisted movement, active movement.

Passive movement is movement that the patient cannot do alone; the movement is carried out with another person or a machine, etc. The aim of the passive exercise is to maintain joint mobility and prevent further complications. The patient exercise is performed by the physiotherapist, followed by a nurse (or family member); the limb must be held above and below the joint during the exercise. Passive movement can also be performed using a machine, e.g. MOTOmed, moto-splint, etc.

Assisted movement is movement made by the patient assisted by a physiotherapist or a nurse. It is used in training for daily activities, the patient is conscious.

Active movement is movement made by the patient, while the nurse or physiotherapist supervises the correct technique in harmony with breathing. The aim of the exercise is to strengthen the muscles, increase joint mobility etc.

For the gradual gain of self-sufficiency, it is important to practice self-care (e.g. turning and lifting on the bed, independence in eating and drinking, managing personal hygiene, dressing, taking items from the bedside table etc.). The degree of self-sufficiency in patients is monitored using the Barthel test of basic daily activities (ADL – activity daily living), whereby the nurse assesses the ability to perform self-care activities. The nurse also assesses the level of patient participation in their own care.

The training includes placing the necessary aids within the patient's reach, depending on their condition and the stage of rehabilitation; in the case of a determined disability, the aids are placed on the appropriate side within reach of the patient and then later to the side that enables use of the affected area (e.g. gripping after CVA).

Patient preparation

It is important that the patient is informed of the procedure they will be partaking in. The procedure should be clearly explained, described, and possibly demonstrated on them.

Verbal and nonverbal communication between the staff and the patient is very important. Communication with the patient should be by short and simple sentences according to their mental level, their ability to receive and follow instructions and the degree of willingness to cooperate. Communicating with understanding and open minded people makes it easier to gain their trust and cooperation.

The approach to each patient, and especially to an immobile patient, should be polite, speaking calmly, clearly, and with good articulation. It is important to listen to the patient and give them enough time to express themselves. If the patient does not understand, look for another explanation so that one instruction includes just one step of the activity required of them.

Non-verbal elements of communication have special importance in communicating with people with dementia, a visual handicap or with deaf people. Choose a pleasant tone of voice, have a friendly and helpful attitude and facial expression. A common handshake suggests that our counterpart is considered as equal.

In deaf patients, stand so that they can see and lip read. Encourage the patient to give a clear impression that we understand them. Do not forget to show respect. Especially in the elderly, avoid the use of childish words such as (tummy, poo, etc.). This type of talk can lower self-esteem and self-confidence in an adult. This form of communication can bring the elderly down to the level of a child. Some geriatric patients may accept the role of a child and may even be happy with it. However, strengthening self-care in these patients will fail.

Rehabilitation aids

Active rehabilitation most frequently involves activity, which may be preformed *with or without aids* to facilitate movement. The most frequently used aids in the vertical position, which is also part of the *bed* are the trapeze, lifting bridle etc.; patients *practicing walking* usually use crutches, walkers, etc. Today, there are many types of aids that facilitate patient mobility and make the work of staff easier.

The following examples of rehabilitation aids are used to facilitate mobility in the patient:

- *Walkers – solid, underarm, two, three and four-wheel* (see Fig. 6-1)
- *Crutches, walking sticks*
- *Wheelchairs* – mechanical, electrical
- *Verticalization tables*
- Suitable for *fitness exercises*: *Exercise bike, rehabilitation pedal exerciser to strengthen the lower limbs* (see Fig. 6-2), and similar.

Fig. 6-1: Patient using a walker

Fig. 6-2: Rehabilitation pedal exerciser

Lifting and handling equipment is used to facilitate lifting and moving of the patient. For example:

- *Hydraulic hoists* operated mechanically or electrically
- *Transposition pads* - OnewaySlide used to facilitate shifting or moving the patient, e.g. on the bed, Easy Belt
- *Roll boards* and transposition plates for transferring a patient from a bed to a wheelchair or to a bed shower (bath) etc.

Selection of the appropriate aid depends on the patient's need and individual functional deficits as well as the therapeutic aim.

Nursing interventions to prevent complications resulting from immobility include:

- *Preventive positioning* of the body or limbs (see Positioning patients)
- *Passive exercise*
- *Basic fitness and breathing exercises*

Breathing exercises

Breathing exercises can be performed separately or they can be part of fitness or specially targeted exercises. Breathing exercises (breathing gymnastics) have preventative and therapeutic importance. These are included if it is necessary to increase lung ventilation, improve expectoration of secretions from the respiratory tract, etc. Exercise should be according to the current medical condition of the patient; the usual recommendation is 20 times, at least 4 – 5 times a day.

Prepare a well ventilated room, e.g. a patient room, where exercise usually takes place. The nurse will at first instruct the patient to start with deep breaths, inhaling through the nose and exhaling though the month. This is preconditioned by free airways. During breathing exercises, the patient observes their own breathing by placing their hands on their chest and feeling the chest moving (rising when inhaling). The patient takes the appropriate position, preferably a semi-recumbent position, or lying down. The patient bends their legs at the knee, and if possible, puts their feet down on the mat.

After abdominal surgery, the patient places their hand on the surgical wound and inhales more in the direction of the second part of the abdomen. It is explained to the patient that through inhaling, which is perceived in the lower half of the abdomen, the lungs are improved. Instructions are given slowly, calmly and each instruction is repeated. Practicing deep breathing is repeated for several days, to allow the patient to master the technique. The following days, the patient is reminded of and supervised when practicing the correct breathing technique. This is followed by practicing *resistance breathing*.

Fitness exercise

Fitness exercise is one of the simplest forms of physical activity for recumbent and walking patients. It is performed in line with the medical condition of the patient, usually 1 to 2 times a day for 10 to 15 minutes, individually or in groups. The physiotherapist or nurse leads the exercise in a group of patients with the same movement limitations, lying down, sitting up or standing. The exercise is performed in a well-ventilated room, usually in the patient's room. If necessary, various aids may be used, e.g. a folded towel, *inflatable rubber balls* of different sizes. Exercises are often interspersed with breaks and breathing exercises.

If the patients have a paretic (or less mobile) upper limb, they are taught to gradually exercise it with the *assistance of their healthy limb*. The patients are at first briefed on what will they practice and the exercises are than described in stages.

The patient is encouraged to actively move at every opportunity, e.g. when shifting on the bed, getting out of bed, sitting on the bedpan, positioning etc.

The fitness exercise is important for maintaining passive and active joint mobility, and for optimal distribution of muscle tension when changing position.

Verticalization

The term verticalization means a gradual change in the patient position to the vertical position. The physical load after each mobility restriction must be gradual and smooth. At first, practice sitting, standing beside the bed, and then walk around the bed, then later in the corridor. Patient verticalization is prescribed by a doctor. The doctor sometimes also prescribes to measure the blood pressure and pulse, e.g. before and after walking. Some patients must have bandages on their lower limbs before they hang them from the bed – before verticalization to the standing position to prevent thromboembolism.

Verticalization in an immobile patient can be achieved using an *adjustable bed,* a bed with a tilt option or verticalization tables.

A serious medical condition, massive blood loss, immediate condition after brain concussion, temperature, pain increased with movement, danger of embolism, or a patient in shock are viewed as a contraindication to early verticalization.

Practicing sitting

Practicing the sitting position (sitting on the edge of the bed), e.g. after surgery, is initially done with the physiotherapist (rehabilitation worker). The patient is taught to sit up from lying on the bed on their side.

Verticalization after orthopaedic surgery is different. The patient must constantly hold between their knees an appropriate aid – block, ball (Powerball) or at least a cushion to prevent rotation of the hip. First, the patient practices sitting on the bed, and the next day after surgery, sitting up with their legs down from the bed. The patient must always be observed in training (watching for signs of increased sweating, lip colour, listen to their feelings).

When sitting on the bed, the feet should be supported with a foot stool, or the bed height should be dropped so the feet touch the floor.

When a patient with apallic syndrome practices sitting, their shoes should be put on.

Technique for gradual repositioning of the patient from lying to sitting:

- The patient bends their knees
- Turn from their back to their side (see Fig. 6-3)
- Then, while on their side, the patient drops their legs from the bed and leans on their elbow for support (see Fig. 6-4)
- While leaning on the elbow, they then begin to lift upper part of the body from lying to sitting (see Fig. 6-5)
- Finally, the patient sits on the edge of the bed (see Fig. 6-6).

Fig. 6-3, 6-4, 6-5, 6-6: Technique for gradually sitting up from lying

Practicing walking

Practicing walking using underarm or elbow crutches is important in terms of patient self-sufficiency. Before practicing, it is necessary to set the height of the elbow crutches so that when standing upright, the crutches rest on the floor, allowing the patient to bend their elbows slightly, without lifting their shoulders.

Practising walking after hip surgery

The patient stands on their healthy leg, the operated leg rests under its own weight on the floor.

- During the first phase, both crutches are moved forward, about the length of a step; it is better to start with short steps.
- The second phase involves the operated leg, which is bent at the hip, knee and ankle, and is rested first at the heel, and then the whole foot touches the floor in between the crutches. The toes are aligned between the crutches, facing forward, not facing outwards.
- In the third phase, the body weight is transferred to the crutches and hands.

- In the fourth phase, the body weight remains on the outstretched hands and crutches, which at this stage supports the weight of the entire body. The healthy, non-operated leg moves forward in the air, in front of the operated leg and the crutches.
- In the fifth phase, the patient stands on the healthy leg and the operated leg remains in a backward position bent at the knee.

The main therapy method involves preventive measures to reduce secondary changes, and methods to improve mobility. Exercise and positioning are most important for preventing immobility.

Complications and prevention

If practising is done faster than required, it can lead to *orthostatic hypotension*; the patient is at risk of *falling*. Therefore, observe patient reactions during verticalization, such as signs of dizziness or breathing difficulties, etc. Preventive measures include careful observation of verbal and nonverbal signs and the gradual repositioning of the patient.

Patient repositioning risks

Before turning on or getting up from the bed, it is important to take care of any inserted catheters (e.g. permanent urinary catheter, drains) and other invasive inputs, to prevent removal during inappropriate manipulation.

It is important to emphasize that in patients after total endoprosthesis of the hip joint, a pillow, ball or other aid must be inserted between their knees to prevent dislocation of the hip on the operated leg.

Additional task

- Lie down on a hard surface on your back and then on your side and try to remain in these positions for 15 – 20 minutes. The areas where you will feel pain, burning or discover a slight skin irritation are called *predilection sites*, i.e. the areas at risk of developing pressure ulcers.
- During clinical practice, position at least two patients into the individual positions as part of the preventive positioning of the body.
- The text includes terms such as pressure ulcers, contracture, deformity, atrophy. If you do not know what they mean then consult a dictionary.

Control questions:

- Explain the terms: Mobility, immobility.
- What is the purpose of mobilizing the patient?
- Explain the terms: Passive movement, assisted movement, active movement.
- Explain how to get the patient to cooperate during verticalization.
- Which aids can help the patient during verticalization?
- Name the appropriate aids to facilitate the movement of the patient.

- What aids are used for lifting and moving a patient?
- What is the correct technique for gradual sitting up of the patient, e.g. after surgery (except orthopaedic)?

6.1 Patient positioning, preventive positioning

Objectives:

After studying this text, you will be able to:

- Describe the individual positions in patients according to their purpose.
- Apply the basic terms related to limb movement.
- Explain the importance of preventive positioning for preventing immobilization syndrome.
- Lay the patient in the correct diagnostic position depending on the type of examination.
- Clarify the psychosocial manifestations of immobilization syndrome.
- Implement correct procedures for preventive positioning of the body.
- Adjust the patient position on the bed as required using auxiliary bed equipment.

Patient examination and treatment positions

The purpose of laying the patient in the *examination position* is to facilitate better access to an organ or body part. *Treatment position* contributes to successful patient treatment. (Team of authors, 2005)

Technical notes

A healthy person actively changes the position of their body as required; the position of a sick person is influenced by illness and the treatment regime.

If a person has unlimited physical activity, the body position changes automatically after a few minutes, according to the feeling of increased pressure on different parts of the body. ***Active*** position – the patient takes this position on their own, feels comfortable and does not submit to the detriment of their body weight or body parts.

In difficulty, usually when in acute pain or with acute shortness of breath, the patient assumes a ***forced*** position, until the difficulty is overcome. Remaining in a forced position for a long period may cause the development of secondary changes in the musculoskeletal system within the immobilization syndrome, including the formation of intertrigo.

If the position of the patient is conditioned by the weight of their body or their body parts (i.e. by gravity), then this is a passive position. The ***passive*** position is considered to indicate serious illness; physical activity by the patient is limited. This position is assumed by e.g. unconscious or physically exhausted patients, who do not cooperate or cannot reposition themselves without assistance.

Basic terms for joint movements:

Flexion (lat. Flecto, flexum) = to bend, bending - movement, during which the joint angle is reduced, e.g. in the elbow or knee joints.

Plantar flexion – movement in the direction of the foot (pointing of the toes)

Dorsiflexion – the opposite movement (the toes move closer to the shin)

Extension – stretching, extension straightening. Movement in the joint during which the joint angle increases, e.g. in the elbow or knee.

Abduction – a movement which draws the limb out to the side, away from the sagittal plane (body, limbs).

Adduction – movement which brings part of the body closer to the middle sagittal plane (body, limbs, e.g. shoulder, hip).

Supination – rotation of the forearm, when standing the palm faces to the front, or when lying the palm faces upwards when lying, i.e. the little finger points towards the body.

Pronation – rotation of the forearm, when standing turning the back of the hand forward and the palm backward; when lying on the back, turning the back of the hand up, i.e. the thumb pointing towards the body.

Internal rotation – rotation towards the centre of the body, e.g. in the shoulder and hip.

External rotation – rotation away from the centre of the body, e.g. in the shoulder and hip, head turning.

Circumduction – movement in circular manner, e.g. in the wrist.

Examination (diagnostic) positions:

Supine position

The patient position may be modified by the position of the lower limbs – stretched or slightly bent. It is suitable for examining organs in the abdomen, chest, neck, head, upper and lower limbs, or for rectal examination and an examination for vital signs. Patients with cardiopulmonary issues will not tolerate this position. The supine position with stretched legs is not suitable for examination of the abdomen.

Sitting position

The sitting position with or without a back support is used when examining the head, eyes, ears, throat, lungs, chest, breasts, upper and lower limbs, neurological reflexes and when listening to the heartbeat.

Side position

The side position is suitable for examining the kidneys, inserting suppositories into the rectum, and for enema administration. The left side position with flexed legs is also used for examining the rectum, and the right side position for examining the spleen.

Gynaecological position

This is a modification of the supine position. In gynaecological examination, the upper half of the body is slightly raised, the legs are spaced apart and bent at the hips and knees and the calf area is supported by stirrups attached to the sides of the table. This position is used in the

examination of women's reproductive organs and for rectal examinations. The position is challenging for women with musculoskeletal problems and for elderly women.

Genupectoral (knee-chest), genucubital (knee-elbow) positions

This is a position in which the patient kneels down and leans forward on their elbows with a curved spine; this is used during endoscopic examinations of the rectum and intestines (see Fig. 6.1-1). It is typical for DRE.

Fig. 6.1-1: Genucubital (knee-elbow) position

The *prone position* is used for examination of the back and spine.

Patient preparation

Patient preparation is important. The patient must be informed of the importance of the special examination position; they need to be reassured and be cooperative. It is necessary to tactfully inform the patient of the need to expose some parts of the body, whereby it is necessary to ensure their intimacy and privacy. If necessary, the nurse will recommend emptying the bladder and colon.

Therapeutic positions

Therapeutic positions are such positions that are part of the treatment regime for certain illnesses or symptoms. The patient is forced to remain in such a position due to their illness. If the patient tries to get into this position themselves, because it brings relief, it is called the relief position. Some therapeutic positions coincide with relief positions (see below).

The indication of the therapeutic position is determined by the illness. Appropriate positioning of the patient is influenced by the patient physique, the type of aid, and workplace standards and practices.

Supine position

The supine position is one of the basic therapeutic positions (see Fig. 6.1-2). The horizontal position is indicated for skull injuries, and after pelvic or spinal surgery. After a lumbar puncture the patient lies in a horizontal position without a pillow under their head.

The patient lies on their back with their head supported so that it is an extension of the spine. The lower limbs are always slightly flexed under the knees, the calves are supported, the heels

lie freely, the feet are supported on a box or foot panel on the bed, the toes are towards the ceiling, the astragal is in the neutral position. In less mobile patients, the blanket must never be tucked underneath the mattress.

For the upper limbs, the elbow in the flexion position alternates the extension position, with supination forearm and pronation position. When positioning a hand, the slight dorsal flexion of the wrist with bent fingers alternates the middle position of the wrist with outstretched fingers.

When positioning the hips and shoulders, the position of the body maintains a forward direction, while the legs are turned inwards and the arms outwards. Positioning aids from the outside of the hips or from outside the legs along the length of the body will prevent the lower limbs "falling over", i.e. external rotation. Predilection sites are supported with anti-decubitus pads. The supine position with bent legs suits those patients with problems in the abdominal cavity; the position is used to release abdominal muscle spasms. If the patient assumes this position as a form of relief, it is usually a sign of peritoneal irritation.

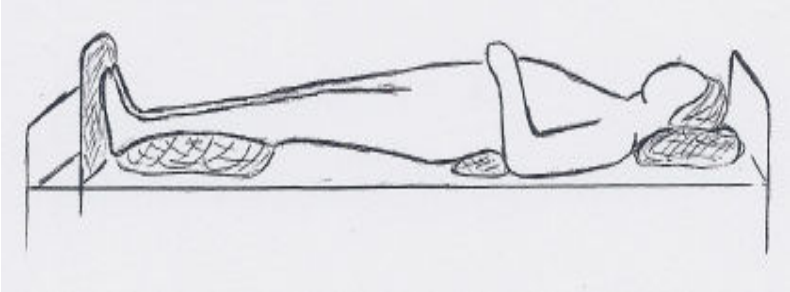

Fig. 6.1-2: The supine position

Fowler's position

This position is used in patients with respiratory problems and cardiopulmonary diseases, in the prevention of bronchopneumonia in bedridden patients, after abdominal and thoracic surgery, etc. Patients are put into Fowler's position during normal daily activities (eating, reading, watching TV, etc.).

The sitting or semi-sitting position on the bed, when the patient's head and torso are raised by 15-45 ° (in relation to the lower limbs) is called Fowler's position (see Fig. 6.1-3). In the high Fowler's position, the torso and head are raised at an angle of 45-90°.

The patient's back and head are supported by the raised part of the bed. Extra support of the head with smaller cushions will prevent the head dropping backwards or sideways. Slumping of the patient can be avoided by placing a box at the foot of the bed. The thighs and knees are supported with a soft cushion, which helps to distribute the weight of the legs and reduce the pressure of the legs on the heels. The knees are at slight flexion. The lumbar and sacral regions can be wedged with small cushions.

If the patient is at a risk of developing pressure ulcers, it is appropriate to place a decubitus mattress underneath the patient, or use other aids that prevent pressure ulcers (see the chapter on the Treatment of pressure ulcers). Bedsores mainly occur in the areas of the buttocks and the sacrum, as well as on the heels and shoulders. When positioning the patient, it is necessary to avoid excessive supporting of the back, which can result in neck contractures.

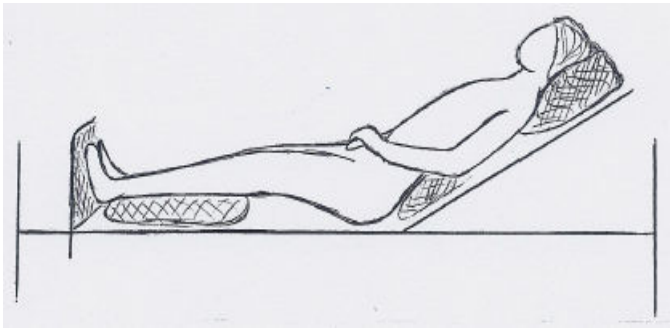

Fig. 6.1-3: Fowler's position

Orthopneic position

The orthopneic position is a fundamental *therapeutic position*. The patients themselves often relieve their pain in this position. It is typical for patients with left-sided heart failure, and mainly occurs at night. The patient is restless and anxious.

When in the orthopneic position, the patient sits on the bed, holding onto the headboard (thus involving auxiliary respiratory muscles), the legs are dropped off the bed. Sometimes, the patient leaves the bed, and either sits or stands bent slightly forward using the surface to support the hands (see Fig. 6.1-4).

The reason for this position is to improve ventilation and increase vital lung capacity; when in the seated position, the patient involves the auxiliary respiratory muscles, and the legs being lowered result in the accumulation of blood, thus complicating the venous return to the congested pulmonary vascular bed.

If the patient needs to leave the bed, they can be seated in the *chair for cardiac patients*. The chair has a soft, anti-decubitus mat to prevent pressure sores on the buttocks, the patient has a cushion behind the back and the hands lean on the surface (dining table), which is softened with a mat (soft cushion). The patient can also rest their arms on the chair's armrests, which prevent the patient falling to the side. The armrests can be folded down. The lower limbs are supported by a cushion or a stool.

Fig. 6.1-4: Orthopneic position

Prone position

The prone position (see Fig. 6.1-5). is used if the patient perceives it as a form of relief for their back muscles, to ventilate the rear parts of the lungs, to improve peristalsis and in diseases in the stomach, duodenum and pancreas. Elderly patients often will not tolerate this position.

The prone position is a position on the stomach, with the head turned to one side without a pillow, only with a slight head support. The pubis and the shin bones are supported by relieving anti-decubitus pads. If the patient will not tolerate the asymmetric head position, the head can rely on the forehead, which is supported by e.g. a folded towel. The abdomen is supported with a cushion, preventing bending in the lumbar spine area. To achieve a comfortable position, the chest should also be supported, taking into account spinal curvature (in particular the head and neck position) and the type of aid.

The arms are laid alongside the head with elbows bent at 90° or both arms are stretched along the body with the palms facing upwards. The shoulders are protected against internal rotation by wedging in accordance with the physique of the patient.

The lower limbs are stretched at the hip and knee joints. If the type of the bed permits it, the toes are left to dangle over the edge of the mattress. The degree of flexion of the knee is controlled by wedging the legs.

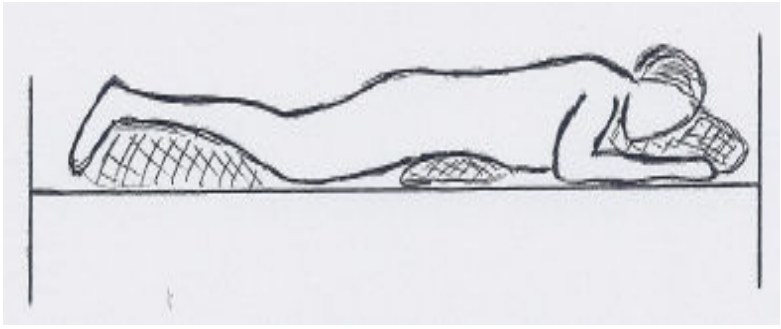

Fig. 6.1-5: Prone position

The Trendelenburg position

This position is used after short-term collapse, in gynaecology to sustain the foetus, in urology during prostate or bladder surgery. The Trendelenburg position worsens pulmonary ventilation, increases intracranial pressure, and the venous return to the heart as well as increases central venous pressure.

In the Trendelenburg position the patient is laid flat on their back or on their stomach with their head lower than the feet and pelvis, using hydraulic bed equipment (see Fig. 6.1-6). In older, standard beds, the position is adjusted using wooden blocks, which are slid underneath the feet of the patient; the bed tilt is 15 - 30°.

Fig. 6.1-6: The Trendelenburg position

Reverse Trendelenburg position

The entire bed is tilted in the opposite direction, i.e. the feet are lower than the head and the pelvis (see Fig. 6.1-7). This position is used for arterial circulation disorders in lower limbs.

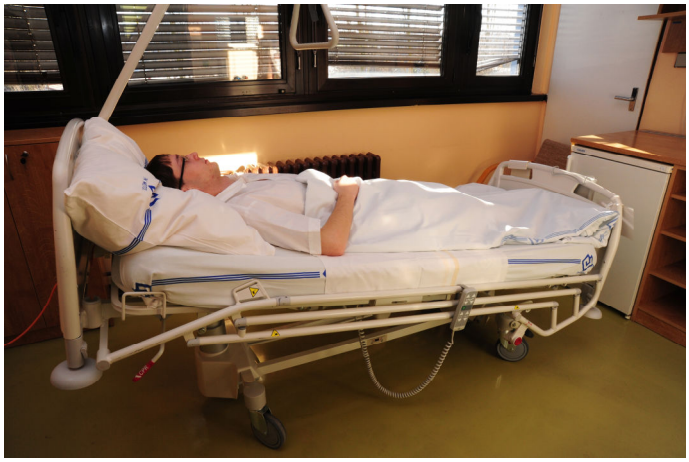

Fig. 6.1-7: Reverse Trendelenburg position

Side position (lateral)

The patient lies on their side with their head supported so that it is an extension of the spine. Both lower limbs are bent at the knee. The bottom leg is slightly flexed, while the top leg is flexed more at the knee and hip. The arms can be rested alongside the body or in the direction of the head. The top arm can be supported by an aid (e.g. a pillow). The position is typical for patients with pleurisy (pleuritis). The patient lies on the affected side, thus reducing their breathing movements and subsequently reducing the pain. The position is used during rest, sleep or when needed to relieve pressure on prominent areas while in the supine position.

Stabilized (Sims', large lateral position) side position

The position is used in unconscious patients and in patients with a complete inability of active voluntary movement (plegia). The patient lies on one side with the under arm behind their back and the upper arm is flexed in the shoulder and elbow. Both legs are flexed, while the upper leg is bent more slightly forward. It is essential to support the body with positioning aids such as when in the lateral position.

Relief (forced) positions

If the patient tries to get into this position themselves, because it brings relief, it is called the relief position. This should be respected and try to influence the cause of pain that compels the patient to assume the relief position by quick therapeutic intervention.

Post surgery patient care

Positioning the patient is part of the examination or procedure, the care of the patient after the procedure is determined by the type of examination. After positioning the patient in the therapeutic position, make sure that the patient can tolerate it. The patient position and the time are recorded in the nursing documentation.

Care of equipment after use

Washable aids used in the diagnostic, therapeutic or preventive positioning of the body are disinfected after use, or if possible sent to the laundry for washing. The used fabric cover is removed and put into dirty laundry.

Preventive positioning of the body

After studying this chapter, you should be able to:

- Identify the predilection sites – a patient in the: supine or side position
- Correctly communicate with the patient during positioning (emphasise what, why and how this will be done).
- Put the patient into the basic position as precautionary positioning of the body in the model classroom and subsequently during clinical practice.

Purpose

The purpose of preventive positioning is to prevent any complications that may occur during prolonged immobility of the patient, e.g.:

- *Intertrigo, muscle contracture, deformities, muscle atrophy*
- Relieve pain
- Allow muscle relaxation
- Improve lung ventilation
- Improve the range of joint movement

The nurse is tasked to *encourage* the patient to change position or to motivate them to cooperate during positioning.

Theoretical notes

In patients with a reduced degree of mobility and in immobile patients, the nurse must ensure the change of body position at regular 1-2 hourly intervals during the day and at 2-3 hourly intervals at night according to the schedule of position changes (positioning hours as customary at the ward) to prevent complications caused by ***immobility*** (unable to do physical activity, immobile (Vokurka, 2007).

Immobility causes a series of damage as a direct result of inactivity - ***immobilization syndrome*** (hypokinetic syndrome, inactivity syndrome). Changes start to develop from the second day of bed rest; pathological changes are evident within 5 to 10 days. They affect all the organ systems in the human body as well as the psyche of the patient.

- *Integumentary system* – decreased skin turgor promotes the development of intertrigo and subsequently ulcers (see chapter 9.4 Care of pressure ulcers). A pressure ulcer is local tissue damage that occurs as a result of direct pressure in combination with friction, immobility and the overall ill health in the patient. They gradually pose a danger to skin tendons and subsequently to bones. Pressure ulcers can be divided into four stages according to the severity. Among the general factors, supporting the formation of pressure ulcers are unconsciousness, paralysis, dehydration inflammation, pain, old age, urine and stool incontinence, insufficient nutrition. Preventive measures include assessment of the risk for pressure ulcers using the Norton scale, the check of predilection areas and relief through the appropriate aids. It is important to ensure proper bed adjustment, thorough drying after hygiene care, regular positioning after two to three hours, passive exercise and if the patient's condition allows it, then active exercise.
- The *cardiovascular system* is compromised during inactivity by venous stasis, which occurs due to the lack of movement of the lower limbs. Later, there is a risk of thrombosis, thrombophlebitis and varicose veins, which may lead to pulmonary embolism. There is a risk of orthostatic hypotension during verticalization of the patient, which may occur as a result of the rapid reduction of blood pressure, and which manifests itself as dizziness, fainting and tachycardia. The patient is asked to move slowly and to perform breathing exercises during verticalization. So the blood can return to the heart through the internal venous system, the patient is given elastic bandages or stockings.
- The *urinary system* is threatened by the stagnation of urine in the bladder, causing the risk of urinary tract infection and formation of kidney stones. The atrophy of the pelvic floor muscles can even lead to incontinence. In a permanent urinary catheter procedure, the patient is threatened with constant urinary tract infections. A permanent urinary catheter must be inserted aseptically, treated regularly with care and replaced in order to maintain increased hygiene in the urinary meatus. In addition, good hydration should be provided and diuresis monitored. In the event of signs of infection or pathological impurities in the urine, the doctor must be informed immediately.
- The *respiratory system* is burdened during the supine position by decreased pulmonary ventilation, which impairs the ability to cough, and the mucus accumulation in the lungs puts the patient at risk of hypostatic pneumonia. There is a possible later collapse of the lung or even lung atelectasis. Treatment of airways, support for coughing, verticalization, mobilization and breathing exercises can prevent complications.
- Changes in the *digestive system* are caused by lack of exercise, and by an insufficient intake of fibre and fluids. Reduced intestinal motility affects bowel movement and causes difficulty in emptying, most often in the form of constipation. Given that a patient is not used to defecating while in an unnatural position and in the presence of other patients in the room, they may be shy which may lead to constipation. Preventive measures include checking the frequency of bowel movements, ensuring a

sufficient intake of food with high fibre content, and if necessary to offer laxatives as prescribed by the doctor. The nurse should help to maintain the patients privacy during emptying, e.g. by using screens, curtains etc.

- *Musculoskeletal system* – immobility causes shortening of tendons, muscle atrophy (decrease in muscle mass), stiffness and limitation of joint mobility (ankylosis). Lack of movement leads to degradation of calcium, and this creates immobilization osteoporosis, which is the cause of fractures. It is important to prevent this through movement and passive exercise as part of the rehabilitation. At the same time, the patient must be provided with the utmost care, because an immobile patient is at risk of falling. When handling a patient, be careful and use protective aids.
- *Metabolic nutrition system* Immobile patients often lose appetite or suffer a swallowing condition known as dysphagia. At the same time, the body suffers an imbalance between catabolic and anabolic processes, i.e. the organism excretes more nitrogen than it receives. These problems can cause malnutrition in a patient.

  Preventive measures: The nurse monitors the nutritional status and seeks a sufficient intake of nutrients and minerals.
- *Psyche* – an immobile patient may suffer from an increased feeling of helplessness, depression, anxiety, fear of the future, lack of motivation. Their perception of time and space may also be distorted.

  Preventive measures: The nurse must quickly recognize the patient's problems and help them to address them.

The patient is sensitive to the nurse's verbal and non-verbal expressions, and so it is necessary to treat the patient and their relatives with empathy. Always speak calmly, clearly, do not increase the voice unnecessarily.

The daily nursing activities include nursing procedures to prevent complications linked to immobility, especially pressure ulcers in the *predilection sites.* Predilection sites – areas on the body that are increasingly at risk of developing pressure ulcers, primarily due to increased pressure on the skin between the surface and a bone, which is an area of decreased tissue perfusion (see Treatment of pressure ulcers).

The following parts of the recumbent patient's body are the most vulnerable:

- In the supine position: Heels, cross and lumbar area, elbows, shoulders and the back of the head
- In the side position: Ankles, great trochanter, pelvis, knees (medial and lateral condyle), shoulder, and on the head – ears and temple area
- In the prone position: Toes, genitals (in men), breasts (in women), acromion, and on the head – ears and cheekbone
- In Fowler's position: the heels, the area round the sacrum and the ischial area, the 7th cervical vertebra

The *term* ***positioning*** of the patient is used for the correct placing of the patient, especially an immobile patient, into the therapeutic position on the bed.

Types of positioning

- *Preventive* – prevents development of complications such as pressure ulcers, contractures, deformities etc.
- *Corrective* – helps to correct complications, e.g. contractures
- *Antalgic* (painkilling) – relieves pain

Principles of preventive positioning

The basic principle of positioning is to put the patient in a comfortable, functional position which is closest to the physiological position of the body part with minimal muscle and joint strain (or to the mid joint position) with maximum comfort. Each position requires supporting the body parts using aids to counteract the force of gravity.

It is important, where possible; to continuously check that the patient is comfortable in order to evaluate the effectiveness of the positioning. It is necessary to avoid placing one body part on another part due to the excessive pressure, which causes damage to the veins in lower limbs or nerves and blood vessels.

Pressure ulcers can usually be prevented by reducing pressure in a:

- Static manner (i.e. using an anti-decubitus mattresses),
- Dynamic manner, i.e. by regular and frequent positioning (after 2 hours during the day and after 3 hours at night).

The following positioning procedures are only a guide. They are the basic positions which must be adapted to the individual needs and medical condition of the patient after consultation with a doctor or physiotherapist.

Preparation of aids

The use of aids for positioning helps to keep the patient in the desired position so as to avoid pressure ulcers developing as well as facilitate the moving of the patient.

- Aids that help to keep the patient in the desired position, or prevent pressure ulcers developing:
    - Decubitus pad or mattress
    - Small or large cushions
    - Feet or elbow pads (or foam rings) for reducing pressure on the skin
    - Trochanter roll or other aids to prevent external rotation of the hip
    - A roll (e.g. inflatable) placed under knee
    - Block (box) of foam or inflatable
- Aids that facilitate the handling of patients are used for positioning less mobile patients. For example, the positioning (cross) mat. It is important that the positioning mat is simultaneously placed under the buttocks and shoulders (see Fig. 6.1-8). If the positioning mat is only under the shoulders or only under the buttocks, the handling is ineffective - see Fig. 6.1-9.

Fig. 6.1-8: Correct use of the positioning (cross) mat

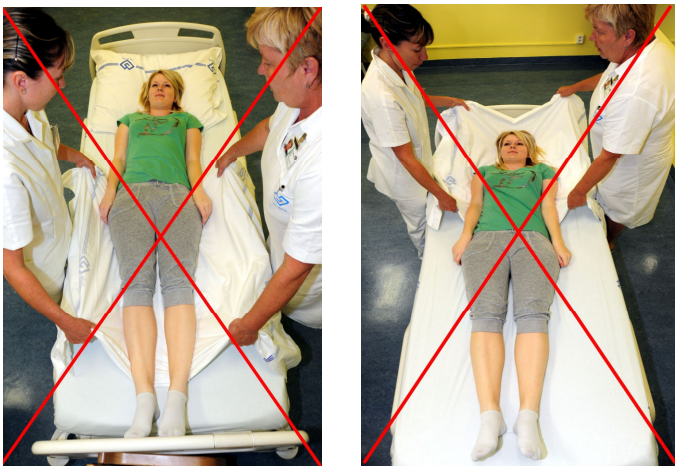

Fig. 6.1-9: Ineffective use of the positioning (cross) mat

Moving an immobile patient from a bed to a wheelchair or to another bed is easier when using a roll board. Transfer of the patient to a roll board (see Fig. 6.1-10 a, b, c).

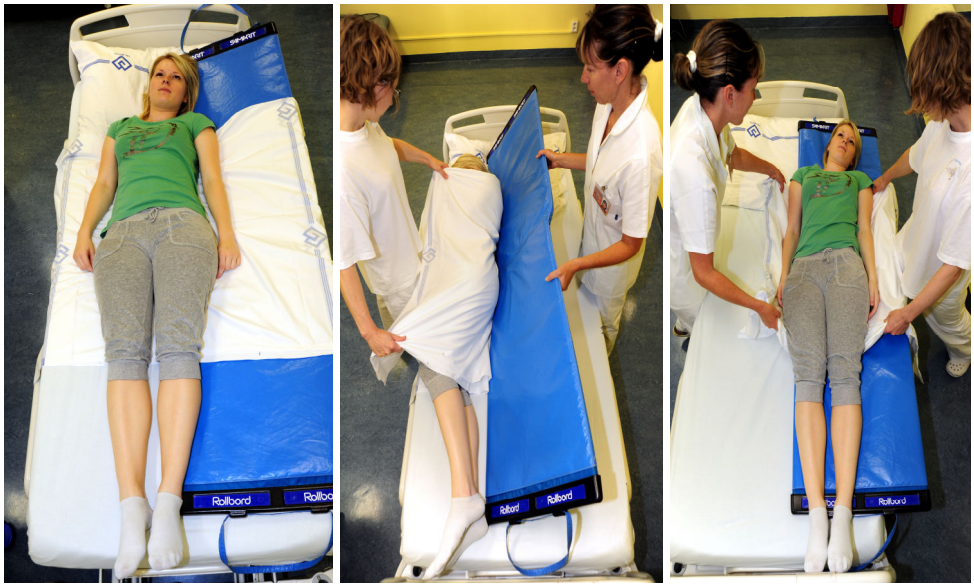

Fig. 6.1-10 a, b, c). Transferring the patient to the roll board using a positioning (cross) mat

Basic preventive positioning of the body includes:

- Dorsal position (supine)
- Fowler's position
- Side position (lateral)
- Prone position (on the stomach)
- Sims' position (great lateral position)

Aids for preventive positioning of the body

These aids help to keep the patient in the desired position, or prevent pressure ulcers developing. The preventive positioning of the body involves the use of various shapes and materials that help the patient to sustain the desired position, i.e. small or large cushions, pads, rolls and blocks (see Fig. 6.1-11). The aids are often made of foam, polystyrene beads (bead aids) and can be inflatable or from other materials.

- The aids enable to sustain the appropriate position:
  - Small and large cushions, rolls, blocks, wedge pillows
  - 2 foam rings
  - Aids preventing external rotation of the hip, or 2 Trochanter rolls
- Aids decreasing pressure on the predilection areas and preventing pressure ulcers developing
  - Decubitus pad or mattress
  - Feet or elbow pads (or foam rings)

Fig. 6.1-11: Aids used for positioning patients

Positioning the patient in the supine position – dorsal position

Patient preparation

Assessment of the patient's clinical condition

It is important that the patient is informed of the procedure they will be partaking in. The procedure should be clearly explained, described, and possibly demonstrated on them.

Cooperation with the patient is required in order to take advantage of the remaining potential for physical activity.

Performing the procedure

The patient is put into the supine position. A cushion is placed under the patient's head so that the cervical spine is not unnaturally bent forward or backward. The upper limbs can be slightly supported and rested alongside the body or flexed at the elbow joint and supported with a cushion to protect against the effects of gravity. The forearm is put into the prone position with the wrist in the direction of the forearm axis, with the fingers in slight flexion. If necessary, the elbows, wrists and fingers are supported with foam rings or other aids to eliminate the pressure. The lower limbs are supported below the knees and the feet pads, the "boots" can also be used (see Fig. 6.1-12).

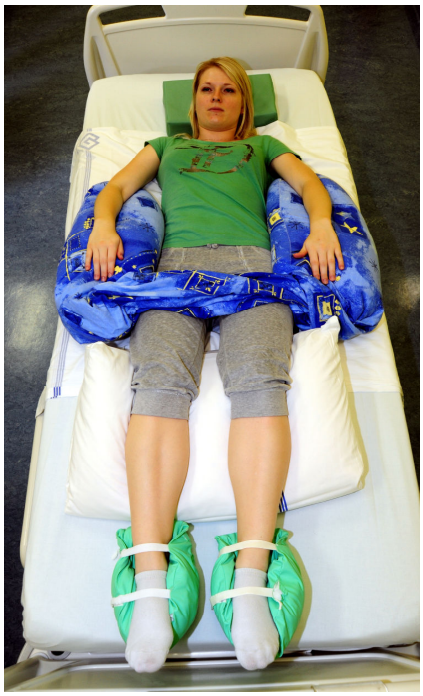

Fig. 6.1-12: Positioning of the patient in the supine position

Positioning of the patient in Fowler's position

Patient preparation

The patient is familiarized with the procedure they will be a part of. The procedure should be clearly explained, described, and possibly demonstrated on them. Cooperation with the patient is required in order to take advantage of the remaining potential physical activity.

Working procedure

Assessment of the patient's clinical condition

The patient is put into the supine position and the position of the shoulders is checked so that they are above the point to be raised using the adjustable part of the bed from 30 to 90°, as

needed. If necessary, the patient is instructed to bend their knees to ensure proper seating and balanced distribution of pressure on the ischium bone. This ensures the semi-sitting position.

Positioning the patient in the side position

Patient preparation

It is important that the patient is informed of the procedure they will be partaking in. The procedure should be clearly explained, described, and possibly demonstrated on them. Cooperation with the patient is required in order to take advantage of the remaining potential for physical activity.

Performing the procedure

Using the positioning (cross) mat, the patient is moved towards the edge of the bed and put into the side position (see Fig. 6.1-13 a, b, c). The head is supported by a small cushion, so the head and cervical spine are level with the extended axis of the chest.

The arm on the bottom is flexed at the shoulder and the elbow joint so that the patient does not lie on it. (See Fig. 6.1-14). The arm on the top is supported with a cushion or foam block, to prevent unwanted internal rotation and adduction in the shoulder; the elbow is flexed and the forearm rests on the cushion.

Lower limbs are slightly flexed in the hip and knee joints with cushions placed in between to prevent internal rotation and adduction of the lower limbs and to eliminate pressure from the top leg on the bottom leg (see Fig. 6.1-15). Rotation of the spine is prevented by positioning the shoulder and hip joints at the same level. The position of the shoulder joint must be adjusted. The patient position and the time are recorded in the nursing documentation.

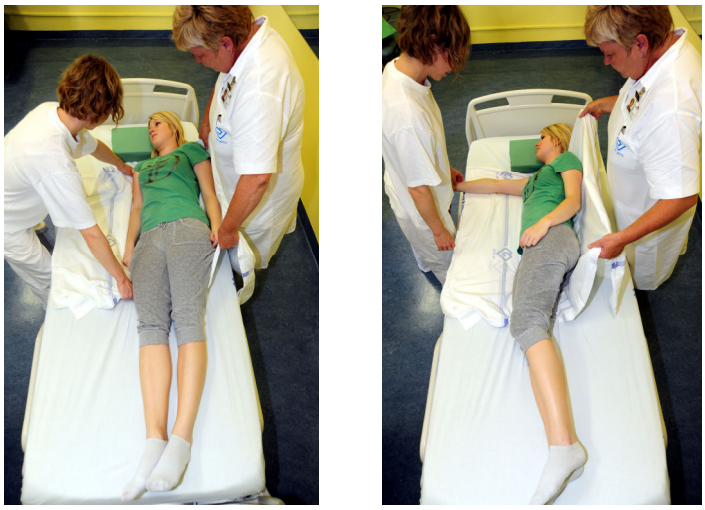

Fig. 6.1-13 a, b: Procedure for positioning the patient from the supine position to the side position

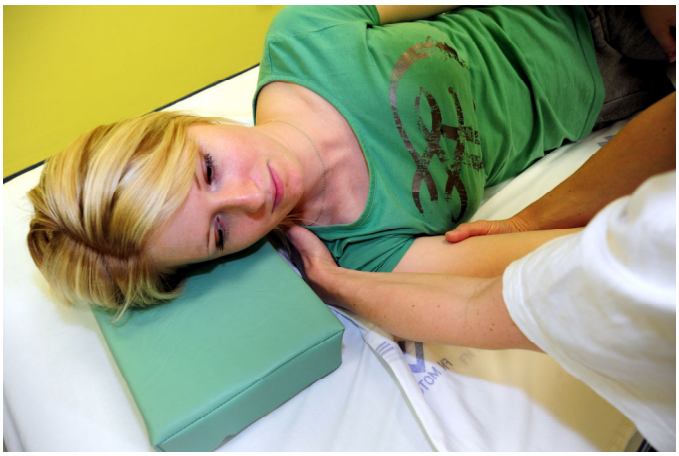

Fig. 6.1-14: Repositioning the shoulder - detail

Fig. 6.1-15: Side position with slight flexion of the knee and hip joint

Positioning the patient in the prone position

Performing the procedure

The patient is placed in the prone position, with their head turned to the side. If necessary, a small cushion is inserted underneath the head, which will help to maintain the physiological position of the head relative to the torso. A small cushion can be placed under the stomach to prevent lumbar hyperlordosis, breathing difficulties and increased pressure on the genital area in men and breasts in women. The pressure on the patella and toes can be eliminated by shin and instep pads (see above).

Post surgery patient care

The prone position can be demanding and not everyone can tolerate it, so the nurse should check while positioning that the patient can tolerate it. The patient position and the time are recorded in the nursing documentation.

Patient positioning in great lateral position (Sims' position)

This is used in patients with consciousness disorders as it provides better stability. The Sims' position is a modification of the lateral position or the recovery position.

Performing the procedure

The patient is put into the side position. After adjusting the shoulder, on which the patient is lying, the torso is leant forward. If necessary, the head is supported with a small cushion, which helps to maintain the physiological position of the head relative to the torso.

The arm on the top remains abducted in the shoulder and flexed at the elbow. It is supported with a cushion on the shoulder and chest area next to the head (See Fig. 6.1-16).

The top leg is abducted in the hip, flexed in the hip and knee and rested forwards. A cushion is inserted between the thigh and the pelvis to maintain the correct position. The leg at the bottom is extended at the hip and knee and rested behind the patient's torso. A foam ring or another aid is placed under the medial and lateral part and below the elbows. Another aid is used, if necessary, to prevent the leg from falling into plantar flexion.

The patient position and the time are recorded in the nursing documentation.

Fig. 6.1-16: Sims' position

Additional task

- Lie down on a hard surface on your back and then on your side and try to remain in these positions for 15 – 20 minutes. The areas where you will feel pain, burning or discover a slight skin irritation are called *predilection sites*, i.e. the areas at risk of developing pressure ulcers.
- During clinical practice, position at least two patients into the individual positions as part of the preventive positioning of the body.

- The text includes terms such as pressure ulcers, contracture, deformity, atrophy. If you do not know what they mean then consult a dictionary.

Control questions:

- Explain the purpose of Fowler's and Orthopneic positions.
- What therapeutic positions do you know?
- What examination positions do you know?
- What areas of the body in the side position are at risk of developing pressure ulcers?
- What is the movement called which reduces the joint angle?
- What is the therapeutic position called in which the patient is seated, has breathing difficulties that involve auxiliary respiratory muscles?
- In the prevention position, how do you put the patient in the side position?
- What aids do you know that will sustain the patient in the desired position?
- What is the aim of the preventive positioning of the body?

6.2 Hot and cold therapy

Objective

After studying this chapter, you should be able to:

- Explain the term "hot and cold therapy".
- Explain the effects of hot and cold therapy on the human body.
- List the aids used in hot and cold therapy.
- Name the individual types of hot and cold treatments.
- Briefly describe the use of selected aids in hot and cold therapy.

Purpose

The purpose of hot and cold therapy is curative and preventive.

Theoretical notes

Thermotherapy (hot and cold therapy) is an area of physical therapy that uses thermal stimuli and procedures on the body.

Initiated methods of treatment are perceived by a person:

- As hot - referred to as thermopositive
- As cold – referred to as thermonegative

Thermopositive and thermonegative procedures can be applied locally or on the whole body. The doctor will determine the number of applications and the duration and intensity of the procedure.

In patients after CVA and with spinal cord injuries, it is necessary to exercise caution with hot and cold therapy, because they do not perceive these sensations and the tissue could be damaged.

It is necessary to inform the patient about the hot and cold therapy prior to the procedure and to appropriately stimulate their psyche. The nurse regularly monitors the effect of the thermopositive/thermonegative procedure (in 10 – 15 minute intervals); for example, they checks if the compress is in the right place, if it is not too cold etc.

Thermopositive treatment (application of heat)

The purpose of the hot treatment is to accelerate or increase all living processes in the biochemical reactions.

The effects of heat on the human body:

- Accelerates blood circulation
- Vasodilation of the blood supply
- Reduces of muscle tension, creating a relaxing effect
- Increases the permeability of capillaries, stimulating edema
- Moderate heat has an analgesic and spasmolytic effect, deepens breathing etc.

Heat is applied in the following ways:

- *Thermopositive (warm) dry treatment*, e.g. thermal gel pad
- *Thermopositive (warm) wet treatment*, e.g. bath, shower

Thermopositive (warm) dry treatment

Patient preparation

The preparation procedure includes educating the patient, which is necessary for their cooperation. The patient is informed of the procedure, the type of cooperation and any risks.

Preparation of aids

For the heat treatment, we need to prepare the required aid, depending on the selected method of treatment. The aid is only used locally. In thermopositive dry treatment, the aids required include thermal gel pads, hot water bottle, hair dryer, heat compress, electric blanket, etc.

Thermal gel pads are small pads in various sizes filled with gel (see Fig. 6.2-1). They are capable of maintaining temperatures from – 20 °C up to +70°C. The thermal gel pads reach the desired temperature by inserting them in a hot water bath at the appropriate temperature or by placing them in a freezer or refrigerator (CryoBag) depending on the application. They are designed for quick, easy and repeated application. The thermal gel pad must be inserted into a protective cover before application.

The patient must be informed of the purpose, method and time of application of the thermal gel pad. The flexibility of the pad is an advantage when attached to the affected area.

Fig. 6.2-1: Thermal gel pads in various sizes

Care of aids

After using a thermo gel pad, the disposable cover is disposed of or the reusable cover is placed in the dirty laundry bag. The thermal gel pad is soaked in disinfectant solution according to the ward disinfection programme, and is then dried and prepared for the next use.

A hot water bottle is a rubber bottle with a plastic stopper, which is filled up to two thirds full with water at 50 to 60 °C while the remaining air is forced out. It is important to seal the bottle well and check it for leaks by turning the stopper down before use.

Before use, the hot water bottle is put in a protective (textile) cover, and then put in bed or on a designated area of the patient's body. Use of such is prescribed by the doctor.

After using the hot water bottle, the textile cover is put into the dirty laundry bag. The water is drained out and the rubber areas disinfected according to the ward disinfection programme and then hung with the hole facing downwards. After disinfection, it is ready for the next use.

Risks: It is necessary to proceed with caution with unconscious patients and children.

A *thermal compress* is a sealed bag in various shapes and sizes, filled with sodium acetate.

Preparation of a thermal compress: After several pressings, the compress is heated to a temperature of 50 to 55°C (via chain crystallization). The compress can be easily attached to the affected areas, even to those areas that are usually difficult in terms of fixation (e.g. shoulder). Before use, the compress is inserted into a cover (sheet cover, towel, napkin etc.).

Thermal compress care after use: After cooling down, the compress is inserted into a container with water and simmered for 10 to 20 minutes (the bag must not touch the sides of the container). The compress is designed for repeated use. It can also be used in cold therapy.

Other aids

- A *hair dryer* can be used to apply heat to various parts of the body; it is used to dry nappy rash in babies. The nurse controls the intensity of the heat and the distance from the skin.
- *Electrical pads* are used to preheat the bed or for warming certain parts of the body. An electrical pad consists of two layers of thick fabric containing insulated wires which are heated after plugging in. The temperature height is adjustable. The electrical pad must be inserted into a protective cover before application.
- A cushion with flax seed can be heated in a microwave oven and attached to the appropriate area on the body.

To support the thermoregulation of the body (maintaining the body temperature) the following materials are used: *aluminium thermo-foil, thermal pad or thermal blanket.*

Thermopositive (warm) wet treatment

The warm wet treatment includes *showers* and *baths,* i.e. used therapeutically in addition to washing. They have an overall effect. They are used in the treatment of scars, burns, when preheating the body before exercise, when replacing bandages after surgery, etc.

Baths are used on part of or all of the body. Essential oils can be also used in bath therapy. Warm wet therapy is widely used in balneology.

Application of phototherapy

Application of phototherapy is also ranked among heat therapy because of the side effects of some procedures using phototherapy, e.g. Solux lighting.

The following devices are used in phototherapy treatment: Solux sunlamp, bio lamp

Solux is a device designed for heat therapy. A desk top Solux is used to warm small parts of the body, e.g. treatment for sinusitis, colds, muscle pain inflammation, rheumatic disease, neuralgia, in the cosmetic industry.

Preparation of the device: It is plugged into the mains before application. It is important to stand the Solux so that it cannot tip over and burn the patient. When used correctly, the device is 50 to 60 cm from the patient.

Patient preparation: The device produces infrared radiation so it is important to protect the patient's eyes with special glasses. The application time is 5 – 20 minutes.

A *sunlamp* is a device that uses the therapeutic effect of ultraviolet radiation. It is used locally or on the entire body.

Patient preparation

When used locally, the other parts of the body must be covered, i.e. in the treatment of pressure ulcers or intertrigo. The distance of the patient from the device for portable devices is 0.5 m and 1 m for large sunlamps. The duration of each treatment is prescribed by a doctor. It is usually from 1 minute with increased daily doses up to a total of 10 minutes.

Preparation and procedure for sunlamp use:

- The device is ready for use when connected to the mains, after 2 – 3 minutes
- It is then directed to the patient
- During this therapy, the patient and everyone else in the room must protect their vision with special glasses.
- The sunlamp is usually operated in a designated room.

Patient care after treatment

It is important to warn the patient that redness will occur within a few hours following treatment.

Risks:

When using a sunlamp, great care must be given to the application times prescribed by the doctor. The distance of the patient from the device is also important and this depends on the make and the instructions for use.

A *Bio lamp* is a device that transmits narrow rays of light at a 940 nm wavelength, utilizing polarized light on the principle of electromagnetic waves, and has an analgesic, anti-inflammatory and stimulus effect. It is used to support the healing process in chronic wounds, to relieve chronic pain in muscles and joints, to suppress inflammatory processes in the treatment of pressure ulcers and intertrigo.

The treated area must be clean and dry. The use of bio lamps varies with the manufacturer, and is described in the manual. Given that the use of the lamp is simple, it can even be used for home treatment.

Procedure:

- The bio lamp is switched on after connecting to the mains.
- The distance from the irradiated part of the body is 6 cm
- A bio lamp cam be used several times a day
- Recommended time of use is 2 to 3 minutes over 3 to 15 days

Thermopositive and thermonegative treatments are widely used, especially in Balneotherapy, e.g. mud baths, peat compresses etc. Thermal spas are also well known.

Risks of heat therapy

Contraindication of heat application:

- In cases where infection may spread to the sensitive tissue area, e.g. in acute inflammation (in appendicitis) or into a cavity such as the abdominal cavity.
- In patients with reduced sensitivity to pain and heat

- If the swelling increases as a result of heat therapy, such as lymphatic swelling
- In bleeding, cancer, heart failure etc.

When using a hot water bottle – due to the temperature of the hot water, the bottle should be used with caution, especially with unconscious patients and children.

Precaution while using an electric blanket:

- Do not leave on overnight
- Do not leave unattended with children, unconscious and incontinent patients
- Do not fold when stored
- Must be regularly checked for faulty insulation (2 x year)

When using a Solux light or a sunlamp: It is necessary to use protective glasses (preferably dark).

A *bio lamp* is not recommended for use with pregnant women, patients with metabolic disorders, in severe vascular diseases. A bio lamp must not shine directly into the eyes.

Thermonegative treatment (application of cold)

The effects of cold on the human body:

- Vasoconstriction of the blood supply
- Reduction of swelling
- Reduction of inflammation
- Reduction of body temperature in fevers over 39°C
- Analgesic effect, etc.

Cold therapy can be used on the whole body or locally. Thermonegative treatments are also important as a form of hardening prevention.

General cold treatments:

- In the form of a nebula, e.g. in special chambers.
- Cold shower
- Cold bath
- Total artificial hypothermia, i.e. lowering the temperature with cold - applied in some surgeries (heart surgery)

Locally applied cold treatment can use CryoBags, ice bags, cold compresses, or a Priessnitz cold compress (i.e. an irritant compress).

Patient preparation: The patient must be informed of the purpose, method and duration of the procedure.

Cold dry aids

The most commonly used aids today are flexible and therefore easy to attach to the affected area, e.g. *CryoBags (gel pads),* which reach a suitable temperature when placed in a freezer or refrigerator according to the reason for use. The gel pads are made of silicon gel, which remain flexible even after freezing up to -18 °C. They can be applied wherever an *ice bag* can be used.

The gel pad must be inserted into a protective cover before application. They are designed for quick, easy and repeated application.

Care of the aid after use

The disposable cover of the gel pad is destroyed after use, or if it is a textile cover it is put into a dirty laundry bag. The Cryo gel pad is immersed into a disinfectant solution according to the ward disinfection programme, and afterwards is dried and prepared for the next use.

Cold moist treatments

A *cold compress* consists of a cloth soaked in cold water which is directly attached to the affected area. The procedure is repeated as required.

In order to gradually reduce high body temperature (over 39°C), an infusion over the ice layer is applied, or exceptionally a cold wet pack is applied to the chest or to the entire body.

Preparation of aids:

- Compress material, e.g. cloth, napkin, gauze, pad, bed sheet, etc.
- Leak-proof material (plastic), flannel cloth, blanket
- Bandages to attach the compress material
- Container for liquids, e.g. water, decoction as prescribed by a doctor

Procedure:

- Prepare a few pieces of fabric, such as a napkin, towels, etc.
- Soak them in cold water
- Attach them individually to the legs, forehead or torso
- Application time is approx. 20 minutes
- A child is unwrapped from the wet pack, dried and dressed
- A wet pack can be applied repeatedly
- The cold compresses are replaced in minimum half-hour intervals

The Priessnitz cold compress (irritation compress) consists of three layers: Cold linen compress, leak-proof foil, dry linen layer. It is used locally, usually for a sore throat, to relax the skeletal muscles, for irritable coughs etc.

Care of the aid after use

- Used compresses or sheets are dried and placed in the designated dirty laundry bin;
- Aids for repeated use are washed, disinfected and put in storage.

Overall cold treatment consists of a *cold bath* and *cold shower.* They are also suitable means to prevent hardening. The water temperature and duration of the cold treatment is dependent on the medical condition of the patient.

The effects of thermopositive and thermonegative treatments can be used in *alternate treatment*, i.e. exposure to heat and cold in hot and cold showers, foot baths etc.

Cold therapy risks

Cold therapy is contraindicated in:

- Allergy to cold
- Sensitivity disorders
- Blood flow disorders (used only for alternate treatments)
- Cardiac disorders (cold treatment can only be applied locally for a limited time etc.) (Vytejčková et al).

CryoBags and ice bags from the freezer must be placed into covers (wrapped in a sheet, towel etc.) before application.

Cold aids (e.g. ice bags) are not suitable for administering to young girls on the lower abdomen.

The effects of heat and cold can be used for example, when treating the respiratory tract by inhalation (see chapter Other non-injection methods for administering drugs).

Types of inhalation regarding temperature:

- Hypothermic inhalation (25°C – 36°C) – anti-inflammatory – reduces congestion of the mucosa airway. In acute airway inflammation in children, inhalation (i.e. the inhaled air) can be colder.
- Isothermal inhalation (36°C – 37°C) – soothes airway mucosa
- Hypothermic inhalation (38°C – 45°C) – increases blood circulation in airway mucosa; it is suitable for treating chronic respiratory disease.

Control questions:

- What are the effects of heat on the human body?
- What thermopositive procedures applied locally do you know?
- When is heat treatment contraindicated?
- What is the procedure for thermonegative treatments?
- For which diseases is cold treatment contraindicative?

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List of Figures:

Keywords:

Mobilization of the patient

Immobility

Verticalization

Thermopositive treatments

Thermonegative treatments

7. HYGIENE PATIENT CARE

Chapter objectives:

After studying this chapter, you should be able to:

- Explain and understand the importance of hygiene care;
- Describe and explain what adult hygiene care involves;
- Find out information on hygiene;
- Perform morning hygiene care of a patient;
- Know how to wash the patient's hair;
- Give a full bath on the bed to patients with varying levels of self-sufficiency;
- Manage and administer oral and dental care (dentures);
- Manage and administer practical special oral care;
- Know the physiological condition of the skin and skin appendages, be able to assess any deviations, disabilities;
- Ensure hygienic emptying of the patient;
- Respect the patient's dignity.

Theoretical notes

Taking care of bodily hygiene and regular emptying is one of the basic civilized needs of each person.

A walking patient takes care of this need alone; bedridden patients, and especially immobile patients, are dependent on the assistance of others. It is desirable to lead the patients to self-sufficiency, so they themselves take care of their personal hygiene as much as possible. This does not exclude the fact that they should be provided with everything they need to ensure their mental and physical comfort, if they cannot or do not want to do so themselves. *Hygiene* is a set of rules and procedures required to support and protect health, or in other words, the maintenance of personal hygiene. *Personal hygiene care* involves activities that fulfil human needs. These are reflective of the mental state of an individual, their mood, satisfaction or dissatisfaction, their psychological attributes. A dishevelled appearance may indicate mental distress and low self-esteem. Hospital *hygiene care* is based on procedures that a person performs daily as part of their personal hygiene. These procedures vary during hospitalization in relation to the patient's health condition and level of self-sufficiency. The external signs of acceptable standards of hygiene are the absence of visible dirt and stains on clothes as well as a lack of bodily odour.

Another purpose of hygiene care is to maintain and improve the protective functions of the skin, which is important in the prevention of pressure ulcers. Hygiene care is performed regularly.

With the current influx of foreigners, the issue of hygiene care in these patients arises very frequently. When caring for patients from different cultures and countries the nurse (healthcare worker) must know, and to the necessary extent respect, the specifics of that particular culture. Religion is an integral part of each culture which is always more or less present. Religion may influence the rules for bathing (e.g. bathing is not allowed during

menstruation), some religions consider a human being clean only if emptying is done under running water, which can sometimes be a challenge in a patient who is confined to a hospital bed.

Basic hygiene care includes:

- Care of bed linen
- Daily hand hygiene
- Morning and evening hygiene
- Full bath taken in the bathroom
- Full bath on the shower bed
- Full bath on the bed
- Teeth cleaning and oral care
- Special oral care
- Shaving
- Hygienic emptying
- Cleaning a soiled patient
- Prevention and treatment of intertrigo and pressure ulcers
- Cutting nails
- Hair care
- Baby bath
- Baby massage

Personal and bed linen

The patient is dressed in their own nightwear or in hospital nightwear. Hospital patients also need a bathrobe, which is replaced as required. Less mobile patients wear the open back hospital gown which is put on from the front and tied at the back. *Linen* must be *clean, free of holes* and a *reasonable size*, with all laces and buttons. *Patients unable to change into clean clothes* are given assistance. If the patient has healthy limbs, they first dress into a pyjama top and then the bottoms. They receive help with the buttons. When putting on a gown, it is gathered and then pulled over the head, gradually putting on each sleeve and than pulled over the torso to avoid folds. If the patient has *a damaged limb, it is dressed first.* The second limb will adapt to movement better. It is preferable to change the clothes on a less mobile patient with two healthcare workers - it is less demanding and more efficient for the patient. A frequent problem is putting on socks. The nurse will help the patient if they cannot put them on by themselves. *Bed linen* is changed as needed.

Regular daily hand hygiene

Daily hand hygiene is a basic personal hygiene habit. Hands are washed prior to each meal, and after each toilet visit. Bedridden patients are offered hand hygiene with regard to their capability.

Morning and evening hygiene

Daily personal hygiene also includes skin care. A washed patient with cleaned teeth, lying on a clean and freshly made bed feels satisfied, which contributes to their good mental condition. If these habits are disturbed by something, and that person does not feel well and is not in the mood then they can feel helpless. This state of mind to some extent negatively affects the healing process.

Mobile patients look after their hygiene themselves. If the patient is *not completely self-sufficient*, but is able to move, they are seated by the sink in the bathroom with washcloths, towels, soap, teeth cleaning products and clean clothes all within arms reach. If necessary, the patient is offered help with washing their back, hair, nail treatment etc.

Bedridden patients who are able to wash themselves have all they need for their personal hygiene prepared within arms reach on their bedside table. If necessary, the patient is offered help so that all their needs are met as required. Bedridden female patients are given a chance to wash their genitals – a special sink for washing the lower parts of the body; a flannel and disposable cloth for drying are prepared within their reach. A portable shower attachment can also be used for easier washing. The same genital hygiene option is also available to male patients.

Patient hygiene care in the bathroom

Patient preparation

- The patient is explained the reasons for hygiene care and is motivated to cooperate during the procedure;
- Provision of privacy.

Aids

- Bed shower, shower corner
- Protective gloves
- Protective clothing, disposable apron
- Bag or trolley for used linen
- Flannels, towels
- Liquid shower gel
- Shampoo
- Massage oil, emulsion
- Comb
- Clean linen

Fig. 7-1: Shower corner with aids for safety and intimacy – seat, screen

Working procedure

- Verification of doctors hours
- The patient is taken to the bathroom in a wheelchair, the patient is covered during transport
- The healthcare worker puts on protective aids
- Washes and disinfects their hands
- If possible, the patient is guided to the shower, with a non-slip floor (mat)
- The patients underwear is removed
- If possible, the patient stands up while holding onto the handrail
- The patient is lightly showered with warm water, then gradually washed from head to toe with a flannel and liquid shower gel then showered once again.
- The patient is properly dried while checking for changes or defects on the skin
- The patient is seated back in the wheelchair, dressed or covered and taken back to the room.
- The patient is laid back on a freshly made bed
- Skin treatment is provided if needed - massage, treatment of skin defects
- The patient is dressed into clean underwear
- Their hair is dried and brushed
- Their nails are checked and cut
- If necessary, their legs are bandaged
- The patient is than put into the prescribed position
- The hygiene care is recorded into the documentation
- Any changes or defects on the skin that wee discovered are recorded
- The procedure ends with cleaning and disinfection of the aids

Patient care after procedure - see the above working procedure

Care of aids after use

Baths (shower corners) are disinfected after each use. Used linen, flannels and towels are put into the dirty laundry bags for transport to the laundry. Disposable aids (mats, washcloths etc.) are placed in the designated waste bags. Other aids are stored at the designated place.

Complications

- Pain when moving
- Exposure to cold
- Patient feels devalued
- Uncooperative patient

Full bath using a mobile or shower bed

Full body hygiene in patients who are not self-sufficient or partially sufficient is performed using a mobile bath (*aquarel*). The patient can be transferred into the mobile bath (depending on the space) in the room - from bed to bed or in the bathroom. At least two healthcare workers are needed to transfer the patient from the bed to the bath. The bath is fitted with a height adjusting device and with the side rails for patient safety. It can be washed and disinfected. Once in the mobile bath, the patient is transferred into the shower. The procedure is the same as in the previous case. The patients back can also be washed. Depending on the needs and the patient's condition, their hair is also washed.

Patient care after treatment

After showering and draining the water from the bath, the patient's skin and hair are dried, they are given a back massage, dressed, transported back to the room and put on the bed – see the procedure in the above text.

Care of aids after use

The bath is disinfected after each use. Used linen, flannels and towels are put into the dirty laundry bags for transport to the laundry. Disposable aids (mats, washcloths etc.) are placed in the designated waste bags. Other aids are stored at the designated place.

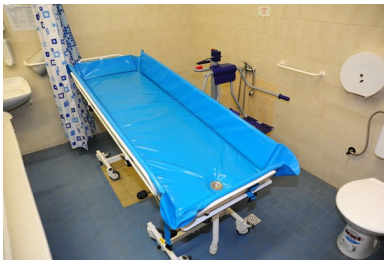

Fig. 7-2: Aquarel (shower bed)

Washing the patient on the bed

Patient preparation

See Patient preparation for the above described procedure

Aids

- Flannels, towels
- Disposable washcloths, mats, cloths;
- Protective gloves;
- Kidney bowl;
- Shower gel;
- Sink for upper and lower body hygiene;
- If necessary, a waterproof mat (to protect the bed sheets);
- Clean clothes and bed linen;
- Bag or trolley for used linen;
- Bedpan.

Other aids are stored in a toiletries basket or on a trolley:

- Nailbrush;
- Fibreglass sponge, pumice stone for removing rough skin on the heels and soles;
- Scissors or nail clippers, nail file;
- Massage oil, emulsion;
- Talcum powder;
- Wadding cut into squares.

Fig. 7-3: Hygiene care aids

Working procedure

- washing and disinfection of hands;
- The patient is informed of the procedure;
- Promote active participation of the patient during the procedure;
- Ensure patient dignity;
- Close windows and doors;
- A sink and necessary aids are placed within reach;
- Release the bed sheet;
- If the patient's condition permits it, the pillow is removed;
- The pyjama top or shirt is removed;
- A towel is placed under the head;
- A wet flannel is used to wash the face without soap, (the patient will determine the water temperature), the eyes are washed with the corner of the flannel away from the inner corner of the eye to outer corner, the face is lightly dried;
- A flannel is also used to wash the ears, neck, chest, abdomen and arms; each part of the body is thoroughly dried (especially under the armpits);
- If the patient can turn on their side, the nurse will gently put them into this position;
- The patient's back is washed and dried. This is followed by a back massage using palms and fingers, moving away from the spine, from the sacrum upward and outward;
- If necessary, overweight patients have talcum powder applied under their breasts;
- The pyjama top or shirt are put back on;
- The water in the sink is replaced;
- The nurse puts on protective gloves and proceeds to wash the genitals;
- A bedpan is used for female patients;

- A disposable washcloth and soap are used to wash the external genitals, away from the pubis to the anus;
- If necessary, the genitals are rinsed from top to bottom with warm water from the bowl and dried with a disposable cloth;
- If the male patient is not able to wash their genitalia themselves, the procedure is as follows; the nurse puts on the gloves and holds the penis, pulls the foreskin and gently washes the urethra, the penis, scrotum and around the anus using gauze or a disposable washcloth; all the areas are then dried;
- It is important to respect the patient's intimacy and dignity during genital hygiene;
- The bed is adjusted in the usual way, including replacing the bed linen, see Chapter 5.2 Bed adjustment with the patient in the bed
- The patient is put back in the original position, a comfortable position;
- All important findings are recorded in the documentation.

Patient care after treatment

See Working Procedure

Care of aids after use

The aids are cleaned and disinfected according to standard procedure

Complications

- Pain when moving;
- Exposure to cold
- Patient feels devalued

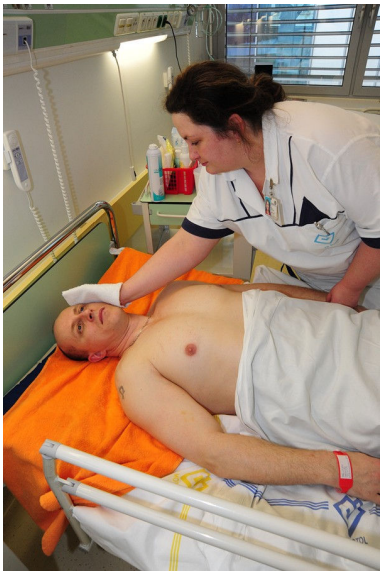

Fig. 7-4: Washing the face

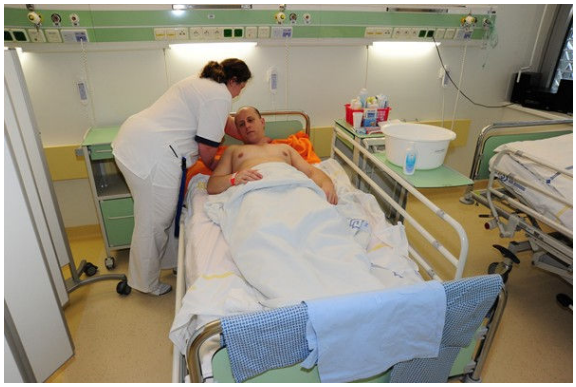

Fig. 7-5: Patient preparation for washing the chest

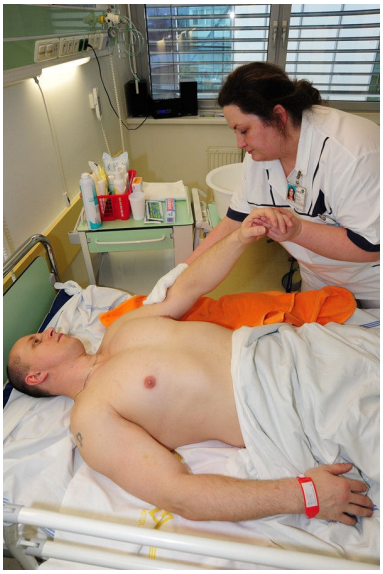

Fig. 7-6: Washing the hands

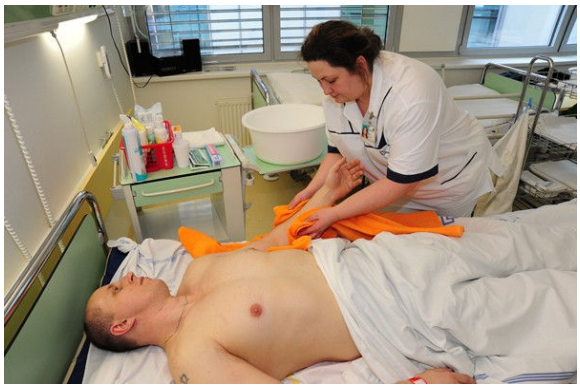

Fig. 7-7: Drying the hands

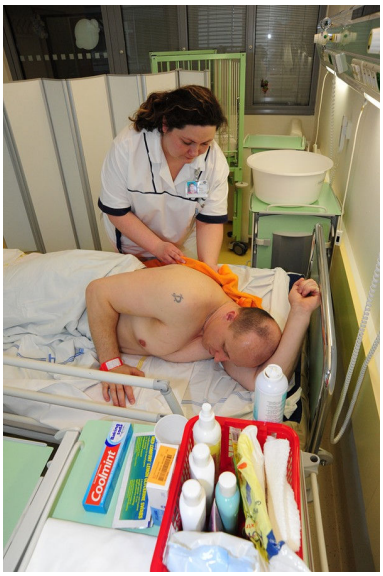

Fig. 7-8: Drying the back

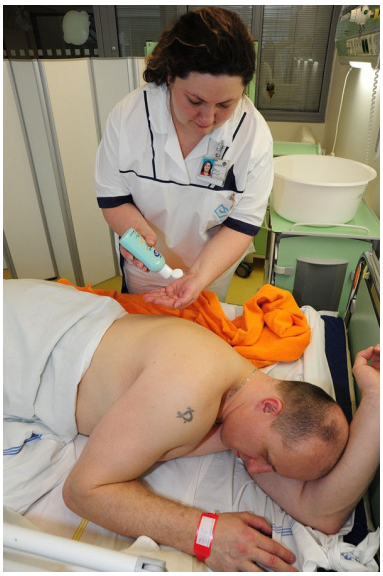

Fig. 7-9: Cream skin treatment on the back

Fig. 7-10: Oral hygiene care

Full bath on the bed

A full body bath on the bed is performed as required for patients who cannot be transported to the bathroom.

Patient preparation

See patient preparation in the above hygiene care descriptions

Aids

See: Washing the patient on the bed

In addition, a sink for washing the lower body is prepared.

Working procedure

- See the text on the procedure above;
- The following hygienic principle must be observed: *The upper half of the body* (from head to waist) is *washed in the basin designed for this purpose with one washcloth* (or with a disposable washcloth), and *dried with a clean towel,* while *the lower half of the body* (waist to feet) is *washed using a different basin, a new washcloth and another towel;*
- After washing the upper part of the body, the patient is dressed;
- The lower limbs are washed and dried from feet to hips, any hardened skin on the heels is removed with a pumice stone;
- The abdomen, buttocks, external genitals and the rectum area are washed last;
- The water in the basin is replaced when necessary;
- The patient is put into a comfortable position;
- The procedure is recorded.

Patient care after treatment

See the above text above on putting the patient into a comfortable position, patient care according to their health condition and as prescribed by the doctor.

Care of aids after use

After the procedure, the aid is treated as described in the above text.

Teeth cleaning and oral care

Mobile patients perform dental and oral care themselves. This also applies to bedridden patients who can still manage this procedure. Dental and oral care is administered to *immobile patients.* In addition to the aids described, a drinking straw must be also prepared. The bed is lifted to support the head and the bed the linen is covered with a towel. The patient rinses their mouth using the drinking straw, spitting out into the kidney bowl. The teeth are brushed using a toothbrush and toothpaste, starting with the top teeth from the gums down and the bottom

teeth from the gums up, and from the back teeth to the front teeth. The occlusion areas are brushed with gentle circular movements. The inner sides are brushed from the gums downwards and upwards. The patient rinses their mouth if necessary. If the patient is unable to sit up, the oral hygiene is administered in the supine position with the patient's head turned to the side. Patients who have own teeth are recommended to chew sugar-free gum to prevent a build up of bacterial plaque. In the event that the patient has dentures, special care must be given to the oral hygiene as dentures suppress the natural micro flora in the mouth. *Dentures* are carefully removed from the mouth using gauze square (wearing protective gloves) and placed in a kidney bowl. The dentures are washed with a toothbrush and toothpaste under running water. The patient rinses and the dentures are put back in their mouth. Clean dentures are put into a special sealable container for the night. The denture cleaning product, (depending on the type of dentures), is also put into the container. The dentures are put back into the mouth in the morning, after washing. The used aid is washed in a standard manner and stored in the designated area.

Special oral care

Patients with *febrile illnesses*, after a *stroke*, with *paralysis of the facial nerve*, after *surgery*, after *injury,* or *unconscious and dying patients* suffer from an accumulation of mucus in their mouth and coated mucous membrane. A patient can breathe in the accumulated mucus and the mucous membrane coatings cause bad breath. Defects on the tongue make sucking and chewing difficult. Oral hygiene must be administered as required, several times per day.

Patient preparation

The patient is informed of the reasons for the forthcoming procedure. The patient is asked to participate.

Aids

- Small sterile swabs in sterile packaging;
- 2 haemostats;
- Dry cotton buds;
- Container with lukewarm solution (decoction of chamomile, agrimony, boroglycerin, a special solution prepared by the pharmacy, etc.);
- Cotton buds soaked in Borax Glycerine, lip balm;
- Intro-oral blades;
- Drinking straw, a glass of water;
- 2 kidney bowls, wadding squares

Working procedure

- washing and disinfection of hands;
- The required aid is placed within reach;

- The patient is informed during the procedure of the next steps;
- The patient's bed is lifted to support the head or the patient lies comfortably;
- A careful oral check is carried out using inter-oral blades;
- Accumulated saliva and mucus can be sucked out using a pump;
- The tongue is cleaned using moist swabs from the back to the tip;
- The mouth palate is cleaned from front to back and the cavity from the back teeth to the front;
- Swabs are replaced as necessary; they are removed from the sterile bag using a haemostat or are dumped directly in the sterile bag (e.g. in Steriking packaging);
- Small swabs or moist cotton buds are used to clean all both sides of the teeth;
- Used cotton buds are put into the kidney bowl;
- If possible, the patient is offered a rinse during the procedure, while spitting into the kidney bowl;
- The tongue is treated with a cotton bud dipped in Borax Glycerine;
- The lips can be treated with a lip balm.

Patient care after treatment

If necessary, the procedure is patient is once again explained to the patient if they are able to treat their oral cavity themselves.

Care of aids after use

The aid is cleaned according to standard procedure, see above.

Cutting nails

Finger nails are cut with round corners and the toe nails are cut straight. The cut nails are filed. When cutting nails, a towel is placed under the hand or foot. The nail cuttings are put in the bin. (it is recommended to leave a manicure and pedicure to professionals).

Hair care

After washing, the patient’s hair is brushed. A towel is placed on the patient’s shoulders or on the pillow (depending on hair length). With long hair, the patient is recommended to plait the hair to stop the head and neck sweating.

Hair washing

Mobile patients and self-sufficient patients wash their hair themselves or assisted by a nurse in the bathroom or in the room. The hair of less mobile and non self-sufficient patients is washed in the bathroom, see the above text, or on the bed.

Hair washing on the bed

This is challenging for both; the patient and the nurse. However, if necessary and for long-term bedridden patients, it is done regularly, at least 1 x week. Some healthcare facilities are provided with aids for hair washing on the bed – an inflatable shampoo basin with a drainage pipe and shower attachment. The pillow is removed from the bed and the shampoo basin is put in its place. The bottom section of the basin supports the neck and shoulders. After washing, the hair is dried with a towel or a hair dryer and brushed.

Washing soiled patients

People who suffer from a paralyzed sphincter in the urethra and rectum are unable to hold urine and faeces – they are incontinent. The urine can be drained with permanent catheter although this does not apply to faeces. There is an aid available that absorbs urine and collects faeces, which prevents soiling. For example, the aid includes:

- *Absorbent mats* of various sizes, made of several layers, specially modified, which are placed under the patient's buttocks;
- *Sanitary towels to catch urine*, are made in different colours (according to the degree of absorption);
- *Elastic sanitary panties*, for securing sanitary towels;
- *Adult nappy* with absorbent pad for incontinent men and women.

All of the above aids are intended for single use. They are immediately replaced after soiling. The patient is allowed to perform hygiene when needed before attaching a clean sanitary towel or nappy.

If the patient is unable to hold urine or faeces, it is necessary to wash the patient whenever necessary, replace their clothes and replace bedding as per standard procedures.

Patient Preparation for the procedure

The preparation is mainly the psychological support. It is essential to communicate with the patient with respect to age and special individual needs.

Aids

- Protective gloves;
- Sink with hot water;
- Ph-neutral soap or foam;
- Washcloths and disposable cloths, protective cream;
- Wadding cut into squares.
- Waste bin;
- Clean, absorbent sanitary towels or nappies;
- Clean linen;
- Bag or trolley for dirty linen.

Working procedure

- The nurse puts on protective gloves;
- Used nappies, elastic panties etc. are put into the designated bag. (disposable aids);
- After putting the patient into the desired position (side), the condition of their skin in the area of the sacrum must be checked; soiled areas are wiped with a pulp square (after application of suitable shampoo foam);
- Wiping continues until all impurities are removed;
- The buttocks, the crease between the buttocks, sacrum area, groin, external genitalia from the pubis to the anus and the rectum area are thoroughly washed with a washcloth and soap.
- Each part is thoroughly rinsed and dried;
- The sacrum area, buttocks and the inner thighs are treated with protective cream;
- Minor soiling can be wiped off using shampoo foam and wet wipes;
- Washed areas are treated with protective cream;
- A clean adult nappy is put on;
- It is necessary to check that all the protective aids are put on correctly and that they do not restrain the patient in any way;
- If necessary the bedding is replaced and the bed adjusted;
- The patient is asked if all is well in terms of bed comfort;
- Washing and disinfection of hands;
- The procedure is recorded in the documentation.

Patient care after procedure - see the above working procedure

Care of aids after use

The disposable aids are put into the designated room; see the above text on cleaning aids.

Prevention and treatment of intertrigo and pressure ulcers

In order for the skin to perform all functions, it must be permanently maintained in a clean and dry condition. Clothes must also always be clean and dry. This will prevent the development of intertrigo and pressure ulcers.

Intertrigo

Intertrigo is an inflammation (rash) of the top layer of the skin which tends to occur in moist areas of the body where two skin surfaces rub against each other. The moist skin could be due to urine, sweat, mucus running from the nose in children, or due to vomiting or faeces. Intertrigo often appears under the armpits, under the breasts in women, skin folds on the abdomen, inner thighs, in the crease between the buttocks and around the anus. In children, it may appear under the knees, on the neck and around the nose in colds. Intertrigo usually

appears red and raw-looking with blisters in the affected area. The patient experiences burning and pain. Prevention is important - keep the skin clean and dry. The critical areas are washed as needed, thoroughly dried and treated with talcum powder. More severe damage to the skin is treated with compresses according to the doctor's prescription and with anti-inflammatory ointment.

Pressure ulcers

See chapter 9.4 Treatment of pressure ulcers

Baby and toddler baths

Maintaining hygiene in babies and toddlers is an important and regular part of daily care for healthy and ill paediatric patients (children).

Important principles

Social contact is an important part of the mental and physical development of a child

- The child is addressed by the name which they are used to when home;
- The child is always talked to in a calm, slow, clear and soothing manner, even when it is a baby; a smile is also very important;
- Gentle touches are important during examination and procedures should not be rushed;
- A child is stroked and cradled at every opportunity;
- Children's reactions are carefully monitored, i.e. changes in behaviour and changes in the health condition; nothing should be left unnoticed;
- The child's safety must be ensured every time – do not leave a child unattended on the examination or changing table, close the baby cot properly.

Baby bath

At home, a baby is bathed in the evening – it falls asleep easier; in hospitals, a baby is usually bathed, due to operational reasons, in the morning. It does not apply anymore that a child must be bathed daily. Excessive use of detergents leads to the disruption of the natural protective film on the baby's skin. It is sufficient to wash the face, moist areas and buttocks on a daily basis. A baby soap with glycerine is the most suitable option. This soap is recommended for regular washing of hands, feet, moist areas and buttocks. A full body wash with soap is recommended 1 x week. The water temperature should be around 38°C.

Preparing a baby for a bath

The baby is undressed on the bed and carefully transferred to the towel on the changing table.

Aids

Everything that is required should be within reach near the changing table

- Washcloth;
- Non-irritating baby soap;
- Towel;
- Skin treatment;
- Baby oil;
- Clean clothes (body, top, playsuit);
- Baby nappies;
- Small nail scissors;
- Hair brush;
- Kidney bowl;
- Bag for used nappies and dirty laundry bag;
- Cotton buds for nose and ear cleaning.

Working procedure

The baby is washed in the baby bath, or showered with an attachment. The room temperature is between 20 - 22°C. The baby is supported with one hand. The skin is lightly dried and treated as prescribed by the doctor. A nappy and clothes are put on according to the health condition and the customs of the ward. The procedure is recorded in the documentation.

Baby care after a bath

The baby is dressed and wrapped, hair is brushed and nails checked. All important findings are recorded in the documentation and subsequently addressed.

Fig. 7-11: Changing table with bath

Hair brushing and nail treatment

If necessary, the nails are cut with small nail scissors with curved ends; the nails are cut so the edges are smooth and round. The baby hand is held gently but firmly, to prevent any unexpected movement leading to injury. The nails are cut short. Finger nails are cut with round edges; the toe nails are cut straight.

Nappy change

Newborns urinate about 20 times a day; the frequency drops with age. The nappy is changed about 7 to 8 times a day, and also after each stool. If the baby has diarrhoea or urinates more, then the nappy must be replaced more often. The baby's nappy is changed before meals, after meals, before a ward round and for the night. When changing a nappy, the skin on the buttocks is first cleaned of stools. It is best to use water and soap or baby wipes. When cleaning around female genitals always proceed from front to back to prevent impurities from entering the vagina and urethra. For males, first clean around the anus, then the groin, under the scrotum folds and the skin under the penis. After washing, the skin is treated with cream or ointment.

Care of aids after use

Dirty linen is put into the dirty laundry bag or into a designated container. Disposable nappies are placed in the designated waste bin. Other aids are washed and disinfected according to applicable standards of the healthcare facility.

Control questions:

(only one answer is correct)

Special oral care is administered in:

- Patients with e.g. febrile illnesses, after a stroke, with paralysis of the facial nerve etc.
- Patients with dentures
- Immobile patients
- Post surgery patients
- Preschool age children

A full bath is given to a patient:

- At least once a week
- Once in 14 days
- In all patients when necessary (prescribed by a doctor)
- Only to patients who are able to cooperate
- Only to patients who are partially able to cooperate

A pressure ulcer (decubitus):

- Is an abrasion occurring in elderly and bedridden patients
- Is always a blister
- Occurs as redness and is painful in the affected area

- Intertrigo
- A pressure sore, compressive lesion, a localized area of cell damage caused by impaired microcirculation and resulting in tissue hypoxia.

Nails should be cut:

- Fingernails round, toenails straight
- Both, finger and toe nails are cut straight
- Fingernails are cut straight and toenails cut round
- Nail cutting is not included in the patient hygiene care
- None of the above options are correct

Water for bathing a baby should have the following temperature:

- 39°C
- Around 38°C
- Around 36°C
- 35°C
- 36. 5°C

Additional task

Research the available literature and find information on baby massage. When on clinical practice, check all the available aids intended for hygiene care, find and expand information on the subject of specific procedures at individual workplaces.

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List of Figures:

Keywords:

Care

Hygiene

Hygiene aids

8. BANDAGING

8.1 Bandaging material

Chapter objectives

After studying this chapter, you should be able to:

- Use all types of bandaging material;
- Select suitable bandaging according to its purpose;
- Explain the desired effect of the bandaging;
- Know the different types of bandaging material.

Theoretical notes

Bandaging is an important part of nursing care and treatment in every healthcare facility. Properly applied bandaging must meet its purpose and fulfil the aesthetic criteria. It must be applied so that it does not restrict, but is not too loose. If administered to an open wound, both the dressing and the bandage must be sterile in order to prevent infection.

Bandaging material according to use

1. *Protection* – protects the wound from the cold, impurities, secondary infection, e.g. gauze square, gauze bandage, plaster, etc.
2. *Compression* – pressure bandage used for bleeding – compression of vascular injuries; also included in this category are elastic bandages, compression stockings, leg bandages – gauze bandage, triangular bandage – First Aid
3. *Fixation* – fixing materials are applied to strengthen the bones and joints, i.e. a broken bone; included are adhesive plasters, starch bandage, plaster bandage etc.
4. *Supporting* – maintains a particular part of the body in the desired position, i.e. injury, paralysis, e.g. starch, Zink paste bandages, splints.
5. *Extended wear* – a stretching aid; attached to compensate for the shortening of the limb caused by a broken bone or by damage to a joint by pulling or countermovement (splints, plaster bandages, specific aids, devices with pulleys and weights).
6. *Redressing* – corrective aid; attached to the affected part of the body to facilitate a gradual change in the shape or growth in another direction, used mainly in paediatric orthopaedics.

Bandaging material

The most common dressing material is a *fabric* such as cotton, flax but also synthetic and elastic fabric materials. Some materials are solid; others are adhesive, or can copy the physiological shape of the human body.

Triangular bandage

This is the simplest dressing aid, most often used in first aid. It is made of cotton fabric – a calico bandage or a bandage from nonwoven fabric for single use.

Hydrofile gauze

Fabric with a high content of natural fibres (approximately 70% cotton and 30% viscose), i.e. ensures high absorbency. The fabric is used in the manufacturing of bandages, gauze squares, tampons, gauze drains.

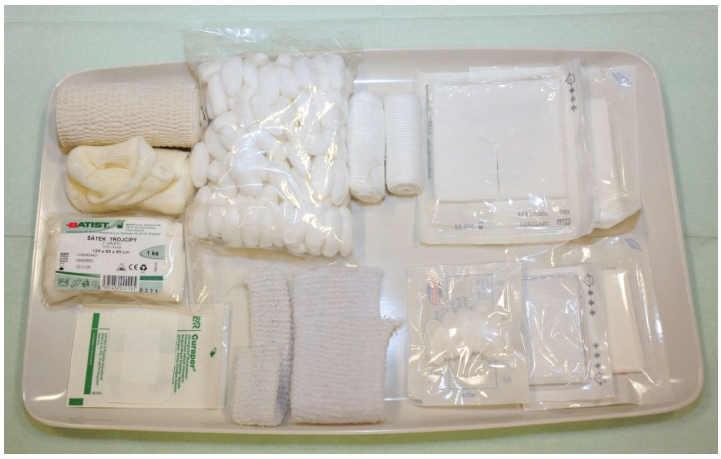


Fig. 8. 1-1: Dressing materials - bandages, gauze squares, swabs, "Pruban" bandage etc.

Bandage rolls

They are rolled strips of fabric, produced in widths of 3 – 30 cm.

Hydrofile bandage – hydrofile gauze is used to cover wounds; the sterile forms are used as individual wound dressings. The bandages are light and permeable.

Flexible elastic bandages can be divided into cohesive bandages, bandages with a medium compressive effect and bandages with a strong compressive effect.

Cohesive bandages contain a high percentage of natural fibre, and are impregnated with latex, which provides good cohesion. It is used to dress the joints and conical body parts. Bandages with a medium compressive effect and bandages with a strong compressive effect are used to attach a supporting dressing to injuries, where there is damage to the musculoskeletal system, to attach a pressure bandage for bleeding and also in sports bandaging.

Fixing bandages are hydrofile bandages impregnated with a firming agent to reinforce the bandage.

Zink paste bandages are impregnated with a special paste. When attaching these bandages, it is necessary to take into account that they contract during drying, therefore they should be attached loosely. Their surface is sticky, so the bandaging must additionally be covered with a hydrofile bandage.

Starch bandages are made of stiff hydrofile gauze, impregnated with wheat, potato or rice starch. They are wrapped in strips of paper, and stored in a dry place until application. They are used to strengthen the joints in minor injuries. Before use, the bandage must be thoroughly soaked in hot water until the water penetrates all the layers, then wrung dry before application. The starch bandage is applied over a cotton wool dressing attached with a hydrofile bandage.

Plaster bandages are impregnated with plaster. They provide reliable fixation of the broken bone. It is a hydrofile bandage which is impregnated with fine plaster. The bandages are wrapped in moisture-proof packaging; moisture would harden the plaster and the bandage would be spoiled. Before use, the bandage is soaked in a 40°C hot water; the bandage is not moved at this point so as not to spill the plaster. Then it is removed and gently wrung and then immediately attached. Attaching requires experience as it must be done quickly – the time for moulding the bandage is short (2 - 3 minutes).

Elastic sleeves and elastic mesh bandages

Elastic sleeves (e.g. Stulpa, Raucotube) – suitable for fixation – attached to cover the wound, also suitable as a dressing and as a sleeve for starch, zinc paste bandages and plaster bandages.

Elastic mesh bandage – (e.g. Pruban, Raukoflex) – used for fixation and protection for various types and sizes of wounds. The bandages are flexible, do not slip or stretch. They are made in sizes six to nine. They come in sizes suitable to attaching to a finger to sizes suitable for bandaging the chest.

Compressions

Gauze compression bandages (e.g. Sterilux ES) – is made of hydrofile gauze, are absorbent, soft and permeable. The disadvantage of protecting the wound with a gauze compression bandage is that it sticks to the wound, which hurts. They are made in different sizes.

Multi layer absorbent compression bandages (e.g. Basepon, Santin, Steripore, Cosmopor) – have an especially adapted contact layer that ensures painless removal and allows drainage of secretions into the absorbent core. The reverse side does not leak the secretion, i.e. it prevents secondary contamination.

Special compression bandages

For example: Sorbalgon – *nonwoven compress* made of calcium alginate fibres. Tender Wet dressing with absorbing polyacrylate element (activated with Ringer's solution). It is used to treat infected wounds, and is difficult to access in deeper layers.

Hydrocolloid compressions (Hydrocoll, Hydrosorb) – self adhesive with gel pad core. They are made in different shapes and sizes. These are used to protect large wounds, accelerate the process of granulation and epithelization. They are suitable for the treatment of chronic wounds; see the chapter on wound dressing. They can easily be removed. The advantage of their transparent foil is that the wound can be checked without having to change the dressing. The compression is replaced as needed, according to the wound secretion.

Fig. 8. 1-2: Special compressions – different types

Compression with ointment (e.g. Atrauman, Grassolind), are made of soft tylexol which is impregnated with active substances. The ointment base is permeable for the secretion; therefore an extra suction layer is needed. For example, it is used in burns.

Cotton wool

Cotton wool is a fibre. It is made of cotton or cellulose. Types of cotton wool products:

Medical cotton wool is made of cotton fibres. It is used in the manufacturing of cotton buds, or it is a part of other absorbent materials such as gauze squares and hygiene products for incontinent patients. It is also used as base material under plaster and splints.

Cellulose wadding

It is made from cellulose. It is used in many nursing interventions. It is absorbent paper in rolls or in various sized squares, depending on the use. It is also made in the form of perforated strips, which are later separated into individual squares.

Plasters

Plasters are used to *reinforce bandages.* They are made of woven and nonwoven fabric, which is coated with rubber resin or with non-irritating polyacrylate adhesive. They are applied to dry and clean skin. Their most common use is in the fixation of bandages, probes, peripheral cannulas, etc.

Traditional plasters are made in skin coloured strips with an adhesive layer of rubber resin. They are very sticky, difficult and painful to remove from the skin. They are made in widths from 1.5 – 30 cm, and can be perforated.

Artificial silk plasters – solid fixation patches made of artificial silk with strong adhesion. They are used in patients with sensitive skin and are porous and water vapour permeable, so that the skin can breathe. They can be used to attach probes, cannulas and catheters and for fixation of all types of dressings. They can be easily removed and do not leave unwanted adhesive residues on the skin.

Plasters made of porous and transparent foil are hypoallergenic, porous and transparent, suitable for fixation of all types of dressings, for transparent fixation of cannulas, probes, catheters etc. They are also suitable for patients with sensitive skin.

Plasters from soft nonwoven material are porous and water vapour permeable, the skin can breathe and does not sweat. They are ideal for patients with particularly sensitive skin. They do not cause maceration even with long-term and large area fixation of dressings.

The wound can be protected against external moisture, with Omnipor – hydrophobic impregnation. The plaster can be used both crosswise and lengthwise.

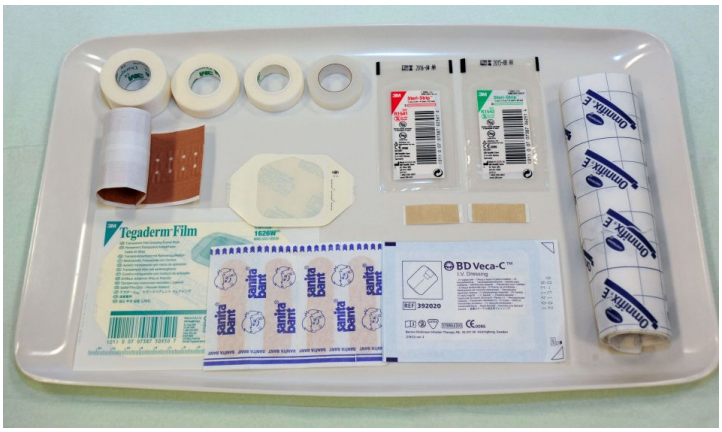


Fig. 8. 1-3: Types of plasters

Nonwoven, elastic plasters are used for large area fixation of wound dressings. Their advantage is the easy and trouble-free use on curved and conical parts of the body.

Padded plasters made of nonwoven fabric are used for treating minor injuries. They are produced in the form of strips, which are cut as needed or are supplied as individual patches.

Compression elastic bandages

These are compression (constricting) bandages, which are attached for the treatment of venous conditions in the lower limbs and often for heart failure. Elastic bandages are also used to support the muscles in the lower limbs, thereby supporting and improving venous blood return. There are ankle, calf and thigh bandages. Also available are glove type bandages and shoulder sling bandages.

They are produced in three compression classes:

1. weak compression – attached to subjective complaints;
2. moderate compression – used in chronic venous diseases;
3. strong compression – mainly used for significant swellings.

The bandage is attached in the morning, before the patient gets out of bed. An elastic bandage can be used to bandage a leg from the toes upwards. The bandage created compression should be strongest at the ankle and gradually abate towards the knee.

Fig. 8. 1-4: Calf bandage

Fig. 8. 1-5: Elbow bandage

Supportive elastic

Splints

Splints are used for the fixation of bone and joint injuries. They are made of different materials in various sizes.

Air splints are mainly used in first aid for the fixation of the arms and legs; they are made of plastic. The air splints are applied like a double sleeve or trousers and filled with air.

Thermoplastic sectional splints are used for the fixation of small bone fractures in limbs. They are heated in hot water or by air at 70 – 90 °C for approx. 1-2 minutes and moulded into the desired shape for about 1 minute. The splint achieves the desired fixation shape after 5 minutes.

Other types of splints are made of lightweight perforated but strong materials with various modifications (length, position).

Fig. 8. 1-6: Thermoplastic splint

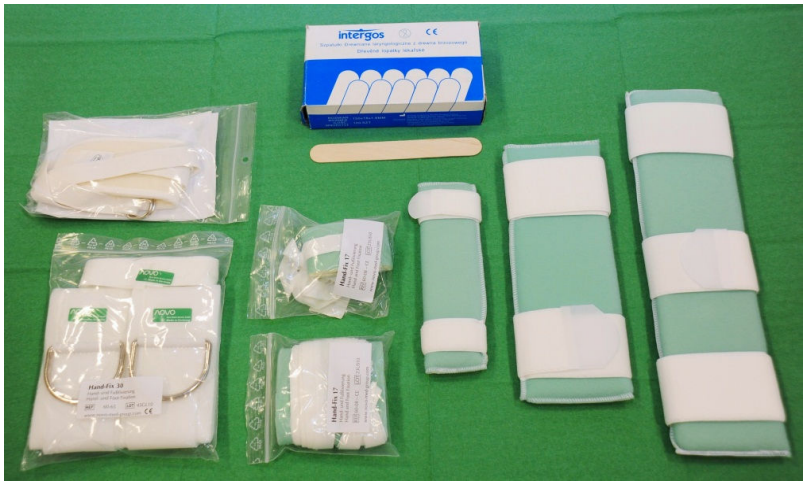


Fig. 8. 1-7: Types of splints

Orthoses

Bandage and non-bandage types of orthoses are used for the fixation of body parts. Bandage type orthoses are made of neoprene. They can be in the shape of a sleeve, reinforced with

plastic or metal splints, blocking bending or not blocking bending. Some types have adjustable setting of the bending.

Non-bandage orthoses are made of plastic. They are divided into fixation (immobilizing) and redressing (remedial) groups. Fixation orthoses are used in bone and joint injuries; neck orthoses have a shape of the collar (height adjustable). Desault's bandage is attached in broken collarbone and shoulder joint injuries.

Redressing orthoses are used in orthopaedic defects (toe, leg out of position) and in contractions (shortening of tendons). Orthoses that are attached to the torso are designed to support and stabilize the spine, or as an after-treatment of spinal fractures, as relief for osteoporosis, and in the treatment of scoliosis and kyphosis.

Fig. 8. 1-8: Orthoses for fixation of cervical spine and head

Additional task

Study chapter 9.3 Wound bandaging

8. 2. Bandaging technique

Chapter objectives:

After studying this chapter, you should be able to:

- Describe the basic terms – types of bandaging material, purpose;
- Know the role of a nurse during bandaging;
- Substantiate compliance with the general principles of bandaging;
- Know the methodology of bandaging techniques;
- Know the necessary aids used in bandaging, and describe the trolley with bandaging material;
- Apply different types of bandaging;
- Know methods for treating wounds;

- Know the aid care procedure after bandaging;
- Communicate in a professional manner with the patient and during the course of the procedure;
- Handle used bandaging material, used disposable aids and other used material;
- Respect the age, and individual specific needs of the patient during the procedure;
- Correctly handle the individual types of bandaging;
- For more, see chapter 8.1 Bandaging material.

General principles for bandaging

- Explain to the patient the reason and the method of bandaging.
- Ensure patient comfort – toilet visit, comfortable position, i.e. sitting down or lying on the bed.
- Respect the patient's physiological abilities.
- Ask the patient to participate.
- Ensure the patient's dignity.
- If possible, always face the patient during the course of bandaging.
- Maintain constant contact with the patient, monitor their condition.
- Prepare the aids within reach, near the patient.
- Put the part of the body that will be bandaged into a position that is the closest to the physiological position and ensure that this position will not change during bandaging.
- Sometimes it is necessary to remove body hair or cut the hair on the head; the skin must be clean and dry before bandaging.
- Apply rolled up gauze or cotton wool to prevent intertrigo in areas where two layers of skin touch (armpits under women's breasts, etc.).
- Before bandaging, the wound is first protected with sterile material.
- Select the appropriate type of bandaging in terms of size.
- During bandaging, the bandage roll is firmly held in the dominant hand while it is unrolled into the palm.
- The bandage is first secured with a spiral turn (the end of the bandage is folded under the second turn).
- The bandaging always starts at the narrowest point and proceeds to the widest point upwards, towards the heart (except for hand and toe bandaging), the next turn overlaps the previous turn by about two thirds.
- The turns are always in the same direction.
- The bandaging finishes with a spiral turn and a lock or it is secured with plaster tape (always outside the wound).

- The turns should not be too tight or too loose, the completed bandage is effective and neat.

Preparation of the nurse, patient preparation, aids care and the working procedure are listed in chapter 9.3 (Wound bandaging).

Triangular bandages

Triangular bandage is the easiest dressing tool. It is used to create *fixation, compression, protection and support* bandages. They are primarily used in first aid due to their easy and quick application. The triangular bandage is a three pointed scarf made of calico or nonwoven fabric. The bandage can be folded to create a bandage strip, the so called *cravat*. The ends are tied with a flat knot to avoid pressing.

Head bandage

The triangular bandage border lies over the forehead just above the eyebrows; the ends are passed around the sides of the head just above the ears, and crossed over at the point of the bandage at the back of the head. The ends are brought forward again and knotted over the centre of the forehead. The tip of the bandage hanging at the back of the head is tucked under the crossed edges of the bandage.

Fig. 8. 2-1: The first phase of the head bandage – triangular bandage

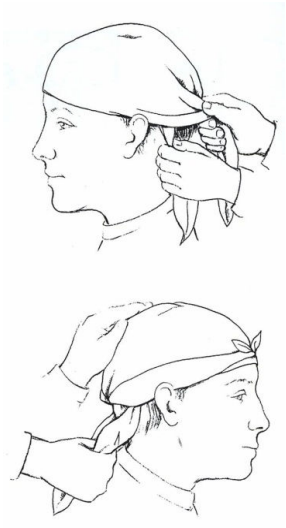


Fig. 8. 2-2: The second and third phase of the triangular head bandage

Pictures taken from the publication of ARCHALOUSOVÁ, A. et al. *Ošetřovatelská péče: úvod do oboru ošetřovatelství pro studující všeobecného a zubního lékařství*. 1. vyd. Praha: Karolinum, 2006. 295 s. Učební texty Univerzity Karlovy v Praze. ISBN 80-246-1113-9.

Hand bandage

This type of bandaging is used to protect the wound.

Full hand bandage

The triangle bandage is placed on the table, the fingers being towards the point; the base of the triangle is below the wrist. The hand is placed on the triangle. Bring the point back over the hand to the wrist, then bring the ends over the back of the hand and cross them over the point; wrap them round the wrist, cross at the front, and knot over the point behind.

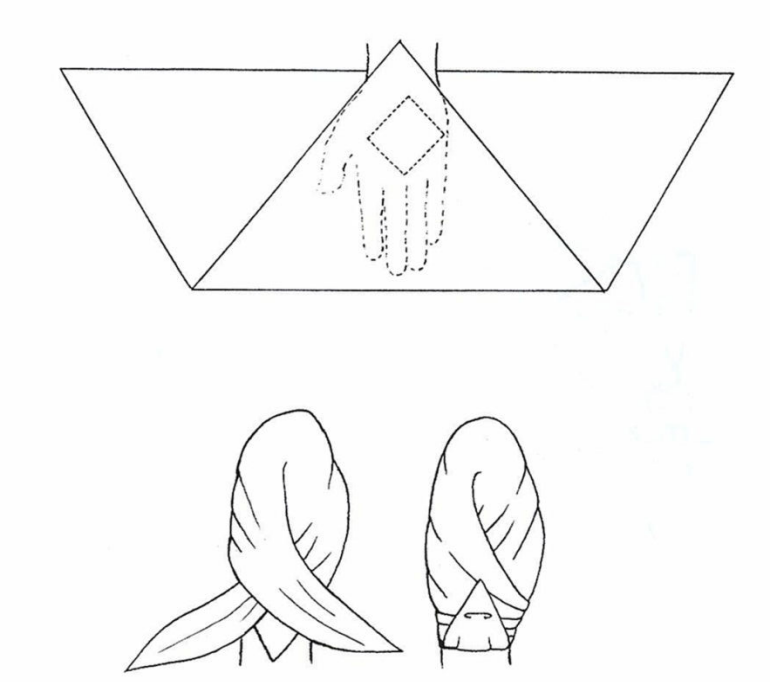


Fig. 8. 2-3: Full triangular hand bandage

Shoulder bandage

Two triangular bandages are needed. One triangle is laid on the table and the second triangle is laid over the first one so its point is approximately in the lower third of the bottom triangle, i.e. 10 cm from the centre. The bottom triangle is rolled from the tip of the top triangle. Thus the prepared bandage is placed on the shoulder; the shorter end of the bandage is in the direction of the sternum, at the front on the chest. The base of the second scarf is wrapped around the arm and both ends are tied on the outer side of the arm.

Lower limb bandages

These are used as protection and fixation bandaging.

Foot and instep bandages

These are attached the same way as a hand bandage.

Heel bandage

The base of the triangle is placed under the foot, the tip pointing to the Achilles tendon. Both ends of the triangle are crossed over the instep, brought to the heel, wrapped around the ankle and tied into a knot. The tip is tucked under the knot.

Ankle (talus) bandage

This is attached as a first aid to strengthen the ankle. The foot and leg are at 90 degree angles. A large four-point scarf is folded to create a three-point scarf and then further folded into a 13 – 14 cm wide cravat. The cravat is placed under the heel with the top of the strip overlapping the Achilles tendon. Both ends are crossed at the front. The outer end of the cravat is brought over the inner ankle on the heel and attached to the top of the strip. Another end is brought over the instep, once again over the outer ankle, and over the Achilles tendon to the front. The end from the inside is brought under the foot and on top of the instep. The ends are tied into a knot. It is a fixation bandage so it should be as firm as possible.

Knee bandage

It can be attached as a covering or fixative. The scarf is folded into a wider cravat. The centre is placed over the knee at the front. The ends are crossed below the knee; one point attaches the cravat above the knee cap, the second below. Both ends are again crossed under the knee again and tied into a knot above the knee cap.

Hip bandage

The hip bandage is similar to the shoulder bandage. The triangular bandage is folded into a cravat and attached at the waist. The second triangular bandage is used to cover the hip. The ends are brought around the thigh and tied on the outside or at the front into a knot.

Four-tail bandage

Some parts of the body, such as the chin and the nose, are difficult to attach a bandage to. These areas are treated with four-tail bandages. This bandage is prepared from a strip of hydrofile gauze which is split in two on both ends. The ends of the resulting strip are knotted on both sides. The part that has not been cut forms a pocket.

Four-tail nose bandage

This is most often used for bleeding from the nose or after nose surgery. It is prepared from a 6 cm wide bandage. A strip is cut off and adjusted as described above. The middle, uncut part, is placed over the nose and the bottom strips are brought over the top of the ear and tied at the back of the neck. The upper strips are brought below the ear to the back of the neck where they are crossed and tied into a knot.

Four-tail chin bandage

It is attached after chin treatment. It is attached in a similar manner as the four-tail nose bandage.

Bandage rolls

These are the most commonly used type of bandage in clinical practice. Attaching bandages is more challenging. The bandaging technique is based on a turn, i.e. wrapping the bandage around the body part.

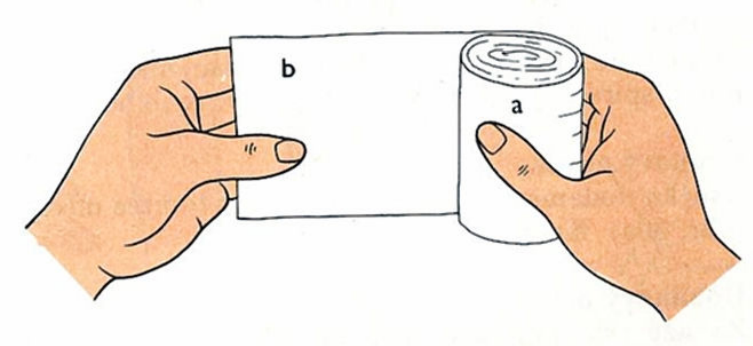


Fig. 8. 2-4: Bandage unwrapping

a - bandage roll b - free end

Bandaging methods

Circular turns

The bandage is applied in a series of overlapping circular turns. This technique is used in minor wounds.

Spiral turns

This technique is used on the body parts that are narrowing or widening such as limbs. Each subsequent turn partially overlaps the previous layer, proceeding upwards.

Open spiral turns

The technique is a series of turns that do not overlap and are spaced out. This technique is used to attach splints or as a dressing layer for a bandage.

Figure of eight turns

This technique is used for bandaging some joints. The figure of eight technique is a series of spiral turns applied in alternate directions.

Spica bandage

The spica is a series of figure of eight turns, where each turn overlaps the other. The spica bandage is usually applied in a diverging manner, i.e. the divergent spica or in a converging manner, i.e. the convergent spica. The spica bandage technique is used to bandage cylindrical body parts.

Divergent spica

This technique is applied in elbow, knee and heel bandaging. The first circular turn goes over the flexed joint, followed by figure of eight turns away from the centre. The turns overlap the more central one.

Convergent spica

The first circular turn goes under or above the joint. This is followed by figure of eight turns where each turn overlaps the one further from the middle. The last turn is brought over the joint.

Each bandaging begins with the loose end placed diagonally (in the bandaging direction) on the body part, followed by an overlapping circular turn.

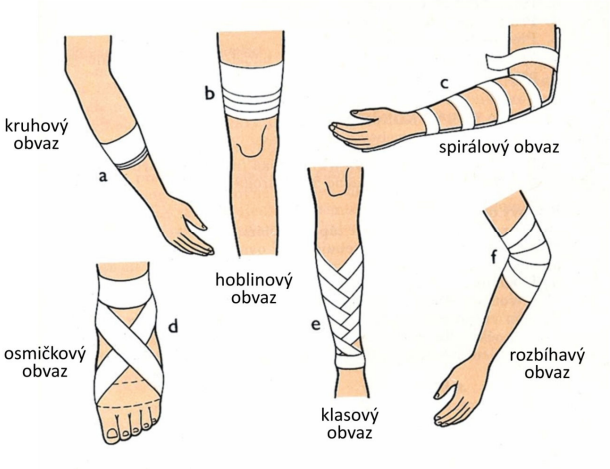


Fig. 8. 2-5: Bandaging methods

a - circular turns, b - spiral turns, c – open spiral turns, d – figure of eight turns, e – spica turns, f – divergent spica

Upper limb bandaging

A large number of upper limb bandaging consists of protection bandaging. Upper limb bandaging uses bandages that are approx. 3 cm wide (used for the fingers and the back of the hand), and with 6 cm wide bandage used for the arms and an 8 cm bandage used for the shoulders.

Spica thumb bandage

The bandaging starts with a circular turn at the wrist, then a turn across the hand and around the thumb. If the thumb needs to be covered, the bandage is folded over the tip several times. The thumb is bandaged using the Prof. Knobloch technique (*aka the thimble*) and secured with a circular turn. The bandage is then applied in the opposite direction from the outside of the wrist. The figure of eight turns are repeated, with each turn overlapping the previous one. The bandaging finishes at the wrist. If it is not necessary, the tip of the thumb is left free.

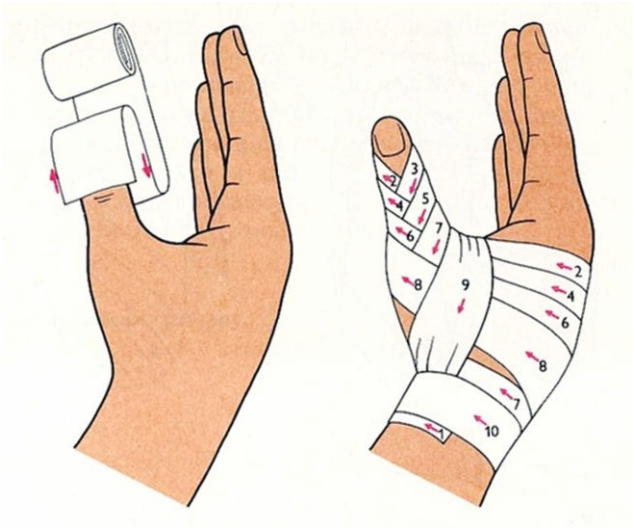


Fig. 8. 2-6: "Thimble" *Fig. 8. 2-7: Spica thumb bandage*

Spica hand bandage

The bandage is applied in a divergent manner. The tips of the fingers are bandaged with a circular turn. The second turn crosses the back of the hand towards the thumb, which remains free. This is followed by horizontal turns across the palm. The turns continue to cross the back of the hand up to the tip of the little finger. The back of the hand is entirely covered with spica turns.

Full hand bandage

The bandaging begins across the palm from the wrist to the finger tips over to the back of the hand and the wrist. The bandage is folded and held with the other hand. The next turns alternate from the centre of the hand to the sides, so as to cover all the fingers. The bandage is secured using circular turns at the wrist. The bandaging continues with the figure of eight turns from the wrist, diagonally across the back of the hand, horizontally across the palm, under the thumb and diagonally across the fingers to the top. The turn is led horizontally at the bottom side of the fingers and then diagonally across the back of the hand. The thumb remains free. The procedure is repeated until the bandaging is complete. The bandaging is completed with the last circular turn at the wrist.

Finger bandage

A circular turn is made round the wrist, and then over the back of the hand towards the finger furthest away (right hand to the thumb, left hand to the little finger). This is followed by a spiral turn to the finger tip, which is covered with several folded layers, and then across the back of the hand; the direction is the opposite to the previous one and this is followed by a turn around the wrist. The same technique is used to bandage the next finger. The bandaging is secured at the wrist, the palm remains free.

Forearm bandage

The bandage is applied in an ascending manner. A circular turn is made around the wrist, followed by overlapping turns or reverse spiral turns.

Elbow bandage

The elbow is bandaged using divergent or convergent figure of eight turns.

Ascending shoulder bandage

The bandaging also includes a dressing, i.e. a gauze square or cotton wool. A circular turn is made at the upper third of the arm. This is followed by a turn which begins on the outside of the arm, goes across the shoulder and then back under the armpit of the unaffected arm. Powdered cotton wool or gauze rolls are placed under the armpits to prevent intertrigo.

The bandaging continues across the chest towards the treated arm, under the armpit, and again across the shoulder and then back to the opposite armpit until the entire shoulder is covered. The bandaging finishes with a circular turn around the shoulder.

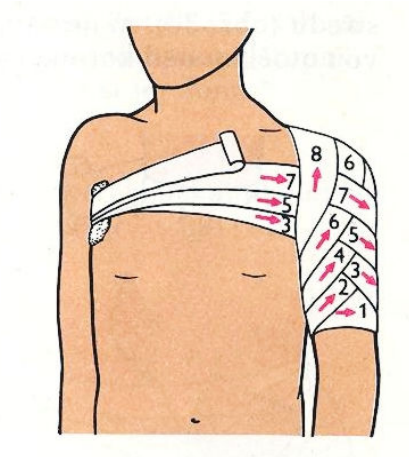


Fig. 8. 2-8: Ascending shoulder bandage

Lower limb bandaging

Use of protection and fixation bandages. A 3 to 4 cm wide bandage is applied to the toes, a 6 cm bandage is applied to the heel and a 7 to 8 cm wide bandage is applied to the lower leg. The 12 cm wide bandage is suitable for hip bandaging.

Foot bandage

A circular turn is applied around the instep closer to the root of the toes, then diagonally across the instep above the ankle, over the Achilles tendon and around the second ankle, diagonally over the instep where the turn crosses. The bandaging continues around the sole of the foot. This is basically the figure of eight turn. Each subsequent turn is placed a bit higher until the instep is completely covered. The bandage finishes around the ankle.

Heel bandage

A hydrofile gauze is used as a dressing and is fixed with an elastic bandage. The technique used in this case is divergent spica bandaging. The first turn is across the centre of the heel, followed by turns towards the centre until the entire heel is bandaged. The bandaging is finished with a circular turn above the ankle.

Leg bandage

A *Leg bandage* is one of the most frequently used. It is done to prevent venous thromboembolism.

A *compression bandage* is tightly applied around the perimeter of the leg so that the pathologically dilated veins narrow down again, so that the venous flap can close again; the venous blood flow is increased and the blood return to the heart is normalized.

Reasons for applying a compression bandage

- In the perioperative period;
- After vascular surgery;
- To prevent blood clots, e.g. in long-term bedridden patients;
- Varicose veins in the lower limbs;
- Prevention of edema.

Effects of a compression bandage

- Increased venous blood flow (prevention of thrombosis);
- Strengthening of vessel walls;
- Narrowing of dilated vessels;
- Support for calf muscles; the venous valves function better.

The *contraindication* of the compression bandage application is usually the diseases in the lower limb arteries, some heart disease, e.g. left heart failure - the compression could cause insufficient blood flow to the limbs.

Bandaging instructions

The bandaging is done using elastic bandages and elastic stockings. *Elastic stockings* are available in white or beige. When choosing the correct size of the stocking, it is necessary to measure around the leg in several places. Measuring is done in the morning, before getting up and after a walk. The stockings have reinforced parts for the toes and the heel, which is also a guide for the correct positioning. Stockings can be washed and even disinfected. It is necessary to pull the stockings fully up to the groin area. Below knee stockings are made for common use at home.

Elastic bandages are available in widths of 8 to 10 cm. The bandage is applied from the toes, across the ankle to the knee, i.e. the below knee bandage, or across the entire lower limb, i.e. the full leg bandage. The bandaging starts with a first circular turn at the base of the toes with the end folded (locked) over the second turn. Bandaging of the lower limbs is via circular or reverse spiral turns. The turns overlap by 2/3. The reverse spiral turns technique is usually tighter and fulfils its function longer. The compression should be especially strong at and directly above the ankles. The pressure should gradually decrease towards the knee. The compression bandage is applied in the morning, before getting out of bed, i.e. before the venous system is filled again. The leg should be in an elevated position for at least 30 minutes before the bandage is applied.

Knee bandage

The slightly flexed knee is bandaged with divergent or convergent spica turns.

Hip bandaging

Hip bandaging is similar to shoulder bandaging. The first turn is around the thigh, about 20 cm above the knee (depending on the patient's height). The next turn is diagonally across the hip joint, followed with a circular turn around the waist, back to the outer side of the thigh, then towards the inner side of the thigh, then across the hip and back. The turns are reminiscent of irregular figure of eight turns. Each subsequent turn overlaps the previous turn. The spica is formed in accordance with the injury, either on the front, side or back of the thigh. The bandaging is terminated with a turn around the waist. Hip bandaging can be also done using ascending spica; in this case the first turn is at the waist.

Bandaging both hips

The first circular turn is at the waist, followed by alternating figure of eight turns covering the right and left hip. The bandaging is terminated with a turn around the waist.

Head bandaging

Ear and eye bandaging requires a 4 cm wide bandage, otherwise a 6 to 7 cm bandage is used.

Eye bandage (monoculus)

The bandaging begins with a circular turn around the forehead. When bandaging the right eye, the first turn starts above the left temple, and when bandaging the left eye, the first turn starts above the right temple; then proceed across the bridge of the nose, under the eye and ear, and above the temple on the opposite side. Each subsequent turn leads above the temple, across the eye but slightly higher. Repeat making 3 to 4 turns. The bandage should not be too tight and the second eye should be kept free. The bandaging is terminated with a turn around the forehead.

Bandage for both eyes (binoculus)

The bandaging begins above the right ear with a turn around the forehead, then from the right temple, across to the left eye and ear and to the back of the head, under the right ear, and diagonally across the eye towards the left temple. The turns are repeated 3 - 4 times. The bandaging is terminated with a turn around the forehead.

Ear bandage

The bandaging starts with a circular turn around the forehead, from the treated ear to the healthy ear. Proceeding from the forehead towards the treated ear, to the back of the head, to the forehead and back to the treated ear, turns are repeated 3 to 4 times, until the ear is completely covered. The bandaging is terminated with a turn around the forehead.

Hippocrates cap

The bandaging consists of two 7 cm wide bandage rolls. One bandage roll is used to cover the crown, proceeding from the back of the head to the forehead and back (from the centre, alternating to the left and right), the second bandage roll is used to bandage around the head, while each turn holds down the other bandage at the forehead and at the back of the head. The bandaging continues until the head is fully covered. The bandaging is terminated with the last circular turn around the head.

Bandaging the nape

This form of bandaging is performed from behind the patient. The bandaging begins with a circular turn around the head, followed by turning above the left ear towards the nape and below the right ear and the neck. To prevent the bandaging from being too tight, a bandage roll approximately one finger wide is inserted under the patients chin, perpendicular to the larynx. The bandaging continues below the left ear, across the nape, above the right ear and to the forehead. The turns are made in divergent spica, from the top of the crown toward the cervical spine, covering the entire nape. The bandaging is terminated with a turn around the forehead. The bandage roll under the chin is removed once the bandaging is complete.

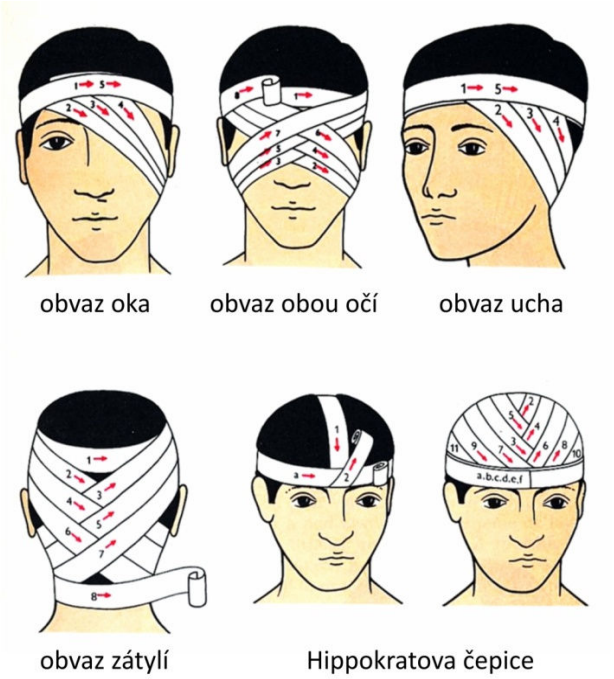


Fig. 8. 2-9: Eye bandage (1. top left)

Fig. 8. 2-10: Bandage for both eyes (top middle)

Fig. 8. 2-11: Ear bandage (top right)

Fig. 8. 2-12: Nape bandage (first bottom left)

Fig. 8. 2-13: Hippocrates cap (middle and bottom right)

Chest bandage

A chest bandage is for protection, compression, support and fixation. The bandages used for this purpose are 8 to 10 cm wide.

Elastic sleeves *(elastic mesh bandage)*

They are used to cover wounds on different parts of the body that are often difficult to reach. Pruban is highly elastic but firm, therefore the wound bandage is fixed, even when subject to extreme movement. The bandaging does not press, stretch or shift. Using Pruban is very simple and quick. It can be cut in any place as it does not fray or tear. When replacing the dressing protecting the wound, the bandage does not have to be removed - only lifted. The bandages are available in various sizes, labelled 1 to 10. Pruban can be sterilized.

Instructions for applying Pruban

- Select the appropriate size of the mesh bandage
- The required length is measured and cut depending on the treated part of the body.
- The wound is protected by a sterile dressing, gauze square.
- This bandage does not stick.

- If necessary, the bandage can be cut.
- Gauze or cotton wool is used to protect the skin from damage caused by the mesh bandage (e.g.. on the armpit).
- When replacing the wound dressing, the Pruban bandage is stretched.

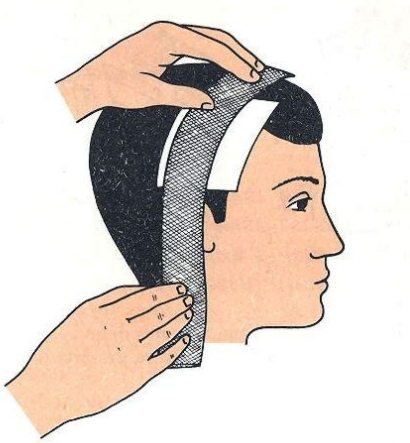


Fig. 8. 2-14: Measuring the length of the bandage

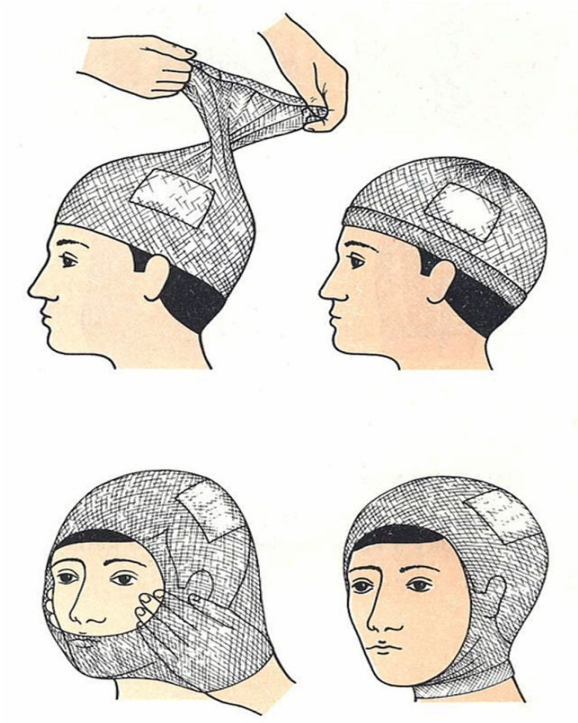
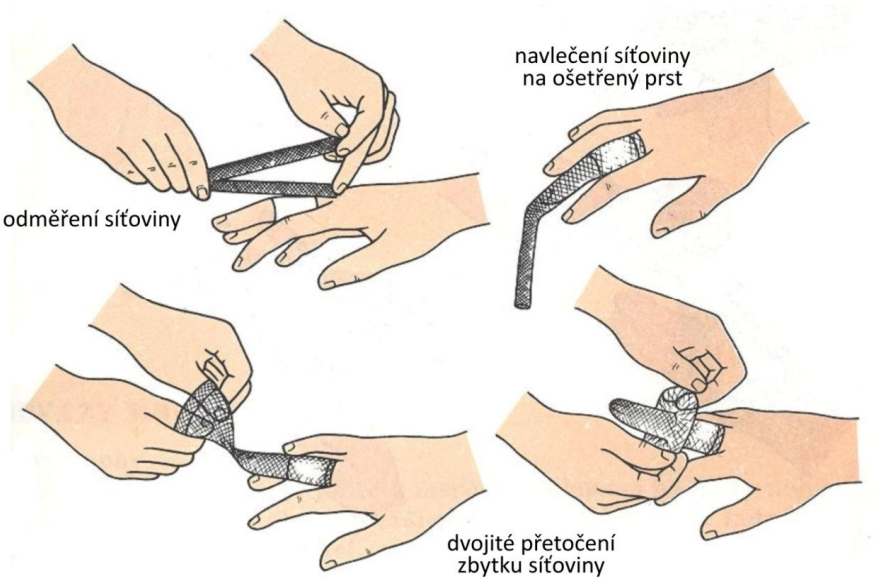


Fig. 8. 2-15: Crown bandage and head and neck bandage

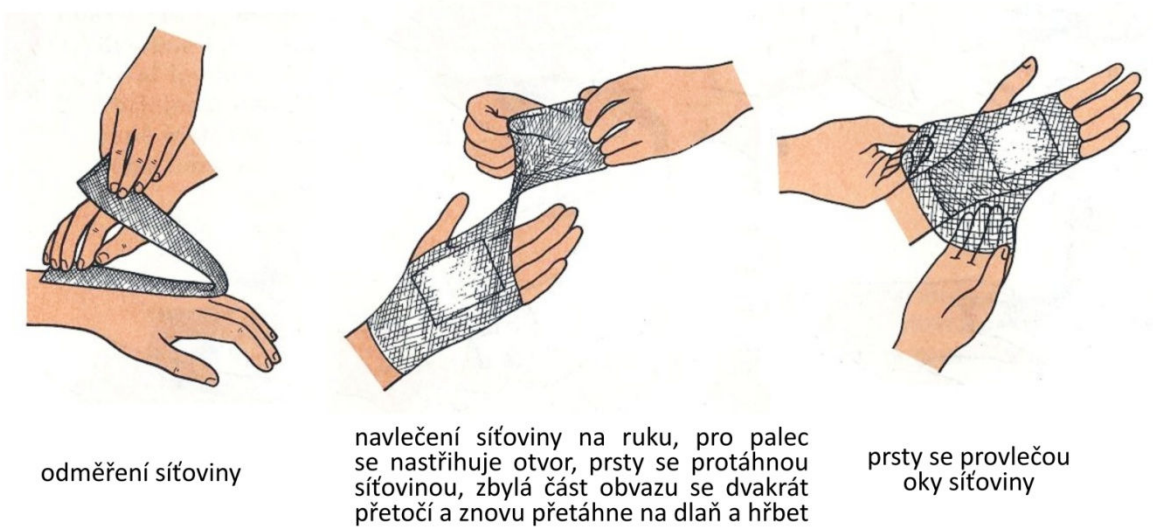


Measuring the length of the bandage

Applying the mesh bandage
to the treated finger

Double folding
of the excess mesh bandage

Fig. 8. 2-16: Finger bandage



Measuring the mesh

Applying the mesh bandage to the hand,
an opening is cut for the thumb, fingers
are passed through the mesh,
the excess mesh bandage is twisted
twice and pulled over the hand

Fingers are passed
through the mesh

Fig. 8. 2-17:Hand bandage

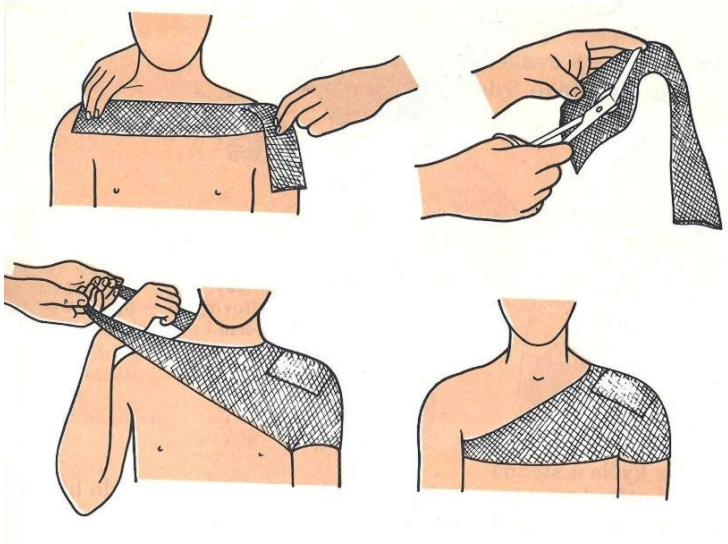


Fig. 8. 2-18: Shoulder bandage

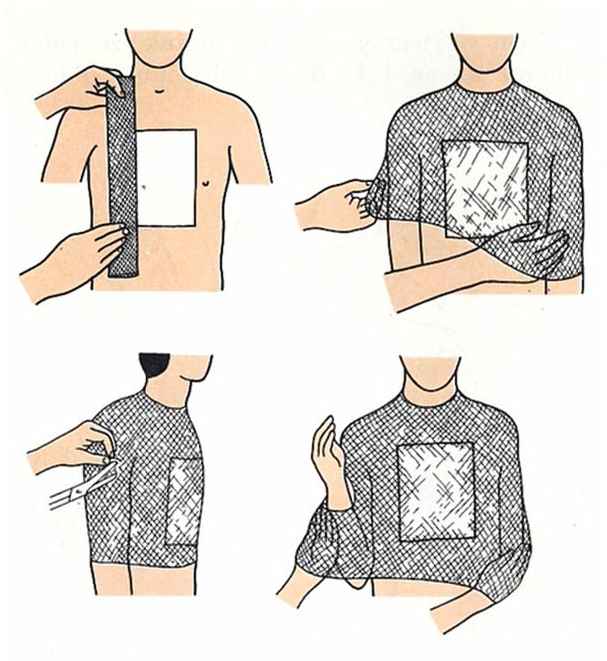


Fig. 8. 2-19: Chest bandage

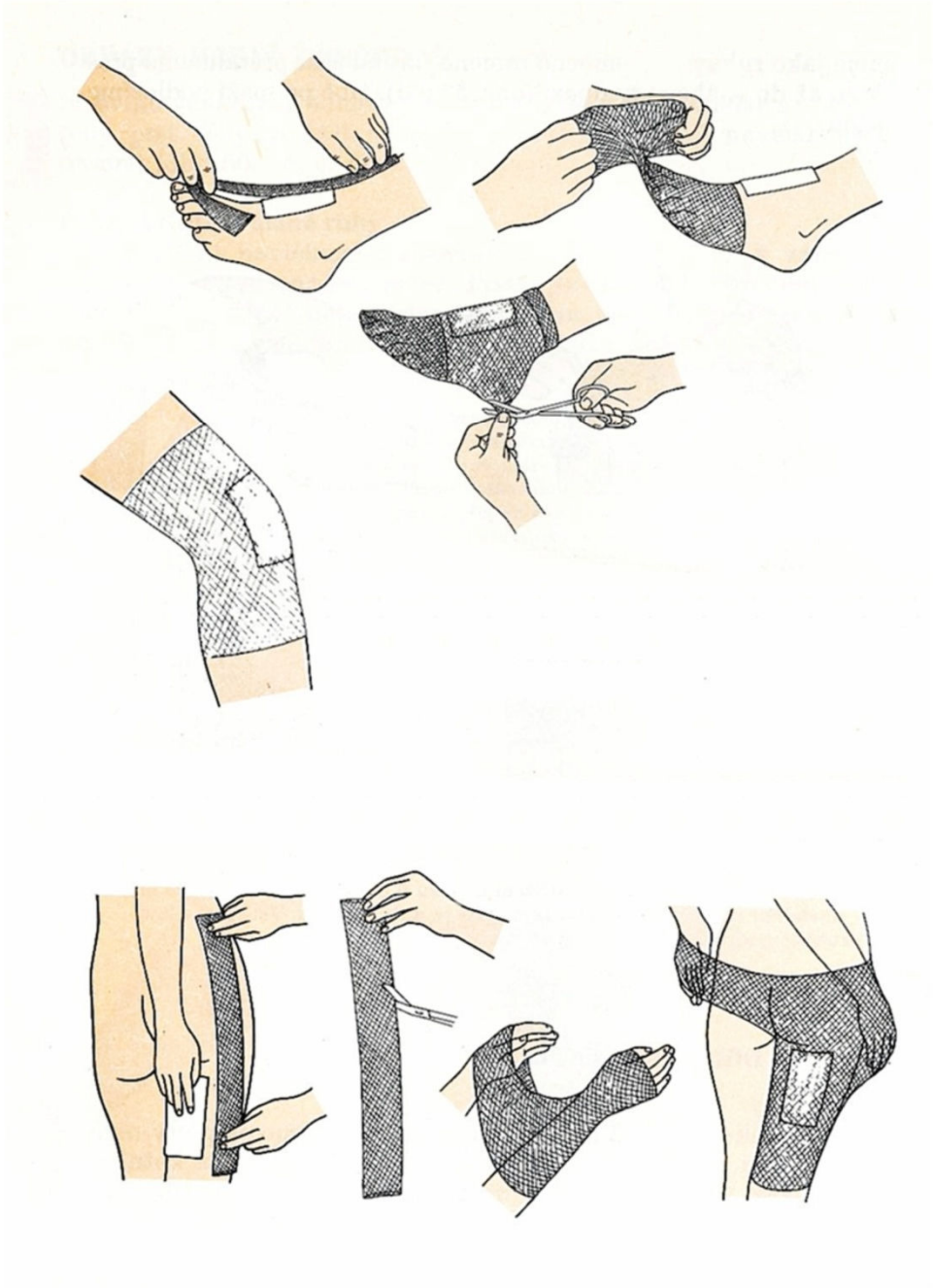


Fig. 8. 2-20: Leg, knee, hip and thigh bandage A - Leg bandage, B – Knee bandage, C – Hip and thigh bandage

Diagrams are taken from the publication of ROZSYPALOVÁ, Marie, ŠAFRÁNKOVÁ, Alena and VYTEJČKOVÁ, Renata. *Ošetřovatelství I: pro 1. ročník středních zdravotnických škol*. 2., aktualiz. vyd. Praha: Informatorium, 2009. 273 s. ISBN 978-80-7333-074-3.

Control questions:

(One answer is correct)

Bandaging material according to use, e.g.

- Protection – protects the wound from the cold, impurities, secondary infection, e.g. square of gauze, gauze bandage, plaster, etc.
- Compression – fixing materials are applied to strengthen the bones and joints, i.e. a broken bone; included are adhesive plasters, starch bandage, plaster bandage etc.
- Fixation – maintains a particular part of the body in the desired position, i.e. injury, paralysis; used are e.g. starch, zinc paste bandages, splints;
- Extension – stretching and pressure bandage is used for bleeding – compression of vascular injuries, also included in this category are elastic bandages, compression stockings, leg bandages – gauze bandage, triangular bandage – First Aid);
- Redressing – protects the wound from the cold, impurities, secondary infection, e.g. gauze square, gauze bandage, plaster, etc.

General principles for bandaging:

- Ensure patient comfort – toilet visit, comfortable position, i.e. sitting down or lying on the bed.
- When in a hurry, do not respect the physiological abilities of the patient;
- During bandaging, the bandage roll is firmly held in the dominant hand while it is unrolled into the palm.
- It is not necessary to always start the bandaging at the narrowest point and to proceed to the widest point, towards the heart (except for hand and toe bandaging); the next turn overlaps the previous turn by about two thirds;
- The bandaging turns do not have to be in the same direction.

Bandaging rolls are:

- The most commonly used type of bandage in clinical practice;
- The least commonly used type of bandage in clinical practice;
- Bandages made of elastic mesh, a very common type of bandaging material; In current clinical practice there is minimum use;
- None of the above options are correct.

When bandaging the leg, a common bandaging technique is:

- Figure of eight turn;
- Circular or densely applied figure of eight turns;
- Spiral turns;
- Pruban bandage;
- Combination of figure of eight turns and a Pruban bandage.

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List of Figures:

Keywords:

Bandaging material

Bandage

Wound

9. PREOPERATIVE AND POSTOPERATIVE CARE

9. 1. Preoperative preparation

Chapter objectives:

After studying this chapter, you should be able to:

- Explain the basic terms – classification of preoperative preparation;
- Determine the actual role of a nurse in preoperative preparation;
- Support the patient, be able to talk about the patient's concerns regarding surgery;
- Explain to the patient the importance and the share of their cooperation in the preoperative preparation;
- Explain to the patient what the surgery involves and the importance of preparation;
- Demonstrate professionalism and skill during nursing interventions;
- Always communicate professionally with the patient;
- Monitor the results of laboratory tests or other examinations and the values of physiological functions.

Perioperative period is the time period of the surgical procedure. The period generally includes the *preoperative preparation* of the patient and *postoperative care*.

Preoperative preparation

The preoperative preparation of the patient begins when surgery is being considered, and the doctor determines the surgical solution to the patient's health condition.

The preoperative preparation focuses on the *time factor* – when the surgery is performed. The preparation is as follows:

- *In emergency surgery´*, or urgent surgery (e.g. bleeding, acute vessel closure), the preparation is minimal, i.e. basic sanitation, securing vital functions, basic blood test (e.g. blood group, bleeding, clotting etc, the STATIM biochemical blood test, i.e. up to 30 to 90 minutes, depending on the type of examination).

- *In semi-elective surgery* (e.g. appendicitis, the inflammation of the appendix) i.e. the time between admitting the patient and the actual surgery is sufficient for the required examination and basic preparation with basic STATIM physical and biochemical tests (e.g. ECG, blood group, bleeding, clotting, indicative urine examination, liver and kidney functions).

- *In elective surgery*, the preparation is divided to:

- Overall general and local preoperative preparation, remote and special;
- Special overall general and local preoperative preparation, remote and special;
- General immediate preoperative preparation;
- Special immediate preoperative preparation.

Overall preoperative preparation - remote

The patient is actively participates in the treatment procedure. The result of the surgery is also dependent on the approach of the doctors and the nursing staff, and on the contacts made with the patient and their family. It also depends on the patient having confidence in the treatment and the overall calmness of the patient.

Overall general preoperative preparation – remote is aimed at the:

- The overall condition of the patient;
- Patients without associated diseases, with no special preparation;
- Patients with associated diseases with special preparation;
- Difficult surgery – *surgery with an expected low degree of complication* (e.g., uncomplicated inguinal hernia, varicose veins, or laparoscopic cholecystectomy), *a surgery with expected postoperative complications lasting several days* (abdominal surgery, the intestines), *surgery which greatly strains the organism*, and that could not be performed without additional therapy such as infusion therapy, transfusion, artificial nutrition (e.g. large-scale surgery , resection ,ectomy ,vascular reconstruction) .

Remote general preparation also includes

- *Psychological preparation* – aimed at preventing or at least reducing the fear of surgery, at the explanation and provision of complete information, justification and clarification of the surgical procedure, including any physical and cosmetic consequences of the surgery; (general practitioner, doctor, internist and anaesthesiologist, anaesthesia nurse, ward nurse). Special attention is given to the patients with malignant diseases, to patients with psychological damage that may be caused by the lack of psychological preparation of the patient - called *iatrogenic* - harm to the patient resulting from treatment by a healthcare professional.
- *Somatic preparation* – focused on careful examination of the patient, consideration of the patient's somatic abilities, choosing the best surgical method, the patient is prescribed a dietary regime depending on the type and extent of the surgery.
- *All surgical departments have a standard examination programme as required by certain workplaces as general, preoperative examinations, including signed approvals included in the patient's medical records (according to applicable guidelines). The patient receives the list of examinations for the planned surgery which they have to undergo and they should be fully informed when and where the individual examination will take place. The examination results and assessment is used by the anaesthesiologist to determine the anaesthetic plan.*
- *Spiritual preparation* – very individual form of preparation. This is at the discretion of the patient and their family;
- *Social preparation* – the patient can be advised on financial and social assistance in times of illness (usually managed by the municipal authorities in the place of the patient permanent residence).

Overall special preoperative preparation - remote

The patient undergoes a *special preparation* depending on the type and extent of the disease.

Special preparation follows the effect of individual diseases on the overall condition of the patient and the effect of the associated disease, which could adversely affect the postoperative course of treatment.

It also includes tests on the diseased organ, e.g. in stomach surgery, the patient undergoes gastric endoscopic examination where sample tissue is submitted for histological examination, etc.

General immediate preoperative preparation for surgery

The next preoperative stage is also referred to as *immediate preparation*. Immediate preparation includes *psychological* support and *local* support.

Psychological preparation involves

Ensuring mental rest, i.e. the patient is once again reassured before the surgery during the morning rounds; the patient rightly expects a further discussion with the doctors and nurses; this is part of the postoperative prevention.

Local preparation includes:

- *Overall hygiene* – the patient must be clean, free of jewellery, makeup, the navel carefully cleaned, hair must be covered, women are expected to remove nail polish (very light or purple colouring to the nails indicates problems with oxygen levels);
- *Denture removal* – dentures are stored so the patient can access them as soon as possible after surgery (in the bedside table with a name label);
- *Preparation of the surgical field* – the surgical field must be clean, possibly shaved (in semi-elective surgery, the surgical field is shaved dry to maintain dry skin); the surgical field must be disinfected, e.g. before elective surgery of the head in order to ensure aseptic conditions for the surgical procedure;
- *Insertion of nasogastric tube* – in patients with an accumulation of gastric content; it is used to aspirate the gastric content,
- *Colon cleansing* is dependent on the type and extent of the surgery; in some diseases, the patient is put on a diet, which includes a light dinner, the patient is then instructed not to eat, drink or smoke after midnight; sometimes the patient is given laxatives to enable emptying or a cleansing enema or special solutions; an enema is never used during preoperative preparation for acute abdominal surgery!
- *Lower limbs bandage* (i.e. an elastic bandage for the lower limbs from the toes to the groin or special stockings, prevention of TEN);
- *Model practicing of postoperative breathing, coughing, holding the wound;*
- The immediate preparation also includes a *first introduction to anaesthesia*, pre-medication (see chapter on anaesthesia from the nursing perspective).

During the second pre-medication phase (see the chapter on anaesthesia from the nursing perspective), the patient is asked to empty their bladder. The patient is also instructed not to leave the bed, lay calmly and informed that they may become sleepy.

The preoperative preparation of the patient finishes with transport to the operating theatre and transfer to the operating table.

Anaesthesia from the nursing perspective

Introduction to anaesthesiology and resuscitation

Anaesthesia is a method used in painful procedures, i.e. blocking the perception of pain. The purpose of anaesthesia is to allow the patient to undergo surgery without experiencing pain and to allow the surgeon to perform the surgery.

Anaesthesiology and resuscitation is a separate medical field. The anaesthesiologist assesses and completes, from their perspective, the preoperative examination results, and participates in the pharmacological and psychological preparation of the patient, proposes and recommends anaesthesia individually, taking into account the patient's condition and the nature of the surgical procedure.

To give a general overview, some basic findings from the field of anaesthesiology are listed below:

Types of anesthesia – local and general

Local (regional) anesthesia

Blocks pain in an area of the body without impairing consciousness. The sedative is applied to the area of the planned minor surgery.

The patient's preparation before administration of local anesthesia *involves*:

- *Psychological preparation*, i.e. the patient is reassured, explained the procedure, given time for questions, notified of possible discomfort caused by introduction of the anesthetic; and also reassured that they will not feel any pain during the procedure;
- *Somatic preparation,* i.e. preparation of the surgical field (e.g. shaving, general hygiene, washing); the patient should undergo surgery with an empty stomach.
- After administration of anesthetic, which will numb a part of the body, the patient is informed of the time that the pain will be blocked for and about any subsequent administration of analgesic.
- Before anesthesia, the patient should be examined by their doctor in regard to allergies and cardiovascular disease. Before anesthesia, the patient must be carefully examined by an internist, who will or will not recommend the planned procedure in terms of internal disease.

Local (regional) anesthesia is divided according to the method and the place of anesthetic administration:

- *Topical (surface)* - anesthetic is administered to the mucous membrane or the skin, e.g. before introduction of the gastroscope or endoscopic device used in the examination of the stomach; following the administration of anesthesia, it is important to monitor the patient until the anesthetic wears off – not to give them anything to drink, eat, as the anesthesia reduces the sensitivity of defence reflexes, therefore the risk of aspiration (aspiration of fluid or food);
- *Infiltration* – anesthetic is injected into the skin or subcutaneous tissue of a particular body area; this form of anesthesia is applied prior to minor surgical procedures, e.g. before the introduction of a central venous catheter; the procedure may have to be on an empty stomach (risk of nausea);
- *Epidural* – anesthetic is injected into a nerve or nerve plexus, thus blocking the perception of pain in a certain part of the body; this group also includes spinal anesthesia, also known as subarachnoid block.

The patient must be monitored after the surgical procedure in terms of a return of sensation and overall condition. The patient is subjected to a special regime. The word "monitor" is derived from English and means to control, observe).

General anesthesia

This is a medically induced coma. General anesthesia is divided according to the method of administering anesthetic:

- *Inhalation* - the anesthetic is inhaled as gas or liquid;
- *Intravenous* – the anesthetic is administered intravenously;
- *Intramuscular* – the anesthetic is administered to the muscle;
- *Rectal* – the anesthetic is administered into the anus.

The most common method of general anesthesia administration is *balanced anesthesia.* The patient receives the anesthetic through inhalation and intravenously.

Patient preparation for general anesthesia

Before the scheduled surgical procedure, the patient undergoes a routine examination, i.e. general internal physical examination, including a check of physiological functions, ECG including evaluation, chest X-ray - lungs, basic blood test - such as blood count, blood group, basic biochemical blood and urine tests.

Further tests can be prescribed, depending on the doctor's requirements, the patient's medical condition, the type of disease and the type of scheduled surgery.

Most hospitals provide patients booked for a scheduled surgical procedure with a form of required preoperative examinations according to the standards, supplemented by hospital practices based on the type of surgery.

The patient (legal representative or guardian) sign giving their consent prior to the surgical procedure.

The patient is always carefully examined prior to general anesthesia by the anaesthesiologist, internist, or by the paediatrician. Each of these professionals prepares the patient's anamnesis

and further medical procedures derived from this. The anaesthesiologist prepares an anesthetic anamnesis, which consists of the following:

- *The patient's subjective symptoms* e.g. shortage of breath, feelings of tension, anxiety.
- *Creates a plan for the anesthesia* prior to the scheduled surgical procedure while focusing on:
  - *Medical history* – myocardial infarction, respiratory diseases, metabolic disorders;
  - *Previous anesthesia* – frequency and course;
  - *Patient medication;*
  - *Allergies, focusing on drug allergies and allergies to disinfectants;*
  - *Smoking, alcohol and coffee consumption;*
  - *Dentures;*
  - *Movement of the cervical spine.*
- After evaluation of the overall condition of the patient the anaesthesiologist determines the degree of risk. The risk assessment is prepared on the basis of the expression and determination of the ASA (American Society of Anaesthesiologists). Health risks are rated with numbers 1 to 5. Number 1 is used for a patient where no risk is expected. Number 5 signifies a high level of risk during anesthesia. Intervention in such cases usually has a vital (life-saving) indication.

During emergency (vital) intervention, the set of preoperative examinations is limited to a blood group test, (depending on the nature of the surgery), and to basic biochemical examinations, basic haematology, and basic physical examination. In emergency surgery, the patient is examined in terms of the condition and the quality of consciousness and the last time the patient ate or drank and the occurrence of allergies.

Special immediate preoperative preparation

Special immediate preparation of the patient for surgery is aimed at special preparation of the surgical field (compress, marking); the patient is placed in an unusual position in order to access the surgical field (lung surgery, position on the side), or for special treatment of the skin (allergy to disinfectants), ensuring venous access, the administration of infusion, the introduction of a permanent urinary catheter, and other interventions as prescribed by the attending doctor or anaesthesiologist.

Control questions:

(One answer is correct)

The perioperative period includes:

- Overall preoperative preparation;
- Only general immediate preoperative preparation;
- The period around the surgery, i.e. the preoperative preparation of the patient as well as postoperative care;
- Special overall general and local preoperative preparation, remote and special;
- Only psychological preparation

General immediate preparation of the patient for surgery consists of:

- Psychological support and local preparation;
- Focus on general hygiene, disinfection of the surgical field;
- Removing dentures and jewellery;
- Examinations aimed at the diseased organ;
- None of the above applies; it depends on the type of the surgery.

Types of anesthesia:

- Local (regional) and general;
- Local, general and remote;
- Immediate and remote;
- Immediate, remote and local;
- Traditional and alternative.

9. 2 Postoperative care

Chapter objectives:

After studying this chapter, you should be able to:

- Describe and explain the basic terms - classification of postoperative care;
- Determine the actual role of a nurse in the perioperative period, particularly in postoperative care;
- Support the patient (combined medical, nursing and rehabilitation care) to enable them to become physically and mentally fit as soon as possible;
- Describe, explain and justify the importance of patient cooperation in the postoperative period;
- Explain to the patient the relevance of the procedure to minimize complications.
- Demonstrate professionalism, skill and autonomy during nursing interventions;
- Know how to and always exercise appropriate communication with the patient, respect their age, individuality and other traits;
- Monitor laboratory test results, and other examinations, values of physiological functions etc., and be able to evaluate and justify the results.

Postoperative period

This is the period where the anesthesia begins to wear off (usually ranging from 2 hours after uncomplicated surgery, up to 24 hours after complicated surgery).

Postoperative care

Following surgery, the nurse receives the patient from the operating theatre in a stable condition, i.e. the patient's breathing is spontaneous and blood circulation is stable (transport of the patient from the operating theatre is supervised by a doctor) or receives the patient into their care from the ICU or RES department. Each patient has a completed medical record.

The postoperative period can be divided in to:

- *Immediate postoperative period (the day of surgery)*
- *Early postoperative period (next days of the postoperative phase)*
- *Late postoperative period*

General postoperative care includes *(day of surgery):*

- *Monitoring of vital signs* (blood pressure, body temperature, pulse, breathing); measuring and monitoring intervals are strictly individual, from 15-20 minutes up to an hourly interval, then later a two hour interval up to three checks a day.
- *Monitoring the surgical wound – checking the bandage and surrounding area* of the wound for seepage, blood leakage, fixing the bandage.
- *Care of inserted devices,* e.g. venous catheters, cannulas, risk of infection, checking the flow, correct wound drainage, permanent catheter, and probe (flow, contents).
- The patient is put into the *prescribed position*; this position is entirely dependent on the medical condition of the patient, e.g. after thyroid surgery, the patient is put in a sitting position, a pillow is used to firmly but comfortably support the patient in bed; a patient after pelvic surgery is put in the Trendelenburg position (position with an elevated pelvis); a patient after thoracic cavity surgery is put into a semi-sitting position, while the patient's position must be secured with additional bed aids, e.g. supporting rolls, foam blocks, side rails etc.
- *Rehabilitation*; the patient is positioned as soon as possible and subsequently seated, and quickly encouraged to get up from the bed (prevention of postoperative complications, expected early normalization of functions, prevention of respiratory complications, thromboembolism).
- *Pain and nursing care* in the postoperative period - according to the degree and duration of pain, the patient is administered the prescribed analgesic treatment; in the postoperative period, painkillers are prescribed every 6 hours, (*continuous postoperative analgesia* is standard in extensive orthopaedic, trauma and surgical operations) and every 4 hours; the analgesic doses are gradually reduced.
- *Regular surgeries preformed by an anaesthesiologist, surgeon, attending doctor* – (examinations, laboratory tests, e.g. ABR, blood count, blood glucose, application of infusion etc.)
- *Sleep and postoperative care* – by eliminating the pain, the patient's sleep usually improves although it can also be improved by suitably arranging the patient's surroundings.

- *Hygiene in the postoperative period* is complicated by the limited mobility of the patient; it is necessary to ensure adequate hygiene with assistance or be fully provided by the nursing staff; oral hygiene must be regular; it has hygienic and aesthetic purposes. As prevention of postoperative complications, it is necessary to encourage the patient from the first day to be independent and be reasonably active in the care of personal hygiene.
- *Monitoring of nausea and vomiting symptoms*, which are generally considered to be physiological for 24 hours after surgery, vomiting or nausea lasting longer are warning signals; a patient which has not yet fully awakened and has such symptoms assumes the position with their head turned to one side; a kidney bowl ready on the bedside table, cotton wool; the patient must be carefully monitored to prevent aspiration, a fully conscious patient should be advised that during nausea or vomiting, their head should be turned to the side, slightly raised to avoid the eventual vomit from entering the respiratory tract; the kidney bowl with the vomit is immediately removed from the vicinity of the patient.
- *Monitoring of urine* - urinating after surgery should be restored within 8 hours, urinating dependents on the type and severity of the surgery; in the event of problems with urinating, then before catheterization, the nursing staff should attempt to remove any psychological barriers (sound pulses – running water, submerging hands in warm water, attaching a warm compress to the abdomen - not always), if regular urination is not restored, the nurse inserts a catheter, and in the case of repeated failure, then a permanent catheter.
- *Monitoring flatulence* - the flatulence adjusts within 48 - 72 hours after surgery, depending on the type and extent of the surgery; a rectal tube or rectal glycerine suppository (prescribed by a doctor) can be introduced to stimulate flatulence; problems with flatulence persisting for more than 3 - 4 days after surgery indicates a serious condition.
- *Administration of fluids* – provision of adequate replacement of fluids, the type of fluid and administration in the postoperative period is strictly dependent on the type and extent of the surgery; it is usually administered when the patient regains consciousness (excluding digestive tract surgery); is spoon fed tea, gradually increasing doses. At other times, fluids are administered after 4 – 6 hours (until then the patient's lips can be moistened with wet gauze or a piece of ice), after restoring the swallowing reflex, as prescribed by a doctor, the patient is spoon fed tea in small sips, the type, volume and method of administration of fluid (tea, water) is always recorded. Furthermore, other patient problems with fluid intake are recorded (nausea, vomiting); fluid intake can be secured in a parenteral way (outside of the intestinal tract), and is prescribed for the patients whose medical condition does not allow them to receive fluids orally (by mouth); via infusion therapy, or administration of blood derivatives, prescribed by the surgeon or anaesthesiologist or the attending doctor; the easiest way to monitor hydration of the patient is to check the tongue; a white coated tongue signifies an insufficient intake of fluids, a pink-red tongue indicates adequate hydration; another indicator is a skin turgor (tension); the patient's forearm skin is gently pressed, if the skin immediately returns, the patient is well hydrated, if the skin is slow to return then it may be a sign of insufficient hydration.
- *Monitoring the skin colour* – the skin colour is carefully monitored, including the nails (pail nails, cyanosis – symptom of circulatory disorder), as well as the patient’s facial expression and the assumed position.

- *Monitoring of the internal balance* – fluid and electrolyte balance in the body is a matter of overall postoperative treatment.
- *Monitoring of dietary therapy* - dietary therapy after surgery should be based on knowledge of the organ function, knowledge of the functional changes that surgery can bring, the knowledge of the general principles of dietetics; tea is spoon fed in the early days, followed by fluids, soft foods, and gradually normal nutritious meals i.e. without restriction. Realimentation after surgery is very individual. The current recommendation is to start intake as early as possible, which is possible in the majority of patients a few hours after surgery, depending on their tolerance levels, and patients who cannot receive food orally, are fed through an enteric tube.
- *Monitoring the patient's mental symptoms* – psychological support, providing sufficient information with regard to the therapy etc. is very important.

The nurse must always monitor the patient before and after surgery and inform the doctor of any changes. The patient should be continuously informed of their medical condition and always have the opportunity to opt for surgery. The patient must be advised of any possible complications and risks even if they refuse surgery. The need for the surgery is emphasized. There must always be an attempt to support the psyche of the patient, and thus prevent any complications.

Postoperative complications

Surgery and anesthesia are stressful events for the patient.

The patient handles stress in accordance with their overall condition, the nature of the surgery and associated diseases.

In cases of planned surgery, patients are usually in best condition and stable in terms of associated diseases.

However, those patients who fall into the ASA 3-4 category are an exception as their associated diseases are so severe that they cannot be improved with preoperative preparation.

A perfect preoperative condition of a patient cannot be expected in semi-elective and emergency surgeries, especially if they are elderly patients, who arrive with significantly limited reserves and often with destabilized associated diseases.

In such patients, postoperative complications can be expected to a large extent.

Post traumatic stress disorder (stress syndrome) can be expected in all patients following surgery. This is an overall and local response of the organism to stress and its effort to cope with the strain. It is a physiological reaction of the organism to stress, which in the worst case scenario can become a pathological or a post-operative complication.

Postoperative complications are events that disrupt the postoperative course and occur in connection with anesthesia or surgery. Postoperative complications occur most frequently during the first hours following surgery. Early detection of a complication is important for the subsequent treatment.

Postoperative complications are divided into early and late complications.

Early complications are usually in connection with anesthesia and are expected within 2 hours after surgery, or possibly within 24 hours. Late postoperative complications occur 4 – 5 days after surgery.

Early complications

These complications occur immediately after surgery, usually in relation to general anesthesia, but may also be related to the actual surgical procedure.

Complications can include:

- Respiratory disorders – laryngospasm, bronchospasm, upper airway obstruction, inadequate breathing (hypoventilation, apnoea), edema and vocal cord paresis.

  Treatment: Well managed anesthesia with the return of defensive reflexes and muscle strength, eventual administration of bronchodilators, oxygen therapy, supporting ventilation or re-intubation and controlled ventilation.

- Cardiovascular disorders – hypotension, hypertension, arrhythmias, shock, myocardial infarction, systole etc.

  Treatment: Stable anesthesia, sufficient volumotherapy, stabilisation of the internal environment and ion imbalance, possible administration of antiarrhythmic agents, catecholamines and antihypertensive drugs.

- Fluid and electrolyte balance disorders – ion imbalance hypovolaemia.

  Treatment: See points 2 and 3

- Late bleeding

  Treatment: Surgical revision if coagulopathy eliminated

- Hypothermia and shivering

  Treatment: Maintaining body temperature with heated beds, heated solutions, minimizing heat loss.

- Hyperthermia

  Treatment: Eliminate malignant hyperthermia, CAS, and further depending on the cause (sepsis – antibiotics, antipyretics, overheating – checks the heated bed, hot line systems, cooling).

- Postoperative nausea and vomiting – danger of aspiration

  Treatment: Gentle anesthesia, surgical technique, antiemetics

- Central Anticholinergic Syndrome (CAS) - inhibition of cholinergic receptors with atropine, anesthetics, benzodiazepines, opioids, leads to tachycardia, heart rhythm disorders, mydriasis, flushing of the face, reduced production of sweat and secretions, slowed intestinal peristalsis, fear, hyperactivity, restlessness, irritability, disorientation, hallucinations, central hyperpyrexia, leading to somnolence and even to coma.

  Treatment: Physostigmine

- Delayed awakening, psychomotor agitation – due to sedatives, opiates, also hypoglycaemia, hypercapnea, cerebral disorders, pain, fear, urinary retention, gastric distension, CAS.

  Treatment**:** According to the cause

Most of these complications occur in the operating theatre and are treated by the anaesthesiologist or the surgeon (bleeding). If they are life threatening, they require immediate treatment (apnoea, asystole, etc.).

Late postoperative complications

The patient may suffer late complications in days later after the surgery, either in the ICU or on the ward. Some complications may persist from the immediate postoperative period (e.g. lung aspiration after extubation with bronchopneumonia aspiration in subsequent days).

Late complications include:

- Ventilation complications – inflammation of the bronchial tree and lungs, vocal cord paresis and edema, pulmonary atelectasis, shock lung.
- Cardiovascular disorders – heart failure, arrhythmias, hemodynamic instability, myocardial infarction, vascular brain disorders, embolism (air, fat, thromboembolism, amniotic fluid), shock.
- Bleeding disorder complications – vein thrombosis, thrombophlebitis, pulmonary embolism, paradoxical embolism, disseminated intravascular coagulopathy.
- Surgical wound complications – infection bleeding, dehiscence, necrosis
- Gastrointestinal complications – gastroparesis, stress ulcers, ileus conditions, singultus (hiccup).
- Renal complications – urinary retention, paradoxical ischuria, infection, renal (kidney) failure
- Impaired hepatic function
- Temperature – after surgery, decay process
- Allergic reaction – to sutures, blood derivatives, medication
- Complications related to invasive inputs (i.e. cannulas, central venous catheter, urinary catheter, drains) – infection, thrombosis, bleeding.
- Nervous system disorders – vascular brain disorders, inappropriate position, perioperative nerve injury.
- Mental disorders – postoperative delirium.

Postoperative complications should be treated according to the underlying cause. E.g. respiratory failure due to inadequate analgesia requires an increase and adjustment of analgesic doses. It is necessary to know the pathophysiology of these complications and prevent them in the preoperative period.

It is desirable to operate on a patient in the best physical condition; if possible, maintain the homeostasis of the organism before operation, hydration, nutrition, analgesia, early mobilization and early rehabilitation training.

Postoperative complications worsen the patient's condition and thus lead to higher treatment costs.

Prevention of complications

Correct preoperative preparation: e.g. breathing exercises, improvement of internal environment by infusion administration, transfusion, lower limb bandages, thorough emptying of the colon.

Postoperative period: early mobilization of the patient after surgery, care of the patient with artificial ventilation, with drainage, nasogastric tube, urinary catheter, etc.

Perfectly executed surgery

Appropriate anesthesia, subsided anesthesia with the return of defensive reflexes, or administration of an antidote for persistent anesthesia effect, particularly opioids or muscle relaxants.

Control questions:

(One answer is correct)

The nurse receives the patient after surgery from the operating theatre:

- In a stable condition with the completed medical record, in the presence of a doctor;
- Partly in a stable condition; the medical records are passed to the attending doctor by the surgeon;
- Partly in stable condition without medical records (the records are handed to the attending doctor);
- A patient in stable condition with complete medical records can be received by a hospital attendant;
- A patient in a stable condition with complete medical records can be received by two hospital attendants.

Monitoring of all vital signs immediately after surgery (blood pressure, body temperature, pulse, breathing, consciousness); the measuring and monitoring intervals are strictly individual, from 15-20 minutes up to hourly intervals, then later a two hour interval up to three checks a day

- Patients in the Anaesthesiological and Resuscitation Departments
- All patients after surgery
- Paediatric patients
- Elderly patients
- Patients after emergency surgery

Urinating in a patient should be restored after surgery within:

- 8 hours
- 4 hours
- 12 hours
- 2 hours
- 3 hours

Flatulence should be restored in a patient after surgery within:

- 48 – 72 hours
- 12 hours
- 8 hours
- 20 hours
- 6 hours

Early postoperative complications are:

- Fever
- Breathing disorders, postoperative nausea and vomiting
- Complications in the surgical wound
- Allergic reactions
- Mental disorders

Additional task

Locate the nursing care standards while at the clinical practice *PATIENT CARE IN THE PERIOPERATIVE PERIOD*

9.3 Redressing wounds

Objectives:

After studying this chapter, you should be able to:

- Explain basic terms – types of dressings, basic surgical instruments, drains, drainage systems, principles of bandaging;
- Know the role of the nurse in redressing;
- Justify compliance with the general principles of assistance for redressing;
- Know the methodology for assistance in redressing, wound dressing algorithm;
- Know the necessary aid used in redressing, and describe the trolley with bandaging material;
- Assist with redressing;
- Know and implement methods of wound treatment;
- Know the aid care procedure after redressing;
- Communicate in a professional manner with the patient and during the course of the procedure;
- Handle the used bandaging/dressing material, the used disposable aids and other used material.

Theoretical notes

The integrity of soft tissues of a different nature and scope can be damaged due to mechanical, chemical, thermal, external (e.g. direct pressure, reduced temperature and low pH in the wound, inappropriate dressing), internal (age, immunodeficiency, anoxia, etc.) and nutritional (e.g. malnutrition dehydration) factors.

The treatment of surgical, trauma, acute and chronic defects represents a set of activities that accelerate and improve the healing process and improve the final aesthetic and functional result. The course of wound healing is also supported by the continuous replacement of dressing and bandage, i.e. targeted, repeated wound treatment - redressing.

The aim of redressing is for example, continuous monitoring and assessment of the wound and the surrounding area, suture removal, protection of the wound from infection or mechanical effects. *Wound redressing* is usually performed in five steps. The individual processes are common for all types of wounds.

- Removal of the bandage and dressing
- Assessment of the wound
- Cleaning and disinfection of the wound and the surrounding area
- Wound treatment
- Application of dressing

Wound redressing with subsequent treatment is carried out in designated rooms (examination room, redressing/rebandaging room etc.)

In the event of a larger number of wound dressings, it is necessary to proceed from aseptic wounds to septic wounds.

Procedure; the nurse:

- Proceeds according to the schedule, methodology and nursing care standards,
- Depending on the type of wound, dressing and treatment, the nurse prepares a trolley with dressings and bandages and places it near the examination bed or the patient's bed,
- Prepares the necessary medical documentation (medical records, daily report, record of the wound healing etc.),
- Instructs the patient of the importance and the procedure,
- If necessary, administers a prescribed painkiller to the patient approximately 30 minutes before the redressing (if painful wound treatment is anticipated),
- Places a protective mat on the bed (examination bed), close to the wound,
- Removes clothing close to the wound
- Helps the patient into the appropriate position to enable thorough treatment of the wound, exposes the required area of the body, respects the patient's dignity,
- Redresses the wound, either by assisting the doctor or by themselves with the assistance of a second nurse,
- The wound is redressed using a non-touch technique - the bandaging is cut or removed, using tweezers, a haemostat or gloves; the subsequent treatment of the wound is with the aid of surgical instruments,
- Manipulation with materials and tools is according to the principles of sterility, strict compliance with aseptic technique (aseptic practice is also complied with in septic wound redressing),
- Estimates the likely consumption of sterile dressing material, according to the type of wound, to avoid wasting material,
- Used instruments are placed in a kidney bowl, used dressing material is placed into a second kidney bowl or directly into the waste bag (designated for infectious waste),
- Maintains visual and verbal contact with the patient during the procedure to minimize patient discomfort,
- Plans activities so that the procedure progresses without interruption and the patient can cooperate,
- Prevents the patient from looking at the wound and waste material,
- When the redressing is done, the nurse checks the patient and the condition of the wound and informs the patient about the next wound treatment procedure.
- After completion of the procedure, puts the disposable material into a designated bin (bag), puts the used instruments into a kidney bowl with a disinfectant solution and subsequently cleans and sterilizes instruments as per applicable regulations,

- After completion of all redressing procedures, all the aids and instruments are removed from the trolley which is then washed and re-equipped.

Types of dressing materials

Traditional dressing materials, examples of use

- *Fabric* – hydrofile gauze, elastic mesh – Pruban (e.g. for attaching dressings)
- *Fibre* - cotton wool, raw cotton, cellulose (e.g. underneath splints, wedging, freely placed on the dressing, pulp squares)
- *Substances stiffening bandages* – starch, zinc paste, plaster (e.g. phlebitis, strengthening of the injured joint tissue)
- *Liquid bandages* – Jodkolodium, Solutio Novikov – currently less suitable application (e.g. suture protection)

Modern dressing materials, examples of use

Modern dressings meet the requirements for moist wound healing and are compatible with other methods of moist treatment. Advantages of modern dressings include:

- Reducing the number of redressings
- Less painful, reduced need of analgesics, less blood loss during redressing
- Reduce treatment time by 50 – 70 %
- Reduce the workload of the nursing staff
- Cost saving in the treatment of skin ulcers

The basic dressings are divided by function. A primary dressing is applied directly on the wound. Secondary dressing absorbs excess exudate. Depending on whether it adheres to the wound, the primary dressing is further divided into adherent and non-adherent.

Rinses and lavage

These are prescribed when redressing necrotic, infected wounds. The rinse, especially with antiseptic solution for clean, granulating and epitelizing wounds is not substantiated. The wound rinse helps to clean the wound of early leaching residues, coatings, necrotic tissue, pus, blood clots, toxins or residues of bacterial biofilm. Rinsing a colonized chronic wound reduces the existing microbial population.

- Solutions suitable for application to wounds: Prontosan solution, Ostenisept, Dermacin, DebriEcaSan
- Less suitable solutions: Betadin, Braunol, saline, Permanganate
- Solutions not suitable for application to wounds: Chloramin sol. 1% - highly cytotoxic, Persteril 0.01% - aggressive, highly cytotoxic, Rivanol 0.1 – 2% - cytotoxic, allergenic, photosensitization, 1-2% hydrogen peroxide- cytotoxic to granulation tissue, Jodisol: Causes irritation and is cytotoxic to the wound, Gentian violet: Carcinogenic effect on the mucous membranes, cytotoxic can only be applied to intact tissue, Solutio Novikov – carcinogenic effect on the mucous membranes, cytotoxic.

Therapeutic dressing of the wound:

- Gauze dressing: Traditional form of wound protection, used as a primary dressing for healing wounds and also as a secondary dressing for light and heavy exuding wounds. The disadvantage is the need for frequent redressing, while the granulation tissue can be damaged during replacement; therefore there is the need for another protective dressing – Sterilux, Steriko, folded hydrofile gauze. Other products used as secondary dressing: Vliwasoft, Mesoft, Surgipad – highly absorbent compression. Release – non-adherent absorbent dressing.
- Impregnated gauze dressing: Gauze with hypertonic saline NaCl – Mesalt – wound exuding, with the need for debridement, daily replacement, gauze is impregnated with iodine – Hyiodine – for application to deep, infected wounds – daily replacement.
- Non-adherent wound mesh: Primary wound dressing made of mesh, flexible and adjustable to the wound surface, suitable for the protection of granulated tissue and epithelium. Secondary dressing is required - Mepitel, Askina Silnet, Tagapore, Adaptic, Jelonet, Lomatuell H etc.
- Non-adherent antiseptic dressing: Non-adherent wound protection mesh containing antimicrobial active substances - Inadin, Braunovidon gauze, Atrauman Ag, Bactigras, Ialugen, Revamil, MelMax. These are applied directly to the wound and protected by a sterile secondary dressing. The frequency of redressing depends on the wound secretion, usually after 2-7 days. The advantage is minimal wound trauma during redressing.
- Transparent film dressing: Semi-permeable adherent dressing with protective polyurethane film – a transparent protective dressing for wounds and skin subjected to repeated trauma. It is applied on the top of a wound which is with or without minimum secretion, protection of the surrounding of the wound from maceration, postoperative protection, fixation of other primary protective dressings, skin protection in the areas at risk from the effects of shearing forces, humidity and excrements - Tegaderm, Hydrofilm, Mefilm, Askina Derm, Suprasorb F, etc.
- Spray plaster: Transparent, fast drying sprayed-on film. When dry, the film is selectively permeable for gases and water vapour and impermeable to water and microorganisms. It is intended for the skin at the risk of repeated trauma and maceration. OptiSite Spray, Cavilon, Cutimed Protect Spray.
- Hydrocolloids: Absorbent, semi-permeable, adherent wound protection. Maintains a moist environment on the wound surface, forms gel on the wound surface when in contact with exudate, Hydrocolloids stimulate the formation of tissue granulation, and support autolytic debridement, including dry eschar. Contraindication – infected wound with anaerobic strains – Granuflex, Granuflex bordered, Comfeel, Suprasorb H, Askina Hydro, Granuflex extra thin, Tegasorb THIN, etc.
- Hydrocolloids in gel: Maintain a moist environment on the wound surface and in the cavities, not suitable for infected wounds. Form gel on the wound surface when in contact with exudate. Stimulate the formation of granulation tissue, support autolytic debridement - Granuflex paste, Flamigel, Flaminal, Flaminal Hydro, Askina Biofilm Paste, Comfeel paste, etc.
- Hydrogels: Gel protection wound dressing of a different composition. Absorb excess exudate, while providing hydration to the wound, including dry gangrene, regulates optimum moisture in the wound, suitable for all stages of healing - Nugel - with alginate ,

Askina gel, Debri EcaSan gel, Suprasorb G, Normgel - 0.9% NaCl, Hypergel - 20 % NaCl, Prontosan gel, Octenilin gel, etc.

- Foam dressings
  - Non-adherent foam dressings: Semi permeable non-adherent polyurethane dressing with high absorption capacity. Create a suitable microclimate and stimulate wound cleansing. Form an effective barrier against the penetration of microorganisms into the wound from the outside thus preventing maceration. Absorb excess exudate. Indication – uninfected, mild, moderate or heavy exuding wounds in the granulation and epithelialization phase. Wounds with the need to reduce the amount of granulation tissue formation. Clean wounds in epithelialization phase up to 7 days – Tielle, Suprasorb P, Allevyn Adhesive, Askina Transorbent, etc.
  - Polyurethane foam with silicone: Semi-permeable, non-adherent polyurethane dressing with a silicone layer on the surface. Suitable for treating clean wounds in the granulation and epithelialization phase, preventing maceration of the surrounding area; the dressing adheres to the skin around the ulcer. Create a suitable microclimate and stimulate wound cleansing. A secondary dressing is not usually required - Mepilex, Mepilex Border, Mepilex Border Sacrum, Mepilex Ag.
  - Hydro polymers: A group of dressings, which ensure optimal drainage of exudate, have a high absorption capacity; prevent maceration of the wound and the surrounding area. Gentle on the wound and surrounding area – Tielle Xtra, Allevyn Compression, PolyMem.
  - Polyurethane foam with added properties – semi-permeable covering of polyurethane, containing other active substances to improve certain properties. E.g. Askina Transorbent – polyurethane foam + hydrocolloid and hydro-gel, Askina Calgitrol – with silver, Kendall AMD – foam with polyhexametyl biguanide – PMBH 0,3% - antimicrobial protection
- Alginate dressings: Highly absorbent alginate fibres from brown seaweed, sodium and calcium salts, alginic acid in varying ratios. Properties: Bacteriostatic agent, cleansing effect, absorption of exudate, haemostatic effect. In a humid environment, organized alginate fibres disintegrate into a hydrophilic viscous gel. This covers the wound and creates optimal hydration. It is used for superficial and deep wounds with moderate to severe secretion, including wounds with infected edges - Suprasorb A, Sorbalgon, Melgisorb, Algisite M. Silvercel – alginate with silver, Askina Calgitrol Ag – polyurethane foam + alginate + Ag, Acticoat absorbent – alginate.
- Antiseptic dressing with silver: Protective dressing with an antimicrobial effect. One of the domain active substances is ionized AG+ or inert AG atoms of silver. AG+ has a broad antibacterial spectrum with a bactericidal effect, including the effect on algae and yeasts, MRSA and VRE. Aquacel Ag, Askina Calgitrol Ag, Biatain Ag, Melgisorb Ag, Algisite Ag, Atrauman Ag, Silvercel, Actisorb plus, Acticoat etc.
- Activated charcoal dressings: Protective dressing which absorbs toxins and odour into the activated charcoal and partially absorbs exudate. Indicated for treatment of odorous, secreting, necrotic, tumorous, contaminated and infected wounds. It is applied directly on the ulcer; the frequency of redressing depends on the recurrence of odour or leakage - Carbonet, Estex, Vliwaktiv, Askina Carbosorb, Tecasorb. Actisorb plus, Actisorb 220, Vliwaktiv Ag - activated charcoal and silver dressing.

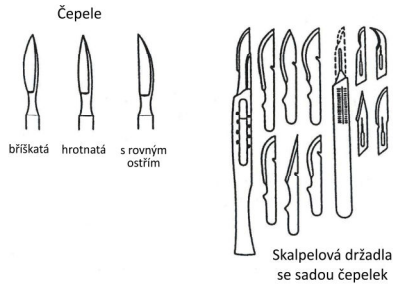
Surgical instruments

Each instrument is named and designed for a specific surgical procedure. Surgical instruments have the following parts:

- *Grip* - the part that is gripped and which, upon contact with a hand without a glove, immediately becomes non-sterile; this part remains sterile if the instrument is held by the hand in a sterile glove.
- *Working* or *functional* – the part that is used to hold whatever is required, e.g. sterile material, another instrument or it can be used to penetrate the wound, e.g. for a revision; the *neck* or *lock* (if it closes) allows the movement of the instrument's components.

The most frequently used instruments during redressing are:

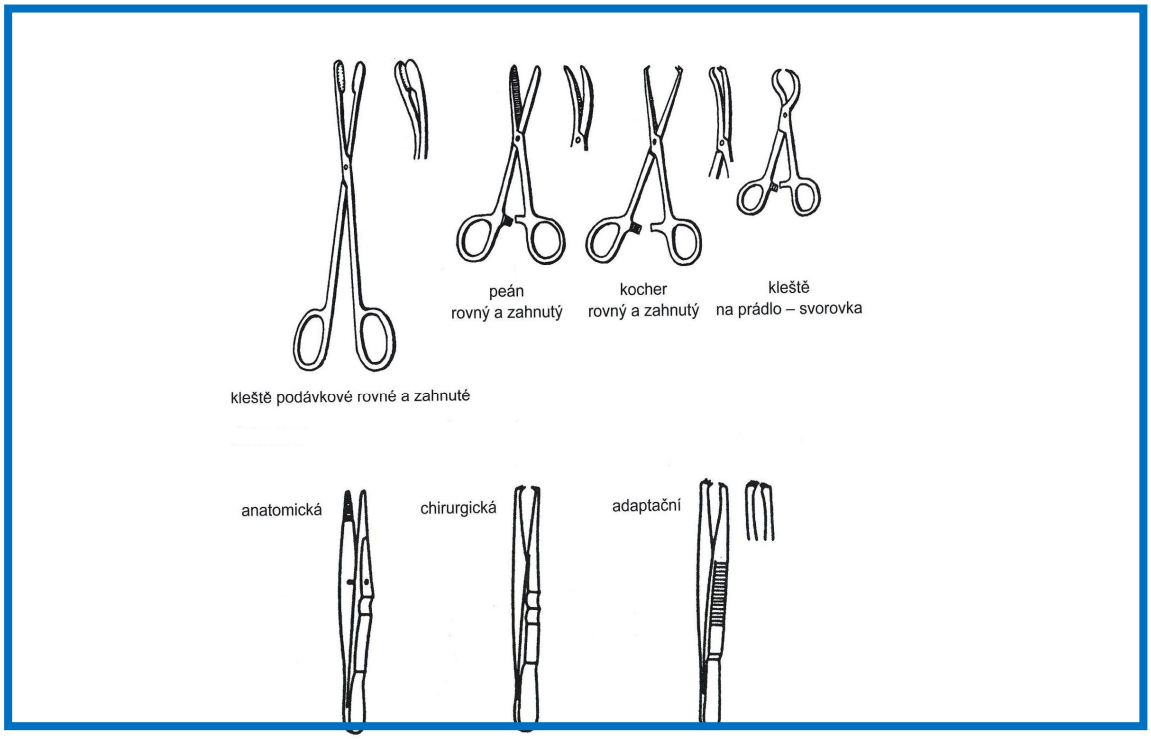
- *Surgical forceps*
- *Hemostat (aka pean)* – gripping tongs, e.g. for gripping other instruments, for handling sterile gauze, to capture vessels (the instrument is named after the French surgeon Jules Émile Péan, 1830 – 1898).
- *Kocher forceps* – have one or two interlocking teeth and are used for grasping skin or fabric, cloths, (the instrument is named after its creator, the German surgeon Emil Theodor Kocher).
- *Surgical knives, scalpels* – intended to cut open a layer of skin or cut open the affected area
- *Surgical scissors* – round, curved, sharp and blunt
- *Anatomic tweezers* - both arms are blunt and smooth from the outside, the inner surface is transversely grooved; *surgical tweezers*, the arms have one and two interlocking teeth; *adaptation tweezers*, have arms with inward interlocking teeth at the end.
- *Probes* - 15 cm long metal exploratory instruments used to map the wound; *mallet probes* are used to measure the depth of the wound, *grooved probes* are used to remove secretions from the wound, and then there are *reversible probes*, with a mallet on one side and a chisel on the other side – these probes are used to adjust the inside of the wound.
- *Surgical spoons* –which are round, sharp and blunt - a surgical instrument used to clean or recess the wound



Blades
curved pointed straight blade

Scalpel handles
with a set of blades

Fig. 9. 3-1: Scalpels

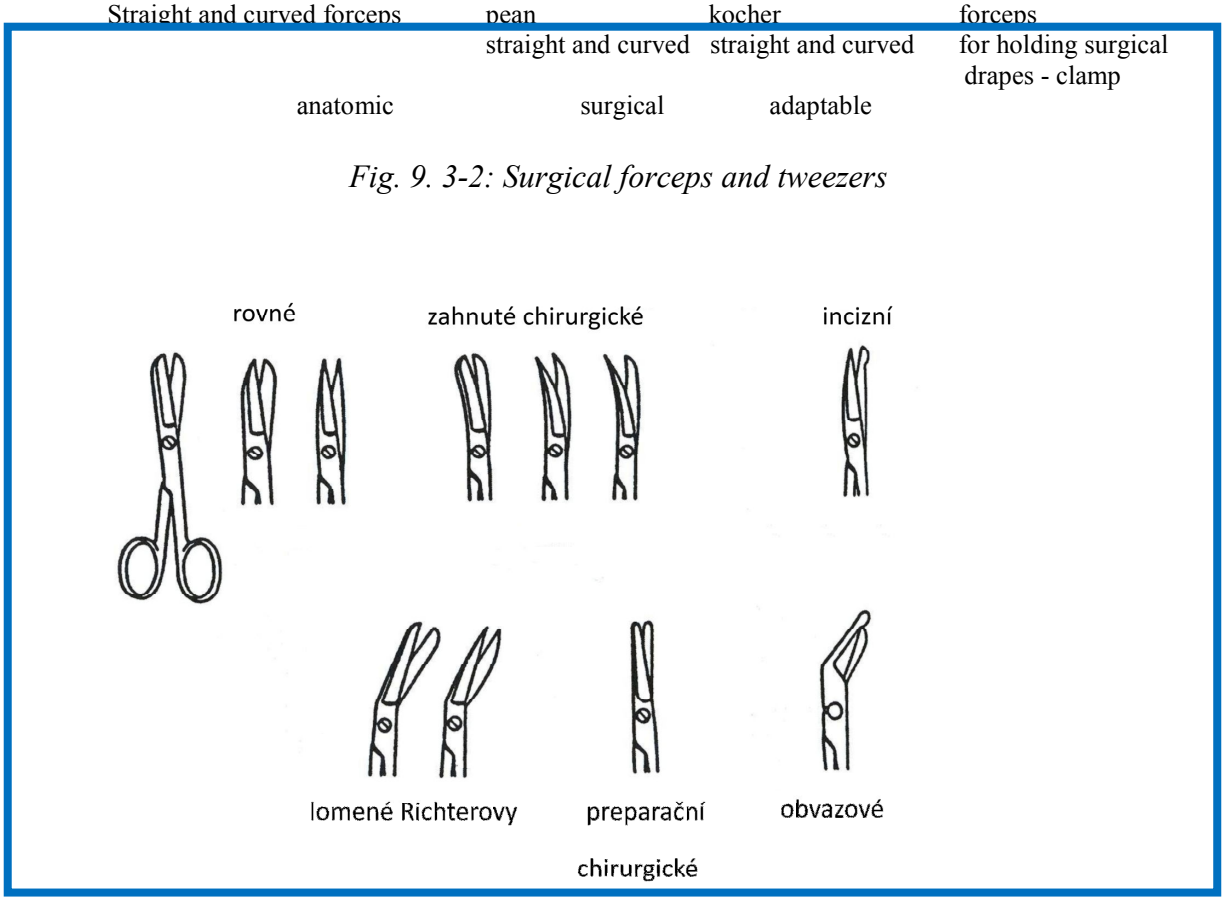


Straight and curved forceps pean kocher forceps

straight and curved straight and curved for holding surgical drapes - clamp

anatomic surgical adaptable

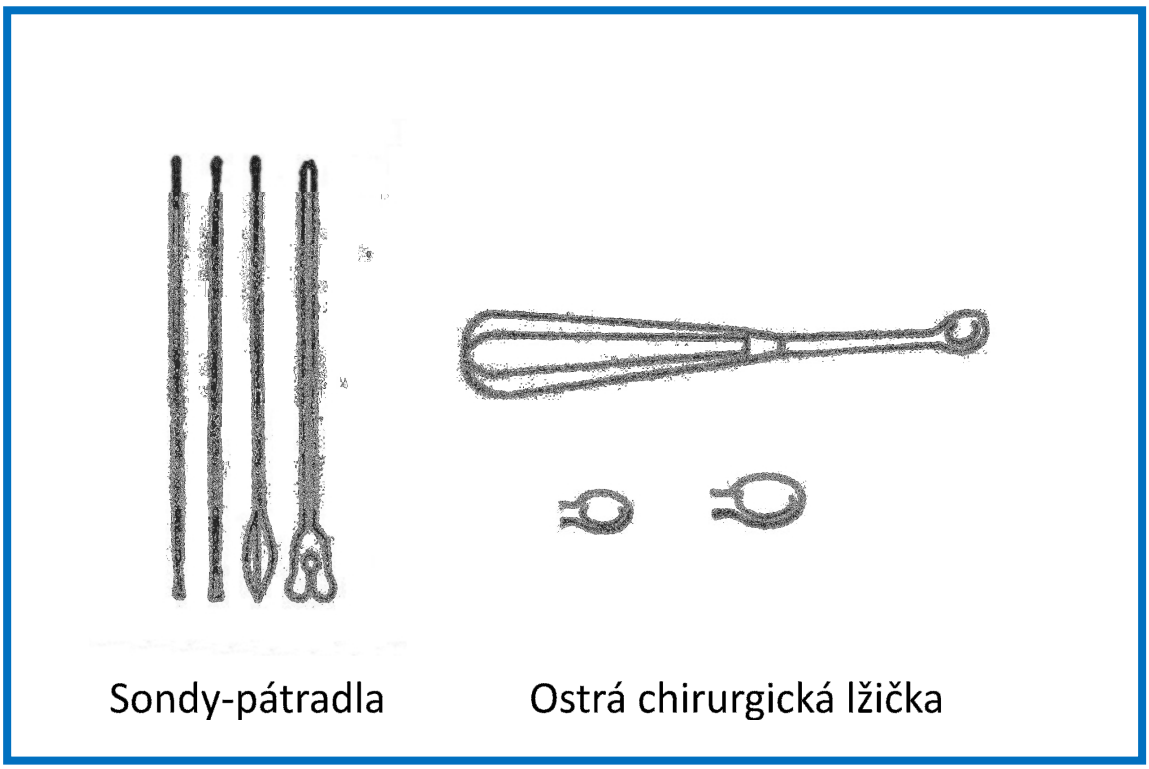
Fig. 9. 3-2: Surgical forceps and tweezers



straight angled surgical incision

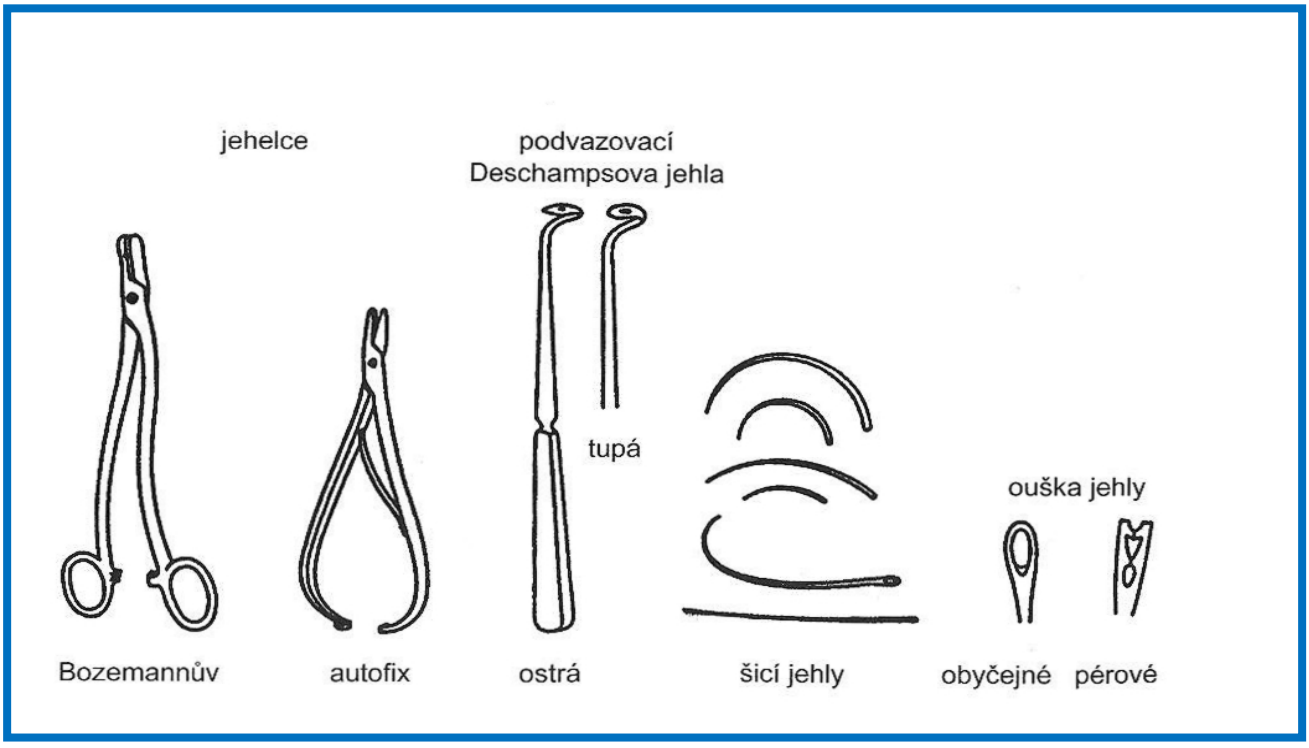
angular Richter dissecting surgical bandage

Fig. 9. 3-3: Scissors



Probes Sharp surgical spoon

Fig. 9. 3- 4: Probes and surgical spoons



Needle holders Ligature
Deschamps needle

Bozeman autofix sharp blunt suture needles needle eye
plain spring

Fig. 9. 3-5: Suture instruments

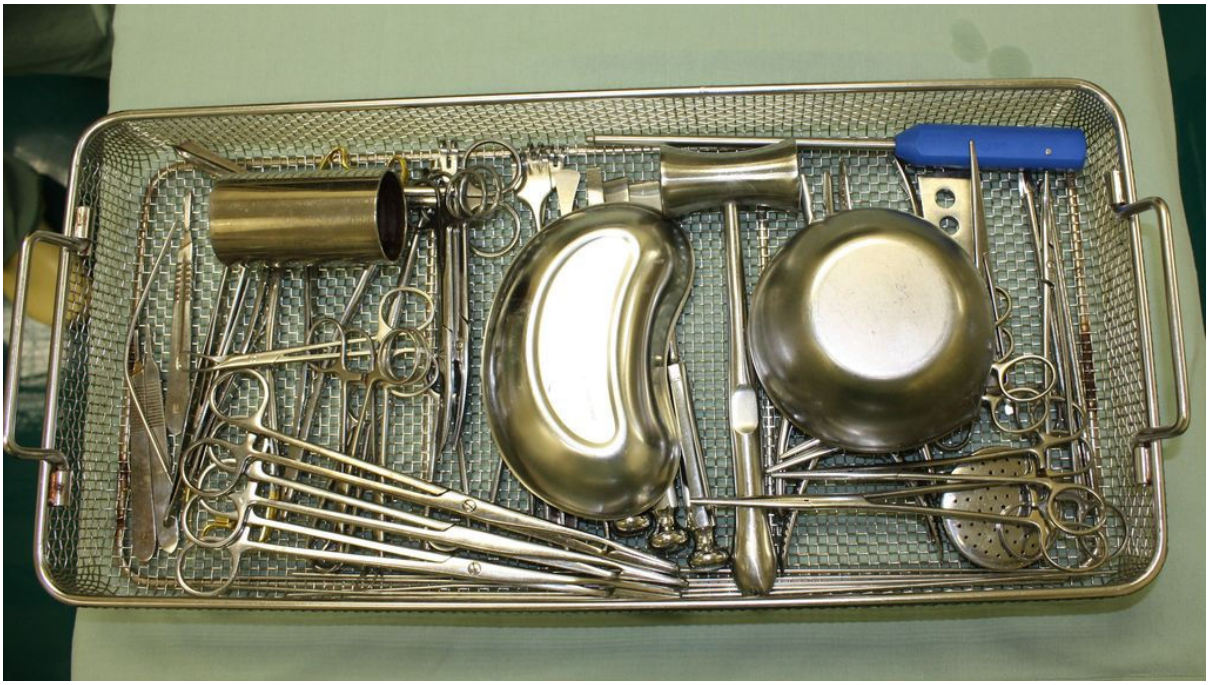


Fig. 9. 3-6: Sieve tray with a set of surgical instruments, kidney bowl, surgical bowl

Fig. 9. 3-7: Basic aids and surgical instruments used for redressing (removing stitches)

Fig. 9. 3-8: Trolley with dressings and bandaging material

Patient preparation

- The nurse instructs the patient on the importance of redressing and on the procedure
- If necessary, administers a prescribed painkiller to the patient approximately 30 minutes before the redressing (if painful wound treatment is anticipated),
- Informs the patient throughout the procedure of the subsequent steps

Aids

Top of the trolley with dressings/bandages

- Sterile swab forceps in the quiver
- Cartridge with sterile instruments (peans, surgical scissors, tweezers, probes) or stored individually in sterile packaging labelled with the date of sterilization
- Sterile swabs, packaged gauze squares (sterile drum or Steriking bags – combined packaging materials (paper/foil)
- Additional dressings with a special formula (e.g. antiseptic dressings)
- Aids for cleaning the wound (Prontosan), for disinfection (Cutasept F etc.)
- Sterile ointments, pastes
- Sterile syringes, needles, gloves
- Liquid bandages (Jodkolodium, Solutio Novikov, currently less used)
- Sterile cotton buds

Lower part of the trolley

- Bandage scissors
- Non-sterile gloves
- Kidney bowls
- Bandaging material – various types of plasters, elastic mesh – Pruban, hydrofile and elastic bandages, transparent foil, cellulose wadding
- Protective mats
- Container with a lid and disinfectant for used instruments
- Waste container

Working procedure

- Patient preparation
- Preparation of aids and documentation
- Organization of the redressing room
- Washing and disinfection of hands
- Two kidney bowls are prepared near the place for redressing
- The nurse puts on gloves
- Removing the protective layer on the bandage
- The bandage roll is cut with bandage scissors on the side or in opposite direction of the wound
- Tape: The skin is stretched and the tape is gently, but firmly removed in the direction of the wound, the wound area is cleaned of any residue from the tape
- The protective dressing is removed, away from the view of the patient and placed into the kidney bowl
- The top protective layer is removed and put into a kidney bowl using a sterile instrument (tweezers, pean), or sterile gloves
- The wound and the healing process are assessed
- The contaminated glove on the dominant hand is replaced with a sterile glove
- The wound area is cleaned using a sterile pean (or using sterile gloves) and sterile swab and antiseptic solution, in all directions *away from the wound*, (the contaminated swab is replaced with a new, sterile swab if necessary), until the wound area is thoroughly cleaned.
- In the event of a drain insertion, the surrounding area is cleaned only after wound cleaning.
- Surgical scissors and pean (or tweezers) are used to remove the stitches.
- Prescribed medication can also be directly applied on the wound or the wound area.

- A sterile dressing is applied, depending on the stage of wound healing, using a pean (sterile gloves); further layers of wound dressing are attached - away from the centre of the wound. The dressing width should be chosen so that it overlaps the wound by at least 2 cm.
- Gloves are removed.
- The dressing is fixed using hypoallergenic tape, elastic mesh (Pruban) or with transparent foil
- Washing and disinfection of hands
- The patient is instructed in the next regime
    - Practicing how to protect the wound when getting up (if not included in the preoperative preparation), when coughing
    - The patient is warned not to try to remove the tape from the wound, not to touch the wound
    - The patient is instructed to inform the nurse or doctor in the event of complications (pain in the wound, dressing leakage, bleeding…)
        - The procedure is recorded in the documentation
        - The bandage is regularly checked as often as required

Patient care after treatment

- The nurse monitors the patient's general medical condition and the condition of the wound.
- See above text - Working procedure

Care of aids after use

After removing the instruments from the disinfectant (after a certain period), they are mechanical washed using a brush. They are inspected after drying and any damaged instruments are discarded; the remaining instruments are put into the cartridges, surgical sieves or into the designated packaging (individually) and sterilized.

Suture material

Suture material is divided into absorbable and non-absorbable. Important features are the strength, adequate healing of the tissue and that the material is well received by the organism. The absorbable material only supports healing for a limited period. The non-absorbable material supports the ongoing tissue healing process.

Preview of absorbable suture material

For example:

- *Catgut* – plain or chrome (highly purified animal collagen, i.e. bio-absorbable thread)

- *Synthetic material* – used for ligation of vessels, skin, subcutaneous tissue or fascia stitching. It is absorbed within a few weeks.

Preview of non- absorbable suture materials

- *Natural silk*
- *Iron nickel and chromium alloy*
- *Polyamide*
- *Polyester*
- *Nylon*
- *Polypropylene*

Used in skin and fascia stitching, in the eye and for plastic surgery etc. The various types of suture materials are stored in boxes in the operating theatre which are packed in boxes with different types of fibres and ligation in simple containers, thus enabling the nurse to pass the required suture material to the surgeon. Each type of suture fibre with a needle is labelled with a different colour. When using a pre-prepared set of suture materials, the nurses do not have to thread the needles, nor prepare and maintain the needles. Trauma sleeves contain different lengths of fibres on the plastic plates or coils, stored in airtight sterile containers with a label bearing the name, fibre length, thickness and type of needle as well as the use by date.

In the case of suture material supplied in plastic bottles with a preservative solution, the bottle must be disinfected prior to each use. The suture is pulled out the lid opening, cut with sterile scissors and then applied as a sterile fibre. These bottles can be used in the operating theatre, but they must be placed in a special stand, covered with sterile and perforated drape and sterile caps.

Fig. 9. 3-9: Hand hygiene before the procedure

Fig. 9. 3-10: Nurse preparation for the procedure

Fig. 9. 3-13: Cleaning the wound area

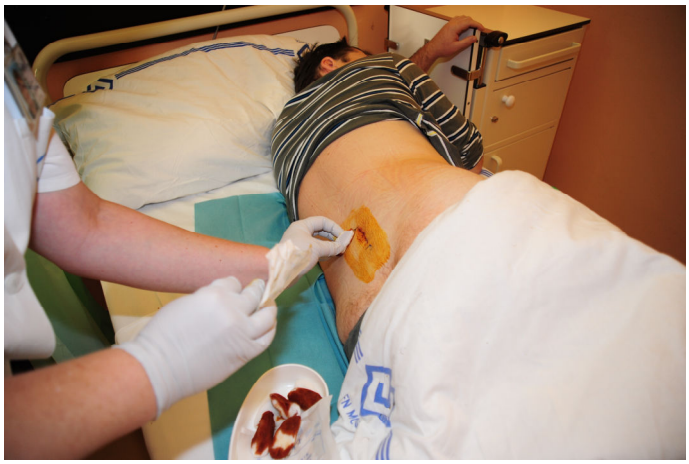


Fig. 9. 3-14: Wound disinfection

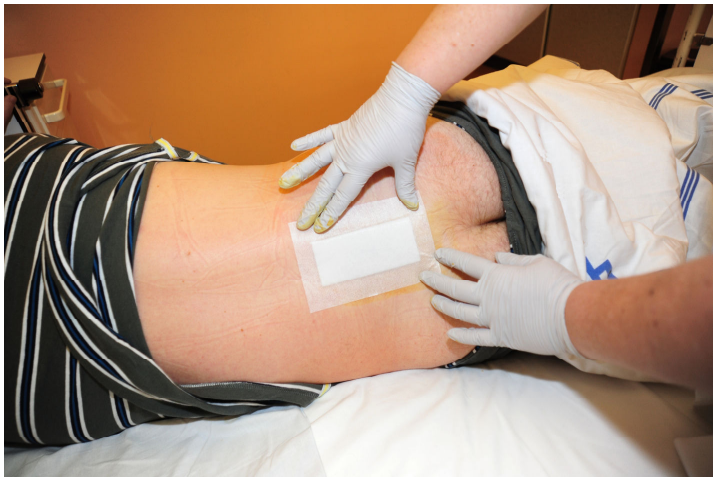


Fig. 9. 3-15: Attaching the protective dressing

Fig. 9. 3-16: Hand hygiene after the procedure

Drains, drainage systems

Drains are used to drain physiological or pathological fluids from the body. The use of drains and drainage systems in surgery significantly affects the overall healing process.

The accumulated fluid can endanger the whole body as it has a mechanical and toxic effect on the surrounding tissue and is a breeding ground for microorganisms. Drains are used to drain fluids from body cavities, organs, wounds and surgical wounds (e.g. blood, wound secretion, bile, intestinal contents, pus etc.) and air (chest drainage).

Drains

Glove (latex)

This is a drain prepared from cut strips of rubber gloves. This drain can be replaced with each redressing. Therefore, it is not such a big problem if it is pulled out when removing the dressing. A latex drain can be dampened in a physiological or other medicinal solution, although it is usually is used in a dry form. Latex drains are used in superficial wounds.

Gauze

Gauze drains are prepared from a gauze bandage. Gauze drains are used for deeper wounds, and are always used when dampened in the solutions as above; they can sometimes be used when applying ointment to a wound.

Plastic or silicone

This is a tube, usually 5 – 10 cm long, with a lumen of 1 – 1.5 cm. The drain is introduced into the wound which needs more time to heal, and when it is necessary to provide drainage of fluids from the deeper layers of the wound. The part of the drain which is introduced into the wound usually has several holes. A safety pin, which is pierced through the centre of the drain tube, will prevent the drain sinking into the wound. When redressing the wound, the bandage must be removed very carefully so as not to pull the drain out. If the wound heals well, the drain is cut shorter during redressing, i.e. it is slight pulled out of the wound and the safety pin is brought lower and the sticking part of the drain is cut off. The safety pins are sterilized just like other instruments.

The surgeon can sometimes attach the drain with a stitch to the skin, close to the opening.

Easy flow drain

This is a 10 cm silicone flat tube, which protrudes from the wound into the collection, adhesive and calibrated bag, which can also be discharged.

The functionality of drains must be ensured for all types of drains and drainage systems, i.e. they must be introduced into the wound, and must not be occluded or bent. When redressing a wound with a drain, it is necessary to be vigilant and not to prematurely remove the drain or damage the function of the drain (e.g. bending the drain).

Drains are handled in a strictly sterile manner, with only sterile instruments and gloves.

Drainage

Natural drainage occurs in the presence of surface deposits and wounds, during spontaneous perforation of an abscess and when the wound sutures loosen. The incision, excision is formed, leaving the wound without suture. The secretion is drained into the absorbent dressing layer, which is replaced when necessary. The drainage is short and usually inadequate.

Artificial drainage is suitable for deep wounds and body cavities. This can take the form of gradient, suction or rinsing drainage.

Gradient drainage sucks the secretions in the direction of the natural gradient (by its own weight), e.g. bile duct surgery (T-drain) or gallbladder surgery. The round, silicone drain is inserted into the cavity's lowest point; the drain tube leads into the collection bag or into the absorbent dressing.

Vacuum drainage is based on a system of secretion suction from the wound under pressure. These vacuum systems, e.g. Redon drainage, consist of a drainage tube and a gradient bottle. It is introduced in breast, thyroid and joint surgery etc. The surgeon inserts one end (perforated) of the tubing into the wound and the second end is connected to the collection bottle.

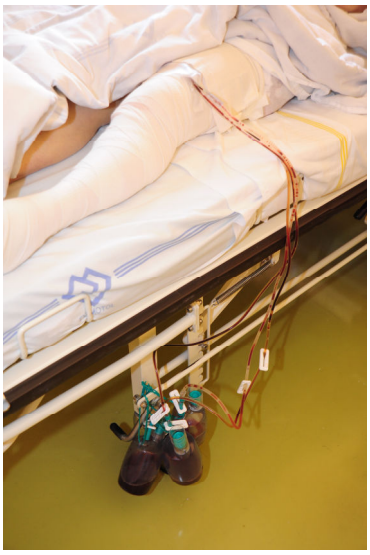


Fig. 9. 3-17 a: Vacuum drainage

UWSD drain – a chest drain that channels the air out during spontaneous pneumothorax or thoracotomy. The drain leads into the collection bottle which is under water (sterile water, antiseptic solution), immersion depth is 2.5 cm or 4 - 10 cm (the depth indicates the negative pressure in the pleural cavity – immersion prevents reverse air intake).

Control questions:

(One answer is correct)

Traditional dressing materials include:

- Elastic or hydrofile bandage
- Dressing cotton wool
- Cellulose wadding
- Pulp
- Sterile pulp squares

Modern dressing materials (containing active charcoal), which are suitable for heavily exuding wounds, odorous, infected wounds include:

- Inadine
- Solutio Novikov
- Pruban
- Betadine
- Actisorb

Surgical tweezers have:

- Both arms with blunt ends, the outer side is smooth, the inner side surface is transversely grooved
- Both arms with blunt ends; the outer and the inner sides are smooth
- Arms with one or two interlocking teeth
- The ends of the arms have small, interlocking teeth
- Grip part and surgical part

UWSD drain system:

- Is based on a system of secretion suction from the wound under pressure. Is a vacuum system, consisting of a drainage tube and a gradient collection bottle.
- Is based on a system of secretion suction from the wound under pressure. Is a vacuum system, consisting of a drainage tube, gradient collection bottle and a bottle holder.
- Drainage which sucks the secretion in the direction of the natural gradient (under its own weight), e.g. in bile duct surgery.
- Drainage which sucks the secretion in the direction of the natural gradient (under its own weight), e.g. in thyroid surgery.
- Chest drainage sucks the air out during spontaneous pneumothorax or thoracotomy. The drain leads into the collection bottle which is under water.

The wound redressing is usually done in the following five stages:

- Removal of the bandage and the protective dressing layer, assessment of the wound, cleaning and disinfection of the wound and the surrounding area, wound treatment, application of the appropriate dressing.
- Wound assessment, cleaning and disinfection of the wound and the surrounding area, wound treatment, application of the appropriate dressing.
- Removal of the bandage and the protective dressing layer, cleaning and disinfection of the wound and the surrounding area, application of the appropriate dressing.
- Removal of the bandage and the protective dressing layer, cleaning and disinfection of the wound and the surrounding area, wound treatment.
- Removal of the bandage and the protective dressing layer, assessment of the wound, cleaning and disinfection of the wound and the surrounding area.

9.4 Pressure ulcer care

Objectives:

After studying this chapter, you should be able to:

- Define and describe the term "pressure ulcer"
- Describe and define the various stages of bedsores
- List and explain the factors leading to the formation of bedsores
- Practically assess the risk of formation of pressure ulcers in patients
- Know the treatment methods for various stages of bedsores
- Define the appropriate procedures for the prevention of pressure ulcers
- Demonstrate skill in the treatment of pressure ulcers
- Respect the age and individual specific needs of the patient when providing healthcare.

Theoretical notes

Pressure ulcer (decubitus, derives from the Latin word decumbere - to lay down, to lie down). A bedsore, compressive lesion, ulcer, is a localized area of cell damage caused by impaired microcirculation and the resulting hypoxia induced by pressure. If the pressure intensity on the tissue is higher than the normal blood pressure in the capillaries, i.e. 4.27 kPa (32 mm Hg), the bloodstream will go into arrest. Irreversible changes in cells and tissues begin to occur after just two hours of a microcirculation disorder. Very often, the tissue lying between the bone and skin with a minimum layer of muscle, e.g. the sacrum area, the heel bone, shoulder plates or the occipital area is damaged.

Classification of pressure ulcers – used to assess the development of and the degree of pressure ulcers. There are several classification scales by different authors. Mostly these scales for the development and assessment of pressure ulcers consist of 3 to 5 stages.

The Torrance classification system distinguishes 5 stages of bedsores:

1. *Degree:* ***Blanching hyperaemia***. The skin is red, although the erythema fades with slight pressing. The impaired microcirculation has not yet occurred. *Symptoms:* Mild swelling, mild redness of the skin, which is more difficult to identify in dark skin with strong pigmentation.
2. *Degree:* ***Non-fading hyperaemia.*** The affected skin is red, slightly raised, and does not fade when slightly pressed. Skin surface damage, including ulceration. *Symptoms:* Redness, swelling of the affected area. A blister may also appear.
3. *Degree:* ***Skin ulceration.*** Ulceration progresses through the dermis to the subcutaneous fascia interface. *Symptoms:* Damage to the skin, reminiscent of a deep graze.

4. *Degree:* ***Ulceration subcutaneous fascia.*** The ulcer expands under the skin, affects the muscles - swollen and inflamed. *Symptoms:* Break-up of tissue resembling a deep open wound.
5. *Degree:* ***Muscle necrosis.*** Dying muscle tissue linked to infection - gangrenous decubitus. *Symptoms:* Dry black necrosis at the pressure ulcer area, necrotic tissue may be slushy, have a rotting smell, part of the tissue has a yellow-green colour. Deep pockets, filled with pus are formed between muscles.

   In terms of clinical evaluation, it is important to know that the pressure lesions progress from the depths to the surface. Slight changes on the surface of the skin may signify extensive damage under the surface.

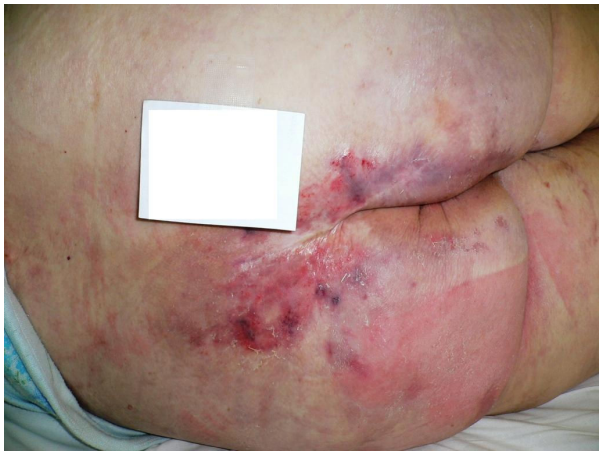


Fig. 9. 4-1: I. Degree of pressure ulcer (no apparent damage to the skin, redness)

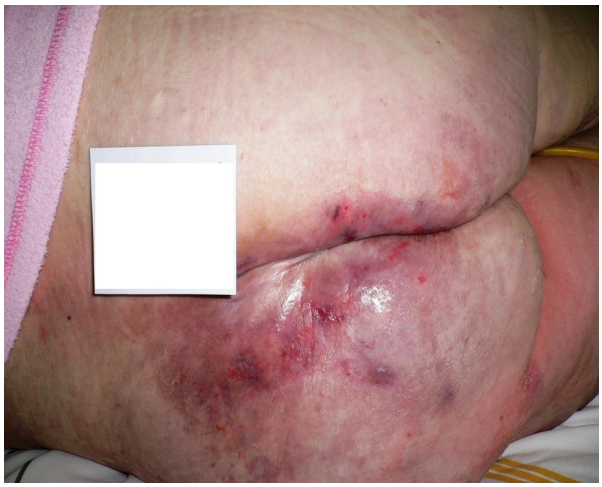


Fig. 9. 4-2: II. Degree of pressure ulcer (partial skin damage)

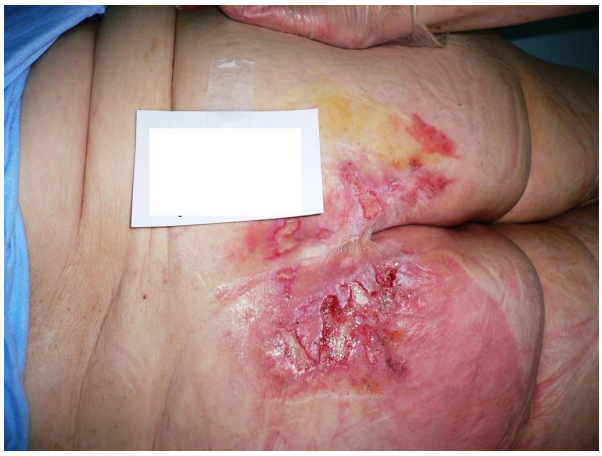


Fig. 9. 4-3: III. Degree of pressure ulcer (most of the tissue layers compressed between the bone and surface are damaged)

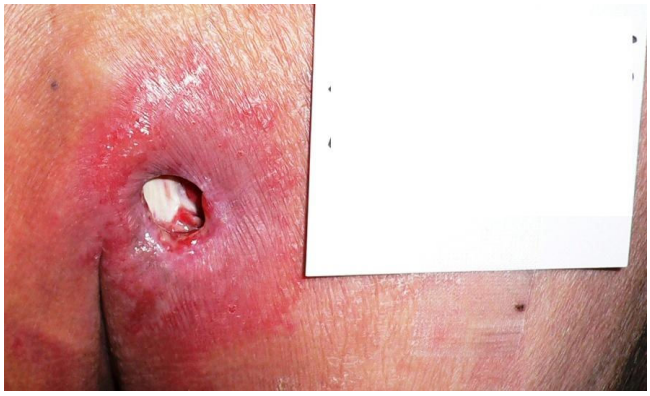


Fig. 9. 4-4: IV. Degree of pressure ulcer (all tissue layers compressed between the bone and the surface are damaged)

Causes of pressure ulcers

Pressure ulcers are primarily caused by uninterrupted pressure that damages even small blood vessels, leading to hypoxia and the subsequent dying of cells. The friction and the associated friction force then impact simultaneously.

Factors influencing the development of pressure ulcers

Pressure – intensity and duration The vertical force has an impact on the skin due to gravitation. The skin and tissue are compressed between a bone and another hard surface (mattress, dentures and catheter).

Normal hydrostatic pressure in the capillary is 4.3 kPa (32 mm Hg) at the arterial end and

3 kPa (15 mmHg) at the venous end. In the semi-recumbent position, the pressure on the protuberance ischium is 10 kPa, and the tissue of an immobile sitting individual is exposed to pressure of up to 300 mm Hg. The pressure on the skin exceeds these pressures and compresses the capillary. This leads to the blood being forced out and the area of the skin begins to fade. When the pressure is released, blood congestion occurs, which shows with redness (reactive hyperaemia). It is a defence mechanism of the body against pressure ulcers. Redness is due to vasodilatation, in this way the body compensates for the previous worsened blood circulation in the affected area. Reactive hyperaemia is significant when the pressure eases before the merging of irreversible changes in the tissues and bloodstream. Reactive

hyperaemia usually persists at half to three-quarters of the time of the reduced blood flow. If the redness disappears during this time, it is clear that the tissue will not be damaged.

The exact time that the tissue can be subjected to pressure without damage cannot be precisely defined. It depends on other factors (general medical condition, weight, moisture, etc.), although low pressure over a longer period of time is more harmful than short-term exposure to high pressure. In extreme cases, the time of formation of the pressure ulcer can be reduced to 2% - 30 minutes.

Gender

Women are more susceptible to developing pressure ulcers than men, because they have a thicker layer of fat than men.

Friction

It is a force that acts in parallel with the skin e.g. skin friction on the bed sheet, when moving the patient on the bed, on the examining table etc. Friction causes rubbing of the skin, which is then susceptible to pressure ulcers.

Shearing force

This occurs as a combination of friction and pressure; the most frequent occurrence of this pressure is in Fowler's position. The patient tends to slide down in this position, towards the foot of the bed. The movement is transmitted to the sacrum and to a deep stored tissue. The skin over the sacrum cannot move due to the friction with the bed surface. In terms of the relation to the bed, the skin becomes relatively immobile, while the deep stored tissue moves downward. The force acting on the interface of the skin surface and deep tissue is called the shearing force. It damages the blood vessels and tissues in the area. This cause is important, especially in patients in the sitting position and the semi-recumbent position.

Humidity

The direct relation between the humidity of predilection areas and the formation of pressure ulcers is well known. The cause of humidity can be incontinence, profuse sweating, drainage secretions or inadequate hygiene care. If not promptly solved, this subsequently leads to maceration and skin damage.

Immobility

A healthy individual normally makes a number of spontaneous movements when experiencing discomfort, which is caused by pressure on the body parts. This natural defence can be reduced or lost due to illness. A patient suffering apathy, plegia, loss of consciousness or body weakness has reduced or no ability to respond to the tissue compressions.

Central nervous system disorders

Innervation disorders of the brain, spinal cord or predilection areas accelerate the formation of pressure ulcers. The nervous system, with its vegetative, sensory and motor functions, is involved in the proper blood circulation in the skin and subcutaneous tissues. In the event of brain activity malfunction (severe depression, loss of consciousness) the ability of the patient to respond to pressure by changing their position is reduced or lost. The resistance to pressure is the lowest during spinal lesion, particularly the first two hours after the injury.

Age

Skin elasticity and strength reduces with age, the skin is therefore more fragile and more likely to become vulnerable. The elderly have a reduced regenerative capacity of the body; they are a high-risk group for developing pressure ulcers. Elderly patients are more likely to

develop pressure ulcers not only due to the above factors, but also because they often have a reduced ability to treat minor tissue damage by themselves.

Nutrition

Inadequate nutrition increases the risk of developing a pressure ulcer and affects the healing process. It also leads to weight loss, loss of subcutaneous tissue and to muscle atrophy, reduces resistance to infection and cellular immunity. Hypoproteinemia, low intake of C vitamin, zinc and iron deficiencies are the most critical factors.

Hydration

Dehydration reduces skin tension and causes the formation of skin fold. Dry skin is prone to swelling and injury. Hyperhydration on the other hand, increases skin tension and leads to swelling and causes a breakdown in the skin integrity.

Immunosuppression

This occurs in malnourished patients, hypoproteinemic patients, after injury, and in patients with malignant diseases. Immunosuppression increases in these patients the risk of wound infection and prolongs the healing process.

Other underlying diseases

A disease impairs the immunity and regeneration of the body. In particular, these mean severe and prolonged diseases such as cancer, infectious diseases, circulatory disorders, anaemia, kidney failure etc. At least two causes are required for the emergence of an open wound, the pressure ulcers. Diabetics often suffer from poor circulation and are more prone to infections. Some diabetics loose sensation in their feet and hands – peripheral neuropathy. This condition cannot be treated. Therefore, patients-diabetics are at high risk of pressure ulcers on their heels, because they are often unaware of the pain or discomfort caused by pressure. Reduced blood circulation, together with the effect of the diabetes, generally leads to a slowing down of wound healing.

Body temperature

Increased body temperature accelerates cell metabolism, leading to an increased need for oxygen and also in places exposed to increased pressure.

Drug effects

Drugs that affect the natural protective mechanism of the body when changing body position, e.g. analgesics or sedatives, may contribute to an increased risk of developing pressure ulcers. Steroids are anti-inflammatory drugs, which reduce protein synthesis, capillary formation and epithelialization, leading to reduced healing ability. Chemotherapy also affects the healing of wounds and the skin condition, as all fast-growing cells are damaged by this treatment.

Assessment of pressure ulcers

There are several classification scales available for pressure ulcer risk assessment. Internationally, approximately 17 different scores are recognized. The most commonly known are the Norton, Braden and Waterlow scores. Currently, the most frequently used classification scale in the Czech Republic is the Norton scale. All the authors agree on the importance of the preventive assessment of risks. It for each workplace to determine which method of risk assessment of pressure ulcers they prefer. It is obvious that the more detailed the system is, the more accurate classification of the patient to the risk group. The rating scores help to take, in patients at risk, early preventive measures, although it is not the only

factor. The most important thing is to provide vulnerable patients with excellent nursing care. The patient is examined by a doctor who assesses if the patient is at risk of developing pressure ulcers without the need of scales.

Norton score

The Norton score was established in 1962. It assesses the overall health of the patient, mental health, activity, mobility and incontinence. The patient is scored with a certain number of points after the assessment. The lower the score, the higher the risk of developing pressure ulcers.

Points	Ability to cooperate	Age	Skin condition	Other diseases	Overall condition	Consciousness	Daily activity	Mobility	Incontinence
4	Good	< 60	Very good	None	Good	Clear	Independent	No restriction	None
3	Partial	61-70	Good	1	Satisfactory	Somnolent	Slightly dependent	Partially restricted	Intermittent
2	Small	71-80	Intact, moist	2	Bad	Soporose delirium	Highly dependent	Very limited	Permanent – urinates
1	None	> 81	Atrophic, allergic	More than 2	Very bad	Comatose	Totally dependent	Immobile	Urinates and bowl movement

Fig 9. 4-1: Norton score for assessment of pressure ulcer risk

The Norton score system was subject to revision due to low accuracy. Modified Norton score. The assessment is in the range of 1 to 4 points and also includes an additional four items. These are: cooperation, age, skin condition, other diseases, overall condition, consciousness, daily activities, mobility and incontinence. The maximum score is 36 points, which represents very low probability; 25 and less points represent a risk of developing pressure ulcers. The lowest possible score is 9 points.

Pressure ulcer areas

Pressure ulcers can occur on any part of the body, but most frequently on what are known as predilection areas. These are areas where the bones are near the skin surface, with just a thin layer of fat and muscle between the bone and the skin. They also vary depending on the long-term position the patient is in.

Predilection areas in the supine position

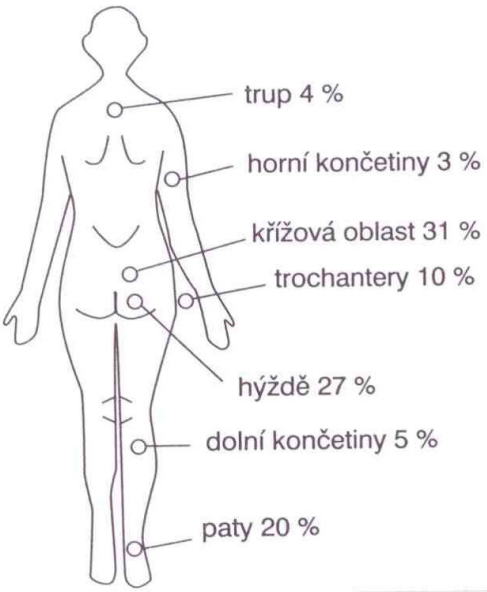
These include areas above the occipital bone, above the mandrel of the 7th cervical vertebra, over the crest of the shoulder blades, over the elbow joints, the sacrum area and on the heels.

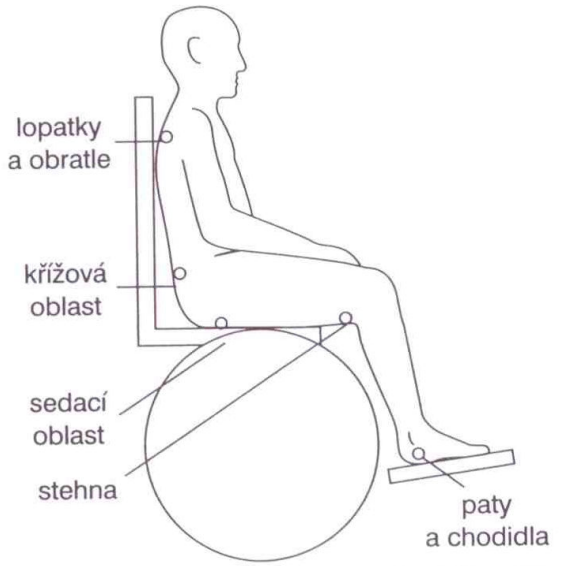
Predilection areas in the side position

These are areas around the temporal bone, shoulder joint, over the crest of the hip bones, over the large trochanter, above the knee joints (medial and lateral condyle, the area around the ankles).

Predilection areas in the prone position

These are the areas above the cheekbone, on the ear, over the crest of the hip bones, above the knees and above the thumbs.





torso 4%
upper limbs 3%
sacral region 31%
trochanters 10%
buttocks 27%
lower limbs 5%
heels 20%

blades and vertebrae
sacral region
ischial region
thighs
heels and soles

Fig. 9.4-5: Areas with the most frequent pressure ulcers in a recumbent patient

Fig. 9. 4-6: Areas with the most frequent occurrence of occurrence of pressure ulcers (sitting patient – wheelchair users)

Taken from: MIKULA, Jan a MÜLLEROVÁ, Nina. *Prevence dekubitů*. vyd. 1. Praha: Grada, 2008. 96 s., vis. barev. obr. příl. Sestra. ISBN 978-80-247-2043-2.

Treatment of pressure ulcers

Principles and programme of pressure ulcer treatment

The concept approach has not yet been established; *the following general principles and working procedures adopted by particular healthcare facilities are applicable:*

- Elimination of external factors that lead to the formation of bedsores and prolong treatment
- Mitigation of internal factors that contribute to tissue destruction
- Ensuring the optimal local environment for wound healing

Care programme

- Elimination of local pressure
- Removal of necrotic tissue
- Treatment of local infection
- Support of adequate granulation
- Adequate treatment of wound (wound algorithm)
- Adjustment of the overall condition of the patient, including treatment of other diseases

It is sometimes necessary to accede to a surgical method of treatment, i.e. closure of pressure ulcers by skin grafts. The condition of the pressure ulcers depends on the correct nursing procedure and is largely the responsibility of the nurse.

Pressure ulcer care and prevention

The aim of local treatment is to ensure an optimal environment for healing. *Moist wound healing* is currently the preferred method. This method makes the most of the physiological natural healing process, i.e. occurrence of ideal conditions for physiological cleansing (debridement) for the growth of granulation and epithelization tissue. It accelerates healing, improves patient comfort (removes odour, secretion and pain, reduces redressing frequency). It also improves the working culture of the healthcare staff. It is also economical as it saves time, material and ultimately, finances.

- Continue the patient risk assessment using a reliable scoring system for pressure ulcers
- Review the risk of pressure ulcers each time the patient's condition changes
- Select and apply an appropriate aid to prevent pressure ulcers
- Prepare a timetable for mobility, positioning of the patient; record everything
- Regularly monitor all the risk areas, and each day assess any newly formed pressure ulcers
- Keep the skin and the bed clean and dry
- Provide adequate hydration and nutrition
- Take care to minimize the effects of other underlying diseases
- Provide the patient with calm and undisturbed sleep
- Provide psychological support to the patient
- Get the patient to participate
- Collaborate with the family, ensure education

Suitable aids and equipment for the prevention of pressure ulcers

Requirements for aids and equipment:

- Even distribution of pressure
- Do not restrict movement, allow repositioning
- The aids must be comfortable and acceptable to the patient
- Do not hinder the nursing care
- Easy care (washing, disinfection)
- Affordable

Aids and equipment used to prevent bedsores:

- Foam pads of various shapes and sizes
- Synthetic fleece mats (Dekuba)
- Air or water mattresses
- Water beds with special mattresses, i.e. filled with water and with temperature control
- Natural fleece (attached directly to the skin)
- Heel and elbow protectors made of fleece
- Cushions (air, gel, liquid fills etc.)
- Positioning and rehabilitation aids with beads - their biggest advantage is their multiple functions: Positioning, fixation, rehabilitation, prevention of bedsores, or used as thermal insulation of the body, exercise aid, a toy etc
- Antidecubitor (a mat consisting of tubes filled with air in which the pressure is regulated by a compressor placed at the bedside)

The selection of aids and equipment depends on the location of the pressure ulcers, mobility of the patient and their current health.

General treatment of pressure ulcers

- Entry wound characterization is carried out prior to commencing treatment (i.e. localization, type of wound size, degree etc.), *it is necessary to ensure that the same nurse* (or a ward consultant) conducts the repeated assessments throughout the wound treatment.
- The overall medical condition of the patient is taken into consideration (underlying diseases, psyche) and social aspects.
- If necessary the condition of the wound and other treatment methods are consulted with a doctor.
- The doctor can prescribe a wound smear (especially for exuding or coated pressure ulcers, or in the 2nd – 4th stage).

- The wound treatment is according to the basic algorithm:
    - *Necrotic wound* – remove necrosis
    - *Infected wound* – clean the wound from infection
    - *Clean the wound* – support granulation and epithelialization
- Select suitable material for wound treatment (contact a consultant specializing in wound healing)
- The wound treatment is always aseptic.
- It is necessary to treat the surrounding area of the wound – prevention of maceration.
- Application of the appropriate secondary dressing.
- The so called "wound locking system" is carried out – stating the date of the next redressing (effective use of dressing).
- Proper documentation of the wound condition and of the treatment (record of ulcer care and skin defects). Comprehensive treatment as prescribed by a doctor and according to the patient's needs.
- The patient is psychologically supported – updated on their improvement, motivation to cooperate (in terms of positioning, hydration nutrition, etc.). If possible, always ensure cooperation with the family of the patient.

See chapters: 5. HOSPITAL BED AND FUNCTIONS, 5.1 HOSPITAL BED AND PARTS, 6. MOBILITY AND IMMOBILITY, 6.1 POSITIONS OF PATIENTS, PREVENTIVE POSITIONING

The professional literature refers to 4 stages of pressure ulcers, e.g. Valkov classification.

I. - IV. Stage classification of pressure ulcers

The "precursor" for bedsore formation is a redness of the skin, which fades when pressed. The chance to prevent the formation of a bedsore is excellent at this stage.

Fig. 9. 4-7: I. Stage – Erythema
- Pressure lesion without damage to the skin. Redness of the skin which does not fade, the area is swollen, warm but not painful. The patient complains of a burning sensation, itching.

Fig. 9. 4-8: II. Stage – blister

- Pressure lesion with partially damaged skin. The skin is damaged, formation of a blister. This stage is very painful.

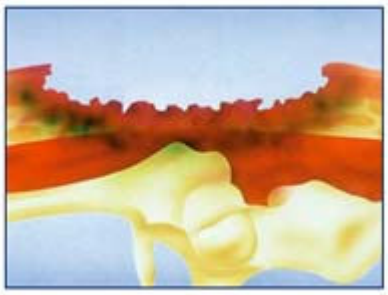


Fig. 9. 4-9: III. Stage – necrosis

- Pressure lesion with destruction of the tissue between the bone and the skin. The damage has reached the subcutaneous tissue layer, which may lead to tissue necrosis. Formation of a deep ulcer, which is often covered with dry, black-brown crust (scab) of dead cells or with a moist yellow-brown coating. The patient has a temperature and suffers a loss of appetite as one of the many responses of the body to the inflammation.

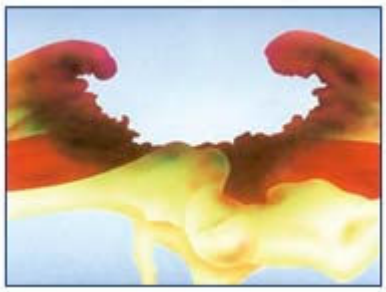


Fig. 9. 4-10: IV. Stage - ulcer

- Pressure lesions accompanied with osteitis and arthritis. Massive destruction and dying of muscle tissue and bone damage. The wound may also be covered with a black-brown scab of dead tissue cells.

Control questions:

(One answer is correct)

The Torrance classification distinguishes:

- 2 stages of bedsores
- 3 stages of bedsores
- 5 stages of bedsores
- 7 stages of bedsores
- None of the above options are correct

Factors influencing the development of pressure ulcers include:

- Pressure, patient's age, body height, shearing force, moisture
- Pressure, patient's age, duration of hospitalization, shearing force, moisture
- Pressure, patient's age, shearing force, moisture, position of the patient in the room
- Pressure, patient's age, moisture, hydration, nutrition, other underlying diseases, immobility
- Pressure, patient's age, hydration, shearing force, moisture, drugs, allergy

Predilection areas in the supine position are:

- The temporal bone, shoulder joint, over the crest of the hip bones, over the large trochanter, above the knee joints
- The area above the cheekbones, on the ear, over the crest of hip bones, above the knees and above the thumbs
- The cheekbones area, on the ear, the temporal bone area
- The temporal bone area, above the crest of the hip bones
- The occipital bone, above the mandrel of the 7th cervical vertebra, over the shoulder blades, over the elbow joints, the sacrum area and on the heels

Predilection areas in the side position are:

- The occipital bone, above the mandrel of the 7th cervical vertebra, over the shoulder blades, over the elbow joints, the sacrum area and on the heels
- Above the occipital bone, above the mandrel of the 7th cervical vertebrae, over the shoulder blades
- The sacrum area, the heels, above the knees, above the thumbs
- Above the ridges of the shoulder blades
- The temporal bone area, the shoulder joint, over the crests of the hip bones, over the large trochanter, above the knee joints (medial and lateral condyle, the area around the ankles).

The programme for pressure ulcer treatment consists of:

- Elimination of local pressure
- The necrotic tissue is never removed
- Treat the local infection only in children and the elderly
- Support adequate granulation – secondary issue and less important
- Occasional treatment of the wound (wound algorithm)

Additional task

Locate the nursing care standards and methodology while at clinical practice: Prevention and treatment of pressure ulcers and chronic wounds

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ŠAMÁNKOVÁ, M. a kolektiv: *Základy ošetřovatelství. Praha: Karolinum, 2006 ISBN 80-246-1091-4.*

List of tables:

List of Figures:

Keywords:
Pressure ulcer (decubitus)
Risks
Prevention
Treatment

10. MONITORING AND PHYSIOLOGICAL MEASUREMENT

10.1 Monitoring, measurement and evaluation of breathing

Objective

After studying this chapter, you should be able to:

- List the basic methods of physiological measurement;
- Describe the basic types of breathing
- Identify changes in the quality of breathing;
- Apply the principles for measurement of breathing in clinical practice;
- Demonstrate this procedure using a model or simulator in the laboratory and later in clinical practice;
- Assess the risks of potential complications;
- Evaluate the significance of changes in the measured values of breathing.

Purpose

- To collect information about the patient's condition;
- To assess the patient's condition;
- Incidence of respiratory disorders;
- Incidence of pathological values in the monitored physiological function;
- To prevent other diseases.

Theoretical notes

Breathing (respiration) - process of oxygen intake and release of carbon dioxide. External respiration – the gas exchange between the lungs and blood and internal respiration – the gas exchange between the blood and body tissues. For correct breathing, the following must be in order for:

- Pulmonary ventilation (free airway, functional breathing muscles, vacuum in the pleural cavity, functional respiratory centre);
- Transport of gas across the alveolar-capillary membrane, i.e. external respiration – (functional alveoli, normal respiratory gases and blood pH);
- Perfusion – the gas exchange between blood and alveolar air only occurs when there is contact of blood and air in a sufficiently large area of alveolar-capillary membrane for a sufficiently long time;
- Transport of respiratory gases via blood (sufficient haemoglobin, functional blood circulation);
- Transfer across cell membranes in the periphery of the internal respiration;

- Diffusion – the properties of the membrane, concentration gradient and the area size all contribute to the diffusion rate or the diffuse flow; The diffuse membrane reacts differently to different gases; Carbon dioxide diffuses more easily than oxygen (20x); during an illness, the transfer of oxygen is affected more than the transfer of carbon dioxide.

  Two types of breathing are recognized: Chest (thoracic) and abdominal (diaphragmatic) Respiration consists of inspiration (inspirium) and exhale (exspirium). Pulmonary ventilation expresses the flow of air through the airways to the lungs and back. Hyperventilation is deep and rapid breathing. Hypoventilation is shallow breathing (see table 10.1-3). The correct operation of the brain centre, nerves and the respiratory muscles is required for proper regulation of respiratory activity. The respiratory centre is located in the medulla oblongata and has two sections: Inspiratory (inhalation), which is larger, as inhalation is active and expiratory (exhalation), which is smaller, because exhalation is passive. Normal breathing (eupnoea) takes place automatically, without the person realizing it. During inspiration, which usually takes 1-1.5 seconds, the diaphragm contracts, the ribs move upward and the sternum moves outward. The anterior-posterior diameter of the chest increases; in the pleural cavity, the reduced diaphragm creates a vacuum that sucks the air into the lungs and enables them to expand. Exspirium, which usually takes 2-3 seconds, is characterized by the release of the diaphragm, the lungs shrink due to their own resilience, the ribs move downward reducing the volume of the chest and the lungs are compressed.

Factors affecting respiration

- Age – the respiratory rate gradually decreases with old age;
- Physical activity – physical activity increases metabolism and thus increases the body's oxygen demand;
- Stress, fear and worry accelerate breathing;
- Altitude – there is less oxygen in the air the higher the altitude, thus increasing the need for oxygen to the body;
- Medications - certain groups of drugs decrease the respiratory rate, e.g. opiates;
- Smoking, sedentary job and lack of exercise, all affect breathing in a negative way;
- Diseases – lung disease (e.g. airway obstruction), heart disease, anaemia, metabolic disease, disease of central nervous system, intoxication.

Scoring breathing

- Respiratory rate – normal breathing is regular, rhythmic. It is called eupnoea. Physiological breath values for each age category are listed in Table 10-1 – 1; and the deviations in the frequency of breathing are listed in Table 10.1 -2;
- The depth of breathing can be determined by observing the movements of the chest and the abdomen. Normal breathing depth represents about 500 ml of air – known as lung volume (LV). The maximum volume that can be inhaled from the end-inspiratory level is called the inspiratory reserve volume (IRV), the maximum volume of air that can be exhaled from the end-expiratory position is called the expiratory reserve volume (ERV). The sum of these volumes is called lung vital capacity (VC), its average physiological

value is 4-5 litres. Changes in the depth of breathing are referenced in Table 10.1-3. An overview of static indicators of lung volume and capacity is referenced in Table 10.1-5. Individual volumes and derived quantities are referenced in Fig. 10.1-1.

- Breathing regularity – monitoring of alternating inspiration and expiration rhythm. Rhythm can be regular and irregular. The most common rhythm disorders in breathing are referenced in Table 10.1-4;
- Nature of breathing – this concerns the evaluation of the effort a person must make when breathing and the evaluation of sound phenomena (whistling, bubbling), that may accompany breathing. Shortness of breath (dyspnoe) – laboured breathing, when a patient feels short of breath. Inspiratory dyspnoea is characterized by slow, laboured breathing while pulling in the intercostals and supraclavicular fossas. The expiratory dyspnoea is characterized by severe slow exhalation with active participation of the respiratory muscles.

Age category	No. of breaths/min – average values
Newborn	40-60
Infant	25-30
Child up to 10 years old	Approx. 20
Adult	16-18

Fig 10.1-1: Respiratory rate according to age

Marked changes in frequency	Medical term	Average breath values/min
Eupnoea	Normal respiration	16-18
Tachypnea	Hyperventilation	≤ 25
Bradypnoea	Slow respiration	≥ 12
Apnea	Respiratory arrest	0

Fig 10.1-2: Evaluation of respiratory rate

Change in depth of breathing	Medical term
Deep breathing	Hyperpnoea (hyperventilation)
Shallow breathing	Hypopnoea (hypoventilation)

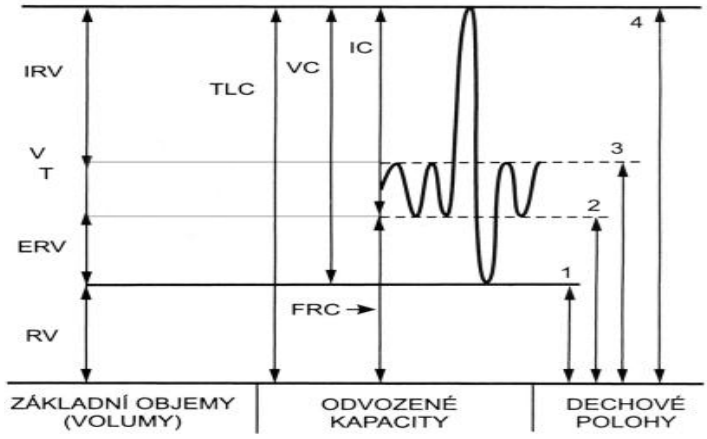
Fig 10.1-3: Evaluation of the depth of breathing

Disorder	Description	Occurrence
Kussmaul respiration	Deep, regular, loud	Acidosis, diabetic coma, sepsis, uraemia
Cheyne-Stokes respiration	Progressively deeper and sometimes faster breathing, followed by a gradual decrease resulting in apnea.	Acidosis, salicylate intoxication, severe damage to the central nervous system
Biot's respiration	Normal, shallow breathing with apnea periods, the depth of breath is approx. the same.	Overall serious condition, encephalitis, sepsis

Fig 10.1- 4: Most frequent respiratory rhythm disorders

Abbreviation	Indicator	Value
TLC	Total lung capacity (VC + RV)	6,700 ml
RV	Residual volume	1,700 ml
VC	Vital capacity	5,000 ml
FRC	Functional residual capacity (ERV+RV)	2,900 ml
IC	Inspiratory capacity (IRV + VT)	3,800 ml
ERV	Expiratory reserve volume	1,200 ml
IRV	Inspiratory reserve volume	3,300 ml
VT	Tidal volume	500 ml

Fig 10.1-5: Overview of lung volume and capacity indicators



BASIC VOLUMES (VOLUMES) DERIVED CAPACITY RESPIRATORY POSITIONS

Fig. 10.1-1: Lung volumes and derived quantities

(*Fyziologie tělesné zátěže vybrané kapitoly* [online]. 2006 [cit. 2011-11-09]. Dýchací systém. Dostupné z www: <http://is.muni.cz/elportal/estud/fsps/js07/fyzio/texty/ch05s02.html>.

Patient preparation

Monitoring, measuring and recording breathing depends on the overall condition of the patient.

- The patient should relax for at least 10 minutes before measuring;
- The intention to measure the patient's breathing is never announced ahead due to the possibility of influencing the frequency and depth of breathing; (evaluation of breathing is not easy, because striated muscles are involved, whose activity is controlled by will power).

Preparation of aids

Observe using a seconds hand, (stopwatch or medical watch), nursing documentation, daily report.

Procedure

- The patient is put in an appropriate position, lying down or sitting.
- Assessment of the skin and mucous membrane colour.
- Assuming a position, the patient begins to breathe.
- It is recommended to pretend to measure the heart rate while actually monitoring and measuring the breathing.
- Monitoring of specific chest movements (thoracic breathing – dominant chest movements, diaphragmatic breathing – dominant abdomen movements).
- The respiratory rate is measured by observing the patient or by placing a hand on the chest.
- Monitor chest respiratory movements for a full minute.
- Observe any additional respiratory phenomena.
- When measuring, do not talk to the patient.
- The measured values are recorded in the nursing documentation and the daily report.

Patient care after the procedure

Patient care after measuring the frequency and quality of breathing is not specific. Try to communicate with the patient and in the case of difficult or laboured breathing, inform the doctor immediately and record this into the nursing documentation. Follow by administering drugs according to the doctor's prescription.

Care of aids after use

If measuring the respiratory rate with a watch with a seconds hand, put it into a designated place so as not to damage it.

Complications of the procedure

- Inadequate patient rest before measuring.
- Measurement of breathing immediately after smoking, eating or in pain.
- Patient restlessness.
- Possible respiratory disorders.
- Insufficient time for measuring breathing.

Task

Practice listening to respiratory phenomena when on clinical practice.

Describe breathing in inflamed bronchi and lungs based on the listening findings.

Describe asthmatic breathing based on listening findings.

Prepare a respiratory curve chart for these types of breathing: Kussmaul, Biot and Cheyne-Stokes.

Control questions:

Choose the correct name for the abbreviations and the breathing volumes:

Abbreviation	Name	Volume in ml
VT		
VC		
RV		

1. Which 3 factors are involved in the diffusion of blood gases?
2. What is perfusion?
3. What is respiration typical for diabetic coma, characterized by a deep, loud, regular breathing called?
4. What is a form of respiration with similar exhalations and inhalations similar in depth, and interrupted with apnoea pauses called?
5. Complete the third column with the Latin name for the respiration rates and individual age categories:

Age category	Respiration rates/min.	Latin name for respiration rate
Child up to 12 years old	20 breaths/min	
Infant	10 breaths/min	
Adult	40 breaths/min	
Newborn	50 breaths/min	
Infant	30 breaths/min	
Child up to 10 years old	35 breaths/min	
Adult	0 breaths/min	
Newborn	20 breaths/min	

10.2 Monitoring, measurement and evaluation of body temperature

Objective

After studying this chapter, you should be able to:

- List the most common types of thermometers;
- Maintain and check their functions;
- Name the various methods for measuring body temperature;
- Evaluate the resulting measured values of body temperature;
- Describe the system of body temperature regulation;
- Demonstrate this procedure using a model or simulator in the laboratory and later in clinical practice;
- Assess the risks of potential complications;
- Evaluate the significance of changes in the measured values of body temperature;
- Implement nursing care in those changes.

Purpose

- To collect information about the patient's condition;
- To assess the patient's condition;
- Incidence of thermoregulation disorders;
- Incidence of pathological values in the monitored physiological function;
- To prevent other diseases
- To prevent extensive heat loss from the skin surface.

Theoretical notes

Factors affecting body temperature include:

- Basal metabolism – produces the minimum amount of energy necessary to sustain life. The value of basal metabolism is dependent on the sex and age and the following generally applies: The younger the person, the higher the value of basal metabolism;
- Increased muscle activity – including tremor. Maximum muscle activity can increase production of heat by up to 50 times;
- Increased temperature of cells (temperature) – increased cell metabolism, based on the changes in the chemical processes in the cell caused for example, by viruses. The increase of body temperature by 1^0C requires 12% more chemical reactions;
- Thyroid hormones – increased thyroxine flooding can excessively increase cellular metabolism throughout the body;
- Adrenal hormones – whose hormones (adrenalin and noradrenalin) affect the liver and muscle cells, thus increasing their activity;

- Psychological processes – simpaticus stimulation can increase the production of adrenaline and noradrenalin, which increases metabolic activity and produces heat;
- Age – children's temperatures are more labile than adults and this persists till puberty; the younger the child the more difficult it is for the body to handle the difference in temperature between the body and the environment. Older people (over 75) have reduced control of thermoregulation and are exposed to the risk of hypothermia for various reasons, e.g. inadequate diet, loss of subcutaneous fat, lack of physical activity, desynchronization of daily rest-activity rhythm, decreased metabolic rate, reduced vasoconstrictor response etc.;
- Time of day – the body temperature changes throughout the day and fluctuates by 2^0C, with the highest temperature around 17:00 – 18:00 hrs; the lowest temperature is generally between 4 and 6 in the morning;
- Physical activity – hard work, strenuous exercise can increase body temperature by 1 – 1.5 °C.
- Overall health;
- External environment, e.g. outdoor temperature, humidity – if the humidity is low, evaporation of the body occurs faster and a human can withstand air temperature up to 65.5°C for several hours. On the other hand if the humidity is 100%, or if the body is immersed in water, the body temperature increases even at 34.4°C ambient temperature. If the person performs a strenuous activity, the critical temperature level is further decreased to 32.3°C;
- Activity of the hypothalamus.

Body temperature values

The physiological body temperature reading is from 36 to 37°C with typical daily motion (diurnal variation). The temperature is the lowest (minimum temperature) between 4 and 6 a.m. and the highest (maximum temperature) between 16:00 and 18:00 hrs. The difference between the minimum and maximum temperature is less than 1°C. Deviations in the measured body temperature values are listed in Table 10.2-1.

Hypothermia (subnormal)	below 36^0C
Physiological	36^0C – 37^0C
Subfebrile (increased)	37^0C – 38^0C
Febris (fever)	38^0C – 40^0C
Hyperpyrexia	above 40^0C

Fig 10.2-1: Body temperature values

The measured body temperature values are all recorded as usual for the ward, e.g. into a daily report or into the nursing documentation or the temperature table. Individual values of the measured temperature in the table can be joined into a temperature curve.

Types of fever

According to how it develops, it is recognized as:

- Febris continua (sustained) – the temperature fluctuates by a maximum of 1°C (e.g. pneumonia, viral infection, streptococcal diseases).
- Febris remittens (remittent fever) – the temperature fluctuates throughout the day by up to 3°C, although it never gets into the physiological norm (e.g. infection, abscesses, TBC).
- Febris intermittens (intermittent) – the period of hyperpyrexia alternating every day with a normal temperature (e.g. sepsis, cholecystitis, pyelonephritis).
- Febris reccurens (relapsing) – days with normal temperature alternating with several days with a fever above 39°C (e.g. malaria, typhus).
- Febris undulans (undulant) – the temperature rises during several days from the norm up to a fever, reaching the maximum and then gradually falling over several days. These periods repeat.
- Febris bifasica (double undulant) – two febrile periods separated by a fever free period (e.g. viral diseases – neuroinfection etc.).

Temperature drop

- Lysis (gradual) – the temperature falls to normal within a few days.
- Critical (sharp) – the temperature falls or drops within several hours and is accompanied by massive sweating, faintness, with a declining number of heart beats, the patient is at risk of dehydration.

Methods of measuring body temperature

- Body temperature can be measured using several methods, which are dependent on the type of disease and on the general health condition of the patient. Appropriate thermometers (see Types of thermometers) are used for measuring the temperature. Each of these methods has its advantages and disadvantages:
- *Axillary method* – non-invasive measurement of body temperature under the armpit. A clean, disinfected and dried thermometer is inserted in an armpit for 7 – 10 minutes. The thermometer is rinsed as a form of preventing allergic reactions in patients. The axilla (armpit) must be dry. Patients who are suspected of altering their body temperature measurements are given two thermometers at the same time under each armpit, and they are monitored during the measuring period. The disadvantage of this method is the long time that the thermometer must remain in the axilla. Another way of dealing with suspected cases of the patient altering the measured values is by ensuring the presence of a nurse throughout the measuring. This time, only one thermometer is required. The current trend is to provide each patient with their own thermometer.
- *Method of contactless measurement on the forehead* – the most common method which is also convenient for the patient. This method involves an electronic contactless digital thermometer. This measuring method is convenient and comfortable for the patient, as it is quick. The patient is comfortable and their sleep does not have to be disrupted when measuring their body temperature in the evening.

- *Oral method* – measuring body temperature in the mouth. Measuring the body temperature with a mercury thermometer is no longer a standard procedure today. It used to be necessary to check that the patient had not had any hot or cold food and drink or smoked at least 15 minutes before measurement. Body temperature was only measured orally exceptionally and only in calm patients. The measuring time in mercury thermometers was 5 – 10 minutes; the thermometer was put in the corner of the mouth and under the tongue. The resulting value differed by +0.3°C from the temperature value measured under the axilla. The value was recorded either as measured or with an added 0.3 °C, depending on ward practice. The advantage of this measuring method was the accessibility of the measuring point; the disadvantage was the risk of damaging the patient's health. This measuring method was not used in children under six, confused patients or patients suffering seizures, patients after nose surgery or after oral cavity surgery etc. The digital thermometers currently used can measure temperature in the mouth within seconds.
- *Rectal method* – measuring body temperature in the rectum. Measuring the body temperature with a mercury thermometer is no longer a standard procedure today. The measuring time with the mercury thermometer used to be 5 – 8 minutes. The thermometer was cleaned and smeared with Vaseline or dipped into oil to facilitate easier insertion into the rectum. The temperature measured in the rectum is about 0.5°C higher than the temperature in the axilla. The measured temperature values were recorded as usual at the ward. The measured temperature was decreased by 0.5°C or the measured value was recorded but with added information – measured in the rectum. The advantage of this measurement technique was its accuracy; the disadvantage was the uncomfortable feeling regarding dignity. At present, digital thermometers are used to take the temperature in the rectum. They have a flexible tip and the temperature is measured within seconds. The current trend in healthcare facilities is to provide each patient with their own thermometer. The thermometer is inserted by a nurse wearing gloves. The disadvantage of this method is the possible presence of a stool in the rectum. To ensure the child's safety; only digital thermometers to measure temperature in the rectum are used today (see Fig 10.2-2). For this method of measurement, the child legs are firmly held. The thermometer is wiped with disinfectant after use. The values are recorded in the nursing documents as is customary on the ward.
- *Vaginal method* – the temperature is measured in the vagina. This method is used to monitor basal body temperature, i.e. temperature dependent on the menstrual cycle. The changes in vaginal temperature appraise the ovulation phase during the menstrual cycle. In a regular cycle, the temperature rises during ovulation to 37°C and higher and falls to the original level just before menstruation. A woman measures the temperature in the morning, before she gets up.

Types of thermometers

According to the Decision of the European Union authorities (March 2006), the use of mercury thermometers, manometers and other mercury containing devices is prohibited. They are being replaced by other types, which are more environmentally suitable.

The mercury thermometers are listed for the illustration and complexity of information in an abbreviated version.

Maximum medical thermometer – traditional glass mercury thermometer with pinched lower part of the capillary tube. The mercury is warmed up by the body temperature and rises from the mercury bulb through the capillary tube upwards, matching the body temperature. The mercury reservoir used to have three shapes: Long – Axillary thermometer designed to measure body temperature in the armpit (axilla), groin and vagina. Pear-shaped – a rectal thermometer designed to measure body temperature in the rectum. Triangular – oral thermometer designed to measure temperature in the mouth.

High-speed thermometer - glass mercury thermometer used to measure body temperature in the rectum in infants and toddlers. The mercury in this thermometer begins to rise immediately after inserting into the rectum. The measured value was recorded while the thermometer was in the rectum and the mercury stopped rising. After removing the thermometer from the rectum, the mercury descended rapidly and it was not possible to read the value. The child's legs had to be held tight when using this measuring method due to the risk of injury to the child.

Electronic thermometer - consists of a battery-powered electronic unit, digital display and measuring probe. These thermometers have a traditional shape and are suitable for oral, axillary and rectal measuring. The body temperature is displayed within a few seconds. The measuring begins, according to the manufacturer's instructions, by pressing the appropriate button. Some electronic thermometers have a memory to recall the last measured value (see Fig. 10.2-1).

Fig. 10.2-1: Electronic digital thermometer

Fig. 10.2-2: High-speed digital thermometer

Electronic forehead thermometer – provides convenient and quick contact free temperature measuring within 2 seconds from pointing at the forehead using an infrared beam. Some types (see Fig. 10.2-3, 10.2-4) will announce the end of measuring with a melody and the measured value is displayed with a sound announcement. Other types have a sound signal informing the beginning and the end of the measuring. The advantage of this measuring method is that it is convenient for the patient and can be used while they are asleep.

Fig. 10.2-3: Forehead digital thermometer I.

Fig. 10.2-4: Forehead digital thermometer II.

Digital ear thermometer - (see Fig 10.2-6) works on the principle of infrared light. It is inserted into the external ear canal (see Fig. 10.2-5). A protective, replaceable cover is slid on the thermometer before use. The measurement method is reliable although it can carry a risk of perforating the ear canal in restless patients). It is currently the fastest and most accurate method of measuring body temperature. It takes 2 – 3 seconds and the measured value is about 0.5°C higher than in the axilla or on the skin.

Fig. 10.2-5: Use of digital ear thermometers

Fig. 10.2-6: Digital ear thermometer

Cutaneous thermometer – the patient has a skin sensor attached, which is a small sensor connected with the device measuring the temperature. It is usually attached to the fingers – the index finger of the right hand or to the toes. It is a reliable method of measuring temperature although it can be obscured by the patient's movement or sweating. The location of the cutaneous sensor is altered in regular intervals to avoid a pressure ulcer forming. The best place for the sensor is under the patient's back, but not in the area of shoulder blades, which is a high risk area of developing pressure ulcers. This method is primarily used in the overall monitoring of a patient or a patient in postoperative care.

Chemical thermometers - used for a quick indicative measuring of body temperature. These are placed on a dry forehead. The measured value is displayed by a colour change. The measured value is only approximate. Another form of chemical thermometer is a strip, which is inserted into the mouth, either to the right or to the left towards the buccal mucosa. This left

in for 1 minute and the reading is done by counting the number of coloured boxes (see Fig. 10.2-7).

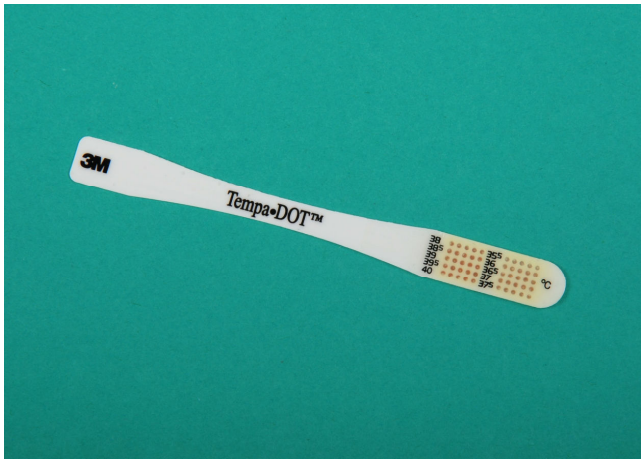


Fig. 10.2-7: Chemical oral thermometer

Body temperature can also be monitored invasively. Invasive body temperature measuring is carried out using sensors and catheters inserted into the body cavities or orifices. E.g. a sensor that is part of the urinary catheter measures the temperature in the bladder, or continuous reading of the temperature is via a probe with a sensor inserted in the rectum. The Swan-Ganz catheter has a sensor at the end. The PiCCo method also uses a sensor at the end of the catheter to measure temperature. The obtained values are transmitted via a cable and module into the monitor where it is displayed.

Measuring the body temperature in the axilla

Preparation of aids

Preparation of aids varies according to the measurement method. This generally includes the use of:

- Undamaged, intact, functional, clean and disinfected thermometers;
- Mercury thermometers showing less than 36°C;
- Digital thermometers in cases, plus replacement covers for probes;
- Kidney bowl;
- Patient documentation.

Patient preparation

- The patient is informed of the importance of following the safety rules for handling thermometers.
- The patient is informed of the reason, method and frequency of measuring the body temperature.

- The patient is informed of the importance of cooperation when measuring their body temperature.
- The patient is informed of the measured values of body temperature.
- The patient is informed of the physiological values of body temperature.
- The patient is informed of the potential treatment.
- The patient is informed of the prohibition on hot or cold liquids or food and smoking at least 15 minutes prior to oral measurement.
- The patient is put into the supine position, a semi-sitting or sitting position for the axillary method of body temperature measurement.
- A calm and peaceful environment when measuring.

Method of body temperature measurement in the axilla

- Preparation of a disinfected, rinsed and dried thermometer.
- Activation of the digital thermometer.
- The thermometer is inserted into the dry axilla so that the inserted part is fully covered by the patient's skin.
- After the specified time period, depending on the type of thermometer, the value of the measured temperature is recorded.
- The thermometer is then stored away.
- The measured value is recorded as is customary on the ward.
- Any deviations from the normal physiological values are reported to a doctor.

Care of aids

- Thermometers are cleaned using disinfecting wipes.
- They are left to dry and stored in a protective case in the designated place.

Measuring the body temperature in the rectum

Preparation of aids

Preparation of aids varies according to the measurement method. Undamaged, intact, functional, clean, disinfected thermometers for measuring body temperature in the rectum;

- Rectal thermometers must be individually labelled with the name of the child; an adult patient always keeps the thermometer close by;
- rubber gloves;
- Oil or Vaseline;
- Wadding cut into squares;

- Kidney bowl;
- Patient documentation.

Patient preparation

- The patient is informed of the importance of following the safety rules for handling thermometers.
- The patient is informed of the reason, method and frequency of measuring the body temperature.
- The patient is informed of the importance of cooperation when measuring their body temperature.
- The patient is informed of the measure values of body temperature.
- The patient is informed of the physiological values of body temperature.
- The patient is informed of the potential treatment.
- The patient is put into a position on their side with bent legs or into a gynaecological position.
- A calm and peaceful environment when measuring.

Method of body temperature measurement in the rectum

- Preparation of a disinfected, rinsed and dried thermometer.
- The nurse puts a glove on the non-dominant hand.
- The end of the thermometer is dipped in the oil or greased with Vaseline.
- The anal opening is better accessed by pulling the gluteal muscles apart; the thermometer is then gently inserted into the rectum. The thermometer is never introduced against resistance!
- The nurse holds the thermometer throughout the measuring period.
- After the specified time period, depending on the type of thermometer, the value of the measured temperature is recorded.
- The measured temperature is generally $0.5^{0}C$ higher than in the axilla.
- The nurse puts the thermometer down and takes off the glove.
- The measured value is recorded as is customary on the ward.
- Any deviations from the normal physiological values are reported to a doctor.

Care of aids

- Thermometers are cleaned using disinfecting wipes.
- They are left to dry and stored in a protective case in the designated place.

Measuring the body temperature in the rectum of an infant

Preparation of aids

- Undamaged, intact, functional, clean, disinfected thermometers designed for measuring body temperature in the rectum of a child – quick speed; (see Fig.10.2-2);
- Rectal thermometers must be individually labelled for each child – room number and bed number;
- Rubber gloves;
- Oil or Vaseline;
- Kidney bowl;
- Patient documentation.

Child preparation

- The child's nappy is removed;
- One hand holds the legs around the ankles, the knees are bent and gently pressed towards the chest;
- The end of the thermometer is dipped in the oil or greased with Vaseline;
- The thermometer is gently inserted;
- The reading is taken off the display;
- The thermometer is placed into the kidney bowl;
- The baby is wrapped;
- The measured value is recorded as is customary on the ward.
- Any deviations from the normal physiological values are reported to a doctor.

Care of aids

- Thermometers are mechanically cleaned with disinfectant wipes;
- They are left to dry and then stored in a protective case.

Measuring the body temperature in the mouth

Oral temperature measuring is not currently done in adults. Special digital thermometers in the shape of a dummy are used to orally measure body temperature in children. The measurement time is 2 – 3 minutes (see Fig. *10.2-8)*.

Fig. 10.2-8: Baby thermometer

Measuring the body temperature in the ear

Preparation of aids

- Functional thermometer; the most commonly used is an electronic thermometer with digital display (see Fig. *10.2-5, 10.2-6);*
- Protective cover;
- Kidney bowl;
- Patient documentation.

Patient preparation

- The patient is informed of the importance of following the safety rules for handling thermometers.
- The patient is informed of the reason, method and frequency of measuring the body temperature.
- The patient is informed of the importance of cooperation when measuring their body temperature.
- The patient is informed of the measure values of body temperature.
- The patient is informed of the physiological values of body temperature.
- The patient is informed of the potential treatment.
- The patient is put into a sitting or semi-sitting position.
- A calm and peaceful environment when measuring.

Method of body temperature measurement in the ear

- The thermometer is switched on.
- A protective cover is placed over the probe.
- The measuring probe is inserted into the ear.
- Press the activation button.

- Measuring time is 1 – 2 seconds.
- The temperature value is displayed on the screen.
- The thermometer is put down.
- The measured value is recorded as is customary on the ward.
- Any deviations from the normal physiological values are reported to a doctor.

Care of aids

- Disposal of the protective cover for the probe.
- The thermometer is stored in a protective case.

Measuring the body temperature on the forehead

It is currently considered to be a highly comfortable and convenient method of measurement.

Preparation of aids

- Functional thermometer; the most commonly used is an electronic thermometer with digital display (see Fig. 10.2-3, 10.2-4);
- Patient documentation.

Patient preparation

- The patient is informed of the reason, method and frequency of measuring the body temperature.
- The patient is informed of the importance of cooperation when measuring their body temperature.
- The patient is informed of the measure values of body temperature.
- The patient is informed of the physiological values of body temperature.
- The patient is informed of the potential treatment.
- A calm and peaceful environment when measuring.

Method of body temperature measurement on the forehead

- The thermometer is switched on.
- The thermometer is placed near the forehead or the temple without touching the skin.
- Press the activation button.
- Measuring time is 1 – 2 seconds.
- The temperature value is displayed on the screen.
- The thermometer is put down.

- The measured value is recorded into the nursing documentation.
- Any deviations from the normal physiological values are reported to a doctor.

Care of aids

- The thermometer is stored in a protective case.

Complications of the procedure

- Inadequate patient rest before measuring.
- Measurement of body temperature immediately after exercise.
- Measurement of body temperature at different times of the day.
- Restless patient, risk of injury.
- Insufficient time for measuring body temperature.
- Faulty measuring device.

Task

Practice measuring body temperature using all available methods. Monitor the level of your body temperature during the day and make a record of it. Assess the levels. If the place of your clinical practice uses a temperature chart, enter the values of the patient's body temperature into it.

Control questions:

1. Assign the below values with the correct name:
   - *BT above 40^0C*
   - *BD between 37 – 38^0C*
   - *BT below 37^0C*
   - *BT above 38^0C*
2. Which of the three basic processes lead to increased body temperature during cooling of the skin?
3. What is the Latin name for fever?
   - Fluctuation of a fever is by a maximum of 1^0C – Febris……
   - The temperature rises during several days from the norm up to the fever, reaching a maximum and then gradually falling over several days, this period repeats – Febris…….
   - The period of hyperpyrexia alternating every day with normal temperature – Febris…….
   - The temperature fluctuates throughout the day by up to 3^0C, but it never gets into the physiological norm – Febris……

4. What term is used to signify the daily fluctuation of body temperature?
5. What type of thermometers are used in the overall monitoring of the patient, e.g. in post-operative care?
6. Indicate the difference in values measured in the mouth and in the rectum versus the values measured in the **axilla.**

mouth	rectum
+ 0.5^0C	+ 0.5^0C
- 0.5^0C	- 0.5^0C
+0.3^0C	+0.3^0C
- 0.3^0C	- 0.3^0C

7. What is the term for falling body temperature accompanied by massive sweating, decrease of heart rate and the patient is at risk of dehydration?

8. The heat loss from the body surface occurs in three ways: *(Add technical terms)*

- radiation…….
- conduction…….
- evaporation……

10.3 Monitoring, measurement and evaluation of the heart rate

Objective

After studying this chapter, you should be able to:

- List the most common points for pulse measurement;
- Demonstrate this procedure using a model or simulator in the laboratory and later in clinical practice;
- Assess the risks of potential complications;
- Explain the different categories when measuring a pulse;
- Evaluate the significance of changes in the measured values of the pulse;
- Understand the context of changes in the frequency and quality of the pulse.

4Purpose

- To collect information about the patient's condition;
- To assess the patient's condition;
- Incidence of cardiac rhythm disorders;
- Incidence of pathological values in the monitored physiological function;
- To prevent other diseases

Theoretical notes

The pulse (heartbeat) is the volume change of the artery, which can be seen, palpated and registered with fingertips or a device. In a healthy person, the pulse reflects the heartbeat – the pulse frequency is the same as the frequency of the ventricular contractions. If there is a difference between a palpation of the peripheral pulse and the frequency of heart sounds then this is what is known as the peripheral pulse deficit which occurs with complete arrhythmia.

We can distinguish:

- *Peripheral pulse* – pulse on the periphery of the body, such as an arm, leg or neck.
- *Apical pulse* (central) – pulse over the apex of the heart.

Factors influencing the heart rate

- Age – gradual decrease of the heart rate with age.
- Gender – on average, men have a lower hart rate than women.
- Activity – the heart rate increases with physical activity.
- Increased body temperature – this is a response to decreased blood pressure as a result of vasodilatation and speeded up metabolism.

- Bleeding – reduced bloodstream volume causes a reduced heart rate. However, the loss of a small amount of blood, e.g. when donating blood, alters the heart rate for a temporary time. An adult with approximately 5 litres of blood can lose up to 10% of the blood volume without adverse consequences.
- Stress, fear, anxiety – sympathetic stimulation increases the heart rate.
- Medications – some drugs can slow the heart rate, e.g. cardiotonics, others increase it.
- Position changes – the pulse rate is usually lower in the horizontal position.

Methods of measuring the pulse

- *Palpation* – on all easily accessible peripheral arteries. Palpation is never carried out with a thumb because of the possibility of sensing your own pulse! In patients in danger of a cardiovascular function failure, the pulse is always palpated on the carotid artery by placement the three middle fingers.
- *Auscultation* – using a stethoscope, placing it on the chest in adults over the heart apex, no more than 8 cm from the sternum, approximately above the 4^{th} - 6^{th} intercostal space.
- *Ultrasound (Doppler) stethoscope* – used to detect pulses difficult to detect through palpation; the stethoscope detects the movement of red blood cells in the blood vessel, while eliminating ambient noise; detects the blood flow in the superficial veins, but not in deeper layers or veins under the bone; battery powered.

Points for measuring the pulse

The pulse is measured by palpation in easily accessible arteries:

- *a.temporalis* - temporal area, medial above the eyebrow, if it is impossible to measure on a.radialis (weak, obese patient);
- *a.carotis* – lateral side of the neck, especially in children and in heart failure; only one-sided measuring in order to ensure adequate blood supply to the brain;
- *a.brachialis* – cubital fossa, in children, in heart failure, before measuring blood pressure;
- *a.radialis* – thumb side of the wrist on the forearm, the most commonly used;
- *a.femoralis* - the middle part of the inguinal region, in children, heart failure, detection of circulation in LL;
- *a.poplitea* – behind the knee, easier to detect with a slightly bent knee, detection of circulation in LL;
- *a.tibialis posterior* – below the inner ankle, detection of circulation in LL;
- *a.dorsalis pedis* – the leg, approx. in the middle of the instep, between the big thumb and second thumb, detection of circulation in LL.

Pulse rate categories

Pulse rate

The pulse rate varies in a healthy adult and fluctuates between 60 to 80 beats per minute (see Table 10.3-1). The measured rate is compared with the standard values for the specific age category (see Kozierová at al., 1995, p.325). The physiological rate in athletes can fall below 50 beats per minute. Physiologically, the pulse rate slows down when bending (Erb's symptom). See Table 10.3-2, which shows general changes in the heart rate.

Age category	Physiological pulse rate/min
Newborn	120 - 140
Infant	100 - 120
Child up to 10 years old	80 - 90
Adult	60 - 80

Fig 10.3-1: Pulse rate in selected age groups

Title	Definition	Occurrence
Tachycardia	Heart rate increased above 90/min	Increased physical activity, excitement, alcohol or coffee consumption, heart and respiratory diseases fever (1^0C accelerates the rate by 8 – 10 pulses), an overactive thyroid, shock.
Bradycardia	Heart rate slowed below 60/min	In sleep relaxation, after sedation, myocardial infarction, hypothermia, unconsciousness.

Fig 10.3-2: Changes in heart rate

Regularity

A healthy person has a *regular pulse – rhythmic (regularis),* which means that the distances between the pulse waves are the same. *Irregular (irregularis) pulse*, also called arrhythmias (dysrhytmias), is a manifestation of cardiac failure, where several regular pulse waves are followed by an extra wave – the *extrasystole.* A situation in which the distances between the pulse waves have different lengths is called *complete arrhythmia*. In the event of an irregular pulse, it is recommended to listen to heart sounds above the heart apex where the heart rate can be faster. The difference between the rates measured centrally and peripherally is called a *pulse deficit.*

Quality

Pulse quality is evaluated according to how the pulse can be felt. See Table 10.3-3. for individual pulse descriptions.

Title	Description	Occurrence
Normal pulse	Full, well-palpable	
Corrigan's pulse	Pulse wave rising and falling sharply, fast	Aortic insufficiency
Hard pulse (pulsus durus)	Strikes against the artery wall are strong, it is difficult to compress the artery	Hypertension

Title	Description	Occurrence
Soft pulse (pulsus durus)	Artery can be easily compressed, pulse is hard to measure	Hypotension
Long pulse (pulsus durus)	Long pulse wave	Shock state
Thready pulse (pulsus filiformis)	Pulse wave is remarkably small	Shock state
Pulsus parvus	Small difference between systole and diastole	Small pulse volume in the left chamber
Alternating pulse (pulsus alternans)	Alternating weaker and stronger pulse waves	Heart failure
Paradoxical pulse (pulsus paradoxus)	Pulse waves are smaller in inspiration than in expiration	Left-sided heart failure
Dicrotic pulse (pulsus dicrotus)	After main pulse wave there is a weaker pulse wave	Shock, left-sided heart failure

Fig 10.3-3: Pulse description

Preparation of aids

- Watch with a seconds hand (Fig. 10.3-2) or stopwatch.
- Stethoscope (for measuring apical pulse).
- In the event of pulse measuring in ICU and Resuscitation Unit – monitor, ECG leads (pulse symmetry).
- Nursing documentation.

Patient preparation

- The patient is informed of the reason, method and frequency of measuring the pulse.
- The patient is informed of the importance of cooperation during measurement of the pulse.
- The patient is informed of the measured pulse rate value.
- The patient is informed of the physiological values of the pulse rate.
- The patient is informed of the potential treatment.
- The patient should rest for at least 10 to 15 minutes before measuring.
- The patient is put in a comfortable position, usually sitting, semi-sitting, lying on the bed.
- The nurse tries to calm the patient before measuring.

Method for measurement of a peripheral pulse

- The patient is asked to disclose the name of the medications they take (deviations in the assessment of the pulse can be due to a disease).
- Try to have warm hands before touching the patient.
- Choose a suitable place for measurement.

- Place the 2nd – 4th finger on the chosen place (Fig. 10.3-1) or just two fingers.
- Gently press down.
- Once the pulse wave is safely felt, begin to watch the seconds hand and start counting.
- The counting takes a full minute.
- When measuring, do not talk to a patient.
- Evaluate the regularity and quality of the pulse.
- Record the measured values into the document.
- Deviations in frequency, quality or irregularity of the pulse are immediately reported to a doctor.

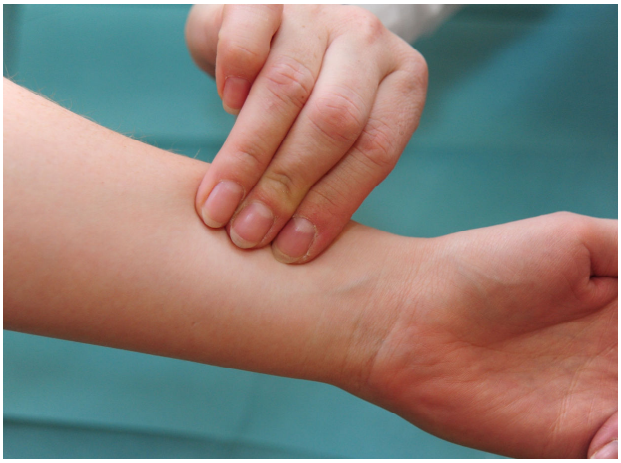


Fig. 10.3-1: Method of measuring the pulse

Method for measurement of an apical pulse

- Prepare a watch with a second's hand (see Fig. 10.3-2) and a stethoscope.
- Put the patient in a suitable semi-sitting position.
- Ensure peace and quiet.
- Expose the patient's chest, making the listening area accessible.
- Place the stethoscope in the place of the 4th – 6th intercostal spaces on the left.
- Listen to the heartbeat for a minute.
- Assess the strength and speed of the heartbeat.
- Record it into the nursing documentation.

Complications of the procedure

- Inadequate patient rest before measuring.
- Measuring the pulse immediately after physical activity.
- Patient restlessness
- Insufficient time for measuring the pulse.
- Faulty measuring device.

Care of aids

Every healthcare worker has a personal watch to measure a pulse, worn in a visible place on the work clothing. If measuring a pulse with other aids, these are then mechanically cleaned, disinfected and stored in the designated place as is customary on the ward.

Fig. 10.3-2: Professional medical watches

Task

Look into a medical dictionary for other diagnosis for different types of pulse descriptions.

Practice listening to an apical pulse.

Find and analyse the extrasystole on an ECG record.

Control questions:

1. Add the Latin name for the pulse according to the description:

Pulse waves are smaller in inspiration than in expiration	Pulsus….
Artery can be easily compressed, pulse is hard to measure	Pulsus….
Small difference between systolic and diastolic pulses	Pulsus….
After main pulse wave there is a weaker pulse wave	Pulsus….
Alternating weaker and stronger pulse waves	Pulsus….

2. Correctly describe Corrigan's pulse:
   - Pulse wave is slow and regular without change
   - Pulse wave rising and falling sharply, fast pulse
   - Pulse wave rising and falling sharply, slow pulse
3. What is the pulse located over the apex of the heart called?
4. What is the device called that is used to detect palpable pulse and which detects the blood flow in the arteries?

5. Choose from the following locations for peripheral pulse measurement:

   a. carotis, a. iliaca, a. cephalica, a. tempovalis, a. brachialis, a. poplitea, a. tibialis posteriori, a. dorsalis pedis

6. Select which of the following pulse values for each age category is physiological:

Adult	78
10 year old child	86
Infant	120
Newborn	135

7. What is the difference between the values of the pulse measured periphery and centrally called?
8. Put the individual steps of measuring the apical pulse in the correct order:
   a) Place the stethoscope in the place of the 4th – 6^{th} intercostal spaces on the left.
   b) Record it into the nursing documentation.
   c) Put the patient in a suitable semi-sitting position.
   d) Listen to the heart beat for a minute.
   e) Ensure peace and quiet.
   f) Expose the patient's chest, making the listening area accessible.

10.4 Monitoring, measurement and evaluation of blood pressure

Objective

After studying this chapter, you should be able to:

- List the most common places for measuring blood pressure;
- Demonstrate this procedure using a model or simulator in the laboratory and later in clinical practice;
- Assess the risks of potential complications;
- Explain the terms related to the measurement of blood pressure;
- Evaluate the significance of changes in the measured values of blood pressure;
- Implement selected methods for measuring blood pressure.

Purpose

- To collect information on the patient's condition;
- To assess the patient's condition;
- Incidence of pathological values in the monitored physiological function;
- Prevention of heart disease and blood vessels disease;
- Measuring blood pressure before and after surgery;
- Measuring blood pressure as part of preventive examinations.

Theoretical notes

Blood pressure (BP) is the pressure that the blood exerts on the walls of arteries. The source of the blood pressure is the heart, pumping the blood into the aorta. The blood pressure rises and falls during the cardiac cycle. This is caused by the heart, which has two basic phases – systole and diastole. *Systole* is the contraction (i.e. contraction of the atrium or a chamber during which the blood is expelled from the appropriated section). *Diastole* is the period of the cardiac cycle between the two systoles, when the heart muscle is relaxed and filled with blood. Depending on the heart's activity, the further distinguishing *systolic* blood pressure - induced by contraction of the chambers and *diastolic* blood pressure where the heart chambers are resting. The highest value of blood pressure is achieved in the systole phase; the lowest at the end of diastole phase.

Blood pressure is dependent on the:

- *Volume of blood in the bloodstream* – the smaller the volume of blood, the lower the blood pressure.
- *Elasticity and malleability of the vascular wall* – malleability decreases with old age.
- *Compliance of the capillaries* - the narrower the lumen of the blood vessel, the higher the blood flow resistance.

- *Blood viscosity* – the higher the viscosity, i.e. the higher the ratio of erythrocytes to plasma (the haematocrit), the higher the blood pressure; the viscosity is considerable increased if the haematocrit value is greater than 60-65%.

Factors affecting blood pressure

- Age – children and old people have higher BP (see Kozierová, 1995, p.325).
- Physical exertion – exercise, physical labour all increase BP.
- Emotions – excitement, fear, stress usually increase BP; nervous unstable patients may display tonometric hypertension, known as "white coat syndrome", where the BP values are affected by their nervous system, changes in the BP values can be provoked for example by looking at the tonometer.
- Gender – women usually have lower blood pressure than men. This differentiation is attributed to hormonal differences; post-menopausal women usually experience increased BP.
- Time of day (diurnal variation) – the BP is usually lower in the morning compared with the BP values in the afternoon and evening.
- Obesity – increases both peripheral resistance and BP.
- Medications – some drugs can increase and others decrease (antihypertensives) BP.
- Arteriosclerosis – increased BP, reduced arterial compliance.
- Bleeding – a reduction in blood volume also reduces BP.
- Fever – increased level of metabolism increases the BP value.
- Environment - ambient heat leads to vasodilation of blood vessels, reducing BP; in cold environments, the opposite happens.
- Heart and blood vessel diseases, endocrine disorders, diseases of the nervous system etc; a condition where the cause of high blood pressure is unknown with a number of explanatory theories is called essential hypertension.

Blood pressure values

According to the WHO definition, the optimal value of the blood pressure is around 120/80 mmHg, (mmHg stands for the measured values of mercury in the mercury column).

Status	Systolic BP values	Diastolic BP values
Normotensive	120 – 129 mmHg	80 -84 mmHg
Higher than normal BP	130 – 139 mmHg	85 – 89 mmHg
Mild hypertension	140 – 159 mmHg	90 – 99 mmHg
Secondary hypertension	160 – 179 mmHg	100 – 109 mmHg
Severe hypertension	180 or more mmHg	110 or more mmHg
Hypotension	Below 100 mmHg	Below 60 mmHg

Fig 10.4-1: Blood pressure values

Methods of measuring blood pressure

Blood pressure can be measured directly or indirectly.

- *Direct (invasive) method* – direct measurement of arterial pressure is by inserting a catheter into the artery, wherein the transducer alters the pressure into an electrical signal, which is transmitted to the monitor in graphic and numeric form. The catheter is usually inserted into a. radialis or a. fermoralis, and less frequently into a. brachialis. It is inserted under strict aseptic conditions. Another option is monitoring the pressure in the pulmonary artery (arteria pulmonalis) using a special catheter (Swan-Ganz catheter) to measure the hemodynamic status of patients in the ICU and the resuscitation unit.
- *Indirect (non-invasive) method* involves auscultation measuring - (listening) and palpation. Auscultation measuring uses a *tonometer* and a stethoscope. These are the most common types of tonometer: *Aneroid and digital*, in the past the most common was a mercury tonometer (see Fig. 10.4-1). A tonometer consists of a cuff and a manometer. To provide comprehensive information regarding a mercury tonometer, then an abbreviated description is as follows: A mercury tonometer was a calibrated cylinder filled with mercury. The pressure was indicated at the place of the mercury column, which should be placed at eye level to avoid erroneous readings. The scale gauge was in kPa and mmHg (millimetres of the mercury column). An aneroid manometer (Fig. 10.4-2) is in the shape of a watch, a calibrated scale has a pointer that indicates the blood pressure value.

Fig. 10.4-1: Mercury tonometer *Fig. 10.4-2: Aneroid manometer*

The cuff of the tonometer is made of rubber, which is covered by fabric and has two outlets. One is connected to a rubber balloon that inflates the cuff. If the valve located on the balloon is turned anticlockwise, the air is drained from the cuff. If the valve is closed (by turning it clockwise), the sucked air remains in the cuff. The second outlet is connected to the manometer. The manometer cuff is a different size. The width of the cuff should be 40% of the arm circumference. To determine the size of the cuff, the arm circumference should be the guide, not the age of the patient. Recommended cuff sizes – see Table 10.4-2.

Size	Arm circumference(cm)	Cuff size (cm)
Child	≤22	9x18
Adult – normal size	22-33	12x23
Adult – Large size	33-41	15x33

Fig 10.4-2: Recommended size of tonometer cuff

A *stethoscope* is a device used to indirectly measure blood pressure. Each stethoscope has a fork with eartips that plug into ears on one end. It is important that they seal the ear canal. The eartips are attached to the metal ear tubes, which are fitted to a rubber tube joined together below the fork, and a hearing aid - the stem at the end. One side of the hearing aid has a diaphragm which transmits the high tones. It is used to listen to breathing sounds. When listening, it needs to be pushed down well. The second side has a smaller end without a membrane, and is called the stethoscope bell. (see Fig. 10.4-3, 10.4-4).

Fig. 10.4-3: Stethoscope eartips and a bell

Fig. 10.4-4: Stethoscope bell and diaphragm

It has deep tones, and is used for heart examinations. It is placed lightly. Most stethoscopes offer both listening options.

At present, healthcare facilities take blood pressure measurements with digital tonometers (see Fig. 10.4-5). The advantage of this measurement is the simultaneous measurement of the pulse, whose value is also displayed. This method of measurement does not require the use of a stethoscope. An important part of measurement is the correct wrapping of the patient's arm. The cuff is marked with a green arrow that shows the location above the a.brachialis, where it should be wrapped. BP should be measured with just one type of tonometer so that the measured values can be compared.

Fig. 10.4-5: Digital tonometer

Blood pressure measuring points

Blood pressure is usually measured on the upper arm. If this is not possible, due to burns, plaster cast etc. the blood pressure is measured on the forearm or on the leg on the thigh or above the ankle.

Patient preparation

- The patient is informed of the reason, method and frequency of measuring the blood pressure.
- The patient is informed about cooperation when measuring the blood pressure.
- The patient is informed of the measured blood pressure value.
- The patient is informed of the physiological blood pressure values.
- The patient is informed of the potential treatment.
- The patient must not smoke or drink black coffee before measuring BP.
- The patient must rest for at least 5 minutes before measuring.
- It is important to obtain all information from the patient regarding other treatments (possibility of influencing BP).
- BP is always measured in the same position of the patient, and if permitted by their condition, also on the same limb.
- Patient, who is concerned about the procedure or is nervous and unstable, need to be fully reassured; wait a while then repeat the BP measuring after about 30 minutes.
- The patient is put into an appropriate position, usually sitting or lying down on the left arm.

Preparation of aids

- A functional tonometer is selected for measuring BP.
- Prepare a suitable, disposable PVC pad which is put under the cuff.
- Select the appropriate cuff size to measure BP.
- Stethoscope – if measuring BP with a mercury tonometer.

Auscultation method of BP measurement with mercury tonometer

- When measuring BP on the upper arm, the arm is stretched with the palm facing upwards.
- The tonometer must be level with the patient's chest and the mercury column at eye level of the person measuring.
- Wrap the cuff around the patient's arm so that the bottom edge is 3 to 4 cm above the cubital fossa.
- The centre of the rubber cuff with the tubing is placed over the centre of the cubital fossa.
- Feel the a.brachialis in the cubital fossa.

- Place the diaphragm of the stethoscope on the point where the pulse is palpated.
- Put the stethoscope eartips in the ears.
- The stethoscope is held by the thumb on the non-dominant hand.
- Close the valve on the balloon and inflate the cuff until the sound of the heart cannot be heard.
- Release the valve on the balloon with the thumb and fingers of the dominant hand.
- Watch the mercury descend and listen carefully to the first, clearly audible beat, which indicates the systolic blood pressure level; the heart sounds begin to get gradually louder, the last clearly audible beat indicates the diastolic blood pressure level.
- If the measured BP was not clearly audible, the air is released from the cuff and the measuring process is repeated.
- The patient is notified of the measured values.
- Pathological changes in the measured values of BP are reported to a doctor.
- The measured values are recorded in the nursing documentation, the daily record as is customary on the ward.

Auscultation method of BP measurement with an aneroid tonometer

The procedure is the same as with the mercury tonometer. In this type of tonometer, watch the movement of the manometer's hand, which corresponds to the movement of the mercury in the mercury column.

Method of BP measurement using a digital tonometer

Using this measurement method, the manufacturer's instructions, which must be enclosed with every digital tonometer, are followed. The procedure involves the correct positioning of the cuff on the appropriate place after previously positioning the disposable circular PVC cuff. This protection cuff helps to prevent the transmission of infection between patients in the healthcare facility. After positioning the cuff, the tonometer is activated by pressing a button and the cuff is automatically inflated. After a while, the display will show the blood pressure systolic and diastolic values and some types of tonometers also display the pulse value. There is no need for a stethoscope in this case.

Palpation method of blood pressure measurement

The palpation method of blood pressure measurement uses a mercury tonometer. This method is included in order to give a full overview.

- The procedure with this method is identical after attaching the cuff.
- The three middle fingers of the non-dominant hand are placed over the a.radialis and proceed as if measuring the pulse.
- The dominant hand gradually releases the valve on the balloon, draining the air from the cuff.
- Observe the mercury column descending.

- The first felt pulse wave indicates the systolic pressure value.
- The diastolic pressure value cannot be palpated.

Complications of the procedure

- Use of a very narrow cuff, which is disproportionate to the circumference of the arm.
- Use of an excessively wide cuff.
- Inadequate patient rest before measuring.
- Incorrectly attached cuff - loose, too tight.
- The patient's arm is above the level of their heart.
- Measurement of BP immediately after smoking, eating or when in pain.
- Poor audible heart beat.
- Faulty device.
- Cracked tonometer cuff.

Care of aids

After measuring the BP, the tonometer function is checked, and if needed the cuff is mechanically cleaned and disinfected. The tonometer is stored in the designated area as is customary on the ward.

Task

Get to know the continuous measurement of BP and the records at your clinical practice.

Look out some of the medical diagnoses, which show changes in the blood pressure and try to explain them.

Find out the term for the phenomenon that occurs with reduced pressure in the cuff of a tonometer below the systolic pressure value.

Control questions:

- Choose the correct definition of essential hypertension:
  - ☐ Hypertension due to heart disease
  - ☐ Hypertension due to arteriosclerosis
  - ☐ Hypertension due to "white coat syndrome"
  - ☐ Hypertension, the cause of which is unknown
  - ☐ Hypertension due to obesity

- Choose the correct wording:
  - The lower the viscosity of the blood, the higher the ratio of erythrocytes in the blood plasma, the lower the blood pressure
  - The higher the viscosity of the blood, the higher the ratio of erythrocytes in the blood plasma, the lower the blood pressure
  - The lower the viscosity of the blood, the higher the ratio of erythrocytes in the blood plasma, the higher the blood pressure
  - The higher the viscosity of the blood, the higher the ratio of erythrocytes in the blood plasma, the higher the blood pressure
- Select the value which indicates the secondary hypertension range.
  - 140 – 90mmHg
  - 160 – 100 mmHg
  - 180 -110 mmHg
- Name the two basic methods of non-invasive blood pressure measurement.
- Fill in the appropriate wording.
  - The smaller the volume of blood in the bloodstream, the…….(lower/higher) the blood pressure
  - The narrower the lumen of the blood vessel, the ……(lower/higher) the blood flow resistance
- Find out the term for the phenomenon that occurs with reduced pressure in the tonometer cuff below the systolic pressure value.
- Put the individual steps for measuring BP in the correct order.
  - Put the stethoscope eartips in the ears.
  - Wrap the cuff around the patient's arm so that the bottom edge is 3 to 4 cm above the cubital fossa.
  - Close the valve on the balloon and inflate the cuff until the sound of the heart cannot be heard.
  - Place the diaphragm of the stethoscope onto the place where the pulse is palpated.
  - Watch the mercury column descend and listen carefully to the first and last audible beat.
  - Release the valve on the balloon with the thumb and fingers of the dominant hand.

10.5 Monitoring, measurement and evaluation of consciousness

Objective

After studying this chapter, you should be able to:

- Identify changes in the quality of consciousness;
- Demonstrate this procedure using a model or simulator in the laboratory and later in clinical practice;
- Assess the quantitative changes in consciousness;
- Assess the qualitative changes in consciousness;
- List the assessment scales of consciousness and the categories;
- Identify nursing problems in patients with a consciousness disorder;
- Assess the risks of potential complications.

Purpose

- Determine the state of consciousness in a patient;
- Assess quantitative changes in consciousness;
- Assess qualitative changes in consciousness.

Theoretical notes

Consciousness is linked to the activity of the nervous system. Consciousness is the awareness of one's own existence, understanding and being in touch with what is happening around you. It is difficult to establish a uniform definition of consciousness. It is for example, used to refer to the opposite state of unconsciousness, or for the state of intentional or focused attention, and it is also significant in terms of self-awareness.

The Big Medical Dictionary (2009) defines the state of consciousness as a state of mind that is based on vigilance which is a prerequisite for other brain functions. Vigilance is a process of paying continuous attention so one is able to perceive and interpret incoming stimuli and is able to respond to them. ARAS - ascending reticular activating system plays a major part in vigilance, however the harmony between the core areas of the cerebral hemispheres is vital. Sensory information, see Nejedlá (2006) enters the brain through two - direct and indirect - routes. The direct route leads from the sensory receptors via the thalamus; the indirect route is via the aforementioned reticular formation. Reticular formation awakens the cortex and prepares it to receive sensory information. If this route is interrupted, e.g. due to injury, part of the brain is separated and goes into permanent sleep. Thus people then look as if they are sleeping, do not speak, and are unresponsive to any stimuli. Other patients with impaired brain cell nutrition are awake, able to swallow, chew, turn their eyeballs but do not perceive. This is the vegetative state and it is very difficult to assess whether they are conscious, because if we view consciousness as vigilance then these patients are awake but if we view consciousness as being aware of one's existence, then they are not conscious. It is therefore obvious that criteria for the evaluation of consciousness and its disorders must have been determined, such as the Glasgow Coma Scale (GCS), see Table 10.5-1 or the evaluation could be made by dividing the qualitative and quantitative disorders of consciousness. The Best

Possible Coma Score is used to assess the state of consciousness in children younger than three. It is based on an assessment of maximum capability with regard to the maturation of the individual.

The state of consciousness is assessed by observation (aspection). This is the oldest examination method, which places great emphasis on the knowledge and experience of the examiner.

The state of wakefulness and cognition in a healthy person is known as orientation of time and place. The patient is questioned about their name, a date (or a day of the week) and if they are aware of where they are. Failures in the activity of the nervous system (wakefulness and cognition) cause various quantitative and qualitative consciousness disorders.		
GLASGOW COMA SCALE		
Eye response	Adults and older children	Young children
1	No response	No response
2	Opens to pain	Opens to pain stimulus
3	Opens to verbal command	Opens to verbal command
4	Opens spontaneously	Opens spontaneously
Verbal response		
1	None	None
2	Incomprehensible sounds	Moans in response to pain
3	Individual words	Screams or cries in response to pain
4	Inappropriate responses	Spontaneously screams, cries, inappropriate response
5	Appropriate verbal expressions	Hums, babbles, observes surroundings, turns towards sound
Motor response		
1	None	None
2	Extension in response to pain	Extension in response to pain
3	Flexion in response to pain	Flexion in response to pain
4	Withdraws from pain	Withdraws from pain
5	Targeted, defensive reaction to pain	Targeted, defensive reaction to pain
6	Appropriate motor response	Normal spontaneous mobility
Evaluation		
13 - 15	None or minor damage	
9–12	Moderate damage	
3 - 8	Severe damage	

Fig 10.5-1: Glasgow Coma Scale (GCS)

Quantitative consciousness disorders

These are reduced cognition and wakefulness disorders. These include:

- *Syncope* (fainting) – short-term, transient loss of consciousness caused by low blood pressure causing brain oxygen deprivation.
- *Somnolence* (lethargy syndrome) – the patient is sleepy, can be woken up from sleep, responds to words and answers questions appropriately but slowly, while the reflexes are preserved.
- *Sopor* (stupor syndrome) – the patient is in a deep sleep; can only be woken up by pain stimuli but fall asleep immediately after waking up.
- *Coma* (unconsciousness) – a state of complete unconsciousness. Two types of unconsciousness are recognized:
    - *Shallow* - with preserved reflexes to painful stimuli, although the patient does not wake up despite painful stimulus.
    - *Deep* – with extinct reflexes, only vital functions are preserved, weakened muscles (urine and stool incontinence), breathing and blood circulation disorders may also occur.

The causes of quantitative consciousness disorders may include e.g. head injury – concussion, contusion, or circulatory, cardiac, neurological causes as well as brain hypoxia etc.

Qualitative consciousness disorders

Qualitative consciousness disorders relate to the failure of one component of consciousness. A typical characteristic includes the distortion of information, the surroundings and their own psychological processes. The consciousness is altered in terms of extent and content. These include:

- *Obnubilation (trance state)* - the patient is oriented, but does not realize their actions. When full consciousness is later regained, the patient does not remember anything. This state of mind is typical in hypoglycaemia. It is also similar to a state of intoxication (EBRI).
- *Ament* (confusion) – the patient is anxious, helpless and forgetful. This is an acute condition after e.g. surgery, febrile states and can occur short-term or temporary.
- *Delirium* – the patient is disoriented, confused, restless and does not concentrate or remember anything. This state can be also accompanied by disturbed perception and thinking.
- *Hallucinations* – altered visual, auditory, tactile, olfactory or taste perception without objective cause. A typical example of tactile hallucination (hallucinating visions of crawling beetles, spiders on the body) is called delirium tremens, which is typical for alcoholics. Auditory hallucinations occur for example, in schizophrenia (hearing of voices).
- *Illusion* – distorted perception of reality, in which there is a real stimulus that caused the distortion, e.g. a rope on the ground is perceived as a snake.
- *Delusions* - the patient is irrefutably convinced of the correctness of their vision. It is a thought content disorder. Delusions are divided into expansive (the patient is convinced of their extraordinary abilities), depressive (patient considers themselves worthless, useless) and paranoid (patient is extremely paranoid, feels hounded).
- *Slowed thinking* – manifests itself with protracted speech with long pauses, monotonous voice.

- *Accelerated thinking* – manifests itself with rapid disordered speech, which may be interrupted by random associations.

  For more see: Nejedlá, M. Fyzikální vyšetření pro sestry. 1. vyd. Praha: Grada, 2006. 248 s. ISBN 80-247-1150-8

Methods and techniques for evaluation of consciousness

Assessment of the state of consciousness is always conducted by asking questions, while changing the technique and intensity of other methods as required.

- *Asking questions* – the questions are put to the patient clearly. If there is no valid answer, the next questions are shorter, more brief, pronounced in a clear and loud voice. Further observation of the response time or how long it takes for the patient to fall back to sleep.
- *Tactile stimuli* – the patient is touched, addressed by their name - if there is no response, the touch intensity is increased.
- *Central stimulus* – if it is not possible to establish verbal or tactile contact with the patient, a central stimulus is applied, e.g. light pinching in the trapezoidal or pectoral muscle.

Detecting the state of consciousness

- Ask questions to determine orientation of time, place, - if no response, then
- Speak with a louder voice, clap hands or make a noise to attract the patient's attention. Check that the patient has not been falling asleep during conversation - if there is no response, then
- Touch, speaking with a louder voice – if no response to sound stimuli, then
- Shake their shoulder – if no response, then
- Using a hard object (oral trowel, pencil), press on the nail bed – if no response, then
- Use a painful stimulus, such as light pinching of the trapezoid muscle.

Never use sharp objects that could damage the patient's health!!!

In unstable patients, their state of consciousness should be examined every 5 to 10 minutes, after stabilization then every 4 hours. (Nejedlá, 2006)

Complications and prevention

Nursing problems associated with an impaired state of consciousness are dependent on the degree of impaired consciousness.

The nursing staff must:

- Monitor vital signs, secure airways, minimize the risk of aspiration of vomit and phlegm;
- Regularly monitor the state of consciousness;
- Protect the patient against any damage associated with changes to consciousness;

- Provide hygiene care, nutrition and toilet hygiene according to the degree of impairment of consciousness, prevent dryness of mucous membranes, formation of pressure ulcers, self-harm;
- Try to involve the disoriented patient in daily activities;
- Ensure the patient's daily needs – maintain a regular daily routine, do not overload the patient;
- Prepare the patient for the planned examination;
- Record all changes regarding the patient's condition in the nursing documentation.

Task

Practice monitoring the patient's consciousness through aspection.

Research using professional literature, the terms "mydriasis" and "miosis" and classify them according to the individual degrees of consciousness.

Control questions:

Indicate which of the categories are included in the assessment of the state of consciousness by the GCS:

- Eye opening to pain stimuli
- Appropriate verbal response
- Unnatural position
- Incomprehensible response
- Verbal attack
- Defensive motor response
- Withdrawn motor response
- Appropriate motor response
- No verbal response

Indicate in which state of consciousness mydriasis without photoreaction occurs:

- Sopor
- Somnolence
- Shallow coma
- Deep coma

Indicate which information is <u>not</u> correct:

- 7 points according to GCS signifies minor damage
- 5 points according to GCS signifies severe damage

- More than 15 points according to GCS signifies minor damage
- Less than 9 points according to GCS signifies severe damage
- More than 13 points according to GCS signifies severe damage
- Less than 9 points according to GCS signifies minor damage

Choose the correct procedure for detecting the state of consciousness

- Touch, sound, question, painful stimulus
- Question, sound, touch, painful stimulus
- Question, touch, sound, painful stimulus

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For more information see:
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Keywords

Breathing

Blood pressure

Body temperature

Pulse

Consciousness

List of Tables

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11. BLADDER EMPTYING AND BOWEL MOVEMENT CARE

Objective

After studying this chapter, you should be able to:

- Practically apply the principles for maintaining regular bladder emptying and bowel movement in patients;
- Identify the most common nursing problems regarding regular bladder emptying and bowel movement.

Purpose

- Bladder emptying and bowel movement care in patients who are not self-sufficient or partially self-sufficient;
- Bladder emptying and bowel movement care in patients after surgery;
- Bladder emptying and bowel movement care in patients with digestive system diseases.

Theoretical notes

Bladder emptying

One of the basic terms with regards to urine excretion is diuresis – the final urine output produced by the kidneys per time unit (usually 24 hours). Final urine output in adults varies between 1500 – 2000 ml/24 hrs, which is 30 – 60 ml/hrs, and in children varies between 300 – 1500 ml/24 hrs. Changes in the amount of urine output may be caused by excessive or insufficient fluid intake, as well as by other diseases, e.g. diabetes mellitus, insufficient kidney function etc.

We can distinguish:

- *Osmotic diuresis* – increased final urine output due to the presence of certain substances in the fluid filtered by the kidneys; these substances are water-binding, thus preventing water resorption;
- *Water diuresis* – increased final urine output due to reduced absorption of water in the kidneys; this phenomenon occurs upon suppressing the formation of an antidiuretic hormone. The urine is evaluated in terms of quantity, colour, odour and density. Urine pH is in the 4.5 – 8 range.

Changes related to the quantity of urine output include:

- *Anuria* – decrease in daily diuresis below 100 ml or complete discontinuance. In young children, it is defined by a urine output of 0 – 0.5 ml/kg/h and in adults by 0 - 50 ml/day. Anuria develops from the oliguria. The most common causes of anuria are acute renal failure, severe dehydration, shock etc.
- *Oliguria* is a condition, where the urine output does not exceed 500 ml in 24 hrs. This may be caused by renal failure, shock.
- Polyuria is a condition defined by excessive urine output, i.e. more than 150% of normal urine output per time unit, depending on the fluid intake (more than 2000 ml/24 hrs/l). The causes of polyuria include excessive fluid intake (polydipsia),

excessive osmotic loading in diabetes, deficiency of antidiuretic hormone (diabetes insipidus neurohumoralis) or antidiuretic hormone receptor (diabetes insipidus renalis), chronic renal insufficiency, release of large swelling, congenital defects etc.

The colour of urine is determined by bile pigments. It depends on the amount of urine. Normally, urine has a bright yellow, amber colour. The pathological conditions involving the change of urine colour to a reddish-brown and in an increased level of urobilinogen, for example occur with a high fever. Brown coloured urine is due to the increased amount of bilirubin and urobilinogen, e.g. in liver and biliary tract diseases.

The smell of urine has a characteristic aroma. A urine collection bottle open for a long time will result in the decomposition of the urea to ammonia, causing a sharp pungent odour.

Urine density ranges from 1005 – 1030 kg/l. The larger the amount, the lower the specific weight. The exception is diabetes mellitus, where the more sugar then the larger the amount and the higher the specific weight.

The final urine output is accumulated in the bladder. When sufficiently filled (in adults 250 – 450 ml, in older children 50 – 200 ml, in infants 10 – 30 ml), the bladder is empted - micturition. Micturition is a complex neurohumoral process controlled by the micturition centre, which is located at the 2 – 4 sacral vertebrae and by the centre for urination control in the cerebral cortex. Damage to these parts of the nervous system causes spontaneous emptying of the bladder, i.e. incontinence, (incontinentia urinae). Patients who suffer from incontinence are treated with an indwelling urinary catheter (Foley catheter). See chapters 11.1 and 11.2 for other types of urinary catheters.

Urinary disorders include:

- *Urinary retention* – the accumulation of urine in the bladder joined by the inability to defecate or frequent urination of small amounts (25-50 ml). Retention is most common in an enlarged prostate, urethral narrowing, due to medications, embarrassment. This urinary disorder poses a risk of urinary stagnation, which leads to the risk of infection. Retention is frequently manifested by pain in the pubic area, frequent urination of small volumes, a disproportionate amount of urine output in comparison to the fluid intake.
- *Urine incontinence* – several types of incontinence can be distinguished. *Overall* – involves continuous and unpredictable urine discharge. Other types include *stress* related incontinence, caused by increased intra-abdominal pressure. Urine output is up to 50 ml. This mostly occurs when coughing, laughing, lifting heavy objects, climbing stairs. The cause is the loss of bladder and pelvic elasticity. Another type is *affective* incontinence, which is defined as an involuntary, unpredictable urine discharge in emotional states such as excessive or uncontrollable affection, strong expressions of regret etc. This disorder can also occur in dementia. *Reflex* incontinence is of a central origin and is not accompanied by the urge to urinate. *Urge* incontinence is characterized as discharge of urine soon after the beginning of a strong urge to urinate caused by an uncontrollable, involuntary detrusor contraction, which feels unbearable. It occurs, for example, in chronic inflammation of the urinary tract. *Overflow* incontinence, which mainly occurs in older men with prostate disease when the bladder does not empty fully. With the new urine filling the bladder, the increased volume causes the urine to overflow - drip. Finally, there is also incontinence brought about by the insertion of a *permanent urinary catheter.*

- *Pollakiuria* is repeated passing small amounts of urine in short intervals. The causes of pollakiuria include urinary tract infections (cystitis, urethritis), lithiasis (formation of calculus) or emotional lability.
- *Dysuria* is difficult and painful urination. The most common causes include local irritation of the urethral meatus by use of inappropriate soap or shower gels, passing of heavily concentrated urine during dehydration, inflammation of the lower urinary tract (cystitis, urethritis), use of medications irritating the lining of the bladder (sulfonamides, cyclophosphamide, amitriptyline).
- *Stranguria* – painful urination caused by muscular spasms of the urethra.

For example, the urine contains blood (hematuria), pus (pyuria), elevated protein (proteinuria), which usually indicates a urinary tract disease or other organ disease. Normally, urine contains minimal amounts of protein (max 150 mg/d). Blood can be visible to the naked eye as a reddish hue (macroscopic haematuria), other times the presence of blood is identified only by microscopic examination (microscopic hematuria).

Bowel movement

Regular emptying of the colon is a basic human need and contributes to maintaining good health. Irregular bowl movement causes health complications. Everyone has a different frequency of regular bowel movement, some 1 x day, others 1 x in 2 - 3 days. Bowel movement (defecation) is influenced by many factors, e.g. by a diet rich in fibre, vegetables, fruit, cereals, or by exercise and change of position, psychological comfort or by practicing emptying reflex. The emptying reflex can be rehearsed by regular daily repetition of several steps which follow in the same order: A patient drinks a glass of mineral water or a glass of cold water with juice, followed by breakfast and tries to defecate. If is successful, the same process is repeated in the coming days, which may lead to developing a conditional discharge reflex.

Defecation is a reflective process that begins with the contraction of circular muscles at the interface of the transverse and descending colon. The contraction of the longitudinal muscle causes a shift of the intestinal contents further into the rectum. The pressure on the rectal mucosa causes weakening of the internal and external sphincter of the anus, followed by defecation. The frequency of defecation is individual. The amount and appearance of faeces mainly depends on the amount and type of ingested food, fluids and the digestion process. The most common defecation disorders include *constipation, diarrhoea* and *stool incontinence,* which occurs most frequently with sphincter damage, neurological diseases or it can occur in the overall weakening of the body, such as in the elderly. When assessing a stool, the following is analysed: Quantity, colour, odour and form. The quantity of one excreted stool ranges from 60 – 250 g. The following stool forms are recognized: *Sausage or snake like shape* due to narrowing at the end of the colon, *separate hard lumps* such as in spastic constipation and *water, no solid pieces* in increased intestinal peristalsis. The stool can have the following colour: A *light* colour when eating dairy products, *dark* colour when eating leafy vegetables, beetroots, paprika or caused by medication, *light grey (acholic)* which means the stool exhibits a lack of bile pigments, *melena,* which is a tarry stool that contains digested blood of the upper digestive tract with a source of an intestinal bleeding and *enterorrhagia,* which is characterized by the presence of fresh blood in the stool. In terms of smell, *putrid, sour* (occurring in diarrhoea) and *sweet* (occurring in melena) smells are distinguished.

Constipation is a difficult bowel movement of a small quantity of dry, hard stool. The most common is *habitual* addictive constipation, resulting from violation of the discharge reflex due to bad eating habits, reduced intake of fluids and fibre, repeated suppression of the urge to defecate, reduced physical activity etc. Constipation is manifested by a reduced frequency of defecation, or by evacuation of hard, dry stools, by strenuous, painful defecation, abdominal pain, pressure, feeling of fullness, headache. Constipation can be of an acute or chronic nature. The cause of acute constipation may be organic, such as paralytic ileus, obstruction. In the case of habitual constipation, it is necessary to adjust diet and fluid intake etc. Laxatives (drugs stimulating bowel movement) should be used for a limited time as overuse can damage the intestinal wall, and possibly change the intestines.

Diarrhoea is the defecation of a liquid stool in an increased frequency, in which the rapid passage of the intestinal contents shortens the time of water and electrolytes resorption. The following symptoms occur in diarrhoea: Convulsive abdominal pain, difficulty (inability) to keep stools, nausea and vomiting, irritated skin around the anus. Diarrhoea can be acute or chronic. Acute diarrhoea is most commonly caused by infection (salmonellosis, dysentery, gastroenteritis, etc.) or by dietary mistakes, by allergies, psychological discomfort etc. Chronic diarrhoea is functional (caused particularly by nerve psychological effects) or organic, caused by intestinal inflammation insufficient pancreatic function etc.

Treatment is based on the cause with the necessary diet adjustment. The main danger of severe diarrhoea is the loss of fluids, electrolytes and metabolic acidosis!

Flatulence (bloating) - excessive amounts of gases in the intestines. Abdominal bloating is usually caused by the alimentary canal opening due to excessive gas content. The cause is usually excessive air swallowing (aerophagia), diet composition, intestinal bacteria, dyspepsia, intestinal obstruction, etc. An increased pass of flatus through the rectum is called *flatulence.*

It is important to check the patient's bowel movements on a daily basis. A record is made in to the nursing documentation. If the patient moved their bowels, it is recorded with +, if the patient moved their bowel several times it is recorded with multiple +++. If the patient did not move their bowel, it is recorded with a 0.

Bowel movement in mobile patients

A mobile patient moves their bowel in the toilet. Each toilet cubical should have a handle bar to enable a less mobile patient finds it easier to sit down or get up from the toilet. These handles must be regularly disinfected.

If the patient cannot fully sit down on the toilet the toilet seat attachment can be used (see Fig. 11-1), which increases the overall height by 10 – 15 cm. The attachment must be washed and sanitized after use.

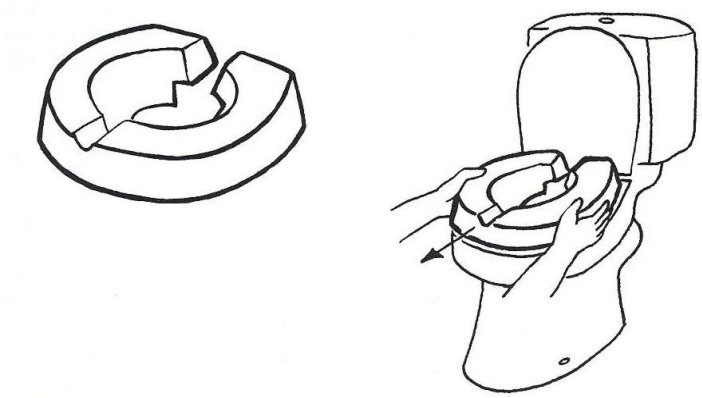

Fig. 11-1: Toilet seat attachment

Taken from: ROZSYPALOVÁ, M., ŠAFRÁNKOVÁ, A., VYTEJČKOVÁ, R. *Ošetřovatelství I.* vyd. 2. Praha: Informatorium, 2009, 273 s. ISBN 978-80-7333-074-3

Bowel movement in mobile patients in the room

Patients who are unable to walk to the toilet, but are able to get out of bed can use a toilet chair.

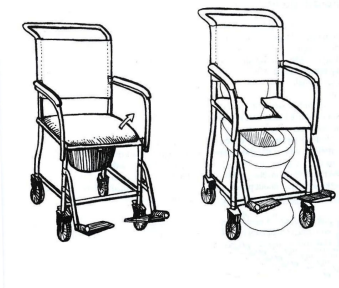

Fig. 11-2: Toilet chair

Fig. 11-3: Toilet chair with wheels

This toilet chair has wheels and the actual seat has an opening for inserting a bucket. The wheels of the chair are also lockable. The chair is wheeled into the room and placed next to the bed. The patient is assisted with getting out of bed and is seated on to the toilet chair. The nurse also helps the patient with wiping after using the and with getting back into bed. The bucket is immediately covered and the contents disposed of. The bucket is washed and disinfected. Some types of toilet chairs can be wheeled over a normal toilet seat (see Fig. 11-2, 3). The patient is wheeled back to the room as soon as they have moved their bowel. The chair is washed and disinfected in the usual way.

Bowel movement in bedridden patients able to cooperate

Bowel movement in bedridden patients who cannot or must not leave the bed can pose a major obstacle. The unusual position, fear of soiling the bed, embarrassment or shyness can trigger bowel movement disorders. The nurse patiently and kindly helps the patient with a bedpan and for men, a urinal bottle. Urinal bottles with an extended neck (see Fig. 11-4) are also fitted with a plug or cap. The patient usually keeps the closed urinal bottle suspended in a wire basket on the side of the bed. The urinal bottle must be emptied, washed and disinfected several times a day. Before pouring out the contents, it is necessary to check if the patient diuresis is subject to monitoring – i.e. the volume of urine output in 24 hrs as well as the colour and other attributes. If that is the case, the contents of the bottle are poured into the collection container placed in the designated room and closed and labelled with the patient's name and date of collection.

Fig. 11-4: Urinal bottle

Women use bedpans for bowel movement and urinating. Men use them only for bowel movement. Bedpans can have different shapes. They are made from various materials, e.g. plastic, enamel, papier maché (see Fig. 11-5, 6). The papier maché bedpans are for use once only.

Fig. 11-5: Bedpan

Fig. 11-6: Disposable bedpan and urinal bottle

The bedpan is put under the patient as soon as they ask for it. Bedpans are stored in the designated room. A clean and disinfected bedpan is brought to the patient either covered with a lid or a small rubber cap. Some bedpans have inside scale markings of 200, 400 and 600 ml, although this is only indicative of the urine volume. When inserting the bedpan, the patient is asked, if possible, for their active cooperation. The instructions must be clear and brief – for example, bend the knees and hips, hold on to the trapeze and lift up the pelvis etc. As soon as the patient lifts themselves, the full part of the bedpan is placed under the buttocks and the open part towards the feet.

Bowel movement in bedridden patients unable to cooperate

The bedridden patient is gently turned to their side and the bedpan is placed on the buttocks while turning the patient back. After the bowel movement, the patient is assisted with wiping and hand hygiene. Passing urine in bedridden patients is usually done via an inserted urinary catheter (see chapter Insertion of long-term urinary catheter).

Care of aids

The bedpan is always carried away covered with the lid and it is never put down on the floor. The bedpan must never be put on the floor even when clean and before it is used by the patient! The contents of the bedpan are emptied into the toilet. Any changes in the appearance of a stool or urine are recorded in the documentation and reported to a doctor.

Care of bedpans and urinal bottles after use depends on the amenities of the ward. The most common practice is to place it into a washer used only for washing and disinfecting aids of a similar nature with a preset cleaning programme (see Fig. 11-7)

Fig. 11-7: Bedpan and urinal bottle washer and storage closet

Those wards that do not have a washer for bedpans and urinal bottles wash these aids manually under running water and then disinfect them according to the disinfection programme before storing in the designated room or cupboard (see Fig. 11-7)

Task

- Learn about the method of disinfection and storage of bedpans and urinal bottles during your clinical practice.
- Practice inserting bedpans under partially mobile and completely immobile patients.
- Get to know the standards of care in regard to bladder emptying and bowel movement at the relevant workplace.
- Find out the meaning of the terms: Nocturia, nocturnal enuresis, paradoxical ischuria.

Control questions:

- Explain the term “melena”.
- What is incontinence caused by the loss of elasticity of the bladder and pelvic muscles, usually occurring when coughing laughing, lifting heavy objects and climbing stairs called?
- What is incontinence which is of a central origin and it is not accompanied by the urge to urinate called?
- Explain the term “paradoxical ischuria”.
- What is flatulence?
- Explain the term “diuresis”.
- What is nocturia?

- Choose the correct statement:
    - Oliguria – 80 ml of urine passed in 24 hours.
    - Polyuria – 2,500 ml of urine passed in 24 hours.
    - Oliguria – 180 ml of urine passed in 24 hours.
    - Anuria – 80 ml of urine passed in 24 hours.
    - Polyuria – 1,500 ml of urine passed in 24 hours.
    - Oliguria – 420 ml of urine passed in 24 hours.
    - Anuria – 700 ml of urine passed in 24 hours.

11.1 Short-term bladder catheterization

Objectives:

After studying this chapter, you should be able to:

- Describe the physiology of bladder emptying;
- Explain pathological changes when passing urine;
- Define the term "bladder catheterization";
- Prepare the aids required for short-termbladder catheterization;
- Educate the patient and explain the importance of their cooperation during the procedure;
- Demonstrate professionalism and skill during the procedure;
- Always communicate professionally with the patient.

Theoretical notes

Physiology of urination (micturition)

The urine is passed from the body via the urinary system, i.e. through the kidneys, ureters, bladder and urethra.

Kidneys (renal tube, nephrons) – filter waste substances out of the body. The filtering is through a unit called the nephron. Actual filtration takes place in the glomerulus. The composition of the resulting infiltrate is very similar to plasma. The filtrate passes through the nephrons and down the renal tubules while 99% is absorbed back into the blood and 1% forms the urine. The kidneys filter approximately 1200 ml of blood every minute. All the blood passes through the kidneys about 12 times per hour.

Ureters – are tubes made of smooth muscle fibres that arise from the renal pelvis and descend towards the bladder. Ureters in adults are 25 to 30 cm long with a 1.25 cm diameter.

The *urinary bladder* is a hollow muscular organ which sits on the pelvic floor, storing urine until it is emptied. The amount of urine that the bladder can hold is individual; an adult begins to feel the urge to urinate when the urine reaches 250 to 450 ml.

Urethra – is a urinary tube that connects the urinary bladder to the genitals, between the labia and clitoris in females and to the distal end of the penis in males. The internal sphincter muscle (uncontrollable by will), and the external sphincter muscle (controlled by will) close tightly around the opening of the bladder into the urethra. In females, they are located in the middle of the urethra; in males they are distal to the prostate urethra.

Urination (micturition) – emptying of the urinary bladder. After filling the bladder, the increased pressure stimulates the nerve endings in the bladder wall. The pulses are fed to the micturition reflex centre, which is located in the sacral spinal cord in S2-S4 segments. The pulses continue to the micturition control centre in the cerebral cortex. The brain sends impulses to the motor neurons in the lumbar region and the parasympathetic nerves are stimulated. The urine can be released from the bladder, but at this point is prevented by the external sphincter muscles. The vigilant part of the brain influences the external sphincter; humans can influence micturition by will. If the external sphincter is released, the urine can leave the bladder. If the micturition reflex is interrupted, the bladder keeps filling up and the

whole process is invoked once again. Micturition therefore begins with contraction of the bladder detrusor, shortening the urethra muscle with the expansion of the inner tract. Under normal circumstances the urine is completely emptied from the bladder. Control of urination is possible if the nerves in the bladder and urethra and all nerve paths, including the brain centres are intact. Injury to any part of the nervous system can result in an uncontrolled outflow of urine – incontinence.

Sometimes urination is not possible, even with an excessively full bladder. This condition, accompanied by an unpleasant, painful sensation is known as *urinary retention*.

A condition where urinating is not possible due to urine not being formed in the kidneys is known as *anuria.*

Factors affecting micturition

- *Growth and development*

  Young children (newborns, infants) are unable to control urinating. Potty training begins when the child is able to sit without support and is able to recognize the fullness of the bladder and announces the need to urinate. The child is able to control urination during the day at about the age of 2, although full control is gained at the age of 4 - 5 years. The ability to control urination is slower in boys than in girls. Adults over 80 experience excessive urination and increased frequency at night due to decreased ability to concentrate urine and reduced muscle tone of the bladder, which also leads to an increased volume of residual urine.

- *Psychosocial factors*

  Factors that affect micturition are for example, the need for privacy during urination, inconvenient position, enough time, the sound of running water, habits.

- *Fluid and food intake*

  A healthy body is able to maintain a balance between the amount of ingested fluids and urine. Increased fluid intake increases the output. Some fluids increase the output due to inhibition of an antidiuretic hormone, e.g. alcohol, coffee and tea. The same applies to foods with high water content. Foods that contain large amounts of sodium can cause fluid retention – too salty foods, mineral water high in sodium. Some food and drinks can alter the colour of the urine. Other foods can affect the urine odour, e.g. garlic.

- *Medications affecting the amount of urine, other effects*

  Diuretics increase urine formation by blocking the absorption of water and electrolytes in the kidneys or antihypertensive agents (drugs that lower BP) and others; the urine odour is also impacted by antibiotics or vitamins (vitamin B).

- *Muscle tone*

  Reduced muscle tone can disrupt the contraction of bladder muscles and reduce the control of the external sphincter.

- *Pathological condition*

  The formation and passing of urine can be affected by e.g. kidney diseases, prostatic hypertrophy, diabetes insipidus.

- *Surgical procedures and diagnostic methods*

  Medical and therapeutic procedures can disrupt the formation and excretion of urine, such as a cystoscopy (endoscopic examination of the bladder), pelvic surgery etc.

Urine formation disorders

The normal urine volume in 24 hours (diuresis) ranges in relation with the fluid intake at around 1,500 – 2,000 ml. The bladder is usually emptied 5 to 6 times a day. *Polyuria* – increased formation of urine, i.e. above 2,500 ml. This disorder is in relation to a high intake of fluids, caffeine and in diabetics. Polyuria symptoms include e.g. polydipsia – excessive thirst, dehydration or weight loss. *Oliguria* – decreased formation of urine, i.e. 100 – 500 ml. It arises in relation to low fluid intake, fever, sweating etc. *Anuria* – decreased formation of urine, i.e. lower than 100 ml a day; (subsequently the volume of urine passed is also decreased to this level).

Urine passing disorders

Retention – retention of urine in the bladder, combined with inability to empty the bladder – urination ceases. The bladder is stretched and the urine stagnates, which increases the risk of urinary tract infection.

Retention of urine causes pain in the pubic region, bladder distension, inability to urinate, increased need for urination, frequent urination of small volumes and increased nervousness in the patient due to the level of liquid intake. *Pollakiuria* – frequent urinating; the bladder needs emptying more often than usual (e.g. with cystitis). Nocturia – increased frequency of urination at night. *Dysuria* – difficult and painful urination. *Stranguria* – sharp pain and burning sensation when urinating. *Urgent urination* – compelling urge to urinate despite the bladder not being full. *Nocturnal enuresis* – night time urinary incontinence in older children. *Ureterostomy* – a creation of a new outlet for the ureters. *Incontinence* – involuntary passing of urine.

Nursing care with regard to the physiological passing of urine

The nurse monitors:

- Frequency (number of times the patient urinates during the day and night)
- Volume of urine in ml (more or less than usual)
- Colour, odour, transparency, other impurities
- Involuntary outflow of urine
- Records data in the nursing documents and monitors in selected patients daily or hourly diuresis.
- Monitors use of medication, intake of fluids and food
- Provides the patient with maximum privacy when urinating and allows the patient plenty of time.

- Helps the patient to take the appropriate position before urinating - men standing up and women sitting down; a bedridden patient is assisted with a (clean) bedpan, urinary bottle and if possible put in Fowler's position. It is further recommended to the patient to leave the tap water running, soak hands in cold water or to rinse the genitals with warm water.

If the patient still did not manage to urinate, despite all efforts, the doctor will prescribe urinary catheterization.

Catheterization

Bladder catheterization involves inserting a sterile catheter through the urethra into the bladder.

Bladder catheterization is performed only as the last resort, because it poses a *risk of infection in the urinary tract.*

A urinary catheter is usually inserted:

- In patients with urinary retention,
- To determine the volume of residual urine (residual urine remaining in the bladder after urination) and to empty the residual urine,
- In some cases, in patients with urinary incontinence,
- In sterile urine sampling for laboratory testing for patients who cannot provide a urine sample themselves,
- In order to rinse the bladder and administer drugs into the bladder,
- For continuous monitoring of urine output (in unconscious patients, after complicated and long surgery, after severe injuries to the lower limbs and pelvis, in patients with paralysis of the lower limbs, with burns).

Types of bladder catheterization:

- *Short-term* – for emptying the contents of the bladder; the catheter is removed after the procedure,
- *Long-term* – the urinary catheter is inserted over a long period of time; the catheter is fixed in the bladder with a balloon filled with sterile saline.

Commonly used short-term urinary catheters:

- Nelaton catheter – a straight catheter with a round tip; used in women, men and children,
- Tiemann catheter – a straight catheter with a curved tip; used in men

Commonly used long-term urinary catheters:

- Folley catheter – made of flexible latex or silicone with a balloon installed; the mouth of the catheter is adapted for connecting to a collection system.

All types of urinary catheters are made in different sizes, both in the circumference and diameter. Catheter diameter sizes are measured in Charriere (CH) also know as French gauge (Fr). No.1 = 1 CH = 1 Fr = 1 mm circumference and 0.3 mm diameter (No. 18 = 18 CH = 18 Fr = 18 mm circumference and 5.4mm diameter). Each catheter package is marked with a

number. The package for long-term catheters also indicates the recommended volume of fluid for filling the fixation balloon. Catheters are sterile packed and usually made of silicone (allowing for a long-term catheterization - 21 days), latex or PTFE-coated. Catheterization should be administered strictly aseptically.

Preparation of aids

- Sterile urinary catheter (short-term or long-term)
- Sterile gloves
- Sterile squares and swabs
- Mucous membrane disinfectant
- Anesthetic gel
- Kidney bowl
- Wadding cut into squares
- For long-term catheter – a syringe with a sterile solution to fill the fixation balloon, tweezers (not always) and a drainage kit with collection bag

Short-term catheterization in females

The catheterization is administered by a general nurse or a midwife who is responsible for gentle and sterile insertion.

Patient preparation

The preparation is both *psychological* and *somatic.*

Psychological preparation – the reason and the course of catheterization are clearly explained to the patient. She is assured that the procedure, under normal circumstances, does not hurt. The nurse shows understanding for the concerns and discomfort feelings of the patient and patiently answers all the questions. The nurse must ensure maximum privacy during the procedure. The catheterization is administered either in the designated room or in the room on the patient's bed.

The nurse's attitude and demeanour strives to earn the patient's trust and willingness to cooperate.

Somatic preparation – a thorough genital hygiene is inevitable; the cleansing is administered using a suitable mucosa disinfectant. The somatic preparation in a bedridden patient is administered by the nurse.

Position – the female patient is put in to the supine position with her legs flexed and spaced apart.

Preparation of aids

- Sterile urinary catheter (short-term Nelaton catheter)
- Sterile gloves

- Sterile squares and swabs
- Anesthetic gel (as customary on the ward)
- 2 kidney bowls (bedpan)
- Wadding cut into squares
- Mucous membrane disinfectant
- Sterile test tube for a urine sample

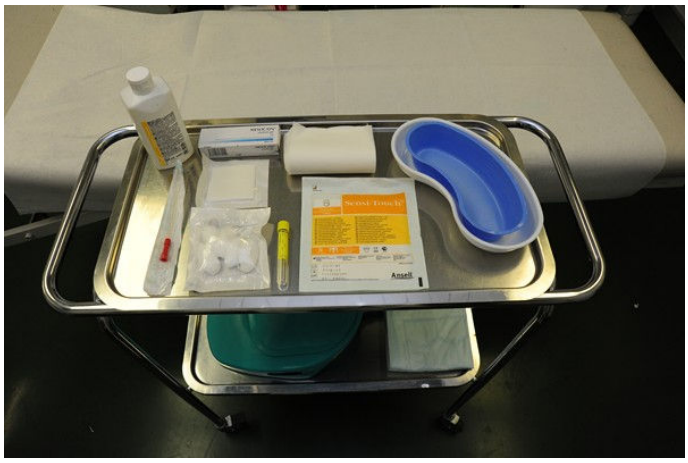

Fig. 11.1-1: Aids for short-term catheterization in female

Some workplaces use ready sterile packages, which save time and facilitate the aseptic procedure in urinary catheterization.

Fig. 11.1-2: Sterile package for short-term urinary catheterization

Working procedure

- Verification of doctor hours;
- The patient is provided in privacy;
- The nurse explains the procedure; the female patient washes her genitals prior to the procedure; the bedridden patient receives nursing care in regards to genital hygiene;
- The nurse undergoes hand hygiene and disinfection prior to the procedure;

- The sterile aids are prepared next to bed so the nurse can use them while wearing sterile gloves;
- The female patient is placed in the supine position with flexed legs;
- A kidney bowl (or bedpan) is placed near the genitals in order to take a urine sample, a second kidney bowl is for the swabs;
- The swabs are moistened with disinfectant, sterile gloves are put on;
- Using the non-dominant hand (thumb and index finger), the nurse separates the labia majora; disinfects the labia major, one swab – one wipe anterior to posterior; proceeds from the pubic area to the anus; the third swab used to disinfect the centre, across the urethral meatus;
- The hand that separates the labia major has now become non-sterile, therefore it must remain in the same position and reveal the urethral meatus throughout the insertion of the catheter;
- The catheter is carefully removed from the packaging and held about 5 cm from the tip, between thumb and index finger; the end is held over the kidney bowel into which the urine will be drained;
- Anesthetic gel is applied to the tip of the catheter (this can be done in advance, depending on ward practice);
- The patient is asked to relax the muscles and to take a deep breath;
- The catheter is gently inserted in the meatus and advanced along the urethra approx. 5 - 10 cm deep;
- If a urine sample is required for microbiological examination, it is collected during the urine outflow into the prepared and labelled test tube;
- After the procedure is completed, the catheter is gently removed and discarded in the kidney bowl; the genitals are wiped with a pulp square;
- The patient is put back in the original and comfortable position;
- The patient receives information about the next steps with respect to their health condition, from a doctor;
- Used disposable aids are discarded with other infectious waste, kidney bowls are put into disinfectant;
- Depending on the doctor's prescription, the urine sample is assessed or is sent to the laboratory;
- Hand hygiene and disinfection;
- The procedure is recorded in the documentation;
- Any changes are reported to the doctor.

Patient care after procedure

See above text - Working procedure

Care of aids after use

Standard cleaning procedure for aids, see text for Working procedure.

Catheterization in male patients

Catheterization in men is usually administered by a male doctor with the assistance of a nurse. The catheterization procedure in men can be conducted under applicable law by a specialized nurse, qualified in intensive care. The catheterization procedure in men differs from female catheterization in several aspects.

Patient preparation

See above – catheterization in female patients

Preparation of aids

- Sterile Tiemann catheter (size as per doctor's instructions; the nurse prepares a selection of sizes)
- Sterile tweezers
- Sterile gloves
- Sterile squares
- Sterile swabs for disinfection
- Mucous membrane disinfectant
- Local anesthetic (e.g. Instillagel, Aqua Touch Jelly)
- 2 kidney bowls
- Eventual sterile test tube for urine sampling

Working procedure

- Verification of doctor instructions
- Washing and disinfection of hands
- Explanation of the procedure to the patient and provision of privacy
- Genital hygiene prior to the procedure
- Sterile aids are placed nearby so they can be handled with sterile gloves
- The patient is placed in the supine position with flexed legs
- Two kidney bowels are designated for urine sampling and used swabs
- The doctor and nurse put on sterile gloves; swabs are moistened with disinfectant
- The doctor firmly holds the penis below the glans,
- The second hand disinfects the glans penis using swabs and disinfectant solution, from the urethral meatus to the edge, using a new swab for each smear

- The doctor lifts the penis vertically to the body and pulls it slightly upwards; applies an anesthetic gel to the urethra
- The catheter is slowly inserted, about 15 cm deep until urine begins to flow
- The nurse presses the mouth of the catheter upwards and after inserting the catheter into the bladder, it is positioned over the kidney bowl into which the leaking urine is captured
- After the procedure is completed, the doctor gently removes the catheter and wipes the outer areas of the urethra with pulp.

Working procedure using instruments

- The nurse prepares the necessary aids and familiarizes the patient with the procedure
- Genital hygiene prior to the procedure
- The patient lies on the bed or on the examination bed in a supine position
- The doctor and the nurse carry out hand hygiene and disinfection; the doctor puts on gloves
- The nurse passes the tweezers to the doctor and prepares the swabs for disinfection of the external urethral meatus
- The nurse also prepares a sterile catheter and local anesthetic
- The catheter must remain sterile!
- The nurse passes the catheter to the doctor who inserts it, using tweezers, into the urethra (approx 12 – 15 cm deep)
- The nurse catches the flowing urine into the kidney bowl or into a sterile and labelled test tube; measures the volume and records it
- The nurse cleans and disinfects the aids according to the applicable standards of the ward
- In the event of urine sampling, the nurse sends the test tube with the sample into the laboratory with the fully completed request form.

Patient care after the procedure

See above text - Patient care after procedure

Care of aids after use

See above text - Working procedure

Urethral catheterization in children

The procedure is administered relatively less often, e.g. for urine bacteriological testing. Catheterization in children is special in terms of preparation before procedure, securing the child (infant, toddler) and in the selection of a suitable catheter. The procedure is preformed by a doctor for young children; in older girls by a female doctor or a nurse. The procedure is identical to the above procedures for female and male catheterization.

Complications during catheterization

- *Perforation of the lower urinary tract* – rupture of the lower urinary tract in forced insertion of a urinary catheter
- *Urinary tract infection* – introduction of infection into the lower urinary tract
- *Paraphimosis* - occurs when the foreskin is pulled back behind the penis glans and stays there; it is necessary to pull the foreskin back over the glans penis after short-term or long-term catheterization
- *Urethral sphincter injury* – a catheter is inserted very gently and considerately; the patient is asked to cooperate; the patient lies calmly, takes slow and deep breaths and concentrates fully on breathing which induces a calm state of mind, releasing tension in the sphincter

Control questions

Urethral catheterization is administered only if absolutely necessary:

- Yes
- Probably yes
- No
- In men
- Only in children

Catheterization should be administered strictly aseptically:

- Only in children
- Yes
- Only on selected wards (e.g. Urology clinic)
- Only in patients before surgery
- Only in patients with reduced immunity

Urethral catheterization in female patients is administered by:

- Nurse, midwife (depending on the situation, by two nurses)
- Doctor
- Doctor and nurse
- Two doctors
- Hospital attendant

Suitable disinfectant for use on female genitalia is:

- Common skin disinfectant
- Mucous membrane disinfectant
- Depending on ward practice e.g. Sekusept
- Common disinfectant used to disinfect wound areas
- Common disinfectant used to disinfect wounds

The following catheter is used for short-term catheterization in female patients:

- Nelaton
- Tiemann
- Pezzer
- Folley balloon catheter
- Malecot

11.2 Insertion of long-term urinary catheter

Objectives:

After studying this chapter, you should be able to:

- Explain the reasons for insertion of a long-term urinary catheter;
- Prepare aids needed for inserting a long-term urinary catheter;
- Educate female and male patients prior to the catheterization procedure;
- Demonstrate this procedure using a model or simulator in the laboratory and later in clinical practice;
- Apply the principles of nursing care for a patient with a long-term catheter.

Purpose

The reasons for inserting a long-term (permanent, retention) catheter, are:

- Inability of the patient to urinate
- Accurate monitoring of diuresis (fluid balance)
- Complications after surgery in the genital area
- Continuous bladder irrigation

Theoretical notes

Emptying is a basic physiological human need. People are embarrassed to talk about emptying, because emptying relates to intimate body parts. The nurse must therefore approach the patient in a sensitive and discreet way. The patient's trust depends on the nurse's professionalism, especially on their communication skills, empathy and knowledge of the patient's psyche.

Emptying is influenced by lifestyle, nutrition and physical activity. Some people are affected by a frequent urge to urinate when under stress. Difficulty with emptying is often experienced in patients who are sensitive to a lack of privacy. The nurse can reduce the feelings of embarrassment by an empathic approach with respect, by providing privacy, e.g. a single bed room or by pulling the curtains.

The most commonly used catheter in long-term (permanent) catheterization is the Folley catheter which has the same tip as Nelaton and Tiemann catheters. The Folley catheter has a balloon inserted around the catheter circumference 2 – 3 cm from the end, which is filled after insertion into the bladder with 5 – 15 ml of sterile saline (see Fig. 11.2-1, 11.2-2). Filling the balloon fixes the catheter in the bladder. Reverse leakage of the saline from the balloon is prevented by a rubber seal (see Fig. 11.2-3).

Urinary catheters have different lumen, which is indicated by the number at the wider end. Catheter diameter and circumference sizes are measured in Charriere (CH) also known as French Gauge (Fr), e.g. 1 Ch/Fr = 1/3 mm, 3 Ch/Fr = 1 mm. Catheters are usually made in sizes 6 – 30 CH/Fr. The correct size catheter is selected according to the patient's age and gender: 14 – 18 Ch/Fr is used in men, the 12 – 18 Ch/Fr is used in women, and the 8 – 10 Ch/Fr is used in children.

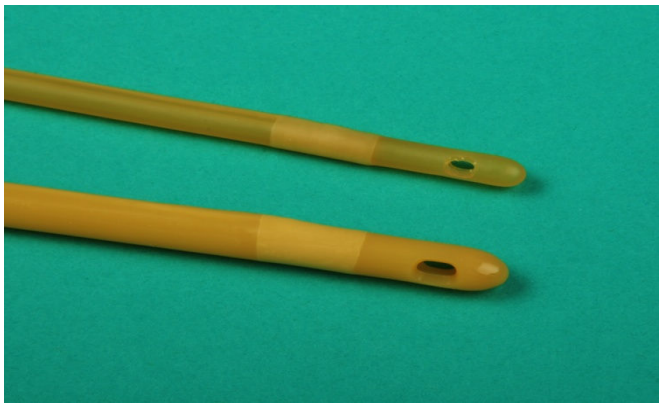

Fig. 11.2-1: Folley catheter with an unfilled balloon

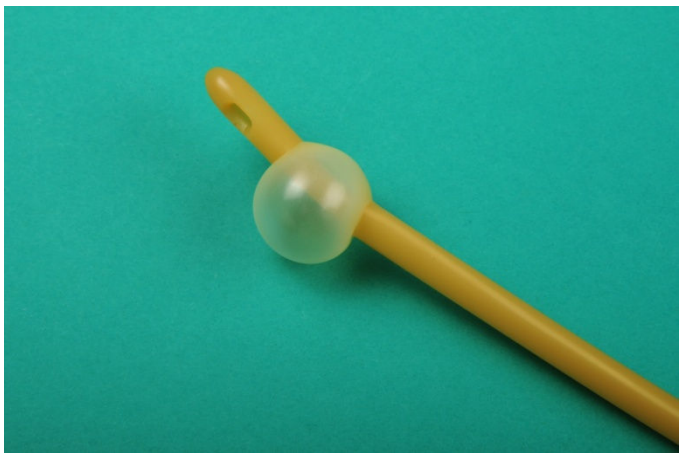

Fig. 11.2-2: Folley catheter with a filled balloon

Fig. 11.2-3: Size marking of a permanent catheter

Procedure conditions

Preparation of aids

- *Genital hygiene:*

  Bowl with hot water, soap, washcloth, towel, disposable gloves

- *Sterile catheter set* including all required aids or individual items (see Fig. 11.2-4) for *insertion of a long-term (permanent) urinary catheter*

Fig. 11.2-4: Aids for inserting a long-term (permanent) urinary catheter

Preparation of aids

- Sterile Folley (balloon) catheter of a suitable size in double packaging
- Sterile distilled water or physiological solution (for filling the balloon)
- Sterile syringe of an appropriate size, e.g. 10 ml
- Sterile swabs in a sealed bag
- Mucous membrane disinfectant (e.g. Skinsept mucosa)
- Lubricating gel depending on the ward practice (e.g. Mesocain gel – applied on a sterile square, Instillagel in pre-filled syringes for direct application into the urethra)
- 2 kidney bowls (bedpan and kidney bowl)
- Sterile gloves and sterile instruments (tweezers or pean)
- Disposable waterproof mat (to protect the bed linen)
- Towel or sheet (or other linen to maintain dignity)
- Good lighting
- Square of pulp or Perlan
- Drainage system – connecting tube and urine collection bag (drainage – see Fig. 11.2-4, without drainage). The patients at the ICU and Resuscitation Unit have a single-use,

closed drainage bag inserted with the option of hourly diuresis measurement and with an anti-reflux valve (see Fig. 11.2-5)

- Nurse's personal protective equipment – as is customary on the ward
- Patient documentation
- Securing the drainage system on the bed (see Fig. 11.2-6)

Fig. 11.2-5: Drainage system with the option of hourly diuresis measurement and sampling port

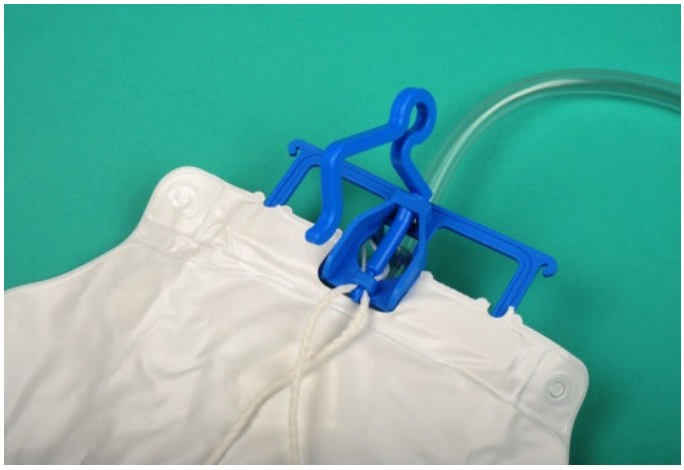

Fig. 11.2-6: Fixture for attaching the drainage system to the bed

If the urine sample will undergo microbiological testing, the nurse will also prepare a sterile capped and labelled test tube.

Patient preparation

The nurse calmly and patiently informs the patient of the reason for the procedure. Educational material (aids, diagrams, drawings) can be used for this purpose. Most people are uncomfortable when their genitals must be exposed, therefore the nurse will explain to the female patient how she can cooperate and where the procedure will take place. In order to ensure calm delivery of the procedure, it is good to encourage the patient to focus on slow, deep breathing through their nose.

Mobile female patients are usually subjected to catheterization in the examination room or a bathroom etc. In catheterization on the bed in the patient's room, the dignity of the patient must be protected, i.e. the other female patients are asked to turn around or to leave the room. Some wards have curtains or screens for this purpose. Genital hygiene must precede each catheterization. Cleansing reduces the number of microorganisms around the bladder and the chance of transfer with a catheter. Self-sufficient patients conduct their own personal hygiene; bedridden patients are helped by the nursing staff. The patient lies in a supine position with flexed knees. A supported pelvis (with padding) allows better access to the outlet of the urinary tract and reduces the risk of catheter contamination.

Working procedure

Long-term (permanent) catheterization in male patients is administered by a doctor and in female patients by an experienced nurse. The procedure is also attended by an assisting nurse or medical assistant. There are several methods of urethral catheterization and selection of a method depends on the ward and the agreement of the attending nurses. It is important to observe an aseptic way of working. The nurse ensures hygienic cleansing of the genitals in the female patient and prepares a dignified environment, e.g. closes a screen between the adjacent beds.

The nurse:

- Complies with hand hygiene and disinfection
- Prepares the necessary aids
- Puts the patient into an appropriate position for catheter insertion
- Suspends the collection bag on the side rail of the bed, below the level of the patient's bladder and prepares it to be connected
- The patient's buttocks are wedged with a disposable pad
- Opens the catheter packaging
- Connects the wider end of the urinary catheter to the collection bag
- Opens the packaging with sterile swabs and moistens them with mucosal disinfectant
- Opens gauze square package and applies Mesocain gel
- Puts on *sterile gloves*
- Removes swabs moistened with disinfectant
- Using the non-dominant hand separates the large and small labia and pulls them gently toward the symphysis (they must remain apart until the catheter is inserted into the bladder – holding the labia apart prevent contamination of the urethra meatus).
- Disinfects the meatus of the urethra with the dominant hand away from the symphysis and towards the rectum (top to bottom) with three strokes using moistened swabs (on both sides and finally in the middle) using a new swab for each smear
- Removes the urethral end of the catheter from the packaging (with the help of an assistant nurse) and dips it into the Mesocain gel
- Asks the patient to relax the muscles before inserting the catheter

- Inserts the catheter with the tip coated in gel into the meatus of the urethra 4 – 6 cm
- If the urine flows out of the bladder, the catheter is correctly inserted (occasionally, patient may suffer anuria – decreased urine output)
- When the catheter is inserted in the bladder, the nurse moves the hand from the labia and holds the catheter about 2 cm from the meatus of the urethra and observes the urine flow
- Checks the urine appearance
- *Fixes* the permanent urinary catheter by filling the balloon with a sterile saline solution (the required volume is indicated at the end of the catheter - see above, e.g. 5 – 10 ml)
- Checks the tightness of the catheter by pulling (note: If the catheter is inserted into the vagina, it can be removed even with the inflated balloon)
- Checks the volume and appearance of the urine
- Wipes the genitalia (e.g. from gel) and adjusts the bed
- Communicates with the patient throughout the procedure and monitors her condition

The following is recorded in the nursing documentation: Date, time of catheterization, size of catheter, balloon filling (saline, volume) or other information.

Another method of inserting a long-term (permanent) urinary catheter:

- The nurse educates the female patient and conducts hand hygiene and disinfection.
- Preparation of aids.
- Also suitable is draping the patient (covering the chest, abdomen, legs with a sheet or a sterile drape with a hole over the perineal area, leavening the labia exposed).
- The patient's buttocks are wedged with a disposable pad.
- The set of sterile aids are placed in between the patient's thighs or by the bedside within comfortable reach (right-handed on the right side and left-handed on the left side).
- A large kidney bowl is placed near the genitals.
- The sterile swabs packaging is opened and the swabs moistened with disinfectant (the disinfectant is at approx. 10 cm height).
- The catheter packaging is carefully opened.
- The nurse puts on sterile gloves; the assistant nurse puts on non-sterile gloves (for own protection).
- Using the non-dominant hand, the nurse separates the large and small labia and pulls them gently toward the symphysis (they must remain apart until the catheter is inserted into the bladder – holding the labia apart prevent contamination of the urethra meatus).
- Disinfects the meatus of the urethra with a dominant hand away from the symphysis and towards the rectum (top to bottom) with three strokes using moistened swabs (on both sides and finally in the middle) using a new swab for each smear

- The assistant nurse hands over the catheter, avoiding contamination of the urethral part of the catheter
- The catheter is held 5 – 6 cm from the urethral end with sterile tweezers or between the thumb and index finger; wrapping the catheter around the hand and placing the free end between the 4th and 5th finger.
- Insillagel or Mesocain gel can be applied to facilitate easier catheterization as follows:
  - Apply gel onto the tip of the catheter
  - Dip the catheter in the lubrication gel
  - Insert Instillagel directly into the meatus of the urethra

  (Some wards do not use gel in female catheterization although it is necessary in males)
- Asks the patient to relax the muscles before inserting the catheter
- The catheter is carefully inserted into the bladder – approx. 6 cm (the urethra in a female measures 4 – 6 cm), the insertion must be sensitive to prevent rupturing of the urethra wall. A silicone catheter adjusts well to the anatomy due to body heat. Insertion can be prevented by a tumour, calculus etc.
- When the catheter is inserted in the bladder, the nurse moves the hand from the labia and holds the catheter about 2 cm from the meatus of the urethra.
- After the outflow of urine, the nurse fills the balloon on the Folley catheter using a sterile syringe and 5 – 10 ml saline solution, or according to the volume indicated on the catheter. This will secure the catheter in the bladder.
- The wider end of the catheter is joined to the drainage system (connecting tubing and collection bag), which is placed below the level of the patient's bladder.

The following is recorded in the nursing documentation: Date, time of catheterization, size of the catheter, balloon filling (saline, volume) or additional information.

Patient care after the procedure

The patient is reminded of the need for increased genital hygiene (washing with soap and water). A long-term catheter is replaced every 3 weeks or as needed. Silicone catheters can be inserted for even longer (2 – 3 months), depending on the manufacturer's recommendations and the budget of the ward. The collection bag without the discharge valve is replaced as needed (1 – 2x a day), the discharge collection bag even later, depending on the ward and the manufacturer's recommendations. If the collection bag includes an anti-reflux valve, it can be used for 7 days or according to the manufacturer's recommendation. It is important to use disposable gloves when handling a catheter and collection bag. Mobile patients must be instructed not to bend, twist or pull the connecting tube from the catheter.

Care of aids after use

The nurse carefully washes, disinfects and cleans all the aids which will be reused, instruments (e.g. tweezers) are prepared for further sterilization. Disposable aids are discarded as infectious waste as is customary on the ward.

Complications

- Transmitting ascending infection into the bladder and urinary tract – due to insufficient hygiene around the meatus of the urethra or due to insertion of a non-sterile catheter. The catheter must remain sterile before and during insertion into the bladder.
- Patients with a long-term catheter can have their urine volumes monitored. Recommendation: Recommended daily fluid intake is up to 3,000 ml as the prevention of inflammatory diseases of the bladder and formation of deposits or catheter obstruction.
- If the urine bypasses the catheter, it must be replaced (sometimes it is advisable to choose a larger size catheter).
- Long-term catheterization leads wrinkling of the bladder and reduction of its capacity. The catheter can be closed and emptied every 2 – 3 hours, subject to the doctor's recommendation.
- Sometimes catheterization is not possible due to narrowing of the urethra (anomaly, tumour, calculus or paraphimosis).
- Traumatic damage to the urethra during catheter insertion with subsequent bleeding, which may be caused by insensitive catheter insertion, wrong angle of the inserted catheter and disregarding anatomical proportions of the urinary tract. A sensitive approach is required, especially in immobile patients.
- Removing a urinary catheter (e.g. in confused, geriatric patients).
- Uncooperative patient. Also very important is the education of the patient and the nurse's empathy, respecting the need for dignity.

Expanding information (Task)

Study:

- Catheterization procedure in males
- Differences in children's catheterization
- What is intermittent self-catheterisation and how is it administered?

Control questions

- How much urine fills the bladder in an adult?
- How much urine fills the bladder in a child?
- What is a long-term catheter with a balloon called?
- What drainage systems do you know?
- Does a drainage system enable to measure hourly diuresis?
- Explain the term "self-catheterization".
- What does the number 20 on the distal part of the permanent catheter mean?

11.3 Enema administration

Objective

After studying this chapter, you should be able to:

- Prepare the patient for enema administration;
- Prepare the aids for enema administration;
- Explain the factors affecting regular bowel movement;
- Demonstrate this procedure using a model or simulator in the laboratory and later in clinical practice;
- Assess the risks of potential complications;
- Explain the terminology associated with bowel movement.

Purpose

- Stimulate stool evacuation in constipation;
- Part of preoperative preparation;
- Part of preparation for intestine examination;
- Preparation before birth;
- Introduction of a contrast agent into the colon.

Theoretical notes

The large intestine (intestinum crassum) forms the last part of the digestive tract, which receives semi fluid mass (chyme) from the small intestine. Digestion is a complex process for the final mechanical and chemical processing of food. The large intestine processes the chyme for 8 – 12 hours.

Defecation is a reflective process that begins with the contraction of circular muscles at the interface of the transverse and descending colon. The contraction of the longitudinal muscle causes a shift of the intestinal contents further into the rectum. The pressure on the rectal mucosa causes weakening of internal and external sphincter of the anus, followed by defecation. The frequency of defecation is individual. It is usually once a day, at around the same time. It depends on activity, change of position, psychological comfort etc. The amount and appearance of faeces mainly depends on the amount and type of ingested food, fluids and the digestion process. The most common defecation disorders include *constipation, diarrhoea* and *stool incontinence,* which occurs most frequently with sphincter damage, neurological diseases or it may occur in the overall weakening of the body, such as in elderly. When assessing a stool, the following is analysed: Quantity, colour, odour and form. The quantity of one excreted stool ranges from 60 – 250 g. The following stool forms are recognized: *Sausage or snake like shape* due to narrowing at the end of the colon, *separate hard lumps* such as in spastic constipation and *water, no solid pieces* in increased intestinal peristalsis. The stool can have the following colour: A *light* colour when eating dairy products, *dark* colour when eating leafy vegetables, beetroots, paprika or caused by medication, *light grey (acholic)* which means the stool exhibits a lack of bile pigments, *melena,* which is a tarry stool that contains

digested blood of the upper digestive tract with a source of an intestinal bleeding and *enterorrhagia,* which is characterized by the presence of fresh blood in the stool. In terms of smell, *putrid, sour* (occurring in diarrhoea) and *sweet* (occurring in melena) smells are distinguished.

Constipation is a difficult bowel movement of a small quantity of dry, hard stool. It occurs most frequently in reduced physical activity of the patient or increased resorption of fluid in the colon, which leads to thickening of the content. The following types of incontinence are recognized: Rectal and large intestine constipation. Constipation is manifested by a reduced frequency of defecation, or by evacuation of hard, dry stools, by strenuous, painful defecation, abdominal pain, pressure, feeling of fullness, headache.

Diarrhoea is the defecation of a liquid stool in an increased frequency, in which the rapid passage of the intestinal contents shortens the time of water and electrolytes resorption. The following symptoms occur in diarrhoea: Convulsive abdominal pain, difficulty (inability) to keep stools, nausea and vomiting, irritated skin around the anus.

Flatulence (bloating) - excessive amounts of gases in the intestines.

Defecation in some patients may be via colostomy. Colostomy brings one end of the large intestine out through an opening in the abdominal wall. The opening (stoma) is a small circular hole 2 – 5 cm in diameter. Colostomy is most often located in the left lower abdomen (sigmoideostomy). The stoma is an outlet for spontaneous passing of gases and stools to which a collection bag is attached. Colostomy is not sensitive to pain because there are no nerve endings in the mucosa of the intestine. Necessary caution is required when caring for stoma as the mucosa can be easily damaged, causing bleeding. The most common types of colostomy include:

- Sigmoideostomy – a stoma formed in the sigmoid colon; if the sphincter is removed, the stoma becomes permanent;
- Transversostomy – a stoma formed in the transverse colon; in this case it is a two-hole (double-barrel) colostomy;
- Coecostomy – an artificial stoma formed between the small and large intestine, it is temporary and is designed to take the strain off the large intestine.

Enema – the introduction of fluid into the rectum and the sigmoid colon, or into the higher parts of the colon in order to flush the colon, remove the remains of faeces, gas, introduce a drug into the mucous membrane of the rectum, insert a contrast agent into the colon or to support peristalsis of the large intestine.

Types of enema

- Cleansing
- Medical
- Diagnostic

The most commonly used solution is water and physiological saline in children. Water is a hypotonic solution, which means that it has a lower osmotic pressure than the blood; therefore repeated enemas with large amounts of water can cause water absorption into the blood stream with a danger of hyperhydration. An enema is usually administered with a silicone rectal tube. The rectal tube is made in different sizes, see Table 11.3-1.

Age period	Suitable size of rectal tube
Infant	No. 12
Preschool age	No. 14 - 16
School age	No. 16 - 18
Adulthood	No. 22 - 30

Fig. 11.3-1: Rectal tube sizes and use by age

1. Cleansing enema

A cleansing enema is administered in order to clean the intestines when constipated, as part of the preoperative preparation of the digestive tract, as part of preparation for examination of the intestines or as preparation for birth. *High* and *low* cleansing enemas are recognized. A low enema is used to cleanse the rectum and the sigmoid colon and a high enema is used to cleanse the higher sections of the colon. The solution used in a high cleansing enema is as follows: Infants up to 250ml, toddlers and preschool children 500ml, school-age children 1,000ml and adults 1,000-1,500ml. The low form of cleansing enema is administered using approximately half the recommended liquid volumes. For adults, a few tablespoons of castor oil can be added into the warm liquid. The most commonly used low form of cleansing enema is Yal. It is recommended for cleansing the colon and rectum before examinations and before examination of the kidneys, urinary and genital organs where cleansing of the colon and rectum is a prerequisite. This also includes endoscopic and X-ray examinations (e.g. colonoscopy, rectosigmoideoscopy, proctoscopy etc.). Yal can also be used for preoperative preparation of the colon and rectum, e.g. haemorrhoidectomy, anal fissures, fistulae surgery, in colon and rectum surgery or before various gynaecological or urological surgeries. Yal can also be used as form of medical micro-enema in the treatment of severe cases of constipation. Another product used for cleansing the intestines before surgery is Fortrans (sachets with powder which is dissolved in 2 litres of water then drunk). The patient must be notified of the need to remain near the toilet.

Patient preparation

- The enema is administered in a designated room or in the patient's room using screens for immobile patients.
- The patient is explained the reason and the course of the procedure.
- The patient is instructed in the need to hold the liquid in as long as possible.
- The patient is warned about a feeling of discomfort during and after the procedure.
- The patient is put into appropriate position, usually on the side (see Fig. 11.3-1).

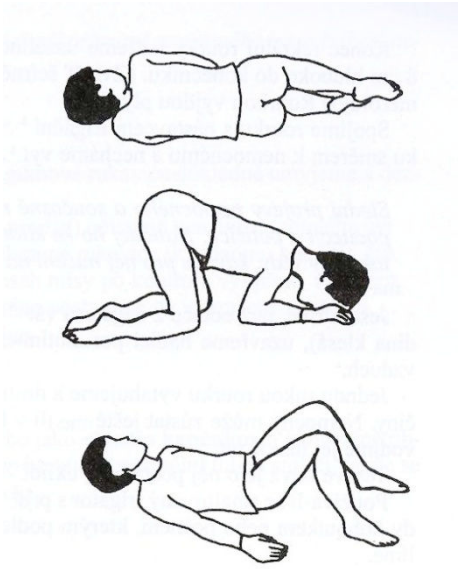

Fig. 11.3-1: Position of the patient during enema administration

Taken from: Rozsypalová, M., Haladová, E., Šafránková, A. *Ošetřovatelství II.* Vyd. 1. Praha: Informatorium, 2002, 239 s. ISBN 80-86073-97-1

Preparation of aids

Disposable mat, bedpan, enema kit – irrigator with a tube and stopper to regulate the flow of liquid (see Fig. 11.3-2), if the enema kit does not include a stopper, a pean can be used instead, solution, lubricant, mesocain, Vaseline, gloves, infusion stand for hanging the irrigator kit, squares of wadding, kidney bowl.

Fig. 11.3-2: Irrigator

Performing the procedure

- Place the disposable mat under the patient
- Put on the gloves
- Lubricate the end of the rectal tube for easier insertion
- Separate the gluteal muscles, making the anal opening accessible
- Insert the prepared rectal tube

- Wait for the passage of gas when administrating the rectal tube
- Connect the irrigator
- Regulate the speed of administering the solution (stopper, pean)
- After introducing the entire amount of the prescribed solution, remove the rectal tube and wipe it with the square wadding
- Ask the patient to clench the gluteal muscles together and hold for several seconds.
- Inform the patient of the need to hold the solution inside for at least 15 minutes

Patient care after the procedure

- Assess the patients reaction to enema administration
- Monitor the effect of the inserted drug, any pain, rectal bleeding, etc.
- Record the data in the nursing documentation
- Report any complications to a doctor immediately

Care of aids after use

- Decontamination of the aids used during the procedure
- Safely liquidate disposable materials.

2. Medical enema

When a medical enema is prescribed, the medicinal substances are introduced into the rectum usually via a micro-enema; a less commonly used method is an enema in droplet form.

Micro-enema

This is a form of enema administration, i.e. small liquid volumes (in adults 60 - 180 ml).

An example of a micro-enema solution used for cleansing the rectum is Yal, which is already prepared by the manufacturer in a transparent bottle with an attached applicator. The contents of the bottle must be thoroughly shaken before use and the sealed end of the applicator cut off (see Fig. 11.3-3). If administering a micro-enema with another solution, not originally prepared by the manufacturer, rinsing is done with a Janet rectal syringe and an appropriate sized rectal tube. Other aids are the same as for other types of enema.

Fig. 11.3-3: A bottle of Yal and the sealed tip of the bottle

Patient preparation

The preparation is the same for all types of enemas.

Preparation of aids

Disposable mat, bedpan, enema solution ready to use, lubricant, mesocain, Vaseline, protective rubber gloves, wadding squares, kidney bowl (see Fig. 11.3-4).

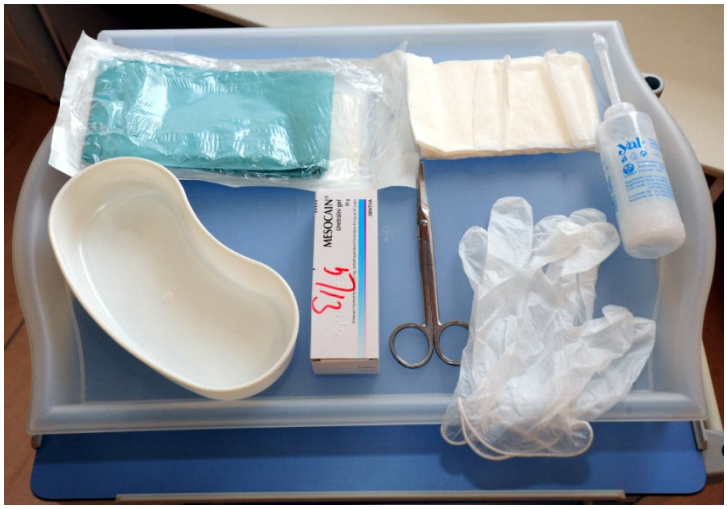

Fig. 11.3-4: Micro-enema aids

Performing the procedure

- Place the disposable mat under the patient.
- Put on the gloves.
- Ask the patient to breathe through their mouth (in order to relax the anal sphincter).
- Shake the medicinal solution.
- Cut off the sealed end of the applicator tip.

- Smear the end of the applicator with Vaseline or mesocain gel for easier facilitation.
- Use the non-dominant hand to separate the gluteal muscles, making entrance to the anus accessible.
- Keep pressing the plastic bottle and apply the solution into the rectum.
- After introducing the entire amount of the prescribed solution, remove the applicator tube and wipe it with the square wadding.
- Ask the patient to clench the gluteal muscles together and hold for several seconds.
- Inform the patient of the need to hold the solution inside for at least 15 minutes.

Patient care after the procedure and the care of aids is the same as for the cleansing enema.

Enema in droplet form

This form involves a slow, prolonged administration of the enema in the form of drops. The most frequently used is saline solution, which may contain prescribed drugs.

Patient preparation

Patient preparation is the same for all types of enemas.

Preparation of aids

Saline, infusion set, disinfectant solution, squares of wadding, thin rectal tube with inflatable balloon or traditional rectal tube, fixing tape, syringe to inflate the balloon; the other aids are the same as for the cleansing enema.

Performing the procedure

- Disinfect the top of the infusion bottle.
- Introduce the infusion set into the bottle with saline.
- Bleed the infusion set, close the stopper, hang the infusion bottle on a rack.
- Insert the prepared rectal tube.
- Connect the set.
- Fix the rectal tube in place by inflating the balloon or with the fixing tape.
- Set the drop speed (approx. 60 drops/min).
- Help the patient to take the appropriate position.

Patient care and care of aids after the procedure is the same as for the cleansing enema, see above.

3. Diagnostic enema

It is a procedure which involves introducing a contrast agent into the colon. It is part of irrigography, which is carried out in order to diagnose stenosis, dilatations, polyps, or colon tumours. The colon needs to be emptied before examinations using several high cleansing enemas. The patient, the aids preparation and the actual procedure is the same as when administering cleansing enema. Patient care after the procedure consists of checking bowel movement after the procedure, as some products used in diagnostic enemas may solidify and cause constipation, followed by stool impaction.

Task

- Educate yourself about other available cleansing enema products during clinical practice.
- Look for recommendations with regard to irregular bowel movement.
- Find out all available information concerning the "discharge reflex".
- Using medical literature, research the term "scybala".

Control questions

- How much solution is used in a high cleansing enema?
- What is the size of a rectal tube used with an adult?
- Name two basic forms of medical enema:
- What is the condition called where fresh blood is present in the stool?
- What is the condition called where the stool has a sweet odour?
- What is scybala?
- Put the individual steps of the procedure in a logical order:
    - Use the non-dominant hand to separate the gluteal muscles, making entrance to the anus accessible
    - Put on the gloves
    - Smear the end of the applicator with Vaseline or mesocain gel for easier facilitation
    - Shake the medicinal solution
    - After introducing the entire amount of the prescribed solution, remove the applicator tube and wipe it with the square wadding
    - Cut off the sealed end of the applicator tip
    - Ask the patient to clench the gluteal muscles together and hold for several seconds.
    - Keep pressing the plastic bottle and apply the solution into the rectum

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http://www.farmaceutika.info/yal#spc

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Keywords

Catheterization
Incontinence
Bladder emptying
Bowel movement

12. DRUG ADMINISTRATION

12.1 Drug administration per os

Objective

After studying this chapter, you should be able to:

- List the basic methods of drug administration;
- Characterize the basic forms of drugs, indicate the type of drug;
- Identify the expiration date of the drug;
- Describe the effects of the drugs;
- Explain the rules for storing drugs;
- Apply the principles of drug administration per os during clinical practice;
- Demonstrate this procedure using a model or simulator in the laboratory and later in clinical practice;
- Assess the risks of potential complications.

Purpose

- Drug administration for therapeutic purposes;
- Drug administration for prevention of disease;
- Control of undesirable disease symptoms;
- Replacement of substances missing in the body;
- Strengthening the body function.

Theoretical notes

Medicines are chemically heterogeneous substances of animal, vegetable or chemical origin, and carriers of a biological effect used to protect against diseases, diagnose and treat diseases and modify physiological functions.

A *drug* is any substance or mixture of substances administered to the patient in order to treat or control the symptoms of a disease, to affect the functions of the body, to determine the diagnosis or to prevent a disease. Pharmaceutical drugs are the finished final form. A patient can be administered drugs in various forms.

An *excipient* is a chemically heterogeneous substance that has no therapeutic effect on its own or in the amount used in manufacturing or preparation. However, it allows the preparation of the drug, the administration and improves the quality, stability and biological availability.

The effect, safety and quality properties in drugs are scientifically validated. When providing medical care, only the administration of registered drugs is permitted. Significant discoveries in drug research extended the offer of conventional first generation drug by second and third generation drugs. Physical properties in drugs, such as the release rate of the drug from the dosage form, solubility and dissolution rate became important.

In the administration of *first generation* drugs, the drug is rapidly released and absorbed and the created therapeutic concentration is rapidly decreased. A second dose of the drug has to be administered to restore the required concentration.

The *second generation of drugs* has controlled release and absorption. The drug is released from the preparation independently of the concentration. The product contains the initial dose that rapidly reaches therapeutic concentrations, while each time unit introduces into the organism the same amount of the drug, while the drug concentration in the blood is maintained for a period of 8 - 12 hours.

Third generation drugs are preparations capable of navigating the drug to the targeted organ and tissues while reducing its concentration. These drugs address the low specific affinity of drugs to a specific organ, the problem with equitable distribution of the administered drug in the body, which is usually the cause of side effects.

Names of drugs

Generic name – international marking of drugs, recommended by the World Health Organization (WHO). This name is given to the medicine before its admission to the official list of medicines (Pharmacopoeia).

Chemical name – provides an overview of the chemical composition of the drug.

Pharmacopoeial name – the main drug name under which it is registered in the official list of medicinal substances. It is either the same or similar to the generic name.

Production (brand) name – is the protected name for a drug produced by a pharmaceutical company. It is the name under which the drug is promoted and sold. The one and the same drug can have more than one brand name.

- Act No. 378/2007 Coll., on Pharmaceuticals and on amending certain other acts (Act on Pharmaceuticals)
- Act No. 167/1998 Coll., on addictive substances and on amending certain other acts
- Decree 54/2008 Coll., on prescribing medicinal products, information included in the prescription and on the rules of use of drug prescriptions

The list of drugs is prepared in the *Pharmindex Breviary* (see Fig. 12.1-1).

Fig. 12.1-1: General breviary, specialized breviaries

The breviary is prepared in two forms:

- MT General Breviary - annually published information on all medicinal products available in the CR.
- MT Specialized Breviary – ten Breviary lines for various medical disciplines, updated every two years

MT General Breviary 2011

The Pharmindex Breviary is published annually - late May/early June, and contains all necessary data on more than 3,500 drugs used in clinical practice in the Czech Republic.

The following data is disclosed for each drug: registered brand name, composition (active substance), indicating group, indications, contraindications, dosage, method of administration and form of dosage, package size, use by date, any prescribing restrictions, expiration date, the holder of the registration decision, the guide price and the maximum payment of the insurance company according to the VZP scale. The publication includes:

- Drug index by dosage form
- Drug index by indication group
- Drug index by active substances
- Company information on new products
- Addresses of all pharmaceutical companies and distribution agencies represented in the CR
- List of other important and useful addresses of important institutions

The Breviary in electronic form is also continually updated on the website www.tribune.cz

MT Specialized breviaries – disciplines "at a glance"

- Cardiology/Angiology
- Gynaecology/Obstetrics/ Urology
- Oncology/Hemato-Oncology/Nutrition
- Respiratory diseases/ORL
- Diabetology/Endocrinology/Gastroenterology
- Antimicrobial Therapy/Vaccines
- Dermatology/Medical Care
- Psychiatry/Neurology/Pain treatment
- Paediatrics/Vaccines
- Rheumatology/Osteology

Prescription – a written order for preparation and administration of a drug

Drug preparation:

- *Manufactured* – proprietary medicinal products
- *Individually* – individually prepared medicinal products - the so called medical supplements

Drug label requirements

Drugs intended for adults are labelled with *for adults*, and drugs intended for children – *for infants.*

The drug packaging label usually states:

1. Name of drug – (production, brand name)
2. Drug efficiency (in g, mg, in SI units, in %)
3. Drug strength – weight in g, mg etc.
    - *Forte* – a drug with higher active substance content
    - *Biforte* – a drug with a double strength effect
    - *Mitte* – a drug with a reduced active substance content
    - *Retard* – a drug that has a prolonged effect due to retarded absorption or conversion in the body.
4. Indication group – a group that is determined according to the intended drug use
5. Application – if the drug is prepared in the pharmacy, it is labelled for internal use with a white label and a red label indicates external use. Combustibles are labelled with a yellow label and poisons with black label and the words "Beware - poison".
6. Expiry date – the date which the drug can be used up to. The drug loses its value after the expiration date. The expiration date can be printed in two ways:
    - EXP 3 590611:
        - 3 – indicates the expiration period in years; it is added to the last two digits
        - 59 – production serial number
        - 06 – month of production (June)
        - 11 – year of production (2011)
        - To sum this up, the drug was manufactured in June 2011 and can be used up to June 2014.
    - The date of expiry is directly marked – e.g. 11/2012
7. Drug composition - individual active substances and quantities plus excipients.
8. Registration number – the number under which the drug is registered on the list of medicines.
9. Package contents – number of capsules, tablets etc.
10. Storage information – usually the recommended temperature, protection from light, moisture etc.

11. Warning – to store out of the reach and sight of children, and to return unused drugs to the pharmacy.

This information leaflet - a brief user guide which indicates the name of the drug, the composition, efficacy (g, mg, in SI units , in%), indication of group, method of use, drug strength, time of day when the drug should be taken, dosage, storage recommendations, indication – for which disease is the drug intended, possible side effects, contraindications - medical conditions that prevent or prohibit the administration of the drug, interactions - mutual interaction with other drugs, manufacturer's name and address, package contents, warning to store out of the reach and sight of children, date of last revision.

Ordering drugs

The drugs are ordered for each ward from the hospital pharmacy by a ward nurse according to the doctor's requirements. On the ward, drugs are kept in a customized medicinal lockable storage cabinet. The medicinal cabinet also has in built safe for storage of opiates and psychotropic substances. The keys are held by the duty nurse.

Principles of drug storage

- Drugs are always stored in their original packaging, so the dosage, composition, expiration date and production serial number can be checked at any time.
- Drugs in the ward medicinal cabinet are stored in alphabetical order, according to the method of use, internal and external use and injectable drugs.
- Ointments and pastes are usually stored in the designated refrigerator.
- Flammable liquids are stored in metal cabinets in the designated room with a ban on naked flames.
- Poisons are stored outside the medicinal cabinet.
- Each group of medicinal products in the cabinet must be clearly sorted so that each box is clearly visible.
- The nurse keeps the ward medicinal cabinet in order – regularly checks and maintains the content.
- Any lack of drugs is reported to the ward nurse who places a new order.
- The ward medicinal cabinet is located so that it cannot be accessed by unauthorized persons.
- The ward medicinal cabinet must not be placed next to the central heating or in direct sunlight.

Drug effects

- *Medical effect* is the main desired effect, which is expected from the drug. Side effect refers to an undesirable effect. A side effect is further classified as expected – can be expected as it results from the drug properties (e.g. a drug for lowering blood pressure in sensitive individuals can cause dizziness and fainting) and unexpected side effects that do not result from the drug properties.

- *Toxic effect* – harmful effect of the drug, e.g. as a result of an overdose, ingestion of external drug, accumulation of the drug in the blood due to metabolism disorder or excretion of the drug
- *Drug allergy* – allergic reactions after ingestion. The patient initially responds to a drug as to an antigen (a substance which the body treats as foreign and begins to produce antibodies), an allergic reaction may occur after repeated ingestion. The most serious allergic reaction, occurring immediately after administration of the drug, is an anaphylactic shock.
- *Drug tolerance* – low or decreasing physiological response to the drug, which leads to the required increase of the dosage to achieve the desired effect. This may be due to increased ability of drug degradation and excretion from the body.
- *Drug interactions* – the interaction occurs in the parallel use of two or more drugs, when the effects of one can be altered or interfered with by the other drug. Some drugs increase each other's effects; on the other hand, some negate them.

Drug forms

The most commonly used drugs have solid, semisolid, liquid or a gaseous form.

Solid drugs

Powders – pulveres (pulv.) have a loose consistency for internal or external use. They are manufactured in small sachets or in gelatine capsules for internal use. The powders can be divided into two groups according to their substance composition. The first group contains one active substance (pulveres simplices) and the second group is a mixture of multiple substances (pulveres compositi).

Tablets – tabulettae (tab.) - manufactured by compressing powder into a small solid disc. Some tablets are made with grooves for easier splitting. Tablets are intended for oral use. The tablets are packaged in tubes, glass bottles with wide necks, stripes, blisters, in which the tablets are individually sealed between two aluminium foils or cellophane. *Oral tablets* should be swallowed whole; they include a systemically acting drug.

Oral pastilles – are dissolvable in the mouth and contain a locally acting drug.

Sublingual tablets are inserted under the tongue and allowed to dissolve. They contain active substances with the overall effect.

Effervescent tablets – tabulettae effervescens (tbl.eff.) – are dissolvable in water and release CO2, creating a sparkling drink containing the dissolved drug. They must be protected from moisture so are packed in tubes containing a desiccant mixture. *Implant tablets* – applied under the skin, containing a long-acting drug.

Vaginal tablets – are applied to the vagina, containing a locally acting drug.

Diagnostic tablets - intended for laboratory use. Besides the above mentioned types of tablets, there are also tablets intended for *preparation of injectable solutions* - these are dissolved into a injection solution, or tablets intended for *preparation of solutions* - such as disinfectants, or for rinsing and compresses etc.

Coated tablets – tabulettae obductae (drg.) are coated to prevent premature dissolution of the drug in the acidic environment of the stomach. These drugs are intended for dissolution in the lower part of the digestive tract. They are not to be crushed, divided or chewed.

Pills – pilullae (pil.) – are forms of drugs with one or more drugs mixed into a cohesive material of various shapes. Nowadays, they are deemed obsolete due to new research developments.

Capsules – capsulae (cps.) – are drugs in a gelatine casing which slowly dissolves in the gastrointestinal tract. They do not irritate the gastric or intestinal mucosa. They are administered orally in the form of hard capsules (cps.dur.), soft capsules (cps.mol.) and round, transparent shapes - gelatinous pearls.

Granules – granula (gran.) – powder compressed into small irregular shapes, administered on a spoon or as semi-products, e.g. as a filling content in hard gelatine capsules.

Semi-solid forms of drugs

Ointments – unguenta (ung.) – based on fat (usually lanolin, petrolatum) with an active ingredient added. These are applied to the skin, mucosa.

Paste – pastae (pst.) – based on fat with an added 50% indifferent powder which forms the paste consistency. The paste does not stick and is porous. It is mostly used to protect the skin against maceration; it is not absorbed into the skin.

Creams – cremores (crm.) – are ointments with high water content. Like ointments, the creams are packed in tubes to limit the access of air, contamination by microorganisms and to prevent water evaporation. This maintains the lasting effect of the ointments and creams.

Gels - clear substances; the medicinal substance is mixed with the gel. These are applied to the skin. Topical (local) gel preparations are applied to the skin and mucous membranes. Gels are mostly used for massaging muscles and joints.

Suppositories – suppositoria (supp.) – produced from glycerol gelatine or cocoa butter with added medicinal substances. They have a cylindrical or conical shape to facilitate insertion into the rectum. They have a local or overall effect.

Vaginal globules – globuli vaginales (glob.vag.) – these are sphere shaped and are introduced into the vagina, the production is similar to suppositories and are dissolved by the body temperature.

Soaps – sapones (sap.) containing active substances, such as sulphur and tar, they are used in dermatology.

Plasters – emplastra (empl.) - stick to the skin and are impregnated with active substances. *Transdermal plasters (emp.tdr.)* – enable active substances to penetrate the skin and tissue, to absorb and provide the general effect. They consist of a backing layer, the drug layer and the protective film, which is removed prior to application.

Liquid forms of drugs

Solutions - solutiones (sol.) - containing active substances dissolved in a solvent such as physiological saline. They are administered in drops – guttae (gtt.) or in measuring cups. They are mostly administered into the eyes, ears, nose and mouth. For oral administration, the drug can also be taken on a spoon in the form of syrup. The syrup may be in powder form, known as “dry syrup”, which is diluted before application by adding water. Gargle – gargarisma (ggr.) - intended for application as a mouth wash.

Mixtures – mixturae (mixt.) are active substances with several dissolved medicinal substances. If the mixture contains an insoluble matter, it tends to settle at the bottom. Therefore, it is desirable to shake the mixture thoroughly prior to administering.

Tincture - tincturae (tinc.) – alcohol or water and alcohol based solutions prepared from medicines usually derived from plants. If the tincture is prepared from one plant, its name is clarified with the term "simplex", and if it is prepared from more than one plant, the name is clarified with the term "composite". They must be protected from light.

Suspension - suspenziones (susp.) – drugs where active substances are mixed with gel. They are taken orally, usually to protect the gastric mucosa.

Extracts – extrakta (extr.) – contain active drugs extracted from a dried plant leached in alcohol or water.

Emulsion - emulsiones (eml.)- consists of two or more liquids which do not bind together. One is in the form of droplets dispersed in the other, e.g. body lotion and massage emulsion. Besides liquid emulsions, there are also "dry emulsions", which must be diluted by water before use.

Tea - species (spec.) – prepared from dried plants in the form of decoction or infusion. Other preparations of dried plans with medicinal effects include bath lotions and compresses.

Gaseous forms of drugs

Foam – spumae (spm) is applied in a thin layer on the skin by releasing the compressed air from the protective container. It is applied from a distance of 1-4 cm, spread or rubbed in.

Aerosols – a colloid of fine solid particles or liquid droplets in the air or another gas. The particle size is less than 0.5 micron, colloidal particles are comprised of non-volatile substances in air or another gas; the particle size is in the range of 0.5-5 microns. The desired particle size is achieved by means of nebulizers - devices used in the application of aerosols.

Sprays are liquids in the air where the particle size is greater than 5 μm. For inhalation, particles less than 10 μm are used.

Methods of administering drugs

Drugs can be administered into the body in different ways. The choice of the method depends on the nature of the drug, the desired onset, duration of the effect, age and the current medical condition of the patient. Methods of administering drugs:

Enteral – the drug enters to the body by absorption through the gastrointestinal tract. These include:

- Sublingual – underneath the tongue;
- Oral - through the mouth;
- Rectal - through the rectum.

Parenteral – a drug enters the body via the parenteral route (outside the digestive tract), e.g. by injection:

- Subcutaneous injection (SC) – into the subcutaneous tissue;
- Intradermal injection (ID) – into the skin;
- Intramuscular injection (IM) – into the muscle;
- Intravenous injection (IV) – into a vein;
- Intra-arterial injection – into an artery;
- Intraosseous injection – into the bone marrow.

Local – a drug is applied to the skin or mucous membranes, this group also includes installation and irrigation drugs, which are administered into body openings and cavities (eyes, ears, nose, mouth, bladder, rectum, vagina). The last group of drugs administrated locally consists of inhalation aids designed to administer drugs through the respiratory tract.

The onset of the drug effect by method of administration

The effect of a drug depends upon the method of administration, the quantity and strength, drug interaction, drug tolerance etc. The drug onset is shown in Table 12.1-1.

Method of administration	Drug onset
Oral – per os	30 min.
Under the tongue – sublingually	1-2 min.
Into eyes, ears	1-2 min.
Into airways	2-3 min.
On skin, into skin	15 min.
Into the vagina	15min.
Rectum – per rectum	15 min.
Injected into veins	1 min.
Injected into arteries	Immediately

Fig. 12.1-1: The onset of the drug effect by method of administration

Principles of drug administration per os

Oral drug administration is the most common and simplest way, if the patient is able to swallow and keep the drug in the stomach. Oral administration of drugs is contraindicated for example, if a patient vomits, is connected to the stomach or intestinal extraction, in an unconscious patient or in patients unable to swallow. When administering a drug, the following principles must be focused on and adhered to:

- Hygiene – wash your hands before handling drugs.
- Drugs are distributed by a nurse who uses a mobile trolley with lockable drawers.
- Full concentration and a repeated check of the administered drug (name, form, strength, dose, method and time of administration) - when the drug is taken out of the original packaging (box), check the drug blister, bottle, stripe and once again when reinserting the drugs into the original package and returning the box to the other drugs.

- Patient identification – check the identity of the patient by asking their name, or by checking the ID on the patient's wristband.
- If the medical condition of the patient permits, the patient must be informed of the use of medication.
- Drugs are administered regularly and at set times – most drugs are administered 3 times a day. Some drugs are served before meals; others after meals, the specifics of the administration of certain classes of drugs must be respected.
- The nurse must not amend the doctor's prescription; replace the drug with another drug or by another form of drug. If the drug is not available, it is necessary to arrange the delivery or to ask the doctor for a new prescription.
- Drug prescription – the doctor records in the daily report the accurate name of the drug, drug form, time of administration, method of administration, the exact amount of each dose, daily dose. (Example: Xyzal 2x1 tbl., Nootropil 1200mg 1-1-0, Diazepam 5mg evening, Paralen as required). The patient's condition is assessed before administering the prescribed drug.
- Check if the patient actually took the prescribed drug.
- It is necessary to recognize the desirable and undesirable effects of drugs, and report any occurrence of adverse reactions to the attending doctor and enter a record of the incident in the nursing documentation.
- Each drug administration must be recorded in the nursing documentation as is customary on the ward.

Patient preparation

- Inform the patient in a reasonable and understandable manner of the reasons for drug administration and of the type, method of use and effects.
- Assess whether the patient is able to take the medication orally.
- Inform the patient of the need to report any incidence of adverse drug reactions – heart palpitations, hot flushes, nausea, vomiting, itching, rash, etc.
- Inform the patient of the need to comply with specific principles for drug use – on an empty stomach, after meals, between meals, at regular intervals, limited exposure to the sun etc.
- Inform the patient of the appropriate and inappropriate types of drinks to wash the drug down with.
- Inform the patient of the expected effects of the drug.
- Inform the patient of the specific effects of the drug, e.g. diuretics - frequent urination.

Preparation of aids

Prescribed medication in the original packaging, drug records, daily drug report including prescriptions, clean dry pill boxes, spoons, teaspoons, measuring cups, original dispensers in the form of syringes (included in the original drug packaging), pill splitter, cellulose squares,

tweezers to remove the drug from the bottles, kidney bowl, container for disposal of halved drug residues (Fig. 12.1-2), suitable liquids to wash down drugs, drug crushing bowl.

Fig. 12.1-2: Aids for administering drugs per os and documentation trolley

Performing the procedure

- Medications are always prepared in the room by the patient's bedside; the relevant documentation is available on the documentation trolley (see Fig. 12.1-2)
- The patient is put into an appropriate position, i.e. sitting or semi-sitting; if necessary, the patient's physiological functions are measured prior to drug administration which may affect their values.
- Avoid contamination of the drugs with own hands.

Solid drugs:

- Each drug that is put into the pill box is immediately marked in the drug documentation with a tick. The record of drug administration can vary as is customary on the ward. Example: Novalgin gtt. p.o. 20-20-20 or Novalgin gtt. p.o. 20 -20//20. The dose indicated after the double angled line is the indication of the morning dose on the next day.
- If the patient refused the drug, the appropriate dose is circled in the documentation. If the drug is administered, the dose is ticked off. If the patient refuses the analgesic, the nurse records this in the nursing documentation together with the VAS (Visual Analogy Scale), i.e. the pain the patient indicates on the 10 point scale. If the drug is administered as needed the nurse must always make a record of the administration time.

- The required number of tablets is put into the pill box directly pressed out of their blisters or strips.
- A single pill box holds all solid forms of drugs intended for one dose.
- The tablets, pills and capsules are not to be chewed; the patient swallows them whole and washes them down with plenty of liquid.
- If prescribed ½ or ¼ of a tablet, the nurse divides the tablet with a pill splitter. Using tweezers, put a tablet in the pill splitter, close the lid and open again. Remove the already split tablet with tweezers and dispose of the second half.
- If the patient has difficulty swallowing, crush the tablets in a bowl or between two spoons, dissolve in a suitable liquid and give it to the patient to drink.
- Effervescent tablets are dissolved in a glass filled halfway with water, which immediately after dissolving is given to the patient.
- In the sublingual method of administration, the patient is asked to open their mouth and place the tongue on the roof of the mouth, place the tablet under the tongue and ask the patient to press with their tongue on the tablet until it dissolves.

Liquid forms of drugs:

- When pouring the medicine on a spoon/teaspoon, into the measuring cup, it is necessary to take a precaution not to damage the label on the packaging and its readability.
- Hold the measuring cup at eye level.
- When administering drops, hold the bottle with the medication upright over the measuring cup and count the exact number of prescribed drops.
- The patient is given enough liquid to wash the drug down. Appropriate drinks are: water, tea, water with syrup; less suitable are coffee and milk and alcohol is inappropriate.
- Pay attention to the use of the drug by the patient. If the patient is not able to hold their pill box in their hand, put the drug directly into their mouth.
- Check the patient's mouth to confirm that they swallowed the drug.
- Record data in the nursing documentation.

Patient care after the procedure

- Evaluate the expected effects of the drug after the time the drug should have started to take effect.
- Monitor possible adverse effects.

Care of aids after use

- The tray with drugs is stored in the medicinal cabinet and the cabinet is locked.
- Patient documentation is put in the designated place.

- Wash the used measuring cups, spoons, teaspoons, kidney bowl.
- Refill the missing drugs.

Complications of the procedure

- The patient is unable to swallow the drug.
- The patient pretends that they swallowed the drug.
- Confusion and restlessness of the patient.
- The patient does not follow the recommended time of drug administration, form or duration when at home.
- The patient masks the signs of the ineffectiveness of the drug.

Task

Prepare an overview of the most commonly prescribed drugs in the clinic and their inclusion in therapeutic groups.

Add information of any adverse reactions for the groups of drugs according to the Pharmindex Breviary.

Mark the option of replacing the drug with another, according to the composition indicated in the Breviary.

Control questions

1. What is a generic drug name?
2. List the principles for administering drugs.
3. Which statement is correct?
    - Drug onset administered by another method than per os is always longer than 30 minutes
    - Drug onset administered by another method than per os is usually longer than 30 minutes
    - Drug onset administered per os is usually within 30 minutes after administering
4. What does VAS mean?
5. Which aids are needed for administering drugs per os?

6. Complete drug onset for the following methods of administering drugs:

Method of administering	Drug onset
per os	
Sublingually	
On skin	
In the rectum	
Intravenously	
Injected into arteries	

7. Name three options for generally dividing methods of administering drugs:
8. What do the following abbreviations mean (in English and Latin):
    - tbl. eff., drg., cps., supp., ung., sol., extr., eml., tinc., spec., spm.

12.2 Other methods of administering drugs

Objective

After studying this chapter, you should be able to:

- Explain the principles of applying drugs to the skin;
- Explain the principles of drug installation to the eyes, nose, ears;
- Explain the principles of administering drugs into the rectum;
- Explain the principles of administering drugs to the respiratory tract;
- Demonstrate this procedure using a model or simulator in the laboratory and later in clinical practice.

Applying drugs to the skin and mucous membranes

Objective

After studying this chapter, you should be able to:

- Explain the principles of applying drugs to the skin;
- Apply various forms of drugs to the skin;
- Describe the differences between various types of dermatological medications.

Purpose

Dermatological medications are administered for the purpose of moisturizing and softening the skin, relieving itching, increasing or decreasing skin secretion, creating a protective coating on the skin, creating local vasoconstriction or vasodilatation etc. They are applied to the skin in the form of ointments, pastes, creams, foams, solutions, gels, transdermal therapeutic plasters etc.

Theoretical notes

Drugs applied to the skin must overcome the phospholipid barrier created by the squamous epithelium of the skin surface. The speed of absorption of the drug depends on the size of the epithelium and on the transfer through the stratum corneum. Dermatological medications (applied to the skin) can also be applied to the nose, ears and rectum. Resorption of the drug through the mucosa is similar to absorption through the skin, with the difference that the mucosal epithelium does not contain a calloused layer. Therefore, the permeability of a drug through the mucosa is considerably higher.

General principles of applying drugs to the skin and mucous membrane

- A dermatological preparation is applied to the skin with a wooden spatula. *Never put the wooden spatula back in the ointment or the cream container once it has touched the patient's skin!*

- A dermatological preparation is applied in sufficient quantities at an exactly specified time.
- Pay special attention to gently washing the skin with warm water before reapplying the drug.
- Special attention is given to the application of sprays and powders, as for example they can cause asthma attacks in asthmatic patients; when applying to the face, protect the patient's eyes.
- If necessary, replace the bed linen and the patient's pyjamas.

Patient preparation

- Inform the patient of the type of medicament applied, the reason of its use and the application procedure.
- Inform the patient about the effects of the administered drug.
- Instruct the patient not to scratch the areas where the drug was applied.
- Inform the patient of the need to report any side affects (e.g. burning, redness, severe itching etc.).
- Inform the patient of the need to avoid sunlight during treatment, e.g. in tar preparation treatment.
- Provide appropriate privacy during the procedure.

Preparation of aids

basic aids required for applying drugs to the skin, prescribed dermatological medications, hot water or another solution to clean the skin, gauze squares, wooden spatulas, hydrofile bandages, scissors, strips of tape, kidney bowl, disposable rubber gloves, clean pyjamas, personal protective equipment, daily report with drug record (see Fig. 12.2-1).

Fig. 12.2-1: Aids for applying ointment to the skin

Performing the procedure

- Check the doctors prescription, and the identity of the patient
- Put the patient in the appropriate position.

- Expose the part of the area to be treated.
- Assess the condition of the patient's skin.
- Put on the gloves.
- Clean the area with warm water or herbal decoctions, use hypoallergenic soap, oil etc.
- Dry the skin thoroughly using hydrofile squares. Do not rub the skin!
- Apply the dermatological medication to the dry skin, clean any previous residues. The application of dermatological medications is listed in Table 2.
- All changes in the skin are recorded during the course of treatment. Any changes are immediately reported to a doctor.

Type of dermatological medication	Application
Ointment	Use a wooden spatula to scoop the ointment out of the container or squeeze it out of the tube directly onto the skin. Smear the ointment gently. Smaller areas are treated with ointment applied to a hydrofile square, placed on the skin and fixed with a hydrofile bandage and plaster tape
Cream	Apply cream on the skin and spread with the hand in long circular motions. This method is contraindicated if the skin is damaged or the skin is damaged due to disease.
Paste	Use a wooden spatula to apply paste around the wound in a 2 - 3 mm layer. The wound can be covered with a sterile hydrofile square. The paste is used to protect the skin against irritating secretions.
Liquid powder	Thoroughly shake the liquid powder before application. Apply using a sterile swab and leave to dry without a cover. Liquid powders are washed after 2 – 3 days.
Talcum powder	Talcum powder is applied directly from the bottle to the affected area or by using a cotton swab. Skin areas that are touching must be separated with gauze squares.
Solution	Apply warm, lukewarm or cold compresses. Gauze squares are soaked in the solution as prescribed by a doctor, attached to the affected area and bandaged.
Plaster	Wash and thoroughly clean the affected area before applying the plaster; the absorption of the active substance will increase in due course.

Fig. 12.2-1: Application of various types of dermatological medication

Patient care after the procedure

- Assess the patient's response after applying the dermatological medication;
- Help the patient to get dressed;
- Assess the patient's response after the expected time of drug onset;
- Record the procedure.

Care of aids

- All used aids are disposed of in the designated waste bins.
- Instruments are placed into the prepared disinfectant solution.
- Ensure safe disposal of disposable and biological materials.

Instilling drugs to the eyes

Objective

After studying this chapter, you should be able to:

- Explain the principles of instilling drugs into the eyes;
- Instilling eye drops and eye ointments.
- Instill eye irrigation.
- Demonstrate this procedure using a model or simulator in the laboratory and later in clinical practice;
- Assess the risks of potential complications.

Purpose

There are many indications for instillation such as eye pain, eye infection, glaucoma, allergy, eye surgery, removal of a foreign body, prevention of neonatal conjunctivitis. The eye irrigation procedure is instilled for example in the case of a eye contact with a chemical substance or the removal of a foreign body.

Theoretical notes

Administration of a drug into a body cavity is called instillation. Rinsing of a body cavity is called irrigation. Eye conjunctiva is treated with ophthalmological medicine – in the form of solutions (eye drops) or ointments. Eye drops are prepared by the manufacturer or by a pharmacy. Eye ointments are packed in small tubes with an applicator adapted to the application.

Patient preparation

- Inform the patient of the type of medicament applied, the reason for its use and the application procedure.
- Inform the patient about the effects of the administered medication.
- Assess the condition of the eye and around the eye, look for signs of redness, secretion, tearing, swelling.
- Observe the patient's behaviour in connection with the eye disease (blinking, rubbing the eye…).
- Find out the feelings of the patient in relation to the eye disease (itching, burning, pain, cutting etc.).
- Inform the patient of the need to report any side affects (e.g. burning, redness, severe itching etc.).
- Put the patient into an appropriate position, the sitting or supine position to allow the solution to drip from the eye into the kidney bowl and not into the other eye.
- Protect the patient's clothes with a waterproof pad.

Aids preparation (see Fig. 12.2-2)

For instillation	**For irrigation**
Prescribed medicine, eye drops, ointment	Prescribed solution
Wadding cut into squares	Eye bath
Kidney bowl	Kidney bowl
Light source	Light source
Scissors, plaster (for eye protection)	Wadding cut into squares
	Scissors, plaster (for eye protection)

Fig. 12.2-2: Aids for instilling medication into the eye

Fig. 12.2-2: Aids for instilling medication into the eye

Performing the procedure

- Check the doctor's prescription, and the identity of the patient.
- Clean the affected area using a sterile swab moistened with sterile solution, from the medial to the lateral corner.
- Instill the medication.

For eye instillation

- Draw the required volume into the drops applicator.
- Ask the patient to look upwards.
- Make the conjunctiva accessible; use the non-dominant hand to pull the lower lid down, holding square of pulp with a thumb.
- Bring the drop applicator 1 – 2 cm above the eyeball and drip in the prescribed number of drops.

For ointment instillation

- Hold the eye ointment with the applicator above the pulled down lower lid.
- Squeeze the ointment from the medial to the lateral corner.
- Ask the patient to close their eyes, which will spread the ointment over the eyeball.

For irrigation using an eye bath

- Wipe the eye and around the eye using a sterile swab.
- Ask the patient to lean forward.
- Press the eye bath tightly on to the eye area to stop the solution leaking.
- Ask the patient to bend backward.
- The irrigated eye must be left open; the patient is asked to move the eyeball up and down.
- Ask the patient to lean forward again and remove the eye bath.
- Empty the used solution into a kidney bowel.
- Dry the area around the eye.
- If necessary, cover the eye with sterile gauze square and fix it in place using tape.

Patient care after procedure

- Assess the patient's response during the procedure.
- Assess the patient's response after the procedure and after the expected time of drug onset.
- Observe and record any painful symptoms experienced by the patient.

Care of aids after use

- Used aids are placed in the designated area for aid disinfection at the relevant ward.
- Ensure safe disposal of disposable and biological materials.

Instilling drugs to the ears

Objective

After studying this chapter, you should be able to:

- Explain the principles of instilling drugs into the ears;
- Apply liquid medicines and ointments in the ears;
- Perform ear irrigation;
- Demonstrate this procedure using a model or simulator in the laboratory and later in clinical practice;
- Assess the risks of potential complications.

Purpose

The ears are treated with medicaments in liquid form or ointment due to inflammation, ear surgery and trauma or due to the removal of a foreign body from the ear. Ear irrigation is usually performed as part of the hygienic cleansing.

Patient preparation

- Inform the patient of the reason, nature and course of the procedure.
- Inform the patient about the effects of the applied medicine.
- Inform the patient of potential effects when instilling the medicine in the ear – a feeling of pressure, warmth, tension etc.
- Ask the patient to monitor the effect of the medication and to report any adverse effects.
- Ask the patient for cooperation when instilling the medication.
- Put the patient in the appropriate position.

Aids preparation (see Fig. 12.2-3)

For instillation	For irrigation
Prescribed medicine, ear drops, ointment	Prescribed solution
Cleansing ear solution	Syringe for solution
Wadding cut into squares	Wadding cut into squares
Kidney bowl	Kidney bowl
Light source	Light source
	Waterproof pad
	Protective gloves

Fig. 12.2-3: Aids for instilling medication into the ear

Performing the procedure

- Check the doctor's prescription, and the identity of the patient.
- During instillation: The patient lies on their side or sits on a chair, while bringing the healthy ear closer to the shoulder or resting on the pillow.
- During irrigation: The patient is asked to sit on their side so that the ear for instillation is accessible and the solution after irrigation can flow freely into the kidney bowel held below the ear. Protect the patient's shoulder with a waterproof pad.
- Assess the condition of the ear and the external auditory meatus (swelling, discharge, bleeding…).
- Notice the nature and volume of discharge.
- Instill the medication.

When instilling ear drops:

- Straighten the ear canal – in children by pulling the ear, in adults by pulling upwards and backwards.
- Carefully instill the drops from a height of 3 – 5 cm.
- Clean the leaking residues using a square of wadding.
- Ask the patient to remain in the position for about three minutes, to prevent premature draining of the solution from the ear.

When instilling ear ointment:

- Secure the patient's head in the temple area in order to prevent injury from unexpected movement of the head.
- Instill the ointment into the external ear canal using a swab.

For ear irrigation

- Straighten the ear canal – in children by pulling the ear, in adults by pulling upwards and backwards.
- Gently insert the cone syringe with the liquid into the external ear canal while directing the flow of the solution upwards.
- Instill the solution slowly, a fast flow could cause pain and damage the eardrum.
- Instill the entire volume of the solution from the syringe, until the ear canal is clean.
- Wipe the area around the ear using a wadding square.
- Monitor the patient's condition throughout the procedure.
- Record the procedure in the patient's documentation.

Patient care after the procedure

- Assess the effects of the instilled medication.
- Observe the patient's condition after instilling the medication.
- Observe and record any painful symptoms experienced by the patient.

Care of aids

- Store prescribed drugs in the specified place in the medicine cabinet.
- Decontaminate the aids used during the procedure
- Ensure safe disposal of disposable and biological materials.

Instilling drugs to the nose

Objective

After studying this chapter, you should be able to:

- Explain the principles of instilling drugs into the nose;
- Instill liquid medicines and ointments into the nose;
- Instill nose irrigation;
- Demonstrate this procedure using a model or simulator in the laboratory and later in clinical practice;
- Assess the risks of potential complications.

Purpose

The administration of medication to the nasal mucosa is usually in the form of drops, sprays (corticosteroid, antiallergics) or ointments for inflammation of the nasal cavity and paranasal sinuses, in reduced blood flow to the nasal mucosa, nasal trauma, surgery of the nasal cavity

and the presence of foreign bodies in the nasal cavity. The nose irrigation is usually instilled as part of the hygienic cleansing.

Patient preparation

- Inform the patient of the reason, nature and course of the procedure.
- Inform the patient about the effects of the applied medicine.
- Inform the patient of the potential effects of instilling the medicine into the nose.
- Find out if the patient is suffering discomfort such as painful itching in the nasal cavity etc.
- Find out if there are any obstacles to breathing through the nose – e.g. large amounts of mucus.
- Note the nature and volume of discharge.
- Ask the patient to monitor the effect of the medication and to report any adverse effects.
- Ask the patient for cooperation when instilling the medication.

Aids preparation (see Fig. 12.2-3)

Prescribed medicine, swabs, wadding squares, kidney bowl, applicator for nasal irrigation.

Fig. 12.2-3: Aids for instilling medication into the nose

Performing the procedure

- Check the doctor's prescription, and the identity of the patient.
- Ask the patient to blow their nose.
- Put the patient into a suitable position, i.e. sitting or semi-sitting with head bent back.
- Remove any impurities from the nose.
- Assess the condition of the nasal cavity (inflammation, secretion, blood etc.).
- Instill the medication to the nose as prescribed by a doctor.

To instill drops

- With the non-dominant hand, gently press on the tip of the nose, expanding the nostrils.
- Hold the drops just above the nostrils.
- Ask the patient to breathe through their mouth.
- Instill the required number of drops to each nostril toward the centre of the nasal septum.
- Do not touch the nasal mucosa with the applicator.
- For children, it is recommended to swab the nasal mucosa with a piece of gauze moistened with the prescribed medication.
- Ask the patient to remain in the initial position for about 1 minute, thus preventing premature drainage of the medication from the nose and to allow the solution to reach the entire mucosal surface.

When applying ointment

- Apply the ointment on the gauze swab in a circular motion to cover the entire swab while pressing on the tube.
- Using the swab, apply the ointment on the patient's nasal mucosa.
- Observe the patient's response during the procedure.

For nasal irrigation

- Ask the patient to bend forward.
- Ask the patient to hold the pulp square in case of leakage from the nose.
- Gently press on the side of one of the nostrils in order to block it.
- Apply the prepared solution with a strong stream to the other nostril by pressing the applicator used to instill the medication into the nose.
- Dry the area around the nose with a wadding square.

Patient care after the procedure

- Record the procedure in the patient's documentation.
- Assess the effects of the instilled medication.
- Observe the patient's condition after instilling the medication.
- Observe and record any painful symptoms experienced by the patient.

Care of aids

- Store prescribed drugs in the specified place in the medicine cabinet.
- Decontaminate the aids used during the procedure
- Ensure safe disposal of disposable and biological materials.

Administering drugs to the rectum

Objective

After studying this chapter, you should be able to:

- Explain the principles of administering drugs into the rectum;
- Administer liquid medicines and ointments into the rectum;
- Administer an enema;
- Demonstrate this procedure using a model or simulator in the laboratory and later in clinical practice;
- Assess the risks of potential complications.

Purpose

Drugs are administered into the rectum in liquid form, as ointment (for rectal varices - haemorrhoids) or in the form of suppositories. The effect is local (such as intestinal antiseptics, laxatives) or overall (e.g. in the administration of analgesics, antipyretics, spasmolytics, anti-emetics, etc.). Drug absorption is faster if the rectum is emptied. The effect of the administered drug takes 15 minutes.

Patient preparation

- Inform the patient of the reason, nature and course of the procedure.
- Inform the patient about the effects of the medicine.
- Inform the patient of possible effects after administering the drug into the rectum (feeling of fullness, urge to empty the bowel etc.).
- Inform the patient of the need to hold the administered drug for at least 15 - 20 minutes, despite the feeling of pressure in the rectum.
- Ensure the patient's cooperation during the procedure.
- Ask the patient to monitor the effect of the medication and to report any adverse effects.
- Put the patient into an appropriate position – on their side with their legs bent.

Aids preparation (see Fig. 12.2-4)

Prescribed drug (suppository, ointment, solution), disposable rubber gloves, wooden spoon, cellulose squares, Vaseline, mesocain, disposable mat, bedpan, toilet paper, kidney bowl and perforated attachment for the tube of ointment.

Fig. 12.2-4: Aids for administering suppositories into the rectum

Performing the procedure

- Check the doctor's prescription, and the identity of the patient.
- Ensure patient privacy and dignity during the procedure.
- Place the disposable mat under the patient.
- Have the bedpan ready near the patient in case it is needed.
- Administer the medicine.

When applying ointment

- Gently wash the rectum and the anus with warm water.
- Dry the area.
- Put on the gloves.
- Put the attachment on the ointment tube.
- Apply the ointment directly into the rectum.
- Ask the patient to clench the gluteal muscles together and hold for several seconds.
- Assess the patient's response during the procedure.

When administering suppositories

- Put on the gloves.
- Ask the patient to breathe through their mouth (in order to relax the anal sphincter).
- Use the non-dominant hand to separate the gluteal muscles, making the entrance to the anus accessible.

- Introduce the suppository into the internal anal sphincter, in children up to 5 cm deep, in adults up to 10 cm deep using the index finger of the dominant hand.
- Ask the patient to clench the gluteal muscles together and hold for several seconds.
- A self-sufficient patient can administer the suppository by themselves.
- Immobile patients are allowed to wash their hands after administering the drug.

Patient care after the procedure

- Record the procedure in the patient's documentation.
- Assess the effects of the administered medication.
- Observe the patient's condition after administering the medication.
- Observe and record any painful symptoms experienced by the patient.
- Report any side effects immediately to a doctor.

Care of aids

- Store prescribed drugs in the specified place in the medicine cabinet.
- Decontaminate the aids used during the procedure.
- Safely liquidate disposable materials.

Task

- Prepare the list of the most commonly prescribed drugs in clinical practice for the above methods of administering.
- Allocate the listed drugs to the indicated drug group.
- Add information of any adverse reactions for the groups of drugs according to the Pharmindex Breviary.
- Identify special traits when administering drugs for the above methods.
- Find more information about neonatal conjunctivitis.
- Research and record in which bones are paranasal sinuses.

Control questions

- What forms the skin structure?
- What is the group of drugs intended for application to the skin called?
- What is the technical term for inserting a drug into a body cavity?
- Define the term "neonatal conjunctivitis".

- Put the individual steps for the eye irrigation procedure in the correct order:
    - The patient moves their eyeball up and down
    - Empty the used solution into a kidney bowl
    - Ask the patient to bend the head backward and to hold the eye bath firmly in place
    - The patient leans forward after the eye irrigation
    - Ask the patient to lean forward again and remove the eye bath
    - The eye bath with the solution is pressed tightly to the surroundings of the eye
- In which bones are the nasal sinuses?
- List the indicated group for these drugs:
    - Supositoria glycerini, Torecan supp., Ophtal aqua

12.3 Administering drugs into the respiratory tract – inhalation

Objective

After studying this chapter, you should be able to:

- Define the term "inhalation";
- Explain the purpose of inhaled drugs;
- Use correctly selected types of inhalers;
- Prepare aids for inhalation;
- Apply the principles of correct inhalation;
- Implement the correct procedure for nebulization.

Purpose of inhaling drugs

- Dilution of secretion in the airways (secretolytic agent – most suitable are salty mineral water, Vincentka etc., essential oils: pine and eucalyptus oil; herbal extracts: Plantain, ivy);
- Control of mucosa inflammation and treatment (mineral waters containing calcium and iron which reduce the irritation cough);
- The release of mucus from the airways (mucolytics such as acetylcystein – ACC, Flavamed, Ambrosan, Mucosolvan, Bromhexin, Mistabron and others);
- Relaxation of the bronchi muscles in order to extend or maintain adequate lumen (inhalation bronchodilators, e.g. Ventolin, Atrovent).

Theoretical notes

Inhalation is intentional and purposeful inhalation of the active substance in the form of powder, gas or vapour into the respiratory tract. Two types of inhalation are recognized. *Natural inhalation (climate)* is by inhaling minerals on the sea shore or balsamic essential oil after rain in a coniferous forest. *Artificial inhalation* is by using compressed air, steam, gas or ultrasound, when the medical substance is dispersed into small droplets or into a nebula.

The respiratory mucous membrane easily and quickly absorbs drugs prepared in the form of gas, vapour or fine dust. The drug onset is approximately 2 – 3 minutes. Drugs administered to the respiratory tract (including oxygen) are prescribed by a doctor especially for chronic obstructive pulmonary disease (CHOPN), cystic fibrosis or cardiopulmonary resuscitation.

Active substances can be inhaled through the mouth, nose, without aids or equipment (e.g. oxygen mask, tent or mouthpiece) by mechanical ventilation, for example through a tracheostomy cannula.
Inhalation is applied individually. Group inhalation sessions are not suitable due to the potential transmission of infection among other participants.

The effect of the inhaled medicinal substance depends on the pharmacological composition, on the concentration level, particle size, breathing pattern (frequency and depth of breath).

Indications for inhalation therapy

- Infectious respiratory disease
- Respiratory disease based on an allergy
- Chemical and physical damage to the lining of the airways
- Trauma and post surgery respiratory damage
- Chronic respiratory disease
- Facilitating expectoration in bedridden patients.

Inhalation systems
Currently there are many types of inhalation drugs available in various forms of inhalation systems.
1. Aerosol dispensers (PMDI - pressure metered dose inhaler)

- This is a small pocket inhaler (see Fig. 12.2-5).
- The patient presses the bottom of the container to release (set) a dose of aerosol and inhales in the standard manner.
- Patients carry their inhalers at all times.
- This method of inhaling requires very precise coordination of breathing and using the inhaler.
- Various metered inhalers (e.g. Easi-Breathe, Respimat SMI) are triggered only by the patient inhaling.

Fig. 12.2-5: Pocket metered inhaler

Using a metered aerosol inhaler without an attachment

- The patient sits or stands upright.
- Removes the cover from the mouthpiece.
- Thoroughly shakes the inhaler.
- Holds the inhaler upside down.
- Exhales slowly and inserts the mouthpiece into the mouth.
- Slowly begins inhaling and when reaches *about 1/3 of the breath, presses the bottom* of the container (some inhalers will trigger with the patient inhalation - Easi-Breathe).
- The patient continues with a deep breath, which should last for at least 5 seconds.
- It is necessary to hold the inhaled aerosol in the lungs for at least 5 - 10 seconds.
- After that the patient can breathe freely. The initial inhalation should be done in front of a mirror.
- Depending on the active substance, the patient administers oral hygiene afterwards.

Metered aerosol inhaler with an attachment (spacers)
Spacers simplify the inhalation technique and utilize the drug effect. The inhaler attachment homogenises the aerosol, thereby increasing the ratio of respirator particles. The known spacers include Volumatik, Holding Chamber, AeroChamber with or without a mask (see Fig. 12.2-6) or optimiser, which also reduces drug build up in the oropharynx. When using a mouthpiece, it is important to connect it tightly to the inhaler. After that, the patient presses the bottom of the container and takes about 10 slow breaths using the attachment. It is recommended to wash and dry the attachment after use.

Fig. 12.2-6: Aero chamber – with a mask for children of all ages

2. Powder inhalers (DPI – dry powder inhaler)

Dry powder inhalers are triggered and driven by the breath of the patient.

Types:

- Capsule inhalers, e.g. HandiHaler (see Fig. 12.2-7, 12.2-8), Aerolizer – dose inhaler with a capsule for each dose (see Fig. 12.2-9), Spinhaler, Inhalátor M, Breezhaler)
- Disc type (Rotadisk)
- The Diskus belongs to the group of pre-filled dry powder inhalers (contains 60 doses)
- Turbuhaler, Easyhealer (have a reserve for further doses).

Fig. 12.2-7: HandiHaler – dry powder inhaler

Fig. 12.2-8: HandiHaler –detail of the mouthpiece

Fig. 12.2-9: Aerolizer

Working procedure

- The patient sits or stands upright
- The procedure for filling and triggering the inhaler varies according to the type of inhaler; therefore follow the manufacturer's instructions.
- The patient is to:
  - *Exhale*
  - *Clamp their lips around the mouthpiece*
  - *Take a quick deep breath through the inhaler*
  - *Remove the inhaler from the mouth and hold their breath for 10 seconds*
  - *Exhale*

Some inhalation systems (Diskus, Turbuhaler) can be ***combined***, i.e. they contain a drug with a bronchodilator and an anti-inflammatory effect. Pre-filled dry powder inhalers include, e.g. Seretide and Symbicort.

Fig. 12.2-10: Diskus

Fig. 12.2-11: Turbuhaler

Working procedure

Each of these dispensers are filled and prepared differently, therefore it is important to follow the manufacturer's instructions.

- Before inhalation takes place, the nurse educates the patient about the reason and the method of inhaling.
- The patient takes the appropriate position.
- The patient initiates inhalation.
- The nurse checks the correct and effective inhaling.
- The results are recorded.

3. Inhalation using a nebulizer

When inhaling with a nebulizer, a fine aerosol is formed, i.e. drugs in liquid form are converted into a fine aerosol. The aerosol can penetrate up to the bronchial trunk. Nebulizers are mainly used in hospitalized patients, i.e. when a large amount of drugs or a combination of drugs must be administered. They are commonly used with patients with acute worsening of a disease, e.g. acute exacerbation of COPD, severe asthma, cystic fibrosis.

Types of nebulizers:

- *Ultrasound* – produces aerosols via high-frequency waves. The size of individual particles depends on the vibration frequency. The ultrasonic nebulizer heats the solution up to 45°C. It is better for home use as the patient does not need to use pressurized gas, but simply plugs the nebulizer into the mains.
- *Jet* (compressor) - produces the aerosol by means of compressed air or high-flow oxygen, i.e. 6-8 litres per minute (see Fig 12.2-12). They are more efficient than ultrasonic nebulizers (4x more efficient than ultrasound)

Inhalation is either via a mouthpiece or a face mask. The mask is often used in uncooperative and extremely asthmatic patients. Oxygen nebulization is administered to patients at risk of hypoxia. It is not suitable for patients with chronic respiratory diseases.

Fig. 12.2-12: Jet nebulizer

Patient preparation

Before administering, the nurse educates the patient about the need, importance and the effect of the treatment. The patient is familiarised with the aids, procedure and use of a particular inhaler. The nurse verifies that the patient is able to use the inhaler themselves.

The inhaled solution and the time of inhalation are determined by a doctor and the nurse will check the doctor's prescription before administering. The patient usually inhales 2-3 hours after meals. The nurse instructs the patient to sit up straight opposite the inhaler with the applicator at mouth level. The patient breathes calmly.

Preparation of aids for inhalation/nebulization

- Suitable source of gas (oxygen, air)
- Connecting hose to the gas supply
- Inhalator/nebulizer
- Drugs
- Distilled water
- Cellulose wadding
- Bin bag (when coughing)

When using an ultrasonic nebulizer, the following will be required: functional nebulizer with accessories, electricity socket and the nebulization solution.

Working procedure

- Prepare aids and solution for nebulization in a nebulizer
- Check that the patient has a wooden pulp square within reach to use when coughing and a bin (bag) for the used pulp
- The nurse:
  - Ensures the cooperation of the patient (the patient sits upright)
  - Explains the procedure and the principles of correct inhalation
  - Connects the nebulizer to the oxygen source (for frequent inhalation, oxygen is replaced with air)
  - Presets the flow rate at 6 – 8 litres per minute
  - Waits until the nebula begins to form in the inhaler
  - Ensures the correct inhalation technique – the patient begins to inhale

The nurse also continuously monitors the patient's condition, the effect of inhalation and the correct inhalation technique.

Patient care after the procedure

- After nebulization is completed, the nurse wipes around the patient's mouth.
- A self-sufficient patient can rinse their own mouth after inhalation.
- A dependent patient is assisted by the nursing staff.

Care of aids after use

- Nurse puts the remaining medication in the bottle back in the medicinal cabinet as is customary on the ward.
- Aids for repeated use are decontaminated according to the disinfection programme at the hospital.
- Disposable aids are disposed of and the used wadding is put into the designated bins.

Complications related to inhalation and methods of prevention

The occurrence of complications during inhalation is minimal; patients generally tolerate the inhalation very well. Prevention mainly involves following the doctors prescription and the correct administration of the dosages.

The following complications may still occur during inhalation:

- Frequent inhalation using oxygen may cause drying of the mucous membrane of the oral cavity and airways.
- Sometimes a fungal infection may form in the oral cavity. This can be prevented by oral hygiene and sufficient fluid intake.
- Nebulization using oxygen is not suitable for patients with chronic respiratory disease as a high flow of oxygen can cause hypercapnia.
- The applied substance may cause adverse interactions:
- Dyspnoea
- Serious allergic skin reaction - rash, itching
- Indigestion
- Dry mouth
- Tachycardia

- Increased systolic pressure
- An uncooperative patient may also cause complications when attempting proper inhalation. Prevention may include the correct education of the patient. It is important to choose the correct type of inhaler for a particular patient. Another way to ensure the correct inhalation technique is training of inhalation using dry powder inhalers and the usage trainer (see Fig. 12.2-13).

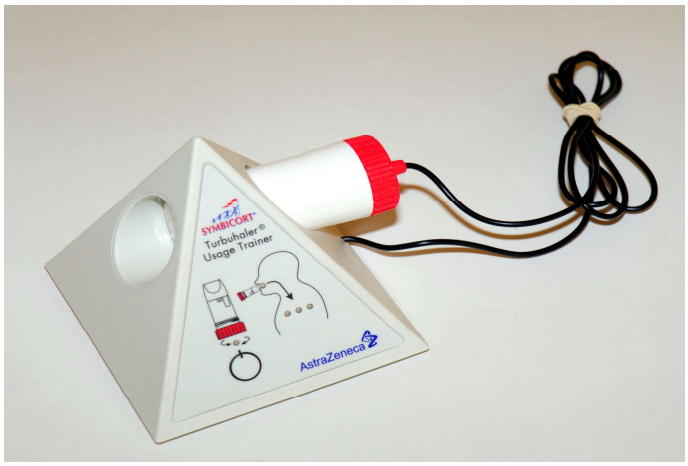

Fig. 12.2-13: Usage trainer for practicing correct inhalation

The nurse may find out in some patients that they do not inhale correctly after long-term use of inhalation drugs (the availability of the drug in the airways is therefore impaired). If that is the case, then **reeducation** is required.

Risks:
It is important when working with oxygen to respect the principles of oxygen handling.

Control questions

- What is the drug onset administered via the lining of the airways?
- What inhalation systems do you know?
- What powder form inhalation systems do you know?
- The HandiHaler belongs to which inhalation system?
- Which inhalation systems include drugs with a bronchodilator and anti-inflammatory effect?
- What aids are needed for inhalation using a nebulizer?
- What is the working procedure for inhalation using a nebulizer?
- What complications can occur after inhaling?
- What is the main difference between a dry powder inhaler and a metered aerosol inhaler?

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13. INJECTION

Objectives:

After studying this chapter, you should be able to:

- Define the term and purpose of the injection;
- Prepare aids needed for an injection;
- Describe the parts of the injection needles and syringes;
- Use the correctly sized injection needle according to the purpose of use (colour coded);
- Implement the correct procedure for the preparation of drugs from ampoules or vials;
- Apply the principles in thinning medications for parenteral administration, e.g. antibiotics.

Purpose

An *injection* is an infusion method of administering fluid into the body tissue, vascular system or into a body cavity using a syringe and needle with the following purpose:

- *Preventive*, e.g. vaccination
- *Medical* (to medically influence the disease and its symptoms)
- *Diagnostic* (administering a substance which can be detected, e.g. a contrast agent in an X-ray)

Theoretical notes

Drugs are administered by injection, if oral drug administration is not possible, or if a faster drug onset is required (e.g. administering analgesics for pain), in substitution treatment (e.g. insulin administration) or in unconscious patients. It is also an important way of administering an antidote, which can rapidly eliminate a life threatening poison, e.g. snake bites etc.

Injection belongs to *the parenteral drug administration* group, e.g. administering drugs outside the digestive tract.

Methods of parenteral administration:

- *Intracutaneous (intradermal)* – IC, (ID) – within the skin;
- *Subcutaneous* (SC) – under the skin
- *Intramuscular* (IM) – into a muscle;
- *Intravenous* (IV) – into a vein;
- *Intra-arterial* (IA) – into an artery;
- *Intracardiac* – into the heart
- *Intraosseous* – into a bone
- *Intramedullary* – into the lumbar spinal cord

- *Intrathecally* – into the spinal canal
- *Intraperitoneal* – into a body cavity (peritoneum)
- *Intraarticular* – into a joint
- *Intralumbar* – into the spinal canal

Injections are given by a nurse based on the medical indication. Nursing activity involving injection is complex. It requires an assessment of the patient's health condition, finding a suitable place for injecting into the skin as well as choosing the correct injection technique considering the patient's position with the subsequent monitoring of the patient's condition. It is also necessary to expect the patient to react to the injection of the drug.

Nursing activities can be divided into:

- *Preparation of drugs from ampoules and vials* – in the preparation room or the nurse's room.
- *Injection* – usually takes place in the patient's room or in the examination room (see topic: Drug injection into the skin and into a muscle).

Injection aids

Currently, most of the aids used (hypodermic needles and syringes) are disposable. The aids are individually wrapped in soft, transparent foil and laminated paper, which is permeable to ethylene oxide – the gas used to sterilize aids. The packaging, if not opened, maintains its sterile content for up to five years.

List of aids (see Fig. 13-1):

- A syringe of the appropriate size (depending on the prepared drug volume)
- Two syringe needles (for intake and administering drugs)
- Drugs according to a doctors prescription (ampoule or vial), or a solution for drug diluting in powder form (e.g. saline)
- Gauze swabs or squares
- Disinfectant
- Kidney bowl
- Disposable gloves
- Container for storing used needles

Fig. 13- 1: Injection aids

Syringes

Syringes are individually wrapped. They must be sterile before application, solid, and of the appropriate size according to the drug volume.

A syringe has three parts (see Fig. 13-2):

- *Tip* – the place where it joins the needle. The syringe tip ***must remain sterile.***
- *Barrel* – graduated in order to prepare the exact amount of medication. The syringe size is indicated on the barrel in millilitres and the scale must be visible.
- *Plunger* – allows the intake of the drug into the syringe. The plunger must be sealed and move well, it has a safety stop.

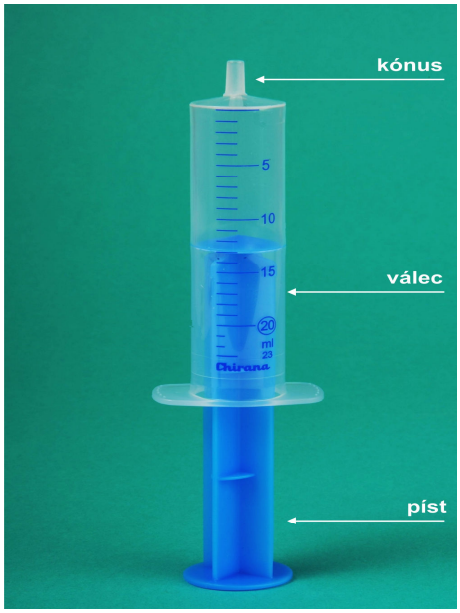

Fig. 13-2: Individual parts of a syringe – tip, barrel and plunger.

The pharmaceutical companies currently supply injectable drugs in pre-filled syringes with a single dose of medication in the exact amount. This type of syringe also includes a needle. These needles and syringes are intended for single use only according to the attached manufacturer's instructions. Some syringes with an integrated needle are provided with a protective needle shield, which is automatically ejected after application, thereby protecting the nurse from possible injury (see Fig. 13-3).

Fig. 13-3: Syringe with integrated needle shield (left-before, right after application)

Syringe needles

- Before injection, each syringe needle must be sharp, sterile, unobstructed and smooth.
- A syringe needle has three parts – the bevel, the shaft and the hub.
- The hub is the only part on the needle that can be touched. Other parts must not be touched in order to keep the needle sterile.
- The colour coding of the needle hub indicates the needle diameter according to ČSN EN ISO 6009 standard (see Fig. 13-4).
- Needles are manufactured from stainless steel and individually wrapped in paper packaging. The bevel of the needle is also protected by a plastic cap.
- A special type of needle is a needle with a cap that can be used for 24 hours providing aseptic conditions are observed.

Syringe needles vary in:

- Length and shape of the angled bevel (the bevel can be blunt or sharp - longer needles are sharper. These are used for subcutaneous and intramuscular injection. The blunt and shorter bevel needles are used for intradermal and intravenous injection).
- Needle length is usually from 0.6 cm to 12.7 cm
- Diameter of the needle – thinner needles cause less tissue trauma, wider needles are used to apply e.g. suspension (penicillin). Lumen ranging from 14 to 28 G (Gauge). The larger the number the smaller the lumen.

Fig. 13-4: Needle types by size

Colour coding for the needle hub	Method of use	Size	U.S. marking
Orange	**ID, SC**	**0.5 x 20 mm**	**25 G**
Blue	**SC**	**0.6 x 25 mm**	**23 G**
Black	**IM, IV**	**0.7 x 35 mm**	**22 G**
Green	**IM, IV**	**0.8 x 40 mm**	**21 G**
Yellow	**IM, IV**	**0.9 x 40 mm**	**20 G**
Pink	**IV**	**1.2 x 40 mm**	**18 G**

Table No. 13-1: Colour coding for needles (adapted according to Krišková et al., 2006)

Drugs in ampoules and vials with sterile caps

- Drugs intended for administration by injection are prepared under strictly aseptic conditions by pharmaceutical companies. These are produced in ampoules or vials in an aqueous solution, oil or as a suspension or powder and have a special sterile cap.
- The ampoule is a sealed vial with a neck. The neck has colour marking indicating the place the ampoule can be easily snapped (see Fig. 13-5).
- The drug in the vial is hermetically sealed with a rubber stopper which is protected with a metal or plastic cap.

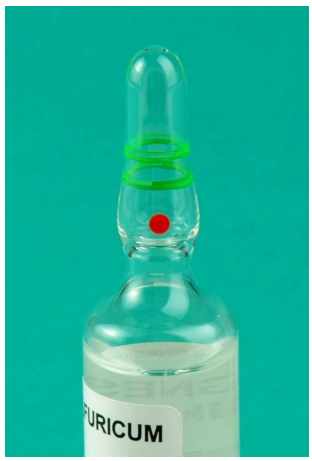

Fig. 13-5: Marking on the ampoule neck

Drugs in powder form must be diluted before use with pyrogen-free distilled water (water for injection), physiological saline or 5% glucose.

Preparation of drugs for injection

Principles

- Take the appropriate position facing a worktop in order to see the aids properly.
- Keep the eyes and eye mucosa at a safe distance from the drug.
- Wear gloves if you are hypersensitive to any component of the drug.
- Keep to the principles of sterility.
- Put the used aids into the kidney bowl or into the designated containers (e.g. containers for sharp objects and glass).
- Handle waste according to regulations and standards.

Drug preparation

- Prepare the medicinal substance according to doctor's prescription as per the medical documentation (daily report).
- Check the label on the ampoule or vial and compare the drug name with the entry in the medical documentation.
- Before preparing the medicinal substance, the nurse triple checks the correctness of the prepared drug:
    - Checks the drug (name, dose, etc.) on the original packaging when removing it from the medicinal cabinet.
    - Before removing the drug from the packaging.
    - When returning the drug in the packaging to the medicine cabinet.

Drawing medication from the vial – procedure

- Prepare an ampoule with the drug, if necessary tapping the top of the vial to get the contents to the bottom of the ampoule
- Disinfect the neck of the ampoule
- Hold the ampoule firmly with one hand, with the second hand pressing gauze square with disinfectant on the ampoule. Apply pressure and snap the ampoule on the neck according to the colour marking, which is where the neck has been filed. The gauze square protects the fingers from any potential glass fragments.
- In the event of glass fragments penetrating the contents of the ampoule, the drug ***must not*** be administered. The drug is destroyed and the entire process repeated.
- Prepare a syringe and a needle.
- Open the syringe protective packaging – peel-back system (see Fig. 13-6)

Fig. 13-6: Removing the syringe from the packaging with the peel-back system

- Remove the syringe from the packaging avoiding the syringe tip touching the surrounding area
- Open the needle packaging using the peel-back system
- Connect the needle hub to the syringe tip
- Remove the needle cap
- Insert the needle into the ampoule
- Draw the prescribed volume of the drug from the ampoule (see Fig. 13-7)
- After removing the needle from the empty ampoule, disconnect the needle from the syringe (put it into the container for sharp objects)
- Attach the injection needle to the syringe tip
- Put on disposable gloves if handling aggressive drugs (see Fig. 13-8)

Fig. 13-7: Drawing medication from an ampoule

Fig. 13-8: Preparation of an aggressive drug – correct holding of the syringe and needle

Drawing medication from a vial

- *A drug in liquid form – solution* does not require further dilution. While maintaining aseptic conditions, draw the medication from the vial using a syringe needle with a wide lumen.
- *Drug in powder form* is diluted under aseptic conditions in a vial using a sterile solution from the second vial or from an ampoule or infusion bottle. The type of diluting solution is governed by the manufacturer's instructions enclosed with each drug. Diluting is usually done with saline, water for injections, 5% glucose or diluent, which is included in the pack. Diluting rugs in powder and liquid form is done most frequently with saline in the infusion bottle, which is supplied with a special needle and cap – aspiration mandrel (see above). The needle can be used 24 hours after removal from the packaging providing its aseptic condition is maintained. After drawing the appropriate amount of diluting solution, it is necessary to cover the needle cap – close it to prevent contamination of the contents of the infusion bottle.

Working procedure

- Remove the syringe from the packaging as described above (peel-back). Use the mandrel to draw the appropriate volume of diluent.
- Prepare the vial with the drug.
- Attach a needle to the syringe - connect the syringe tip with the needle hub as described above.
- Maintain the aseptic principles (disinfect the rubber stopper), puncture the stopper with a needle.
- Draw the air from the vial with the drug in powder form and add the diluting solution, unless stated otherwise in the enclosed manufacturer’s instruction leaflet.
- Mix the contents of the vial.
- After dissolving the powder in the diluting solution, draw the required volume using the syringe.
- Remove the needle from the vial. The correct way to hold the syringe and the needle is shown in Fig. *13-8.*
- Replace the needle used for diluting with the injecting needle.

Be careful not to incorrectly hold a syringe with medicine. If holding the syringe incorrectly then the drug may leak from the syringe prematurely.

Diluting drugs for parenteral administration, e.g. antibiotics

Antibiotics for injection are prepared under strict aseptic conditions by pharmaceutical companies in sealed vials. Antibiotics produced in powder form must be diluted before administering with the appropriate amount of diluting solution (see above).

It is important that the staff on the ward use the same method of diluting ATB so that 1 ml of the diluted solution always contains the same volume of the drug in the respective units (in g, mg, etc.). A drug is always diluted so that 1 ml contains the amount of drug that will be easy to count, i.e. the resulting total volume can be easily divided.

Antibiotics should be diluted *close to the time for administering* in specified intervals as prescribed by a doctor. A doctor must be immediately informed upon the occurrence of any side effects.

Examples of dilution:

Amoksiklav contains 1.2 g (= 1,200 mg) of medicinal substance. By adding 6 ml of diluting solution to the vial, 1 ml of the solution will contain 200 mg of the drug. If 800 mg is prescribed, the nurse will draw 4 ml of the drug into the syringe.

Ampicilin K – package content 500 mg, diluted with 2.5 ml of solution so that 1 ml contains 200 mg. If 120 mg is prescribed, the nurse will draw 0.6 ml of the drug into the syringe.

Special administration of some parenteral drugs

Some drugs must be prepared in order to prevent exposure to light before and during administration, so special dark syringes are used for this purpose (see Fig. 13-9) or other aids made of materials impervious to light or the syringe and the connecting tube are wrapped in aluminium foil.

Fig. 13-9: Special syringe used for administering drugs sensitive to light

Care of aids

All used aids are immediately placed into the kidney bowl; needles and sharp objects into a special container for sharp objects. This is followed by recycling the waste into appropriate waste containers as is customary on the ward. Aids for disinfection (e.g. kidney bowl) are submerged in a disinfectant solution. Further steps are in accordance with the hospital disinfection programme. Aids to be reused are stored in a designated place as is customary on the ward.

Complications when administering injections – general

- *Introduction of infection* into the injection site if the aseptic condition was not observed.
- *Haematoma* – as a result of injection or introduction of a cannula through both walls of the vein. This can be prevented by administering the injection carefully.
- *Injected nerve* – by selecting an inappropriate injection site.
- *Injected blood vessel* – discovered in blood appearing in the syringe; the nurse halts the procedure and prepares a new injection, repeating the whole process.
- *Injected bone* – during inconsiderate application in cachectic patients; choosing the wrong needle length or inappropriate choice of injection site.
- *Broken needle* in clumsy handling during application.
- *Allergy* – to a disinfectant or an administered drug.
- *Phlebitis* – inflammation of the superficial vein manifested by tenderness, pain, redness, swelling, strips, palpable hardening in the vein and suppuration.
- *Embolism* – lodging of an embolus in blood vessels which leads to subsequent clotting and ischemia. Complications can occur in IV injectable forms of therapy.
- *Abscess* (pathological inflammation filled with pus accumulated within a tissue) – can occur in the subcutaneous tissue when administering a drug injected deep into the muscle.

  Prevention is by correct and careful injection of the drug.

Injection risks

Parenterally administered drugs are absorbed faster than orally administered drugs. Therefore it is necessary to act very responsibly when preparing and administering parenteral drugs prescribed by a doctor. The administering method must be strictly adhered to as confusion could put the patient's life at risk. Parenteral administration of a drug requires theoretical knowledge, manual dexterity and adherence to aseptic procedures.

When administering a drug by injection, the following principles must be adhered to.

Administer:

- The correct drug
- To the correct patient
- At the right time
- Correctly
- In the right dose

Control questions

- List the parts of the syringe and needle.
- Can the drug from an ampoule be administered if there is a small particle of glass present in it?
- Name the aids needed for administering an injection.
- What is the aid called which, can be used while maintaining aseptic conditions after removing from the packaging, within 24 hours?
- How Zinacef (ATB) is diluted which contains 750 mg of the drug in the vial, if 500mg is to be administered?
- The vial contains 1 g of Ampicilin K; 600 mg of the drug is to be administered. What amount of drug in ml will be drawn into the syringe, if diluting the drug with 5 ml of diluting solution?
- What principles must be adhered to when administering drugs?
- What is the method for correctly extracting a syringe or needle from the packaging called?

13.1 Injecting drugs under the skin

Objectives:

After studying this chapter, you should be able to:

- Identify suitable sites for administering subcutaneous injections;
- Prepare aids for subcutaneous injection;
- Implement the correct procedure for subcutaneous injection;
- Implement the procedure for administering insulin using an insulin syringe on the model or a simulator under laboratory conditions and subsequently in clinical practice;
- Inject insulin using an insulin pen;
- Educate the patient prior to administering insulin (in relation to the type of insulin);
- Prepare the aids needed to administer and inject low-molecular-weight heparin (LMWH) correctly under laboratory conditions and subsequently in clinical practice;
- Assess the risks of potential complications.

Purpose

Subcutaneous injections are usually administered for *therapeutic purposes.*

Theoretical notes

- An injection is an infusion method of administering fluid into the body tissue, vascular system or into a body cavity using a syringe and needle. In a subcutaneous injection, the needle penetrates the three main layers of the skin – the epidermis, the dermis and the subcutaneous fat layer (subcutis). The most frequently used *sites suitable for subcutaneous injection* are located: On the outer side of the arm, the musculus biceps brachii
- On the outer side of the thigh, the musculus quadriceps femoris
- In the abdomen area and around the navel, the musculus rectus abdominis
- The ventrogluteal and dorsogluteal area, musculus gluteus medius (see Fig. *13.1-1*)

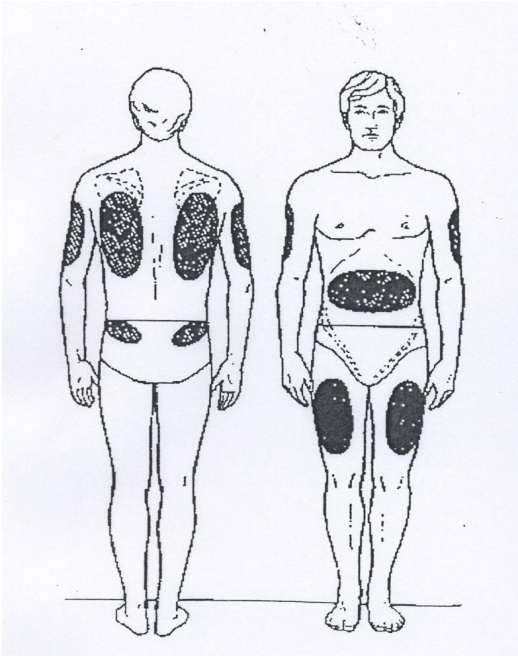

Fig. 13.1-1: Suitable sites on the body for subcutaneous injection (Source: KOZIEROVÁ, B., ERBOVÁ, G., OLIVIEROVÁ, R.: *Ošetrovateľstvo I. and II. part* Martin: Osveta, 1995. p. 1276 ISBN 80-217-0528-0)

The order of preference for the most frequently located subcutaneous injection sites differ if they are:

- *Searched for by the patient* (1st abdomen and around the navel, 2nd upper part of a thigh, 3rd outer side of the arm)
- *Searched for by the nurse* (1st the outer side of the arm, 2nd the abdomen and around the navel, 3rd the upper part of the thigh).

Up to 2 ml of a drug can be injected into the subcutis. The drug is absorbed gradually and slowly, the drug onset is 10 – 15 minutes. The injection technique depends on the type of drug, syringe and needle. The needle pierces the skin either under 45°, or under a 90° angle.

The most frequent subcutaneous injection of insulin involves low-molecular-weight heparin (Clexan, Fraxiparin) and vaccines. The most commonly used syringes in subcutaneous injections of insulin are pre-filled syringes with built in needles (e.g. for injecting low-molecular-weight heparin), or a thin needle (25 G), length 1 - 1.6 cm and 2 ml syringe.

<u>*Patient preparation*</u>

- The patient must be informed of the reason, method and type of drug to be administered.
- The patients current health condition must be checked prior to drug administration (e.g. before injecting insulin, the current blood glucose level must be tested, or a blood clotting test must be carried out before administering low-molecular-weight heparin).
- The patient must cooperate during subcutaneous injection, by sitting or lying down.
- The patient is notified of the need to report any possible reaction to the administered drug.

Preparation of aids

The required aids prepared by the nurse include: (see Fig. 13.1-2):

- Ampoule or vial with the drug prescribed by the doctor in the patient's medical records
- Sticker to label the syringe with the patient's name
- Container for storing used needles and syringes
- Kidney bowl
- Gloves (as is customary on the ward)
- Sterile syringe of the appropriate size
- Sterile syringe needles:
  a) For drawing the drug from the ampoule/vile (e.g. needle 18G – with a pink hub)
  b) For injecting the drug (needle 25G - with an orange hub)
- Gauze swabs or squares
- Disinfectant and plasters

Fig. 13.1-2: Aids for subcutaneous injection

Performing the procedure

- Prepare the medicinal substance according to the doctor's prescription as per the medical records.
- Draw the medication from the ampoule or the vial as described in chapter on injection technique. Observe the aseptic conditions when preparing the injection and throughout the procedure.
- Label the syringe with the patient's name, date of birth and the name of the drug, volume and method of administration information.
- It is necessary to assess the patient's health condition prior to application. Verify the identity of the patient, inform the patient of the need, method and type of administered drug and help the patient to take the most appropriate position (their identity is verified with the following question: "What is your name?" or verify the patient's name by checking their identification bracelet).

- Select a suitable site for SC injection (without increased tenderness, swelling, scars, birthmarks, frequent punctures, local inflammation).
- Disinfect the injection site using a swab with disinfectant; let the antiseptic dry.
- Put the gauze square between the ring finger and the little finger of the non-dominant hand, ready to treat the injection site after injection.
- Hold the syringe with the thumb and fingers, remove the cap from the syringe needle and proceed so that the needle does become contaminated. Check the syringe for any air bubbles, if found then they must be removed.
- Using the non-dominant hand, grip the skin fold between the thumb and the index finger (see Fig. 13.1-3) and inject the needle at a 45° angle into the skin (the index finger of the dominant hand steadying the needle hub).
- Release the grip on the skin fold, using the free hand; draw the plunger out to check if there is no blood in the syringe. If not, apply slow pressure to the plunger and inject the drug, (otherwise, remove the needle, discard the syringe with the impaired content, prepare a new drug for injecting into another injection site).
- Remove the needle after administering the drug and attach the gauze square.
- Fix the square with plaster tape after a few seconds.
- Make a record of the subcutaneous injection in the nursing documentation, also of the effects of the drug on the patient.

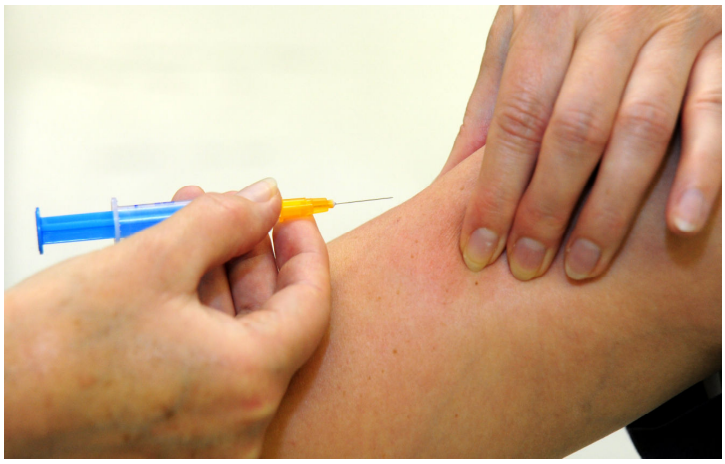

Fig. 13.1-3: Subcutaneous injection

Complications

- Introduction of an infection into the tissue due to violation of aseptic procedures.
- Drug penetration into a vein; prevention is to draw the plunger out to check if the needle has entered a blood vessel.
- Administering a drug intended for subcutaneous injection into a muscle can lead to faster absorption. Insulin injection may pose a risk of hypoglycemia. Heparin injection may pose a risk of bleeding, haematomas or petechiae.
- If the injection sites are not alternated often enough, especially in long-term drug administering (e.g. insulin), changes in the dermis may occur, especially lipodystrophy. The site looks unattractive and causes complications with drug absorption; these changes are often irreversible.

Prevention is by correct and careful injection of the drug.

Patient care after the procedure

The patient is put into the appropriate position after the procedure. The patient is notified of the need to call the nurse in the case of any problems related to the procedure by using an alarm. Check the effect of the drug at appropriate time during a conversation with the patient.

Care of aids after use

Used needles without a cap, syringes and sharp objects are deposited into a mobile container for sharp objects or into a kidney bowl together with the other used aids. This is followed by recycling the waste into appropriate waste containers as is customary on the ward. Aids for disinfection (e.g. kidney bowl) are submerged in a disinfectant solution. Further steps are in accordance with the hospital disinfection programme. Aids to be reused are stored in a designated place as is customary on the ward.

Special requirements for administering insulin

The insulin must be introduced into the body by injection as it cannot be administered orally, because it is a protein which is broken down by enzymes in the gastrointestinal tract and thereby deactivated.

Types of insulin

Insulin is currently produced in two types:

- *Human insulin* – produced synthetically, it has the same composition as human insulin
- *Analogue insulin* - produced biosynthetically

Insulin is divided into 4 groups according to the onset:

- Suitable for administering before meals:
  - Rapid analogue insulin – onset in 15 min. (e.g. Novorapid, Humalog)
  - Short-acting insulin - onset in 30 min. (e.g. Humulin R)
- Basal insulin:
  - Intermediate-acting – onset in 12 – 14 hrs
  - Long-term analogue insulin - onset in 20 – 24 hrs

Insulin is further classified according to the lasting effect:

- Short-acting: Insulin R, Actrapid, Humulin R, Insuman Rapid, Novorapid (analogue), Humalog (analogue)
- Intermediate acting: Insulatard HM, Humulin N, Insuman Basal
- Long-acting: Lantus (analogue)

	Short-term analogue	**Short-acting:**	**Intermediate acting:**	**Long-acting:**
Drug onset	In 15 minutes	In 30 minutes	In 1 – 2.5 hrs	In 2 – 3 hrs
Maximum effect	In 1 – 2 hrs	In 2 – 3 hrs	In 6 – 8 hrs	In 8 – 10 hrs
Lasting effect	4.5 – 5 hrs	6 – 8 hrs	12 – 14 hrs	20 – 24 hrs
Name	Humalog Novorapid Apidra	Humulin R Actrapid	Insulatard HM Humulin N Insuman Basal	Lantus (analogue) Levemir (analogue)
Administering method	SC, IV, IM	SC, IV	Only SC	Only SC

Fig. 13-2: Types of insulin according to the lasting effect and method of administration

Stabilized mixtures

Short-term analogue insulin brands: Novomix 30 Penfill, Humalog Mix 25, Humalog Mix 50

Short-acting insulin brands: MIXTARD 30 HM penfill, Humulin M3 (30/70) cartridge

Principles for the preparation and administration of insulin

- Insulin in vials is usually stored in the fridge; insulin pens with cartridges are kept at room temperature. Storage and the method of administration are governed by the manufacturer's instruction.
- The time and storage conditions of the vial after the first use are governed by the instructions given in the packaging leaflet or by the product summary characteristics (issued by SÚKL – State Institute for Drug Control). After the first administration, *mark the vial with the date of the first drawing*.
- Draw into the syringe the *exact amount of insulin* without any air bubbles.
- Insulin mixtures (intermediate, long-acting) must be mixed before drawing into the syringe; do not shake the vial.
- Administration time depends on the type of insulin: *15 – 30 minutes before meals.*
- Inform the patient of the need to alternate the injection sites. Enquire about the last injection site and proceed as is customary on the ward (see below).
- After injecting insulin under the skin, hold the needle for *5 more seconds* in the subcutaneous tissue to prevent leakage of insulin dose through the puncture channel.
- Do not massage the injection site.

Methods of insulin injection:

- *Insulin syringe* – a special syringe with a short built in needle for the exact dosage. An insulin syringe has a scale marking according to the content (the capacity content cc). It is used to inject insulin from a vial which contains 100 units in 1 ml. The insulin syringe can be used to inject insulin at a 90° angle (e.g. into the abdomen). The exact method of injecting depends on the size of the subcutaneous layer (obese x cachectic patient) and the practices of the ward.
- *Insulin pen* – in the shape of a large pen, includes the dispensing mechanism, a very short and thin needle and a cartridge containing insulin. The pen enables precise dosage administering (with ½ unit accuracy)
- *Insulin pump* (micropump) – provides a continuous flow of insulin. It is in the shape of a small box which contains the insulin cartridge.

Administering insulin using an insulin syringe

Patient preparation

A patient must be educated about the principles and methods of administering insulin either at a diabetes clinic or at the hospital ward if diagnosed with diabetes mellitus and dependent on insulin.

During hospitalization, the nurse injects the patient using insulin syringes (for patient preparation, see above) or the patient self-administers the insulin using the insulin pen, which enables very accurate dosage (with ½ unit accuracy).

List of aids (see Fig. 13.1-4):

- Vial of insulin as prescribed by a doctor
- Sterile insulin syringe – see Fig. 13.1-5
- Gauze swabs or squares
- Disinfectant and plasters
- Sticker to label the syringe with the patient's name
- Container for used insulin syringes
- Kidney bowl
- Gloves (as is customary on the ward)

Fig. 13.1-4: Aids required for administering insulin using an insulin syringe

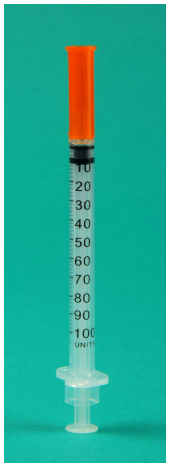

Fig. 13.1-5: Insulin syringe

Fig. 13.1-6: Drawing insulin into the syringe

Preparation of the correct dose of insulin is linked to the current value of blood glucose. The nurse draws into the syringe the precise volume of insulin as prescribed by a doctor (see Fig. 13.1-6). The procedure for injecting insulin using a syringe is similar to subcutaneous injection (see above).

Insulin administration using an insulin pen

Patient preparation

A patient who self-administers insulin using an insulin pen (see Fig. 13.1-7) is educated in a diabetes clinic.

Recommendations for administering insulin with an insulin pen:

- Do not inject insulin into a site that is unusual in any way, e.g. redness, swelling, rash, loss or accumulation of subcutaneous fat.
- Follow the information on the package leaflet.
- Each injection should be at least 3 cm distance from the previous one. Injection sites should be varied to avoid changes to the subcutaneous tissue.
- Check before each application if the insulin pen is well prepared and that the needle is not blocked. Expel one unit of insulin; a drop of insulin will appear on the needle tip.
- Leave the needle in place for several seconds after injecting is complete. Removing the needle too fast will cause the insulin to drip out thus reducing the injected dose.

Preparation of aids

Advantages of insulin pens:

- The insulin is injected using a very thin needle, which is less painful
- The insulin dose can be prepared easily – there is no need to draw each dose individually into the syringe
- The use of a pen ensures the patient's dignity – the preparation and the whole procedure only takes a short time
- It reduces the risk of inaccurate dosing, especially in patients with impaired vision or with musculoskeletal diseases or in the elderly (dosage can be easily adjusted – the setting of each unit is audible, the number of clicks = number of units).

Fig. 13.1-7: Insulin pen

Administering insulin using an insulin pump (micropump)

Continuous insulin administration is particularly advantageous in patients with diabetes mellitus type 1. The insulin is administered using an insulin pump which mimics the physiological secretion of insulin in the body. Setting the basal mode maintains individual normoglycemia, i.e. continuously over 24 hrs according to the patients needs.

The patient applies a "bolus" dose of insulin to modify increased hyperglycemia before meals or if an additional dose of insulin is needed. The disadvantages of an insulin pump are the cost and the demanding technical maintenance as well as the requirement to frequently measure the blood glucose.

Complications of insulin therapy – general

- *Hypoglycaemia* (= reduced blood sugar level) occurs with the imbalance of administered insulin, food intake and physical activity. When the insulin dose exceeds the need of the organism.
- *Insulin lipodystrophy* – indicates changes or even the disappearance of subcutaneous fat around the insulin injection site.

  - Injection sites must therefore be alternated during long-term insulin therapy
- *Allergy* – formation of rashes after insulin injection
- *Obesity* – weight gain occurs in patients who fail to follow the dietary regime while taking insulin

Patient care after insulin injection

- The patient is notified of the need to have a meal 15 - 30 minutes after insulin injection.
- Each administration of insulin is recorded in the nursing documentation.
- Food consumed by the patient is also recorded in the nursing documentation.
- The nurse educates the patient regarding prevention of lipodystrophy and the need to alternate the injection sites.
- The method of alternating the injection sites is determined by the nursing care guidelines issued by healthcare facilities. (For example see Fig. *13.1-8*).

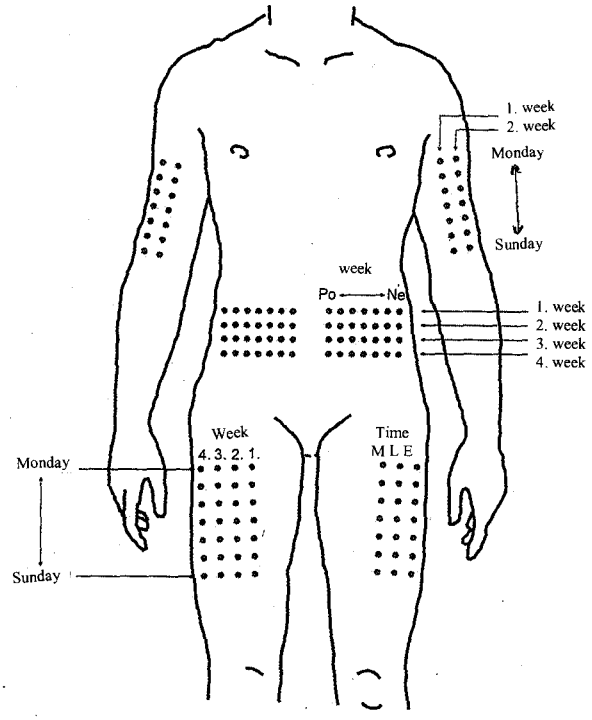

Fig. 13.1-8: System for alternating suitable injection sites for insulin administration (source: Nursing care guidelines - FNM)

Care of aids after use

All used aids are immediately placed in the kidney bowl. Used needles without a cap, syringes and sharp objects are deposited into a mobile container for sharp objects.

Special requirements for subcutaneous administration of low-molecular-weight Heparin

The most frequently administered factory-made medications include: Clexane (enoxaparin), Fraxiparine (nadroparin), Fragmin (dalteparin), Clivarin etc. A single dose can be prepared from an undiluted dose of Heparin retard (1ml/25,000 units); although it is currently rarely used.

Patient preparation

- The patient must be informed of the reason, method, type of drug and the injection site.
- The patient must be tested for blood clotting before Heparin administration.
- The patient must cooperate during the injection, by sitting or lying down.
- The patient is notified of the need to report any possible reaction to the administered drug.

Preparation of aids

The required aids prepared by the nurse include: (see Fig. 13.1-9):

- Pre-filled syringe with integrated needle (containing the appropriate volume of the drug) as prescribed by a doctor and entered in the patient's medical records.
- Sticker to label the syringe (patients name, date of birth, abbreviation for the ward plus room number, time of administration, doctors prescription)
- Container for depositing used sharp objects
- Kidney bowl
- Gloves (as is customary on the ward)
- Gauze swabs or squares, tape
- Disinfectant

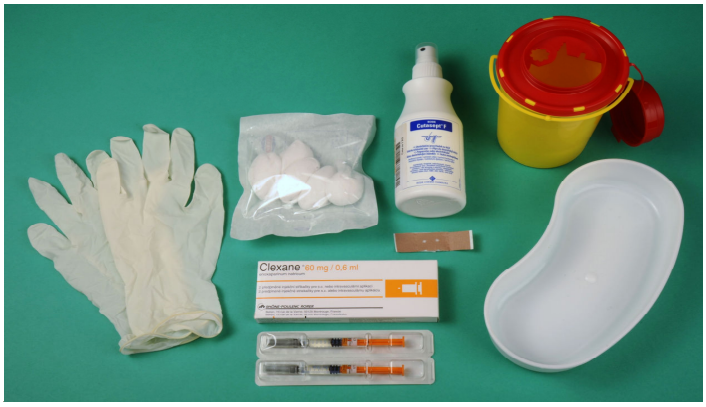

Fig. 13.1-9: Aids for administering anticoagulants (Clexane)

Performing the procedure

- Prepare the medicinal substance according to the doctor's prescription as per the medical records.
- Verify the patient's identity (identify the patient by asking: "What is your name?" or verify the patient's name by checking their identification bracelet).
- Choose an appropriate injection site (without tenderness, swelling, scars, birthmarks, frequent punctures and local inflammation) and help the patient to take the most appropriate position, usually the supine or semi-sitting position.
- Disinfect the injection site and allow the antiseptic to dry.
- Put the gauze square between the ring finger and little finger of the non-dominant hand, ready to treat the injection site after injection.
- Do not try to expel the air bubble from the syringe; hold the syringe between the thumb and the fingers.
- Using the non-dominant hand, grip the skin fold between the thumb and the index finger and insert the needle under a 90° angle under the skin in the abdomen 5 – 10 cm from the navel.
- Hold the skin fold throughout the drug application; do not check for blood aspiration.
- Remove the needle; **do not massage** the injection site.

Complications

- The APTT values must be checked before a Heparin injection (risk of bleeding, formation of petechiae, etc.)
- A frequent complication in low-molecular-weight heparin administration is the formation of haematoma at the injection site, which is due to the anti-hemocoagulation effect of the injected drug. Therefore the injection site must not be massaged after heparin administration.

  Prevention is by correct and careful injection of the drug.

Risks:

- *Injury caused by a used needle*
  - Prevention:
    - Handle used needles carefully to avoid injury. *Do not put the cap back* on a used needle.
    - Proceed with caution when sorting used material (including needles in the kidney bowl).
- *Mistaken identity of the patient*
  - Prevention:
    - Triple drug check before administering the drug.
    - Identify the patient before injection as is customary.

Additional task

Take a look at the topic "Types of insulin":

Portál Mefanet 2. LF, obor: Pharmacology, topic: diabetes mellitus - https://mefanet-motol.cuni.cz/clanky.php?aid=27

Control questions

- What is the colour of the needle hub used for subcutaneous injection?
- What is the normal level of blood glucose in an adult?
- What is the term for an increased blood sugar level?
- What aids are required for injecting insulin?
- Why is it necessary to alternate the injection sites when administering insulin? What changes in the skin does it help to prevent?
- What are the complications of insulin therapy?
- Under what angle is low-molecular-weight Heparin injected?
- Name the four special requirements for subcutaneous administration of low-molecular-weight Heparin.
- What is the onset time for these types of insulin: Actrapid HM, Humulín R, Novorapid, Humulin N?
- Which aids are required for administering the low-molecular-weight Heparin?

13.2 Administering drugs to the skin

Objectives:

After studying this chapter, you should be able to:

- Define the term "intradermal injection";
- Identify suitable sites for administering intradermal injections;
- Prepare aids suitable for administering intradermal injection;
- Assess the risks of potential complications;
- Prepare aids for skin prick testing;
- Implement a procedure for safe administration of ID injection on a model or simulator under laboratory conditions.

Purpose of intradermal injection

- *Diagnostic* (e.g. Mantoux test – tuberculin test, allergy tests)
- *Prophylactic* (vaccination – active vaccination, e.g. BCG vaccine)

Technical notes

The most common intradermal injection sites:

- Skin on the arm (musculus deltoideus)
- Skin on the outside and inside of the forearm
- Skin on the upper chest (musculus pectoralis major)
- Skin on the shoulder blades (musculus trapezius)
- Skin on the outside of the thighs (musculus quadriceps femoris)

Intradermal drugs (tests) can be administered in two ways:

- Intradermal injection
- Skin prick test

Intradermal drug administration via intradermal injection

Intradermal injection is the most commonly used method of administering the BCG vaccine. The recommended injection site for the vaccine is above the lower ligament of the deltoid muscle (approximately between the top and middle third of the arm). The injection should be slowly administered into the upper layer of the skin, because an injection administered too deep increases the risk of an abscess, therefore the BCG vaccine can only be administered by personnel trained in administering intradermal vaccines.

Procedure conditions

Patient preparation

- The patient must be informed of the reason, method and the type of drug or vaccine to be administered.
- Before administering the drug or vaccine, the patient's health condition must be checked.
- The patient must cooperate during the injection, by sitting or lying down.
- The patient is educated (in small children, the parents are given the information) about the need to report any reaction to the administered drug.

List of required aids

- Drug as prescribed by a doctor in its original packaging
- Sterile syringe, 1ml size with appropriate calibration (in hundredths ml)
- Short sterile needle (25G or 26G x 10mm)
- Sterile gauze swabs or squares
- Disinfectant
- Kidney bowl
- Container for storing used needles and syringes
- Sticker to label the syringe with the patient's name
- Plaster
- Gloves (as is customary on the ward)

Preparation of BCG vaccine:

The lyophilisate is dissolved with the supplied SSI solvent. Using a sterile syringe, draw 1.0 ml of solution into a vial for 10 doses or 2.0 ml of diluting solution with 20 doses of lyophilisate BSG vaccine. Turn the vial over several times so as to completely dissolve the vaccine. The vial with the dissolved vaccine must be gently mixed before drawing each dose. *Do not excessively shake the vial* with the vaccine.

Method of administering an intradermal injection

When administering an intradermal injection, only a very small amount of the drug is injected (0.1 - 0.5 ml). The drug must be absorbed slowly through the blood capillaries into the body. The injection is usually given by a doctor or a specially trained nurse.

- Prepare the drug from the ampoule or vial as prescribed by a doctor. (see topic "Injection technique")
- Aseptic principles must be observed throughout the procedure.

- The prepared syringe with the drug is labelled with the patient's name, birth year, drug name, volume and method of administration, date and time of application.
- The patient's identity must be verified prior to administering the drug (via identification bracelet or by asking – what is your name?). The patient is informed of the need for, method and type of drug to be administered.
- Assess the patient's health condition and help them to take the most appropriate position.
- Select a suitable site for ID injection (without increased tenderness, swelling, scars, birthmarks, frequent punctures, local inflammation).
- Disinfect the injection site using a swab with disinfectant; let the antiseptic fully dry.
- Put the gauze square between the ring finger and the little finger of the non-dominant hand, ready to treat the injection site after injection.
- Remove the cap from the needle to avoid contamination.
- Remove any air bubble from the syringe.
- Using the free non-dominant hand, stretch the skin and inject the needle, with the needle tip lumen facing up, into the skin at a 15° angle (almost horizontal).
- Inject the drug slowly.
- After injecting the drug, a small white impression will form (approx. 0.5 mm) below the epidermis (see Fig.) 13.2-1).
- The patient will feel a burning sensation.
- Remove the needle after administering the drug and attach the gauze square.
- Do not massage the injection site so as not to force out the drug through the injection channel to the surface. The injection site can be treated with a patch.
- Make a record of the intradermal injection in the nursing documentation, also of the effects of the drug on the patient, date, time and name of the doctor.

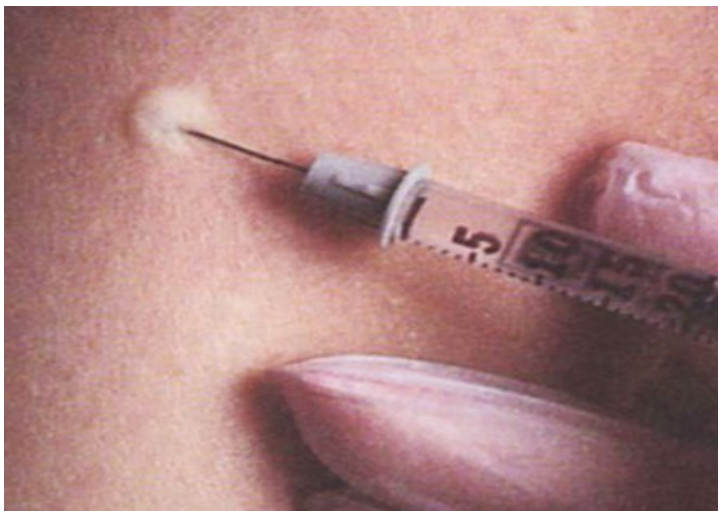

Fig. 13.2-1: White impression formed after intradermal injection

Source: Potter, Patricia A. Perry, Anne G. *Fundamentals of nursing. Concepts, process and practice*. Third edition, 1993, ISBN 0-8016-6667-8 (p. 657) step 25

Patient care after the procedure

If the vaccine is administered on the ward, the patient is instructed to call a nurse using an alarm to report any problems with the procedure. If the vaccine is administered in an outpatient facility, the patient is educated on possible side effects of the administered substance and how to proceed in such a situation. The effect of the administered drug is assessed by a doctor or a specially trained nurse.

Care of aids after use

All used aids are immediately placed in the kidney bowl. Used needles without a cap, syringes and sharp objects are deposited into a mobile container for sharp objects. Do not put the cap back on the used needle to prevent injury by a used needle. The remaining used material is subsequently recycled into the appropriate waste containers.

Intradermal prick test

Skin allergy testing is a method for medically diagnosing allergies. The skin tests involve administering purified extracts of individual allergens (dust mites, various pollens, cockroaches, cats, dogs, etc.) mostly using the skin prick method.

A microscopic amount of an allergen, usually 0.02 – 0.05 ml of the substance, is introduced to a patient's skin with a skin prick test lancet. The skin prick tests are not very painful and almost painless. They can be conducted on patients of any age. The injection is usually given by a doctor or a specially trained nurse.

Patient preparation

Patient preparation is similar to intradermal injection (see above).

Note: The patient should not be given antihistamines for 7 to 15 days before conducting the skin tests.

Aids preparation (see Fig. 13.2-2):

- Medical documentation
- Original packaging for the allergen as prescribed by a doctor
- Skin prick test lancets
- Gauze swabs
- Wadding squares
- Disinfectant
- Kidney bowl and container for sharp objects (or 2 kidney bowls)
- Gloves (as is customary on the ward)
- Alarm clock (to set 15 – 20 minutes for application)
- Colour marker pen to indicate injection sites of allergen drops
- Ruler to deduct the test results

Fig. 13.2-2: Aids for application of allergy tests

Procedure

- The forearm is marked with the points for allergen application.
- The allergen is applied in drops in a predetermined order.
- The allergen drops are applied (imprinted, pricked) into the skin with a lancet.
- The excess amount of the applied substance is allowed to soak in e.g. a square of wadding.
- The nurse asks the patient to wait in the waiting room for the evaluation of the test.

Patient care after the procedure

The skin prick test is usually done in an outpatient facility. The patient is notified of the potential reactions regarding the applied substances and must wait for at least 15 – 20 minutes in the waiting room for the test reading.

Evaluation of the skin prick test:

If the site of application turns red – erythema (min. size 7 mm), or there is an impression (min. size 3 mm) - *the result is regarded as positive.*

Care of aids after use

All used aids are immediately placed in the kidney bowl. Used lancets are immediately thrown into the mobile container for sharp objects or into a second kidney bowl. The remaining used material is subsequently recycled into the appropriate waste containers.

Complications of the procedure

Overall:

- Allergic reaction to the administered substance or disinfectant.

Local:

- Introduction of an infection into the tissue due to violation of aseptic procedures.
- The injection site is not to be massaged in order to avoid:
  - Penetration of the substance into the deeper layers of the skin
  - Displacement of the substance after withdrawal of the lancet.
- Painful application
- Haematoma

*S*evere forms of Atopic dermatitis are *contraindicated*. (L209)

Risks:

Adverse reactions after BCG vaccine SSI:

- Injection site induration after ID injection (often transformed into a lesion then possibly ulceration). Lesions usually heal spontaneously, leaving a surface scar 2 - 10 mm in diameter. Exceptionally, the ulceration persists at the injection site for several months. A tight bandage is not recommended.
- A slight enlargement of the regional lymph nodes – up to 1 cm – is common. Enlargement of axillary lymph nodes may sometimes persist for several months after vaccination.
- Less common: headache, fever. Local: enlarged regional lymph nodes > 1 cm. Exuding ulcers at the injection site.
- Very rare: Disseminated BCG complications such as osteitis or osteomyelitis. Allergic reactions, anaphylactic reaction. Local effects: Purulent lymphadenitis, abscess.

Control questions

- Into which layer of the skin is an intradermal injection administered?
- What is the formation on the skin immediately after injecting the drug (syringe and needle) at the injection site called?
- What is the abbreviation for medications applied into the skin?
- Why are intradermal injections administered?
- What is the other term for the Mantoux test?
- What is the appropriate position of the patient when administering an intradermal injection?
- Can you administer an ID injection into swelling, scars or birthmarks?
- Which aids are required for ID injection?
- What is the method of administering ID injection using a lancet called?

13.3 Administering drugs to muscles

After studying this chapter, you should be able to:

- Find suitable sites for administering intramuscular injections;
- Prepare aids for administering intramuscular injections in adults and paediatric patients;
- Observe special requirements for administering intramuscular injection in children;
- Apply the aseptic method during procedures;
- Explain the importance of intramuscular injections;
- Assess the risks of potential complications.

Purpose

Intramuscular injections are usually administered for *therapeutic purposes.*

Technical notes

When administering intramuscular injection (IM), the needle penetrates the skin layers, subcutaneous tissue and the muscle. The drugs injected into the muscle are usually in the form of an aqueous solution, suspension, emulsion and oily drugs in the content of 1 – 20 ml. The drug is gradually absorbed. The absorption rate depends on the injection site and the condition of the circulatory system.

Sites for administering intramuscular injections

The most commonly used muscles for intramuscular injections are:

- *musculus glutaeus maximus* – dorsogluteal injection site

  Method of palpating the injection site: Palpate the iliac crest with the side of your right hand (with fingers closed) and the anterior superior iliac spine with your thumb. Distancing the index finger from the middle finger will give you the best IM injection site (see Fig. 13.3-1). This area is free of nervus ischiadicus and the gluteal artery.

- *musculus glutaeus medius* – ventrogluteal injection site

  Method of palpating the injection site: Put the palm of the left hand on the right trochanter and stretch the index finger towards the anterior superior iliac crest. Stretch the middle finger to create a letter "V" - in the middle of this is the best injection site (see Fig. 13.3-2). This injection site is particularly suitable for immobile patients who may have atrophied muscles. The injection site is known as Hochstetler's. It is a site where a maximum 2 ml of drug can be administered.

- *musculus vastus lateralis* – lateral thigh

  Method of palpating the injection site: Imagine a perpendicular line from the trochanter major towards the outer edge of the kneecap (patella). The middle third of this imaginary connecting line is suitable for safe intramuscular injection. A skin fold can be gripped before injecting.

- *musculus deltoideus*

  Method of palpating the injection site: Palpate the acromion and place three fingers underneath so that the fingers follow the humeral head. The most suitable injection site is below the fingers (in the centre of the shoulder side wall in the axilla line). The injection site is suitable for adult males with developed musculature (see Fig. 13.3-3). This site is suitable for administering a max. 2 ml of drug.

The injection sites are alternated and checked when necessary to prevent an accumulation of punctures.

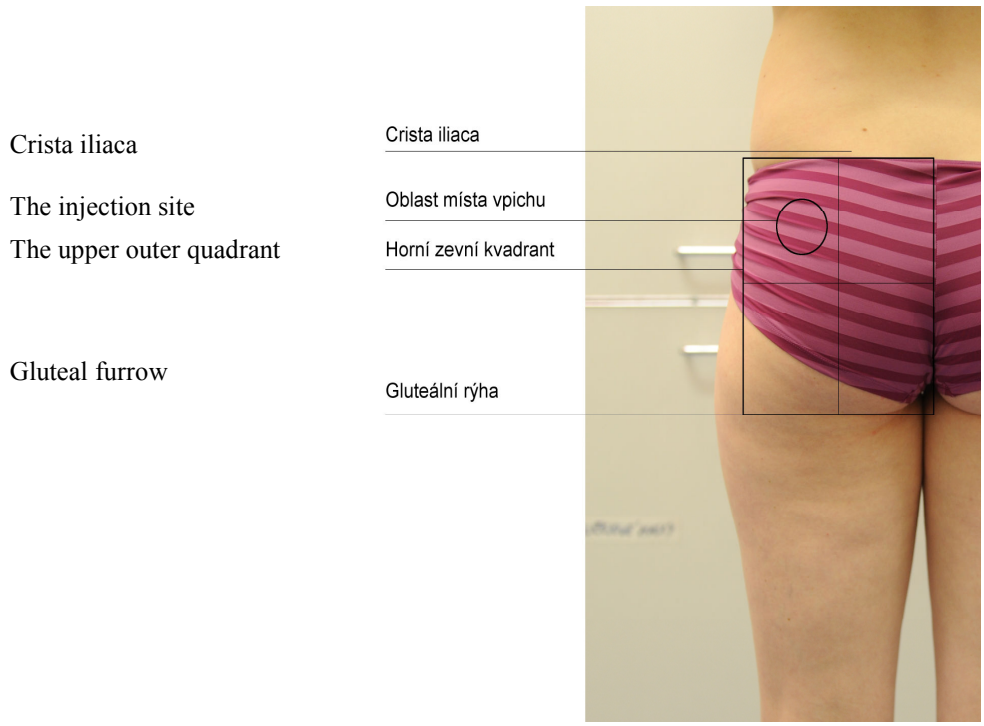

Fig. 13.3-1: Suitable injection site into the musculus gluteus maximus

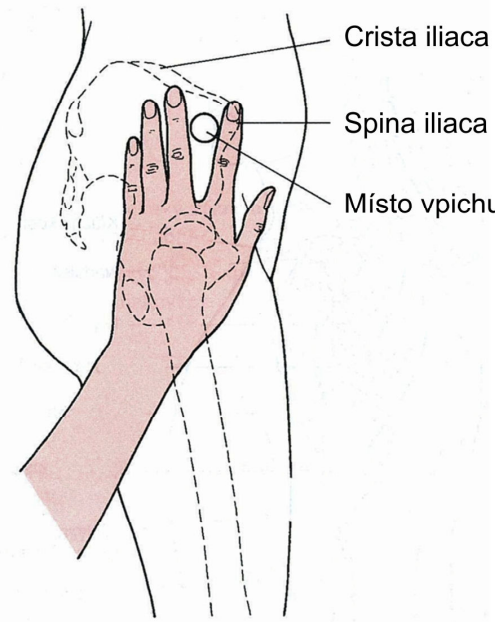

Fig. 13.3-2: Suitable injection site into the musculus gluteus medius

Source: KOZIEROVÁ, B., ERBOVÁ, G., OLIVIEROVÁ, R.: *Ošetrovateľstvo I. a II. díl*. Martin: Osveta, 1995. s.1281 ISBN 80-217-0528-0.)

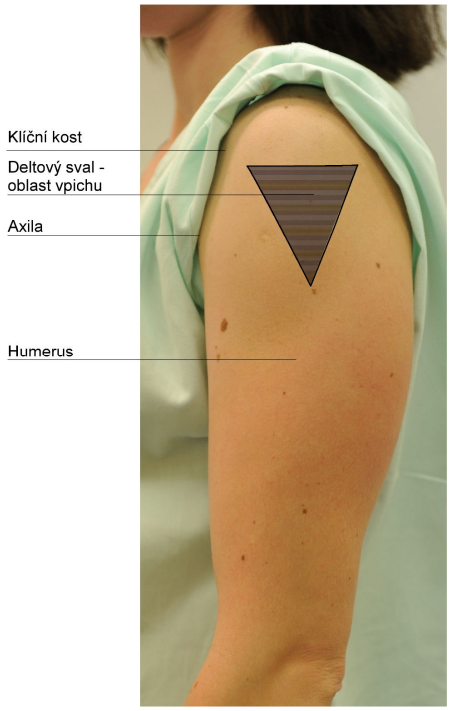

Fig. *13.3-3: Suitable injection site into the musculus gluteus deltoideus*

Only healthy muscles are used for intramuscular injection. The injection sites are alternated to prevent accumulation or other complications. The intramuscular injection technique depends on the type of drug and injection site. The needle is usually injected at a 90° angle (musculus gluteus maximus, musculus vastus vateralis), or eventually at a 60° angle (musculus gluteus medius). The most commonly used syringes for intramuscular injection are 2 ml, 5 ml, 10 ml or 20ml.

The drug onset of intramuscular injection is within 10 – 15 minutes.

Due to the possibility to administer drugs intravenously, the current indication for IM injections decreases.

Circumstances affecting the administering technique of intramuscular injections:

- *Age:* The selection of a suitable injection site can be affected by weak muscles in geriatric patients.
- *Overall condition:* Cachectic and exhausted patients often have weak muscles and an impeded blood flow, including skin, therefore making drug absorption difficult.
- *Type of drug:* The choice of the injection site is affected by the amount, consistency and frequency of the administered drug. For example, the suitable administration of injections with a depot effect (a form of drug with slow absorption or with prolonged effect) is into the muscle (musculus gluteus maximus).

Patient preparation

The nurse informs the patient of the need, method and type of intramuscular injection and ensures the patient's cooperation. The nurse also assesses the patient's health condition, enquires about any allergic reactions when given intramuscular injection in the past, and alternatively proposes a contraindication.

Correct positioning of the patient prevents muscle tension. When administering an injection into the musculus gluteus maximus, the patient is put into the prone position where the toes point inwards which helps to relax the gluteal muscles.

Preparation of aids

List of aids (see Fig. 13.3-4):

- Ampoule or vial with the drug according to the doctor's prescription and recorded in the medical documentation, diluting solution as appropriate.
- Sterile syringe needles:

  For drawing the drug from the ampoule/vile (18G needle – with a pink hub)

  The drug is injected with an appropriately sized needle – the needle hub for an adult patient is black. A green needle hub is used for overweight patients.
- Sterile syringe of the appropriate size
- Sticker to label the syringe with the patient's name
- Gauze swabs or squares, disinfectant
- Patch to cover the injection site
- Gloves (as is customary on the ward)
- Kidney bowl, a container for storing used needles and sharp objects

Fig. 13.3-4: Aids for preparing and administering an intramuscular injection

Working procedure

- Prepare the medicinal substance according to doctor's prescription as per the medical documentation (daily report).
- The needle used to prepare the drug into the syringe is replaced with a needle for injecting (when administering an oil based drug or suspension, use a needle with a wider lumen).
- Observe aseptic conditions when preparing the injection and throughout the procedure.
- Label the prepared syringe with the patient's name, date of birth, room number, bed number in the room and the name, amount and method of drug administration (e.g. Jan Novák, 1956, r.no. 4/1, Novalgin 1 amp., drug volume, IM).

At the bedside:

- Verify the identity of the patient and inform them of the need and type of intramuscular drug treatment. Assess the patient's current health condition; ascertain if they have any allergic reactions.
- Instruct the patient to alert you of any adverse reactions when administering the injection and afterwards.
- Talk to the patient when administering the injection.
- Help the patient to take the appropriate position.
- Palpate the skin at the suitable injection site; assess the skin condition (e.g. redness, haematoma).
- Disinfect the chosen injection site.
- Place a swab in between the ring finger and the little finger on the (non-dominant) hand.
- Stretch the skin slightly above the point of injection.

- Hold the syringe (usually) at a 90° angle (vertically like a pen), the index finger or the middle finger supports the needle hub.
- Puncture the skin without hesitation, injecting the needle into the muscle (usually up to the needle hub).
- The fingers of the left hand (thumb and index finger) support the needle hub, the right hand draws the plunger out (to check for blood aspiration); if there is no blood, inject the drug slowly into the muscle.
- After administering the drug, remove the needle and treat the injection site (compress it for few seconds with a swab and attach a plaster).
- If the patient complains of abnormal sensations (tingling, warmth in the leg, pain radiating to the leg), interrupt the procedure and inform a doctor.
- If blood appears in the syringe, prepare a new dose and repeat the whole procedure.

Patient care after the procedure

Put the patient into an appropriate position and observe the effect of the drug administration. The patient is notified of the need to call the nurse in the case of any problems related to the procedure by using an alarm. The nurse notifies a doctor of any possible complications. The procedure is recorded in the relevant documentation.

Care of aids after use

Take care of the aids as is customary on the ward. The aids that will be used again are stored away (e.g. disinfectant), disposable aids are safely discarded (e.g. into the container for sharp objects).

Complications in administering intramuscular injections

- ***Introduction of infection*** into the injection site through non-compliance with the aseptic procedure (e.g. the administered drug or aids are no longer sterile), inadequate skin disinfection. Prevention of this is in careful compliance with the aseptic procedure.
- ***Haematoma*** – as a result of vein puncture and the release of blood into the subcutaneous tissue. Prevention is the correct technique for administration and careful injecting. The haematoma is treated with cold compresses.
- ***Injected nerve*** or injecting in the immediate vicinity at an inappropriate choice of injection site. The complication is manifested by tingling, numbness or pain radiating to the lower limbs along the nerve, or even paralysis of the limb. Terminate the injection immediately and remove the needle. Apply ice to the injection site and inform the doctor. Prevention is careful selection of the injection site.
- ***Injected blood vessel*** – discovered in aspiration when checking for blood return to the syringe; if that is the case then the nurse must halt the procedure, pull the needle out and prepare a new injection, repeating the whole procedure at a different injection site. The affected area is treated with ice.
- ***Injected bone*** – during inconsiderate administration in people with low subcutaneous and muscle layers, e.g. cachectic patients, choosing a wrong needle length or selecting an

inappropriate injection site. The needle is withdrawn by about 1 cm. The impact on the bone may deform the needle tip, causing it to bend with subsequently painful withdrawal. Prevention is the correct choice of hypodermic needle, appropriate depth and careful injecting.

- ***Broken needle*** in clumsy handling during application. This may be caused by excessive force, by resistance of an extremely tightened muscle or a technical glitch. A broken needle must be surgically removed after X-rays. Prevention is the correct injection technique.
- ***Allergic reactions*** – to a disinfectant or an administered drug.
- ***Abscess*** – the cause may be inappropriately chosen injection site, injection of drug into the subcutaneous tissue using a short needle. An abscess is manifested by inflammation – the site is red, painful; resistance can be determined through palpation. Inform the doctor. It is often necessary to surgically remove the abscess including administering preventive antibiotics. Prevention is a careful identification of the injection site, choosing the correct needle length and complying with the aseptic procedure.

Complications can generally be prevented by correct implementation of the procedure.

In the event of administering medication which is highly irritating to the skin and subcutaneous tissue, the Z-tract method can be used. The procedure for the Z-tract method is similar to that described above. The only change occurs before administering the drug - when using the non-dominant hand, the skin and the subcutaneous tissue are pulled 2.5 - 3.5 cm from the injection site. After aspiration (no blood in the syringe) and subsequent drug injection, hold the outstretched skin. After removing the needle, allow the skin to return to its original place (see Fig. 13.3-5).

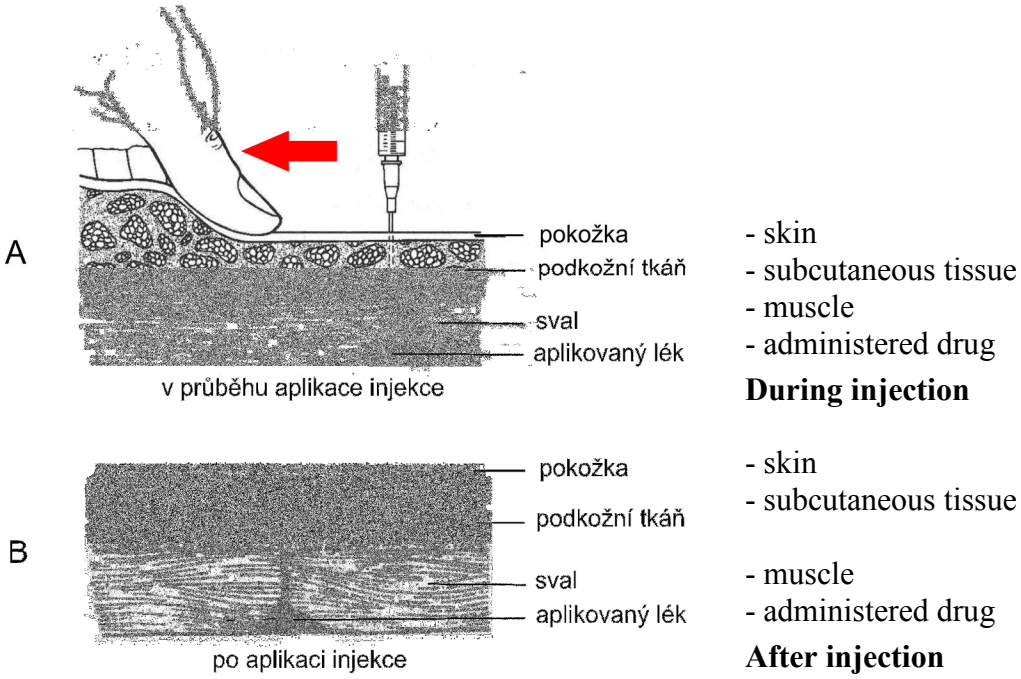

Fig. 13.3-5: Administration procedure for IM injection using the Z-tract method

Source: KOZIEROVÁ, B., ERBOVÁ, G., OLIVIEROVÁ, R.: *Ošetrovateľstvo I. a II. díl*. Martin: Osveta, 1995. p.1281 ISBN 80-217-0528-0.)

Special requirements for intramuscular drug injection in children

Theoretical notes

Since the high quality intravenous cannulas, which when fixed well remain inserted in the child's bloodstream for several days, are currently the most common used method, the intramuscular injection method is chosen where it is not possible to administer the intravenous cannula. The doctor decides which of the parenteral administration methods will be used.

Specification of suitable injection sites for intramuscular injections in children

The most common injection site for intramuscular injections in newborns and infants is the musculus vastus lateralis region. The musculus gluteus medius region is used for children who are at least two years old. The musculus gluteus maximus is not used for children younger than 3 years old. The muscle is underdeveloped, so there is a risk of injury to the nervus ischiadicus (sciatic nerve). The musculus deltoideus is not used for injection in children younger than six years old, depending on the muscle mass.

Patient preparation

The child must be mentally prepared in order to cooperate (the child is briefed on the procedure, the mother is also asked to participate, or a games therapist may be involved. The mother is asked to stay with the child and to try to distract them from the actual procedure while holding the child in the desired position. If the mother cannot be present, a second nurse assists during the procedure in order to prevent any complications.

Preparation of aids

The choice of aids for intramuscular injection in children is the same as for adults, only the size of the needle is chosen according to the child's muscle mass. Unless the administration involves suspension (e.g. penicillin), a needle with a blue hub (size. 23G 0.6 x 25 mm) is used in newborns. The penicillin is administered with a yellow hub needle, size (20G 0.9 x 40 mm); needles with a narrower diameter could be obstructed – risk of needle blocking. Only a reasonable part of the needle is injected, not all of it.

Working procedure

The technique for intramuscular injections in children is similar to that in adults.

Special requirements for intramuscular injections in children:

- The injection is administered into the child's thigh muscle at a 60° angle.
- The needle length varies; it is chosen according to the child's muscle mass.
- The smaller the muscle mass, the smaller the angle of the needle (however, max. 45° angle, no less).
- In children, the intramuscular injection is administered into a skin fold.

Additional task

Practice preparation and administration of IM injection in the course of professional training.

Study the anatomy of suitable intramuscular injection sites. Learn to palpate the correct injection sites for intramuscular injection.

Study: Caring for a child patient – before and after the procedure (see: Sedlářová, p. 127 - chapter *Účinné strategie zvládání strachu a bolesti u dětí (Effective strategies for handling fear and pain in children).*

Control questions:

- What is the drug onset when administering an intramuscular injection?
- What drug volume (in ml) can be injected into the muscle?
- What is the most frequent angle for administering an intramuscular injection in an adult?
- What are the most common complications in intramuscular injections?
- What is the procedure when giving an injection to a paediatric patient? How can you distract the child from injection pain?
- How do you ensure the mother's cooperation when injecting a child?
- Which injection site is the most appropriate for intramuscular injection in newborns and infants?
- Why should an adult patient lie on their stomach with their toes facing inwards when administering an injection in to the musculus gluteus maximus?

13.4 Intravenous drug injection

Objective

After studying this chapter, you should be able to:

- Explain the importance of intravenous injections;
- Apply the aseptic method during procedures;
- Assist in administering intravenous injections;
- Care for the intravenous injection site;
- Assess the risks of potential complications.

Purpose

Intravenous drug administration is preferred when an immediate effect must be achieved or if the medicine cannot be administered in any other way.

Theoretical notes

Suitable venipuncture sites are soft to the touch flat veins, if possible on the non-dominant limb. The most common sites of intravenous injections are localized in the peripheral venous system of the upper limb; veins in the temporal area of the head are used for young children. For prolonged therapy, the veins on the back of the hand and forearm are preferred - v. basilica, cephalic v., v. cephalica accessorie, v. median cubiti, v. median antebrachii, v. metacarpae. The venous network in the dorsum of the foot - v. saphena magna and the dorsal vein plexus are not recommended for use in adults because of the risk of damage to the venous valves and the subsequent deterioration of the venous return. The veins on the paretic limb, rigid and sclerotic veins and the previous cannulation sites are considered unsuitable for intravenous injections. Drugs dissolved in an aqueous solution of various volumes are administered into the vein. A larger volume of the drug is administered via an established peripheral venous catheter. The administration of the drug by the intravenous route always requires drug dilution with saline. IV injections may be administered only once using a hypodermic needle and syringe. In this case, the drug is diluted using saline and the volume is a maximum of 20 ml, or the drug is administered through a peripheral venous catheter. The usual volume administered is up to 100 ml of physiological saline and is administered as an infusion. In this case, the principles of intravenous infusion administration are observed. The drug onset in intravenous administration is very fast, 30 – 60 s. The intravenous infusion is administered by a doctor; the nurse only assists.

Patient preparation

- Inform the patient about the need, the method and type of intravenous therapy.
- Assess the patient’s vital signs.
- Assess the patient’s medical record regarding allergies to drugs, plaster disinfectant etc.

- Explain the procedure, i.e. length of administration to the patient and answer any questions.
- Adjust the patient's bed to provide maximum comfort.
- Ensure the patient goes to the toilet before the procedure.
- Put the patient in the appropriate position (half-sitting, lying down).
- Instruct the patient of the need to remain in the position during the intravenous injection via peripheral venous cannula.
- When administering an IV injection through a peripheral venous cannula, arrange for an alarm to be within the patient's reach in order to call for the nurse if needed.

Aids preparation (see Fig. 13.4-1)

Prescribed drugs, Esmarch tourniquet, sterile syringe, sterile needle (for drawing and administering the drug), a bottle with a sterile saline solution, disinfectant, cellulose squares, sterile swabs, kidney bowl, strip of tape, protective gloves, description labels, disposable pad for supporting the limbs, bin (container) for needle disposal.

Fig. 13.4-1: Intravenous injection aids

In case of IV injection of a higher drug quantity, the nurse also prepares an infusion set and infusion stand.

Performing the procedure

Intravenous injection using a needle and syringe:

- Verify the doctor's prescription (patient's name and surname, date of birth, prescription date, type, strength, form and quantity of drug, method of administration and the time the drug should be administered).
- Draw the prescribed drug from the vial or ampoule; follow the aseptic principles (see Fig. Administering an injection).
- Draw saline into the syringe to the minimum of 20ml.
- Remove the needle used for drawing the drug.

- Attach the injecting needle.
- Label the prepared syringe with the diluted drug – patient's name, room number, bed, drug name, drug volume, method of administration.
- Support the upper limb with a disposable pad.
- Gently tie the Esmarch tourniquet above the injection site (approx. 6 - 8 cm).
- The doctor puts on their gloves.
- The doctor also chooses a suitable injection site by palpating the veins.

  If the veins do not display well enough:

  Ask the patient to clench their fist and to flex and extend the arm at the elbow joint repeatedly (this way the vein will fill with blood).

  The area can be massaged in distal manner, away from the injection site in the direction of the venous flow to the heart.

  The skin can be gently tapped with fingertips above the puncture site.

  Remove the tourniquet and if necessary apply a warm compress.
- The doctor will carefully disinfect the venipuncture site.
- It must not be touched after it has been disinfected!
- The protective cap is removed from the syringe needle.
- The doctor removes the air bubbles by slowly pushing the syringe plunger.
- The non-dominant hand gently stretches the skin to fix the vein.
- The syringe is held in the same manner as in the SC injection.
- The doctor smoothly injects the needle.
- The doctor aspirates to check if the needle has entered the vein.
- The Esmarch tourniquet is released.
- The drug is slowly administered.
- When administering the drug the doctor monitors the injection site, the overall condition of the patient and the effect of the administered drug.
- The needle is then pulled out.
- The injection site is compressed using a swab and fixed with tape.
- Ask the patient to press on the injection site with the swab until the bleeding stops. It is not recommended to flex the arm at this point as it would increase the risk of haematoma!
- The doctor makes a record of the intravenous drug administration in the relevant documentation.

Intravenous administration via a peripheral venous cannula, see chapter - Introduction of IV cannula, Administration of infusion.

Complications of the procedure

Complications in administering intravenous injections:

- Punctured veins – an improperly administered needle leads to subcutaneous bleeding; the injection must be terminated and the drug injected into another vein; the affected injection site is treated with a cold compress (see Fig. 13.4-2).
- Infection – breaching the aseptic principles may result in pain, redness, increased body temperature; the doctor must be informed immediately.
- Extravasation administration – administration of the intravenously infused drug into the extravascular space which results in pain, swelling at the injection site; the injection must be terminated and the drug infused into another vein; the affected site is treated with a warm or cold compress, depending on the type of drug. Dry cold compresses causes vasoconstriction, i.e. limiting the leak of the drug strictly intended for IV administration into the perivascular space and subcutaneous tissue. The disadvantage of the cold compress is a reduction in lymphatic transport or decreased cellular intake of the drug. Application of a dry warm compress causes vasodilation, improving absorption and transport through the lymphatic vascular system. The disadvantage is the increase of the local activity of certain drugs, such as some cytostatics, thereby increasing their cytotoxic effect.
- Reaction to medication – intravenous drug administration is very slow, following the manufacturer's instructions. The patient is monitored throughout the administration and in the event of an adverse reaction (rapid breathing, sweating, dizziness, etc.) the administration is immediately discontinued.

Risks:

- Damage to the patient's health due to confusion of the administered drug.
- Mistaking the patient due to insufficient identity verification before the procedure.
- Collapse of the patient due to a sudden drop in blood pressure caused by improper positioning.
- Harm to the patient due to improper drug administration rate.
- Harm to the patient due to unsuccessful and repeated introduction of the needle into the venous system.

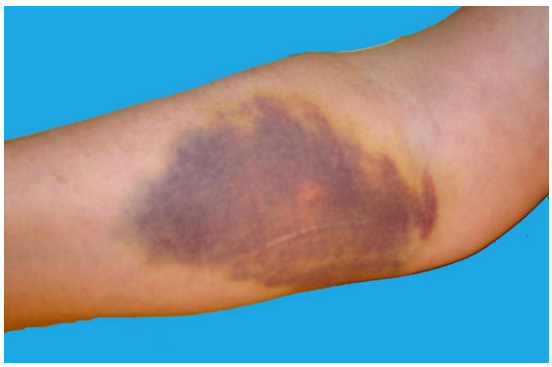

Fig. 13.4-2: Haematoma as a result of a punctured vein

Task

- Practice attaching the Esmarch tourniquet.
- Practice the intravenous drug administration assistance.
- Identify the most common methods of IV drug administration during clinical practice.

Control questions

Select from the below options which of the sites are deemed inappropriate for administering an IV injection?

- Insufficiently showing veins
- Rigid, firm vein
- Sclerotic vein
- Veins on the paretic limb
- Veins after previous cannulation

Which aids required for IV injection are missing from this list?

- Prescribed drugs
- Sterile syringe
- Sterile syringe needles (for drawing and administering drugs)
- Cellulose squares
- Esmarch tourniquet
- Sterile swabs
- Kidney bowl
- Strip of tape
- Description labels
- Disposable pad for supporting the limbs
- Waste bin (container) for disposing of needles.

Indicate the correct order of the individual steps for administering an IV injection:

- The Esmarch tourniquet is released
- Carefully disinfect the venipuncture site
- Inject the needle in three phases
- The injection site is compressed using a swab and fixed with tape.
- Choose a suitable injection site by palpating the veins.

- Label the prepared syringe with a diluted drug.
- Gently tie the Esmarch tourniquet above the injection site (approx. 6 - 8 cm).
- The non-dominant hand gently stretches the skin to secure the vein.
- Check (aspire) if the needle has entered the vein.
- Monitor the injection site, the overall condition of the patient and the effect of the administered drug.
- Make a record of intravenous drug administration in the relevant documentation.
- Put on the gloves.
- Slowly inject the drug.

13.5 Insertion of IV cannula

Objective

After studying this chapter, you should be able to:

- Explain the importance of introducing a peripheral venous catheter;
- Demonstrate this procedure using a model or simulator in the laboratory and later in clinical practice;
- Name the basic types and parts of IV cannulas;
- Assess the risks of potential complications;
- Identify changes in the care of a peripheral venous catheter;
- Implement the aseptic procedure;
- List potential complications associated with the procedure.

Purpose

- Administration of drugs via the parenteral route (antibiotics, cytostatics).
- Administration of infusion or transfusion solutions.
- Fast supply of fluid into the bloodstream.
- Long-term parenteral nutrition.

Theoretical notes

When choosing an appropriate site for vein puncture, it is necessary to take into account the clinical condition of the patient, the age, the condition of the peripheral venous system, the size of the cannula, the planned therapeutic approach, how long the cannula will remain inserted, the type of drug administered, and if the blood will be repeatedly taken for examination. A peripheral venous puncture is usually administered to adults on the back of the hand, on the forearm and around the cubital fossa. The venous system of the lower limbs is only used when necessary and in exceptional cases. The selection of the injection site is guided by the anatomical proportions of each individual. As a rule, avoid areas on the body with arteries and nerves close to the veins, because of the potential to puncture. Therefore, avoid punctures near the joints. If a puncture cannot be avoided in these areas, it is necessary to fix the joint with splints and therefore prevent movement and development of complications. If injection into the vein on the lower limb cannot be avoided, the injection sites are on the instep and medial malleolus. It is necessary to allow sufficient time to choose the injection site!

The intravenous cannula is selected according to:

- Knowledge of the anticipated therapeutic procedure (cannula length, type of therapeutic solution, volume of solution administered, administration rate);
- Knowledge of the condition of the peripheral venous system.

Generally, the smallest possible cannula in terms of diameter and length is used, which permits unrestricted blood flow and thereby a faster dilution to the administered drug or solution, but with regards to the type of therapy, the volume and density of the infusion solution, etc. This will help to prevent damage to the inner endothelia of the vascular wall and reduce the risk of mechanical irritation to the vessel wall. The principle is that the greater the irritation of the vein wall and the risk of thrombosis, the smaller the ratio of the lumen diameter to the cannula diameter. A wider lumen cannula is chosen for the purpose of transfusion. When selecting the appropriate IV cannula, the information of the individual manufacturers acts as a guide. The choice of injection site must be so that cannula movement during limb movement is kept to the minimum.

General division of intravenous cannulas

- Design - straight cannula, cannula with wings, without injection port, with injection port (see Fig. 13.5-1).
- Type – Teflon, polyurethane.
- With safety mechanism – a metal clip is activated when the needle is withdrawn from the cannula which protects against injury from the cannula needle (see Fig. 13.5-2).

Fig. 13.5-1: Intravenous cannula with wings and injection port - folded and unfolded

Fig. 13.5-2: Safety mechanism for protection against needle injury supplied with some IV cannulas

General use of intravenous cannulas

- For quick blood transfusion - size 14 – 16G.
- For fast transfusion of large volumes of fluids and fluids with high viscosity - size 17G.
- In treatment with large volumes of blood or fluid - size 18G.
- In long-term medication – size 20G.
- For cancer patients, in long-term medication, or in patients with thin veins - size 22G.
- For paediatric patients, newborns, patients with fragile veins – size 24 – 26G.
- *The cannula must never fully obstruct the inner lumen of the vein!*

Patient preparation

- Check the patient's identity (see Fig. 13.5-4).
- Assess the patient's clinical condition.
- Explain the procedure to the patient.
- Put the patient in the appropriate position (lying down or half-sitting).
- Adjust part of the patient's clothing so it does not obstruct access to the site of the peripheral venous catheter.
- Ensure a suitable position of the limb for inserting an intravenous cannula.
- Select the appropriate injection site.

Aids preparation (see Fig. 13.5-3)

IV cannula of appropriate size, 10 ml syringe, saline, aspiration spike, disinfectant, rubber gloves, Esmarch tourniquet, gauze squares (swabs), sterile dressing for cannula fixation, kidney bowl, container for storing used needles, disposable pad to prevent soiling of bed and clothing, extension (connection) tubing and infusion solution as prescribed by a doctor.

Fig. 13.5-3: Aids for inserting a peripheral venous catheter, different types of IV coverage

Performing the procedure

- Check the integrity of the intravenous cannula packaging, and the expiration date.
- Wash and disinfect your hands.
- Maintain verbal contact with the patient throughout the procedure.
- Fill the connecting tubing with saline and rinse it.
- Apply a tourniquet (Esmarch tourniquet) about 15 – 20 cm above the venipuncture site. Tie the tourniquet to prevent the blood flow in the veins, but not so as to interrupt the blood flow in the arteries. Check if the radial pulse is still palpable which indicates that the blood flow through the arteries has not been interrupted.
- Place the limb in the appropriate position (below the patient's heart); gravity slows the venous return and expands the vein; dilated blood vessels can be punctured more easily.
- Palpate the injection site.
- Select a suitable site for cannulation. Inadequately filled veins can be enhanced by additional measures e.g. clenching the fist, lowering the position of the limb, external heat application, etc. (see Fig. 13.5-5).

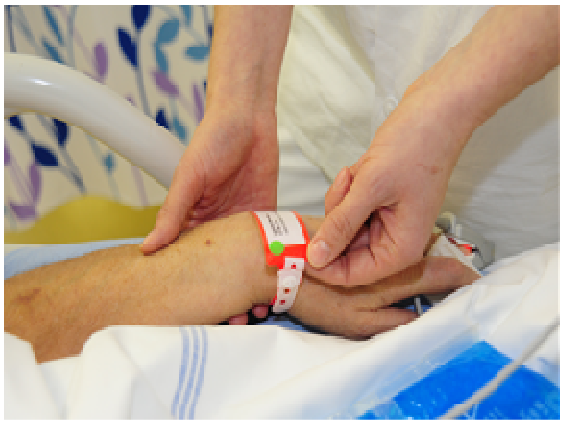

Fig. 13.5-4: Identification of the patient

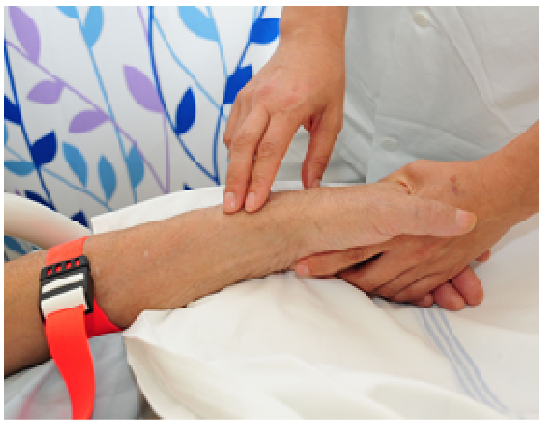

Fig. 13.5-5: Injection site palpation

- Put on disposable rubber gloves which do not need to be sterile.
- Disinfect the injection site. In order to achieve the disinfecting effect, allow the disinfectant to dry (about 1 min.), apply disinfectant gently, the disinfected area must be large enough; the disinfectant is applied in one direction or in circular movements from the middle of the anticipated injection site.
- It must not be touched after it has been disinfected!
- Remove the cannula from the original packaging, remove the protective cap.
- Hold the cannula with a three-point grip (between the index and middle finger of the dominant hand; the thumb fixes the bottom part of the cannula).
- Anchor the vein by pulling the skin with the thumb of your non-dominant hand; this will also reduce the pain during penetration of the needle into the tissue.

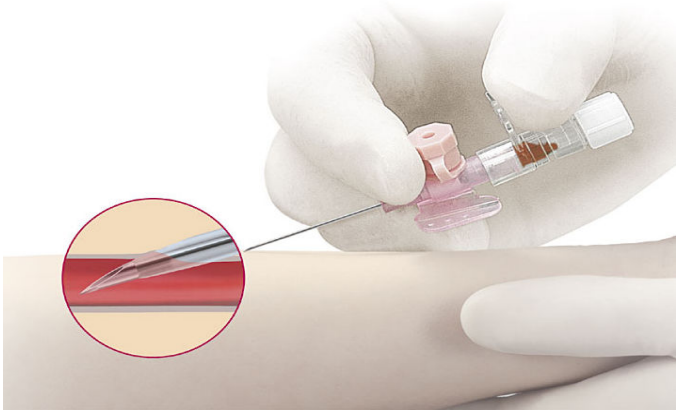

Fig. 13.5-6: Inserting an IV cannula and filling the flashback chamber with blood

- The needle is inserted at a 30° angle upwards; after the needle pierces the skin, tilt the needle so that it is nearly parallel to the skin, and insert it in the direction of the vein 1-2 cm deep; decreasing the angle reduces the likelihood of piercing both walls of the vein.
- The entry of the needle into the vain is indicated by the presence of blood in the cannula flashback chamber (see Fig. 13.5-6).
- After the puncture, quickly remove the tourniquet from the limb.
- Do not insert the needle any further but ensure the plastic part of the cannula is also in the vein.
- After successful inserting the cannula into the bloodstream, place a finger over the vein above the tip of the cannula to prevent bleeding when removing the needle stylet (see Fig. 13.5-7).

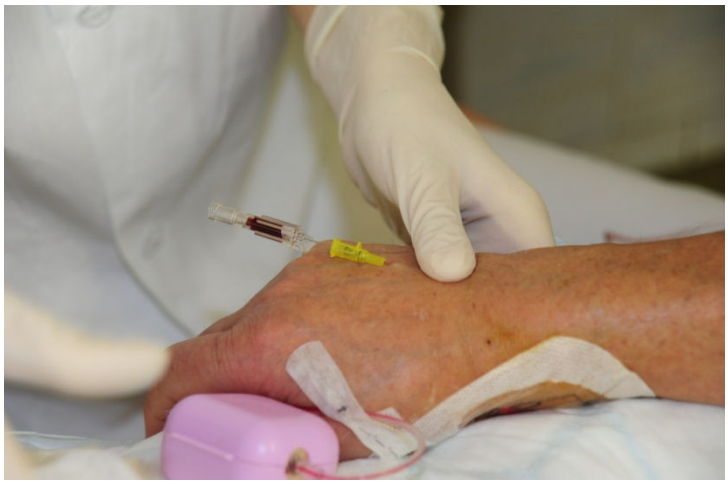

Fig. 13.5-7: Pressing in front of the cannula

- Withdraw the needle stylet. Never reinsert the stylet as this can shear off the end of the cannula.
- Attach the flushed connecting tubing to the end of the inserted IV cannula (see Fig. 13.5-8) or directly using a syringe, flush the intravenous cannula with the saline prepared in the syringe.

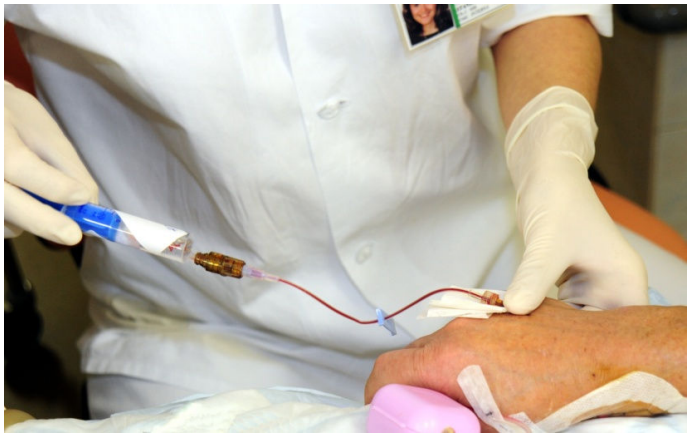

Fig. 13.5-8: Flushing the tubing connecting the IV cannula

- The cannula is carefully secured with a special sterile non-occlusive IV dressing, which prevents contamination of the injection site (see Fig. 13.5-9). Under the cannula, place a sterile gauze square (if part of the dressing) to prevent skin pressure sores while keeping the injection site dry. Each movement of the cannula leads to irritation of the vein wall and the subsequent inflammatory process which reduces the potential insertion time; fixation must not affect the blood flow around the cannula.
- The connecting tubing is fixed with a strip of tape and the end of the connecting (extension) tubing is protected with a special sterile dressing (see Fig. 13.5-10).
- Write down the date of cannula insertion (see Fig. 13.5-11).

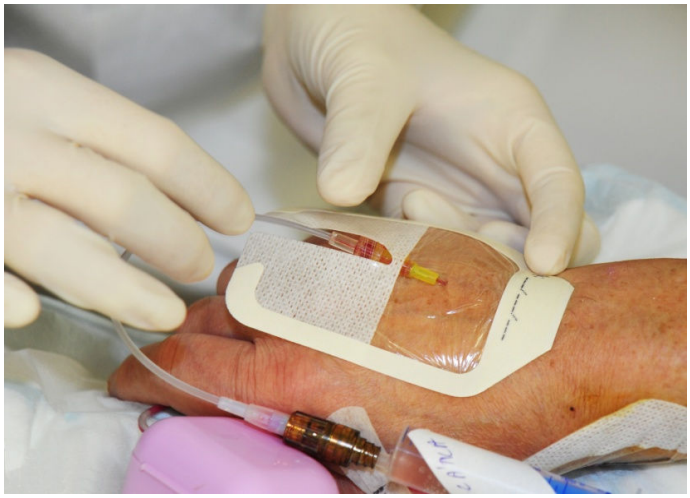

Fig. 13.5-9: Final fixation of the inserted peripheral venous catheter

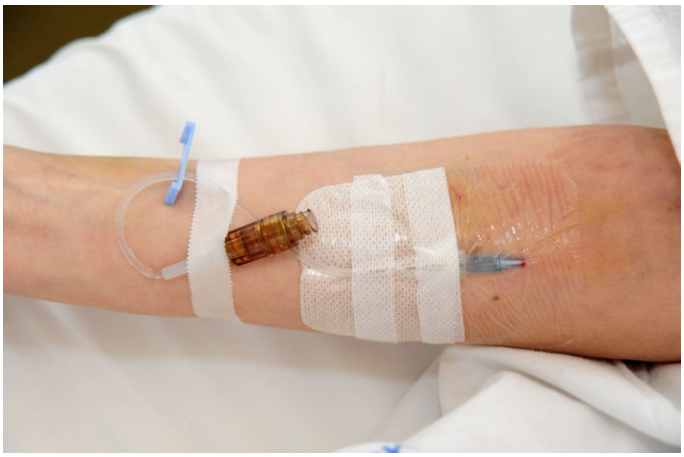

Fig. 13.5-10: Fixing the connecting tubing with a needle-free access point using a strip of tape

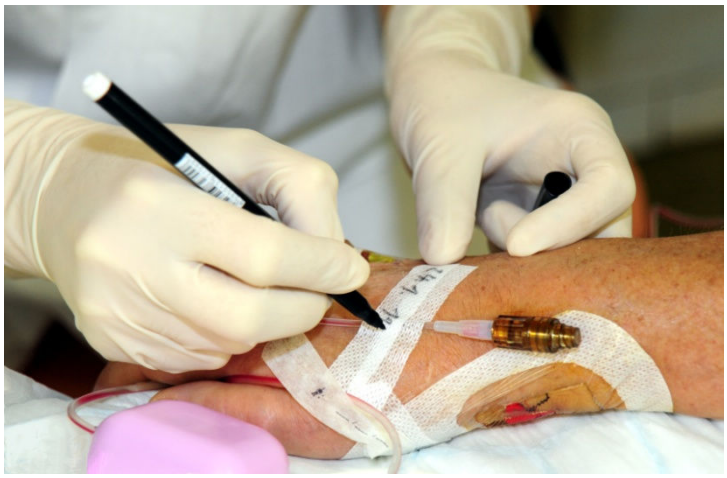

Fig. 13.5-11: Recording the date of IV cannula insertion

- To administer an infusion solution, connect the tubing with the prepared infusion line.
- Always check the injection site and its surroundings before drug administration via IV cannula.
- Always flush the cannula before and after administering drugs. The flushing is done in pulses, i.e. inject 2 ml of saline solution using a syringe to the extension tubing, slow down and again quickly inject 2ml, repeat the pulse flushing and when injecting the last 2 ml of the saline solution close the connection tubing using a pean or a stopper on the tubing and attach the sterile protective cap.
- If there are no signs of inflammation or other complications, the cannula can usually remain in the vein in adults up to 96 hrs, or as recommended by the manufacturer.
- The cannula replacement depends on the type and condition as well as on the condition of the injection site etc. If the protective dressing is not transparent it must be replaced after 24 hrs due to the required visual inspection of the injection site. Applying a transparent dressing on the injection site enables visual checks. The IV cannula can be redressed even after 96 hrs if the injection site does not show any signs of inflammation. The cannula dressing is often replaced simultaneously with the cannula. However, if the cannula dressing is loose, it provides insufficient protection and/or is wet, soaked with blood, then it must be replaced immediately, regardless of the date of the previous redressing. Once again, mark the date and time of the IV cannula change of dressing.

- The date and time of redressing and replacement of the cannula is also recorded in the nursing documentation.
- The cannula must be removed in the event of local complications (the injection site is painful to the touch, red, swollen).
- If there are any signs of inflammation, which may indicate systemic infection, remove the cannula and cut about 2 cm off the cannula distal end using sterile scissors and send it for a culture examination.
- Insert a new cannula at different injection site. It is recommended to alternate the limbs; the vein can be repeatedly used after 24 - 48 hrs; avoid inserting a peripheral cannula into paresthetic limbs, at the place of fracture or into rigid sclerotic veins.
- A short version of introducing peripheral venous catheter can be viewed at: http://www.youtube.com/watch?v=iPwJ_dPi5j8.

For more info see: FAIX, Pavol. *B Braun Echo* [online]. 2002 [cit. 2011-04-06]. Intravenous cannula. Available from: <http://www.bbraun.sk/bbecho/r2002/bbe_mar2002b.htm>.

Patient care

Educate the patient after the procedure of the need to remain in the appropriate position, to limit movement of the respective limb and on the occurrence of potential problems related to the procedure. In addition, notify the patient of the available signalling device to alert the nurse in the case of pain in the injection site, not to tamper with the infusion set (if used) and to notify the nurse of when the infusion bottle is empty.

Care of aids

- All used aids are immediately placed in the kidney bowl;
- The remaining aids are recycled depending on the material and put into designated waste bins according to the ward standards.

Discontinuation of drug administration through an IV cannula

The IV cannula is removed as prescribed by a doctor while observing the aseptic procedure. The cannula is usually removed after the last drip of the prescribed infusion.

Patient preparation

- Explain the procedure to the patient.
- Encourage the patient to cooperate when removing the cannula.
- Choose the appropriate position for the patient with their limb accessible.

Preparation of aids

Protective gloves, sterile swabs, disinfectant, kidney bowl, strip of tape.

Procedure

- Put on the gloves
- Loosen the tape strips that hold the connecting tube.
- Using the dominant hand, release the sterile dressing from all sides, pulling towards the patient's skin while holding the inserted cannula with the non-dominant hand.
- Put the IV cannula dressing into the kidney bowl.
- Use a sterile swab with disinfectant to press on the inserted cannula while removing the catheter.
- Put a plaster on the injection site.
- Check that the peripheral venous catheter is not broken; otherwise immediately report back to the doctor due to the risk of embolism.
- Record the cannula removal into the patient's documentation.

Complications of the procedure

- Haematoma – as a result of failed insertion of the cannula and a puncture or when removing the cannula. The prevention of this is a carefully planned and executed procedure. The formation of the haematoma can be prevented by pressing the point of puncture for 3 – 4 minutes after removal of the cannula, elevating the limb and for patients with anticoagulant treatment by attaching a pressure bandage for at least 15 minutes.
- Extravasation - leakage of administered substances into the tissue outside the vascular bed. The leakage of certain substances can cause tissue necrosis. In this case the patient typically complains of a burning sensation, pain, and hardening of the injection site. During prolonged leakage into the subcutaneous tissue, the limb begins to swell. If extravasation is suspected, discontinue the infusion, inform a doctor, remove the cannula, elevate the limb, monitor the extravasation site and record all changes and the course of healing in the nursing documentation.
- Phlebitis – inflammation of the superficial vein manifested by tenderness, pain, redness, swelling, strips, palpable hardening in the vein and suppuration. If a blood clot is formed in a vein independently from the presence of inflammation of the vein it is referred to as phlebotrhombosis.
- Embolism – this can occur in all forms of IV therapy; air embolism occurs if there is negative pressure in the vein, for example, if the injection site is above the level of the heart, or due to insufficient venting of the infusion set; embolism is caused by a blood clot in the cannula due to flushing a blocked cannula and when cutting off the end of the cannula tip of the cannula when re inserting the needle into the plastic part of the cannula.
- Allergy to a disinfectant or an administered drug.
- Injected artery or nerve during an inappropriate choice of injection site for an intravenous cannula.

- For more see: HUDÁČKOVÁ, Andrea. *EAMOS – education system* [online]. 2010 [cit. 2011-02-15]. Peripheral cannulation, porty CVK. Available from: <http://www.eamos.cz/amos/kos/modules/low/kurz_text.php?id_kap=15&kod_kurzu=kos_392>.

Risks:

- Mistaking the patient due to insufficient identity verification before the procedure;
- Collapse of the patient due to a sudden drop in blood pressure caused by improper positioning of the patient;
- Damage due to improper patient positioning when inserting an intravenous cannula;
- Damage to the patient due to unsuccessful and repeated introduction of a IV cannula.

Introduction of a central venous catheter

Objective

After studying this chapter, you should be able to:

- Define the term "central venous access";
- Name the indications for introduction of a central venous catheter;
- Describe accesses for inserting a central venous catheter;
- Prepare aids for inserting a central venous catheter;
- Assist the doctor during a procedure;
- Assess the risks of potential complications;
- Name the nurse's responsibilities when assisting the doctor during the procedure.

Purpose

The central venous catheter provides access to the central venous system in the event of:

- Inaccessible peripheral venous system;
- Providing long-term access;
- Swelling of the limbs;
- Repeated venesection;
- Measurement of central venous pressure;
- Long-term metabolic care in malnutrition and malabsorption syndromes;
- Intravenous administration of concentrated substances and large volume replacements;
- Extracorporeal elimination method, e.g. in haemodialysis.

Theoretical notes

Access to the central venous system can be gained through the:

- Superior vena cava through the vena subclavia (supraclavicular, infraclavicular access), or the vena jugularis interna or less often through the vena jugularis externa;
- Inferior vena cava through the vena femoralis.

Patient preparation

- Educate the patient on the reasons for securing central venous access.
- Inform the patient about the procedure.
- Encourage the patient to cooperate in the care of central venous access.
- Arrange an X-ray of the patient's heart and lungs as prescribed by a doctor.
- Check the physiological functions.
- Shave the injection site.
- Put the patient to the appropriate position – i.e. in cannulation at the superior vena cava – moderate Trendelenburg position with the head turned to the opposite side of the injection site, in the cannulation at the femoral vein - supine position with the padded side.

Preparation of aids

Daily report, prescribed infusion, sterile gloves, sterile surgical gown, mask, disposable insertion kit, local anesthetic, perforated sterile drape, sterile syringes, sterile needles to draw and administer anaesthetics, sterile swabs, sterile dressing, sterile surgical instruments (needle holder, needle, suture, scissors, surgical forceps), saline , disinfection, kidney bowl, non-sterile scissors, waste bins.

Procedure

- Prepare the prescribed infusions.
- Prepare instruments on the sterile table (sterile and non-sterile), and the remaining aids on the tray.
- Verify the patient's identity.
- Assist the doctor according to the ongoing phase of the procedure.
- Monitor the physiological functions in the patient during the procedure.
- Put a sterile dressing over the injection site.
- Mark the date and time of inserting the central venous catheter.
- Record the procedure in the documentation.

Patient care after the procedure

- Inform the patient of the follow-up care.
- Check the injection site daily and report any changes to a doctor.
- Adhere to the aseptic procedure when redressing the central access.
- Use sterile transparent dressing material.
- The dressing is replaced once every 3 – 5 days, or whenever required.
- A standard dressing is replaced once every 24 hrs or whenever required.
- Mark each new dressing with the date and time.
- Replacement of the infusion, the set, the three-way taps and the connecting tubing as is customary on the ward, usually once every 24 hrs.

Care of aids

- All used aids are immediately placed in the kidney bowl;
- The remaining aids are recycled depending on the material and put into designated waste bins according to the ward standards.

Complications of the procedure

- Extravasation insertion of the catheter;
- pneumothorax, fluidothorax, hemothorax;
- paroxysmal ventricular contractions;
- Sepsis from a non-sterile procedure;
- Air embolism, blockage of the catheter with thrombus due to an incorrectly conducted procedure;
- Allergy;
- Blockage of the catheter by a thrombus which is not directly related to the course of procedure.

Assist the doctor when removing the central venous catheter. Check catheter integrity as is customary on the ward and by sending the end piece for microbiological examination. Cover the injection site with a sterile dressing. Record the removal of the catheter - date, hour, time, catheter integrity and description of the injection site.

Task

Using the anatomical atlas, locate the blood vessels of the upper and lower limbs that are most frequently used to insert a peripheral venous catheter. Write these down and draw a picture.

Practice preparing aids to insert a peripheral venous catheter at the clinical workplace.

Look for specifics in the procedure for peripheral venous catheterization at the individual clinical workplaces.

Practice the insertion of a peripheral venous catheter in a clinical workplace under the guidance of an experienced nurse.

Control questions

- How soon can the vein be subjected to repeated cannulation?
- When should the tourniquet be removed from the limb with the insertion of the peripheral venous catheter?
- What is phlebitis?
- What are the best sizes of peripheral intravenous cannulas in long-term intravenous medication?
- What is the recommended time for inserting a peripheral venous catheter into the venous system of an adult?
- Provide at least 3 types of embolism which can occur with IV therapy.
- Provide the correct order of the individual steps when introducing a peripheral venous catheter:
    - Insert the needle at a 30° angle upwards
    - The cannula is carefully secured with a special sterile non-occlusive IV dressing
    - Put on the protective rubber gloves
    - Insert the needle in the direction of the vein, 1 – 2 cm deep
    - Withdraw the needle stylet
    - Cover the end of the cannula with a special sterile cap
    - After the puncture, quickly remove the tourniquet from the limb.
    - Attach the Esmarch tourniquet
    - Palpate the injection site.
    - Disinfect the injection site
    - Anchor the vein by pulling the skin with the thumb of the non-dominant hand
    - Do not insert the needle stylet any further but ensure the plastic part of the cannula is also in the vein.
    - Choose a suitable site for cannulation
    - Using a syringe, flush the intravenous cannula with the prepared physiological saline
    - After the successful insertion of the cannula into the bloodstream, place a finger over the vein above the tip of the cannula

13.6 Infusion, parenteral nutrition

Objective

After studying this chapter, you should be able to:

- Explain the importance of infusion therapy;
- Explain the division system of infusion solutions according to the purpose of administration;
- Implement the preparation of intravenous infusion;
- Demonstrate this procedure using a model or simulator in the laboratory and later in clinical practice;
- Care for the intravenous injection site;
- Assess the risks of potential complications.

Purpose

- To supply fluid to a patient who is unable to receive enough fluid orally;
- An infusion solution serves as a carrier for the active substance;
- Replacement of fluid loss due to diarrhoea, vomiting, excessive urination, sweating;
- Supply of minerals needed to maintain electrolyte balance;
- Provision of nutrition by administering individual food components (amino acids, sugars, fats);
- Adjustment of the acid-base balance (acidosis, alkalosis);
- Inducing osmotic diuresis;
- Replacement of blood plasma.

Theoretical notes

Infusion is the administration of large volumes of fluid into the body by the parenteral route. Infusion is an integral and often essential part of medical treatment. The most common method of administration is intravenous, exceptionally the subcutaneous, intraosseous methods. Intravenous therapy is prescribed by a doctor and the nurse is responsible for the correct administration and course. The most common infusion administration sites are localized in the peripheral venous system of the upper limb; veins in the temporal area of head are used for young children. For prolonged therapy, the veins on the back of the hand and forearm are preferred - v. basilica, v. cephalica, v. cephalica accessoria, v. mediana cubiti, v. mediana antebrachii. In some cases it is necessary to administer the infusion into the central venous system through the v.subclavia, v. jugularis interna, and exceptionally v. femoralis.

Types of infusion solutions

Classed according to composition:

- Crystalloid solutions – low-molecular-weight solutions with a rapid effect but remain only briefly in the bloodstream (salt biogenic elements, amino acids, carbohydrates).

- Colloidal solutions – a high-molecular-weight, remain in the bloodstream for a long time (proteins).
- Emulsion (fat – fatty acids).

Classed according to purpose:

- Solutions for adjusting the fluid and electrolyte balance

  Solutions that help to maintain:

  - A constant amount of ions in the bodily fluids – isoionic solution; (division of infusion solutions to isoionic, hypoionic and hyperionic), see Table 13.6-1);
  - Steady activity of hydrogen ions in bodily fluids – isohydric solution;
  - Constant osmotic pressure of bodily fluids – isotonic solution; (division of infusion solutions to isotonic, hypotonic and hypertonic), see Table 13.6-2);
  - Constant volume of bodily fluids – isovolumetric solution.

Type of infusion solution	Infusion name	Composition
Isoionic	Isotonic saline (F1/1)	9g NaCl 1000ml aqua apyrogenata
	Ringer solution (R1/1)	NaCl, KCl, CaCl 1000ml aqua apyrogenata
	Ringer lactate	NaCl, KCl, CaCl, lactate and 1000ml aqua apyrogenata
	Hartmann's solution (H1/1)	NaCl, KCl, CaCl, MgCl, Na lactate and 1000ml aqua apyrogenata
	Darow's solution (D1/1)	NaCl, KCl, CaCl, lactate and 1000ml aqua apyrogenata
Hypoionic	Saline with glucose (FR ½)	Same ratio of FR 1/1 and G5%
Hyperionic	NaCl 10%, KCl 7.5%	

Fig. 13.6-1: Infusion solutions according to the amount of ions in fluids

Type of infusion solution	Infusion name	Composition
Isotonic	Isotonic saline (F1/1)	
	Saline with glucose (FR ½)	
	Ringer solution (R1/1)	
	Hartmann's solution (H1/1)	
	Darow's solution (D1/1)	
Hypertonic	Glucose 10%	100g of Glucose 1000ml aqua apyrogenata
	Glucose 20%	200g of Glucose 1000ml aqua apyrogenata
	Glucose 40%	400g of Glucose 1000ml aqua apyrogenata

Fig. 13.6.-2: Infusion solutions according to osmotic pressure

- Solutions for adjusting the acid-base balance

  These are indicated to balance alkalosis or acidosis of the body. They include:

  Alkalizing solutions – supplying an alkalizing substance to the body, e.g. Natrium hydrogencarbonicum (NaHCO3 4.2%. 8.4%).

  Alkalizing solutions – supplying an alkalizing substance to the body, e.g. Arginine chloride 21%.

- Solutions to replace blood plasma

  These are indicated, for example, in hypovolemic shock, toxic-septic shock or burns. They increase the blood volume in large blood losses and remain in the vascular bed for 6 - 8 hrs. They include e.g. Hes 6%, Voluven 6%, Tetraspan 6%. 10%, Gelaspan 4%.

- Solutions inducing osmotic diuresis

  They increase the osmotic pressure and therefore the transfer of water from the intracellular into the extracellular area. Substances capable passing through the glomerular filter attract water and thus increase osmotic diuresis. These solutions are most often indicated for edema, ascites, renal insufficiency, intracranial hypertension, anuria, poisoning, glaucoma and eclampsia. They include e.g. ardeaosmolmanitol 10%.

- Solutions for parenteral nutrition

  The individual components of parenteral nutrition are divided into macronutrients (carbohydrates, lipid emulsions and amino acid solutions), water and electrolytes and micronutrients (trace elements, vitamins). Macronutrients include:

  Sugars – glucose is currently the only source of carbohydrate energy, which is used in parenteral nutrition. It is a universal energy substrate for all the cells and is given preference by the body in terms of utilization and oxidization. Intake should cover about 55% of the total energy intake during parenteral nutrition. Glucose is however, also the source for synthesis of other substances. The minimum dose of glucose should cover the needs of the organs that are glucose dependent. This is mainly the nervous system, blood cells (red and white blood cells), kidneys and damaged, ischemic and regenerating organs. This dose is equivalent to 200 – 250 g of glucose.

  Fat emulsions are viewed as an integral part of a parenteral nutritional support or complete parenteral nutrition. The body fats are stored primarily in adipose tissue which is the main source of energy. Fats have other physiological properties in the body. They are, for example, part of cell membranes, etc. The dose of fat should not exceed 30% of the energy intake. This corresponds to a dose of 0.5 – 1 g/kg/day, which corresponds to an average 50 grams of fat. Fat emulsions are a safe source of energy and can be administered to patients with damage to any organ. An exception may be severe sepsis, where the fat emulsion can negatively affect the body's defences.

  Amino acids – the quality of protein in the diet, or in other words, the composition of the administered amino acid solution as part of the parenteral nutrition has a major impact on the course of the anabolic processes in the body. It is therefore necessary to provide the patients - especially patients with severe conditions and patients with malnutrition with a complete amino acid solution (a solution which contains the full range of essential and nonessential amino acids), to ensure sufficient protein synthesis

and tissue regeneration. The total daily dose of amino acids need for the adult organism is from 0.75 to 1.5 g / kg, while the total intake is dependent on the degree of physical strain. The need increases in severely malnourished patients and patients with severe conditions (trauma, sepsis, the strain of surgery), reaching up to 2.5 g/kg.

Electrolytes – a balanced and regular daily administration of electrolytes must be part of the parenteral nutrition: Na, K, Ca, Mg, Cl and P.

The micronutrients include vitamins and trace elements. Although they are present in trace amounts, they are essential for the correct functioning of the organism. The body is threatened in the first stage by the lack of water-soluble vitamins (especially vitamin C and vitamins from group B); after 14 – 21 days it is necessary to supply trace elements and vitamins soluble in fats. If the body is in the phase of severe malnutrition or there are signs of increased losses (e.g. loss of zinc through intestinal fistulas or loss of iron through bleeding), it is necessary to supply vitamins and trace elements into the body immediately upon starting nutritional support.

Malnutrition is a pathological condition caused by a lack of nutrients. Malnutrition can have various causes, e.g. Development of anorexia, indigestion, impaired absorption of nutrients, changes in temporal distribution of food, differences in hospital food, the presence of infection, pain, stress etc. There are two types of malnutrition:

- Kwashiorkor – a lack of protein causes a reduction of oncotic pressure, the fluid draining away and accumulating in the interstitium, the patient is swollen.
- Marasmus – the patient suffers from a lack of all nutrients and has a typical cachectic appearance.

Administration routes of parenteral nutrition components

- Infusion bottle, bag, multi bottle - this administration route requires frequent handling of the infusion set, thus increasing the risk of infection; each infusion bottle contains an individual nutritional component.
- Infusion bag – "all in one" system

  The infusion bag is prepared by a pharmacy based on a doctor's prescription and according to the patient's medical condition. The bag contents are usually 2,000 – 3,000 ml and stored at 4-6^{o}C. It contains a mixture of carbohydrates, amino acids, lipids, vitamins, minerals and trace elements. It is manufactured as a dual-chamber bag (containing amino acids, sugars, electrolytes) or as a three-chamber bag (with added fats - see Fig. 13.6-2). The bags are prepared in the pharmacy or by the manufacturer. They can have a different concentration and can be used for continuous 24 hour nourishment; administration is by an infusion pump. The expiration date of a bag depends on the manufacturer, usually 1 - 2 years.

Fig. 13.6-1: Dual-chamber bag for parenteral nutrition

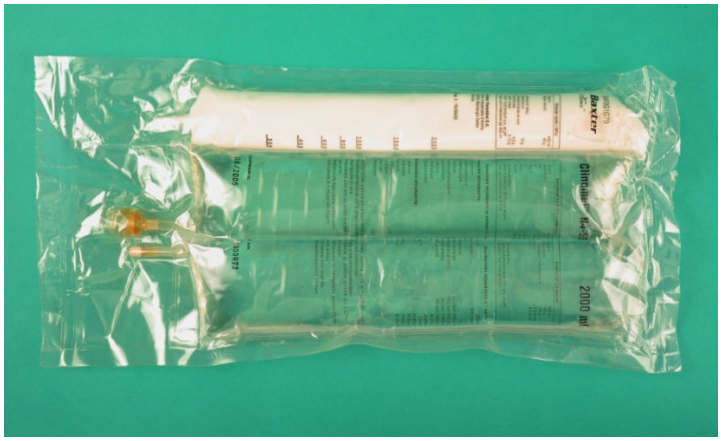

Fig. 13.6-2: Three-chamber bag for parenteral nutrition – all in one

Food component	Infusion name	Composition	Notification
Carbohydrates	Glucose 5% (G5%)	50g of glucose 1,000 ml aqua apyrogenata	Can be administered to the periphery
	Glucose 10% (G10%)	100g of glucose 1,000 ml aqua apyrogenata	Can be administered to the periphery
	Glucose 20% (G20%)	200g of glucose 1,000 ml aqua apyrogenata	Can be administered to the central stream
	Glucose 40% (G40%)	400g of glucose 1,000 ml aqua apyrogenata	Can be administered to the central stream

Food component	Infusion solution name	Notification
Amino acids	Neonutrin 5%, 10%, 15%	
	Aminoplasmal 10%, 15%	
	Nutramin VLI	Liver On.
	Aminoplasmal Hepa 10%	Liver On.
	Nephrotect	Kidney On.
Fats	Intralipid 20%	
	SMOF lipid	
	Lipoplus	
	ClinOleic 20%	
	Omegaven	
Electrolytes	NaCl 10%	
	KCl 7.45%	
	$MgSO_4$ 10%, 20%	
	Calcium gluconicum 10%	
	Sodium hydrogen phosphate ($NaHPO_4$ 8.7%)	
Trace elements	Tracutil	Zn, CU, I, Mn, F, Cr, Fe, Mo, Se
Vitamins	Cernevit	Contains water soluble vitamins
	Vitalipid	Contains fat-soluble vitamins

Fig. 13.6-3: Division of infusion solutions according to individual food components

Infusion solutions are manufactured in different sizes: 50ml, 100ml, 250ml, 500ml, 1,000ml, and 2,000ml. These are supplied in glass or plastic bottles (see Fig. 13.6-3), or in plastic bags (see Fig. 13.6-4)

Fig. 13.6-3: Infusion solutions in glass and plastic bottles

Fig. 13.6-4: Infusion solution in 250ml, 500ml and 100ml plastic bags

Individual components of an infusion set (see Fig. 13.6-5) include:

- Perforation needle;
- Drip chamber (reservoir);
- Control terminal with the rider, pusher;
- Custom infusion set tubing;
- End piece with a protective cap;

The perforating needle must be kept sterile. It is inserted into the infusion bottle only when the solution is ready to be administered. Additional drugs can be supplied into the infusion solution shortly before administering. Some modern infusion sets include safety features which prevent the entry of air into the patient's venous system. (see http://braunoviny.bbraun.cz/clanky/prvni-infuzni-set-s-bezpecnostimi-prvky-intrafix/).

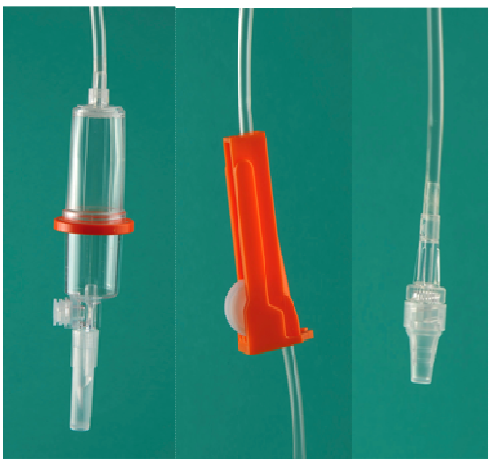

Fig. 13.6-5: Infusion set drip chamber with perforating needle, control slider and the end piece of the set with protective cover.

Infusion methods

- Disposable needles are only used exceptionally for intravenous injection, mainly for single or short-term infusions. In this case, connect the prepared infusion set directly to the injected needle which is fixed with tape to prevent perforation of the vein. Secure the limb in a suitable position before the injection and inform the patient of the risk of injury. Monitor the injection site and the condition of the patient during the infusion. After administering, remove the needle and put it in the designated container. Cover the injection site with a sterile gauze square or swab and tape. Care of the aids is the same as for an injection.
- Peripheral venous catheter (cannula) is the most common aid when administering an infusion. See topic "Introduction of IV cannula". In order to eliminate the risk of infection when administering larger volumes of infusion solutions, and to reduce mechanical irritation of the vein as well as the risk of extravasation, it is necessary to provide proper care and to ensure patient comfort during the procedure.
- The central venous catheter is usually inserted into the superior vena cava via infraclavicular access through the subclavia or supraclavicular access. The catheter is inserted by a doctor under strictly aseptic conditions. The injection site is protected with a sterile dressing and a large patch. The catheter dressing is replaced, the skin condition is checked for swelling or redness including stitches which fix the catheter to the skin as is customary on the ward. The catheter must be handled under strictly aseptic conditions, i.e. use of sterile instruments and aids, including sterile dressing materials, with minimal disconnecting of the infusion systems in order to prevent infection. The insertion of a central venous catheter is preferred in the case of prolonged procedures e.g. repeated administration of antibiotics, cytostatics, rapid administration of large volumes of fluids, administration of hypertonic nutrient solutions which are irritating to small or peripheral veins or in order to measure the central venous pressure. For details, see chapter 13.5.2
- Peripherally Inserted Central Venous Catheter (PICC) – provides medium-term access to the central venous bed. This is inserted into the superior vena cava usually via the v. brachialis, v. basilica and v. cefalica. The advantage of this implementation is the lesser probability of complications, administration of a contrast agent, allows the measurement of central venous pressure, administration of blood derivates and blood collections. Catheter care is carried out under aseptic conditions.
- Implanted catheter Port-a-Cath system, (see Fig. 13.6-6) is another infusion option. The device ensures repeated access to the central venous system, while limiting trauma and the incidence of complications resulting from frequent injecting of the venous system. It is a chamber that is implanted into the subcutaneous tissue with a catheter that is terminated in the superior vena cava. The chamber has a special membrane which is capable of contracting after withdrawing the needle and thus prevents bleeding into the dermis. The port is introduced under strictly aseptic conditions. The device is surgically implanted into the subcutaneous pouch under local anesthesia; usually above the 3-4 ribs, lateral to the sternum. The distal end of the catheter is inserted into the central vein and the proximal end is introduced via the subcutaneous tunnel to the implanted device. A special Huber needle is used to inject the port under a 90° angle, (see Fig. 13.6-7). The use of the implanted port is recorded in the documentation. This type of infusion is usually chosen for long-term intravenous therapy, administration of cytostatics, antibiotics, for repeated access into the central venous system etc.

Fig. 13.6-6: Port a Cath

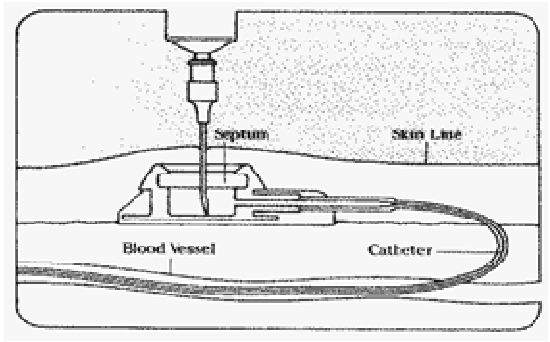

Fig. 13.6-7: Diagram of the port implanted in the subcutaneous tissue

Patient preparation for administering intravenous infusions

- Inform the patient about the need and importance of infusion therapy.
- Assess the patient's clinical condition.
- Check the patient's medical records regarding allergies to drugs, plaster disinfectant etc.
- Assess the patient's intake and output in the previous period.
- Record the fluid intake and output.
- Explain the procedure, i.e. the length of the administration to the patient and answer any questions.
- Instruct the patient of the need to remain in position while administering the intravenous infusion.
- Adjust the patient's bed; provide maximum comfort (enough fluids as the patient is allowed, newspapers, magazines, glasses, etc.).
- Arrange for the signalling device to be within the patient's reach to call for the nurse if needed.
- Ensure the patient goes to the toilet before the procedure.
- Put the patient in the appropriate position (half-sitting on the bed).

Preparation of aids

The aids (see Fig. 13.6-8) are the same as in the preparation and administration of a peripheral venous catheter. In addition, prepare a bottle with a sterile solution for infusion, an infusion set, connecting tubing, prescribed medications, sterile syringe, sterile needle, infusion stand, disinfectant, pulp squares, kidney bowl, solution intended for flushing peripheral venous catheter.

Fig. 13.6-8: Aids for preparation of infusion solution

Performing the procedure

- Verify the accuracy of the medical prescription (type of infusion, volume and rate of administration, infusion expiration date, type of added drug, volume, concentration, expiration date of the added drug, administration method, prescribed hour of administration).
- Check the bottle and condition of the infusion – clarity, integrity of the packaging, expiration dates of the infusion.
- Check the compatibility of the drugs and solutions that are to be mixed together.
- Draw the prescribed drug from the ampoule.
- Find the injection port on the infusion bottle to inject the drug.
- Disinfect the injection port.
- Inject the drug from the syringe into the infusion solution.
- Withdraw the needle and put it into a plastic container for storing needles.
- Plastic infusion bottles have self-closing ports.
- Label the infusion bottle as is customary at the ward for easy identification when it is hung on the IV stand (the room and bed numbers, name and surname of the patient, name and volume of the prescribed drug, time of connection, ranking no. of infusion as prescribed by a doctor which must match the order prescribed and entered in the daily report).
- Open the infusion set protective paper packaging.
- Remove the infusion set from the packaging.
- Move the slide clamp to the top part of the infusion set, this will enable access to the roller clamp to control the infusion rate.
- Close the roller clamp (move the roller to the narrower part of the clamp).
- Close the bleed valve on the drip chamber (unless already closed by the manufacturer).
- Remove the protective cover from the perforating needle.

- Insert the perforating needle into the infusion bottle in a circular motion.
- Grasp the infusion bottle firmly with the non-dominant hand, turn it upside down and lift it to eye level.
- Press the bottom of the drip chamber repeatedly and partially fill it with infusion solution which will prevent the air entering the infusion set.
- Release the roller clamp to fill the infusion set with the solution. Do not remove the protective cover from the distal end of the infusion set! *Air bubbles in the infusion set can cause an air embolism!*
- Hang the bottle on the IV stand.

For further steps, see the insertion of a peripheral venous catheter.

- Flush the connecting tubing with saline.
- Connect the infusion set to the connecting tubing of the peripheral venous catheter under strictly aseptic conditions (see Fig. 13.6-9 to 11).

Fig. 13.6-9: Disinfection of the end of the connecting tubing for needle-free access

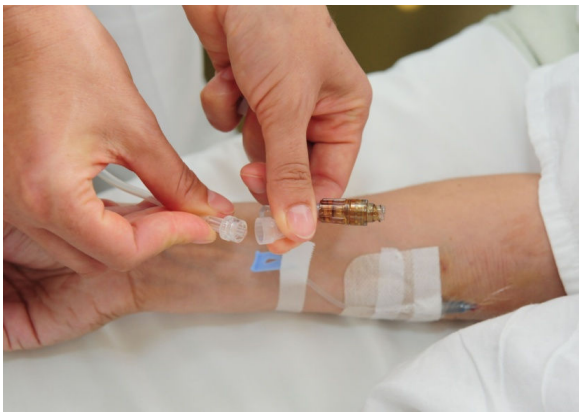

Fig. 13.6-10: Uncovering the end of the infusion set before connecting

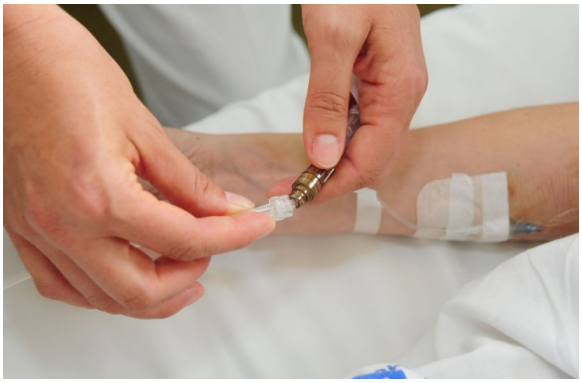

Fig. 13.6-11: Connecting the infusion set to the tubing for needle-free access

- Regulate the rate at which the IV fluid infuses.
- Check the injection site of the peripheral venous catheter.
- Check the overall condition, subjective feelings and mental condition of the patient.
- Instruct the patient about the availability of a signalling device to alert the nurse if necessary or in the event of any undesirable changes related to the infusion.
- Make a record of the infusion administration in the documentation.

Regulation of the infusion rate

1. Without an infusion pump

   The flow rate of intravenous infusion can be regulated with the roller (clamp) in the infusion set. To be able to calculate the flow rate, the infusion volume and the time for which the infusion should drip must be known. The flow rate is indicated in the two most common ways:

   - With the number of ml of fluid which should be administered per hour.

     The flow rate is calculated by dividing the total infusion volume (in ml) by the total infusion time (in hours). E.g. 3,000 ml (total volume of infusion)**:** 24 hrs. (total infusion time) = 123 ml/hr.

   - With the number of drops to be administered per minute

     The flow rate is calculated by multiplying the volume of the administered single infusion (in ml) with 20 (1ml = 20 drops) and dividing the result with the time by which the infusion should drip (in min). This will show how many drops should drip in 1 minute enabling to prove the prescribed volume of solution in the correct time period. E.g. 500 ml (infusion volume in single bottle) x 20 = 10,000 **:** 4hrs. (240 min. i.e. the total time of infusion in minutes) = 42 drops/minute. For more see: http://braunoviny.bbraun.cz/clanky/bezpecnejsi-infuzni-terapie-infuzni-sety-s-novym-regulatorem-prutoku/.

2. With an infusion pump

   The infusion pump (see Fig. 13.6-12) is an electronic device that allows precise infusion dosage over a specific time period. There are two basic types of infusion pumps. The first one controls the number of drops per minute; the second type controls

the number of ml per hour. The pumps that control the number of drops per minute are primarily used in administering fluids at a constant flow rate with the aim of maintaining the drug levels in the bloodstream. The pumps that control the number of ml per hour should be used when it is necessary to administer a specific volume of fluid per time unit.

There are many types of infusion pumps e.g. rotating, peristaltic, piston and diaphragm. They are all fitted with either an audible or visual alarm. Some of the pumps will automatically stop after the alarm is activated; others maintain a low flow rate which maintains the venous system patency. Additional accessories include a drops detector – a photoelectric device that registers the formation of drops and activates the alarm when they cease to form. Air detector registering the air in the infusion set tubing. The pumps are also fitted with meters which display the volume of administered fluid; others display the volume of fluid which is to be administered. The flow rate setting is included in all models. The setting involves either the number of drops per minute or ml per hour. Other accessories may be a detector signalling blockage or constriction of the infusion set, or a detector for extravasation administration etc.

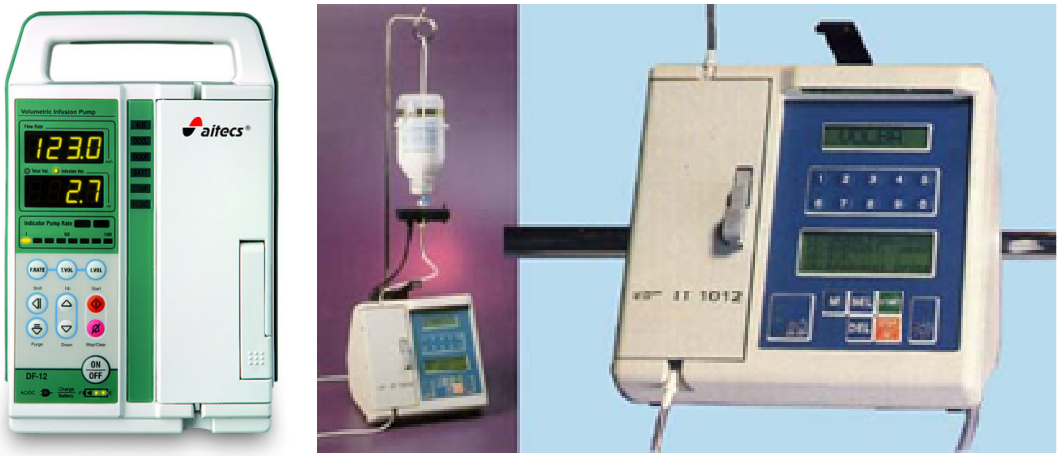

Fig. 13.6-12: Infusion pumps

Linear perfusors are used to ensure the continuous administration of small volumes (see 13.6-13). In this method of administration, the solution is injected from the 10 – 100 ml syringe which is mounted on the carrier of the device. The infusion flow rate is adjustable from 0.1 to 1,500 ml/h.

Fig. 13.6-13: Linear perfusor

Replacing infusion bottles and sets

The infusion bottle is replaced when it is empty but there is still fluid in the drip chamber. The recommended frequency of replacing the infusion set is in accordance with the manufacturer's recommendations and standards of the healthcare facility. The procedure is as follows:

- Prepare a new infusion bottle with the prescribed infusion solution.
- Label the bottle as is customary on the ward.
- Inject the prescribed drug into the bottle and mark it on the infusion bottle (see Preparation of infusion solution).
- Assess the injection site of the peripheral venous catheter.
- Assess the injection site for the potential occurrence of complications.
- Check the infusion set for the air column.
- Disinfect the top of the infusion bottle.
- Remove the perforating needle from the previous infusion bottle.
- Disinfect and introduce the perforating needle into the new infusion bottle.
- If the air entered the infusion set, disconnect it from the tubing of the peripheral venous catheter, release the air column and reconnect to the venous catheter. Do not contaminate the distal end of the infusion set when releasing the air column. Work strictly aseptically!
- Disinfect the end of the infusion set first and only then reconnect to the tubing of the peripheral venous catheter.
- Regulate the required flow rate as prescribed by a doctor.
- Check the overall condition, subjective feelings and mental condition of the patient.
- Instruct the patient about the availability of a signalling device to alert the nurse if necessary or in the event of any undesirable changes related to the infusion.
- Make a record of the infusion administration in the documentation.
- When replacing the infusion bottle and the infusion set, the working procedure is identical to the procedure for preparing the first infusion bottle.
- Make sure the ends of the connecting tubing and infusion sets are thoroughly disinfected before reconnecting!

End of infusion

In the case of disposable needle administration

- Close the roller clamp by moving the roller to the narrowest part of the clamp if the infusion bottle is completely empty, although there is still infusion solution in the drip chamber.
- Carefully remove the tape so as not to dislocate the needle.
- Attach a sterile swab or gauze square on the injection site and withdraw the needle from the vein.

- Press the injection site down for about 2 minutes to prevent bleeding.
- Patients with prescribed anticoagulant therapy must have the injection site compressed for longer because anticoagulants affect the blood clotting mechanism.
- Attach a sterile dressing with tape.
- Dispose of used needles to the designated container.
- Dispose of the infusion set according to ward standards.

If using a peripheral venous catheter

- Close the roller clamp by moving the roller to the narrowest part of the clamp if the infusion bottle is completely empty, although there is still infusion solution in the infusion set.
- Draw a sterile solution into 10 ml syringe to flush the peripheral venous catheter.
- Disconnect the end of the connecting tubing and the infusion set by clamping the tubing with a pean to prevent air infiltration into peripheral venous catheter and blood returning back into the tube.
- Disinfect the end of the connecting tubing and attach the syringe with the prepared sterile solution and pulse flush.
- Some healthcare facilities use for example, B. Braun Omniflush®, or BD Saline SP, which is a sterile polypropylene syringe which has been filled with sterile pyrogen-free isotonic solution for direct application which streamlines and speeds up the process of intravenous catheter flushing.
- Release the pean and connecting tubing and flush the cannula.
- Using a pean or the clamp on the connecting tubing, interrupt the flushing at its final phase and disconnect the syringe.
- Disinfect the end of the connecting tubing and cover it with a sterile cap.
- Remove the infusion set and bottle from the stand.
- Record the end (time) of infusion into the documentation.
- Dispose of the infusion set as is customary on the ward. The infusion bottles are recycled according to the material from which they are made.

Complications related to administering an infusion

- Extravasation - leakage of administered substances into the tissue outside the vascular bed. The leakage of certain substances can cause tissue necrosis. In this case the patient typically complains of a burning sensation, pain, and hardening of the injection site. During prolonged leakage into the subcutaneous tissue, the limb begins to swell. If extravasation is suspected, discontinue the infusion, inform a doctor, remove the cannula, elevate the limb, monitor the extravasation site and record all changes and the course of healing in the nursing documentation.
- Puncture of the vein, formation of haematoma – discontinue the infusion, withdraw the needle, attach a cold compress and inject the needle into another vein.

- Allergic reaction, increased body temperature, rash, redness, hives – discontinue the infusion, report to a doctor.
- Phlebitis – inflammation of the superficial vein manifested by tenderness, pain, redness, swelling, strips, palpable hardening in the vein and suppuration. If a blood clot is formed in a vein independently from the presence of inflammation of the vein it is referred to as phlebotrhombosis (see Fig. 13.6-14) – discontinue the infusion, attach a compress.

Fig. 13.6-14: Phlebitis when inserting a peripheral venous catheter

Source: University of Maryland Medical Center [online]. 2011 [cit. 2011-04-05]. Thrombophlebitis superficial. Available at WWW: <http://www.umm.edu/esp_imagepages/18086.htm>.

Risks:

- Mistaking the patient due to insufficient identity verification before the procedure.
- Confusion of administered infusion solution.
- Harm to the patient due to ignorance of the infusion flow rate.
- Failure to follow aseptic procedures prior to infusion.
- Inadequate monitoring of the patient when administering infusion therapy.
- Inadequate monitoring of the patient after finishing the infusion.

Task

- Practice the preparation of infusion solutions in the hospital and record any differences in preparation at the various clinical workplaces.
- Research which drugs should not be introduced into the infusion solution simultaneously.
- Find out about other infusion products (and their indications) that are used at the clinics.

Control questions

- What is the saline composition?
- What does isotonic mean?
- What is kwashiorkor?
- Indicate which of these solutions can be administered into the peripheral venous system?
- G 20%, G 5%, G 10%, G 40%
- Which parts form the infusion set?
- What flow rate (how many drops/min) is set for infusion if the indication is 500ml G 5% for 4 hours?
- Indicate two basic principles regulated by the infusion pumps.
- List the solutions replacing amino acids.
- Indicate the correct order of the individual steps when administering an infusion:
    - Fill the infusion set with a solution
    - Check the data according to the documentation
    - Close the roller clamp
    - Prepare the aids for administering an infusion
    - Introduce the infusion set into the infusion bottle
    - Fill the drip chamber with the infusion solution
    - Mark the infusion bottle with the necessary data
- What is the complication called that relates to administering an infusion that manifests with redness, tenderness, pain, swelling, strips, palpable hardening in the vein?

13.7 Transfusion

Objectives:

After studying this text, you should be able to:

- Define the term "transfusion" and explain its significance.
- Describe the basic types of transfusions.
- Name the most common transfusion preparations and blood derivatives.
- Prepare the aids and all the documentation before transfusion.
- Assist with transfusion at your clinical practice.
- Learn the procedure for verifying the blood groups of the donor and recipient using the ABO serum test diagnostic set (sanguine test).
- Assess the risks of potential complications.
- Describe the most common complications (post-transfusion reaction) that can occur during or after a transfusion.

Theoretical notes

Transfusion is defined as the transfer of human blood or its components from one person (the donor) into the bloodstream of another person (the recipient). It is a specific form of transplant.

The term "transfusion" is derived from the Latin word transfuzio (pouring, mixing). The branch of medicine that blood transfusion belongs to is called *transfusiology.* Transfusion is prescribed by a doctor who is also responsible for the correct administration and verification of the donor and recipient blood groups before the transfusion begins.

Human blood composition is 55-60% of blood plasma and the solid components - erythrocytes, leucocytes and trombocytes. The total amount of blood in the body is 7 – 8% of body weight (i.e. 5 - 6 litres in an adult).

Purpose

Indications for blood transfusion:

- Blood loss – acute, chronic, hemorrhagic shock, shock trauma, surgery, injury, burn shock, difficult labour and others
- Blood disorder including anaemia, thrombocytopenia
- Other – e.g. poisoning (carbon monoxide, haemolytic poisons) infectious disease, cancer, chronic kidney and liver diseases

The diagnostic analysis of the blood components impairment precedes the indication of the transfusion.

The doctor is responsible for administering the transfusion product and for monitoring the patient (15 – 20 min.) at the start of the transfusion. The nurse collaborates on the preparation, cares for the patient during and after the transfusion.

Blood transfusions:

Indirect – the donor's blood is administered to the recipient from the blood bag. Direct transfusion is when the donor's blood is transferred directly into the bloodstream of the recipient.

Autotransfusion – the process wherein a patient receives their own blood for a transfusion. It is most commonly used in orthopaedic and other surgeries or after surgery. Blood sampling is performed 5 – 7 days before surgery at the blood transfusion station if the patient's health condition permits it.

Autotransfusion can also include *the recovery of red blood cells (erythrocytes),* when the blood is drained from the surgical field, subsequently modified and returned to the bloodstream. Special apparatus for red blood cell recovery is used in surgical procedures (orthopaedic, cardiac, vascular and others) with an estimated blood loss above 1,000 ml.

Pressurised transfusion – transfusion of blood or blood derivatives under pressure using a pressure cuff (see Fig. 13.7-1a, b, c).

Fig. 13.7-1: Pressure transfusion cuff (front and rear)

The *purpose* of a pressurised transfusion is the rapid transfusion of blood where the blood is administered through a heating device. The cuff is filled with air to 100 mmHg. The patient must be closely monitored throughout. This procedure is carried out at the ICU and on standard wards.

Exchange transfusion – is administered if the patient's entire blood must be replaced with the donor's blood (up to 15 litres of blood). Up to 90% of the blood is intermittently withdrawn and an appropriate volume is simultaneously administered back. This is administered to adults with burns, uraemia, poisoning or in the event of a haemolytic disease in a newborn (erythroblastosis fetalis) which occurs if the mother is RhD negative and the baby takes after the father, i.e. is RhD positive. The immunological response of the mother towards the foetus usually occurs in the second or third pregnancy, because after childbirth, each RhD negative mother is administered specific globulin anti-D as prevention.

Blood transfusion preparations

Blood transfusion centres and blood banks prepare and store blood transfusion preparations from human blood. The blood is collected from the previously examined donor into a sterile blood bag (transport packaging) and stored with an added preservative as whole blood. At

present, the most commonly used blood bags – triple and quadruple blood bag systems. The quadruple blood bag system consists of a sampling bag and three satellite bags used for erythrocytes and plasma.

Component blood processing of the transfusion unit (T.U.) from the sampled whole blood enables to obtain the individual components (erythrocytes, platelets and plasma), thereby enabling treatment of several patients from just one blood T.U. using various blood products. Targeted administration of the missing blood component minimizes the application of those components that the patient does not need while reducing the incidence of post-transfusion reactions. The blood transfusion unit represents the volume of transfusion product prepared from one unit of whole blood, i.e. from 450 ml of blood.

Types of blood products

- ***Whole blood*** is the donor's blood collected with added preservative and stored in a plastic bag. It is usually subjected to further processing. In the Czech Republic, whole blood can only be used for planned surgical procedures with an anticipated greater blood loss when the patient donates blood for themselves (autotransfusion) in advance as a reserve. This autologous blood donation serves for the use of blood by the donor. The blood is stored for 35 days at 2-6 °C.
- ***Red blood cell preparations*** (with a high content of erythrocytes) are used for transfusion in cases of major blood loss, in the treatment of anaemia etc. The erythrocyte preparations are *usually stored for 42* days at 2-6 °C in special cooling boxes (see Fig. 13.7-3).
    1. *Erythrocytes resuspended without buffy coat* (EBR), is a preparation containing red blood cells after withdrawal of the plasma. After the withdrawal of plasma, an appropriate resuspension solution can be added to the erythrocytes. This reduces the viscosity of the concentrate. This preparation is used in cases of major blood loss or to increase the volume of transported oxygen. The blood bag contains approx. 220 ml of erythrocytes, 80 ml of plasma, 20 ml of preservative.
    2. *Erythrocytes resuspended leukodepleted* (ERD) – a blood transfusion preparation with resuspended white blood cells, therefore minimizing the production of antibodies and preventing the occurrence of post-transfusion reactions (see Fig. 13.7-2).
    3. *Resuspended erythrocytes* (washed erythrocytes) – plasma is replaced by a solution.

Fig. 13.7-2: Erythrocytes resuspended leukodepleted (ERD)

Fig. 13.7-3: Storing erythrocytes transfusion products in a special cooling box

- ***Platelet preparations*** – used to adjust thrombocytopenia and bleeding conditions, e.g. in patients with cancer, after bone marrow transplant, or with myelosuppression.
- ***Platelet concentrate*** – concentrate of platelets in plasma. It is administered in the absence of blood platelets.

  It is prepared in two ways:

  - Thrombocytaphereses method (from one donor) – using blood component separators
  - From a unit of whole blood (from 4 - 6 random donors)

Platelets are stored at 20 - 24 °C under continuous stirring in special bags with only a 5 day expiration date. The above measures must ensure pH ranging from 6.4 – 7.4.

- ***Leukocyte-depleted platelet concentrate*** - poor in leukocytes.
- ***Fresh frozen blood plasma*** is obtained from whole blood donations or by plasmapheresis (see Fig. 13.7-4). It is used to maintain colloid osmotic pressure to provide coagulation factors. It must be frozen within 1 hour after collection. The donor is subjected to new testing after 6 months (donor blood testing at serology), and after the quarantine, the plasma can be expedited. The shelf-life of the fresh frozen plasma depends on the storage temperature. If the storage temperature is -25 or more (up to -40 °C), the expiration period is 36 months (see Fig. 13.7-5). The plasma must be defrosted before use in a water bath with a maximum temperature of 37 °C. Before administering blood plasma, it is important to determine the blood group of the recipient (while the RhD is not important). The plasma must be administered immediately after defrosting. The plasma cannot be frozen again once it has been defrosted.

Fig. 13.7-4: Bag with blood plasma from the apheresis after 6 months quarantine

Fig. 13.7-5: Box freezer for storing fresh frozen plasma

Blood derivatives (plasma fractionation) are isolated individual plasma proteins in a more or less pure form which are derived from industrially processed plasma using fractionation.

Blood derivatives:

- *Albumin* – a plasma protein solution of which 95% is albumin; used in cases of major blood loss as a blood substitute (see Fig. 13.7-6).
- *Immunoglobulins* - preparations predominantly containing immunoglobulin. These are administered intramuscularly or intravenously. Specific immunoglobulin preparations include IgG (gamma globulin), immunoglobulin against hepatitis B, anti-D etc.
- *Coagulation factor concentrates* – produced in dry form (lyophilized). These are intended for intravenous administration (concentrate FI (fibrinogen), concentrate FVII,

concentrate FVIII., IX. - Indispensable in the treatment of haemophilia A and B, prothrombin complex concentrate and others.

- *Human fibrinogen* is administered in the treatment of blood diseases.
- *Fibrin glue* is composed of fibrinogen, F XIII and aprotinin. It is used locally in various surgical procedures.

Fig. 13.7-6: Blood derivative – Albumin

Transfusion preparation

- *Ordering transfusion preparation*

  Transfusion preparation (TP) is ordered from the blood transfusion centre or blood bank based on the completed request for immunohematology examination and blood transfusion preparations. The request is sent together with a correctly labelled test tube with the identification of the patient. The request is sent to the blood transfusion centre in electronic and printed form. In the event the blood is to be used immediately, the request form will be completed with the term "Vital Indication", and the blood will be ready in 10 - 15 min. (tested only for the blood group), under the maximum time pressure (without the possibility of laboratory testing) only erythrocyte preparations 0 RhD negative, plasma - group AB can be supplied; always obtain a pre-transfusion patient sample. If the request form is marked with the word STATIM, the blood is supplied within 90 minutes, including a complete pre-transfusion examination. The preparations for the planned procedures are ordered using a request form and marked BASIC, and completed with a pre-transfusion examination.

- *Supply of transfusion preparation to the ward*

  The *preparation is delivered to the hospital ward* from the Transfusion centre or from the blood bank at the desired time, immediately prior to transfusion with the appropriate documentation.

Principles for administering a transfusion:

- The *principles of aseptic procedure* must be followed during the preparation and administration of a transfusion.
- Outstanding *accuracy and responsibility* must be exercised when working with patient identification data to avoid confusion (during blood collection, labelling test tubes, filling in request forms).
- Blood and erythrocyte TP must be administered within 2 hours from removal from the cool box, and plasma within 1 hour from defrosting, platelets immediately.
- Before each transfusion, new control tests for transfusion blood suitability are carried out once again and a new transfusion set is introduced into the transfusion preparation (blood bag).
- N.B. If the blood is not used within two hours from the time it was collected from the cool box, it must be immediately returned back to the Transfusion centre together with the return form (the dispatch note with a highlighted notification that it is the blood that was out of the cool box).

Preparation of aids

Aids required by the assisting nurse during blood transfusion:

- Transfusion preparation
- Transfusion set with filter (see Fig. 13.7-7, 13.7-8)

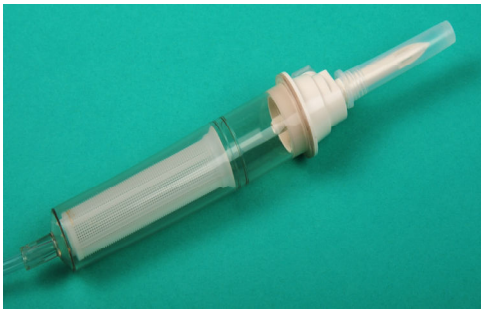

Fig. 13.7-7: Drip chamber with filter

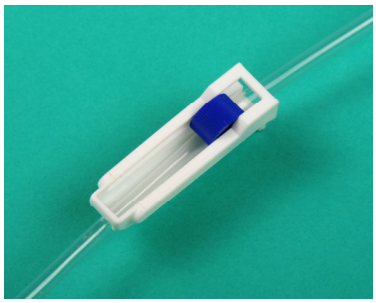

Fig. 13.7-8: Roller clamp for blood flow regulation

- Cannula with connecting tube, if no PVC (peripheral venous catheter) has been inserted.
- Infusion stand (stand alone or as part of the bed)
- Disposable gloves
- Kidney bowl
- Aids for sampling capillary blood from the patient's finger
- Diagnostic ABO serum test set to check blood groups at the bedside (sangvitest) (see Fig. 13.7-9, 13.7-10)

Fig. 13.7-*9: Diagnostic ABO serum test set*

Transfusion preparation

The transfusion preparation must be labelled with following information:

- Exact name of the preparation
- Identification number
- Collection number
- Identification barcode
- Donor identification number
- ABO blood group, RhD
- Guarantee of negative examination tests
- Composition and volume of preservative solution
- Transfusion preparation volume
- Date of collection
- Expiration date
- Storage instructions

Distinguished labels for RhD positive and negative preparations are used for better differentiation and control of blood transfusion preparations with a different blood group.

An important part of aids preparation is to check the documentation and forms that are supplied together with the transfusion preparation to the ward (see above) and which are later filed in the medical documentation.

Before administering a blood transfusion, the following must be checked:

- Dispatch note with the result of the immunohematology examination (proof of blood group) – the data must match the data on the transfusion preparation
- Delivery note for the transfusion preparation – the data must match the data on the transfusion preparation
- The transfusion record must be entered into the daily report (it can have the form of a sticker or a stamp which is printed in the daily report)

The record contains the following information:

- Date of transfusion
- Diagnosis, blood transfusion volume
- Blood group of the patient
- Identification number of the transfusion preparation
- Exact time of transfusion start and end
- Reinsurance testing of the blood group conducted prior to transfusion
- Blood pressure, temperature, pulse prior to and after the transfusion
- Urine test results before and after the transfusion
- Signatures of the doctor and the nurse administering the transfusion

Patient preparation

Doctor

- Informs the patient they will be given a blood transfusion as a necessary part of their treatment, why and when.
- Asks the patient to sign the consent to administer transfusion preparation and explains any potential complications.

Nurse:

- Informs the patient about the length of the procedure
- Answers the patient's questions
- Asks the patient to urinate (WC, bedpan)
- Adjusts the patient's position – depending on the patient's condition
- Prepares the signalling device within the patient's reach
- Measures and records the patient's BP, P and BT.
- Conducts a chemical urine test

Working procedure

- *Check* the ***documentation and identity*** of the *patient* (nurse and doctor)
- Washing and hand disinfection and protective gloves
- ***Blood group*** *check* – direct testing of the donor and the recipient blood groups using the ABO diagnostic set at the patient's bedside (sanguine test).

Blood group check at the bedside:

The doctor (or nurse while a doctor is present) conducts a capillary blood test from the fingertip. The ABO diagnostic kit includes test cards which are split into two parts. The upper part is used to test the blood sample of the patient (recipient) and the bottom part is reserved for examination of the TP sample. A drop of blue diagnostic Anti-A serum is put into each

blue circle and a drop of yellow diagnostic Anti-B serum is put into each yellow circle. A drop of the recipients (patient) blood is put into the red drops on the upper part, marked as PK (whole blood) and a drop of blood from the blood bag segment is put into the red drops on the bottom part of the card. Using two sticks from the diagnostic kit, each drop of serum is mixed individually with a drop of blood in a 1:1 and 2:1 ratio and the agglutination result is calculated and left to dry. The test card must be pre-labelled with the name of the patient and the number of the blood bag.

The test result is generally available within 1 minute or within 3 minutes:

- If the blood cells in the blue circle cluster together with the Anti-A serum, the recipient and the donor have blood group A.
- If the blood cells in the yellow circle cluster together with the Anti-B serum, the recipient and the donor have blood group B.
- If the blood cells cluster together in all the fields of the diagnostic card, the recipient and the donor have both AB blood group.
- If the blood cells will not cluster together in any of the fields of the diagnostic card, the recipient and the donor both have blood group 0.

Transfusion preparation for administering to the patient's bloodstream

Nurse:

- Lets the transfusion preparation warm up to room temperature for 30 – 60 minutes
- Turns the blood bag upside down – do not shake
- Unpacks the transfusion set
- Removes the protective cover from the seal on the blood bag
- Inserts the perforation spike into the blood bag
- Closes the clamp
- Hangs the blood bag on the stand and fills the drip chamber with the transfusion blood
- Expels the air from the transfusion set

Inserts a wider lumen cannula into the patient's vein, or checks the passability of the established permanent venous catheter (see chapter 13.5 Insertion of IV cannula).

Connects the transfusion set to the peripheral venous catheter. Releases the clamp and the blood starts to flow into the patient's bloodstream. After this there is *increased medical supervision* (previous biological test). The doctor and the nurse monitor the patient's condition. At the first stage the blood flow rate is faster, about 20 ml of blood (2 x 150 drops) then decreases. If there is no adverse reaction in the patient, the test is repeated twice. A doctor must be present at the beginning of each transfusion for at least 15 – 20 minutes.

The blood flow rate into the bloodstream of the recipient is determined by a doctor. It is usually 40 – 80 drops per minute and it should not (1TU) take longer than 2 hours. Pressurised transfusion is used in the case of large blood loss.

The patient/recipient must be carefully monitored during the transfusion of the blood component. The nurse checks the patient's condition in 10 minute intervals, the condition of the skin, for chills and checks the breathing. The nurse will also determine that the patient is not complaining of shoulder pain, headaches, tightness of the chest, tachycardia, nausea, anxiety etc. If the patient complains of any subjective or objective symptoms, the nurse stops the blood flow into the patient's bloodstream and immediately informs the doctor. The ***venous access must never be removed*** during any complications!

In the event of administering another transfusion preparation, a new sterile transfusion set is connected and the patient's blood group rechecked using the AB0 diagnostic kit at the bedside including increased medical supervision.

The transfusion is terminated when blood still remains in the transfusion set and in the blood bag (about 10 ml). The nurse disconnects the transfusion set from the peripheral venous catheter and applies saline into the cannula (flushing) and closes it or removes it completely from the vein.

Patient care after the transfusion

After disconnecting the transfusion set, the nurse measures the patient's vital signs (BP, P, and BT), tests the urine (chemical test) and checks the urine colour. The results are recorded in the daily report. In the event of post-transfusion complications, a record of the post-transfusion reaction is made and the incident is reported to the Blood Bank Department.

Care of aids after transfusion

The transfusion bag with the remaining blood and the transfusion kit are stored in the fridge with a card and results of the sanguine test, all in a plastic bag for 24 hrs. If there are no adverse reactions in the patient within this period, it is removed from the fridge and put into the infectious material container.

Disposable aids are discarded with infectious waste as is customary on the ward, and the remaining aids are mechanically cleaned, disinfected (e.g. kidney bowl) and stored away.

In the event the transfusion component is sent back the blood bank due to serious reasons, a new blood sample from the patient is sent together with the form.

Complications

The complications include all adverse reactions - ***post-transfusion reactions***, which in the broad sense include all adverse reactions associated with administration of the blood transfusion preparation. In compliance with all policies and with careful testing, complications occur very rarely. However, it is important to know of the possible complications and be able to provide first aid.

- ***Haemolytic reaction*** – occurs in incompatible blood transfusions. It is the most serious reaction. It manifests itself with chills, fever, several hours after transfusion with a pain in the lumbar region, tightness of the chest, nausea, difficulty in breathing, anxiety, disorientation and anuria up to shock.

  First aid: Stop the transfusion, call a doctor, measure the physiological functions, prepare a replacement infusion, calcium and everything necessary for infusion and IV injection; administer oxygen. If necessary, dialysis is also provided. Arrange for the remaining

blood in the blood bag to be sent together with the patient's blood sample for blood group and compatibility tests.

- ***Febrile reaction*** occurs 30 to 120 min. after transfusion and is manifested with chills, fever to febris, tachycardia, nausea, vomiting. It is the most common complication.

  First aid: Stop the transfusion, call the doctor, measure the physiological functions, cover the patient and prepare the aids for injection, antipyretics and sedatives.

- ***Hypervolemia (fluid overload)*** is caused by the fast transfer of large blood volumes, especially in elderly patients with heart failure in circulation overload so that the heart is not able to pump the increased volume of blood so fails. The signs are dyspnea, cyanosis, tachycardia, hypertension, coughing sputum to haemoptysis.

  First aid: Stop the transfusion, call a doctor, put the patient in an elevated position, prepare oxygen, measure the physiological signs.

- ***Septic (bacterial) reaction*** occurs in the bacterial contamination of blood components, e.g. due to improper storage. The signs are from the beginning e.g. chills, fever, nausea, vomiting, diarrhoea, headache.

  First aid: Stop the transfusion, call the doctor, measure the physiological functions, cover the patient to keep them warm and prepare the medications and aids for injection.

- ***Allergic reactions*** usually occur after the transfusion. The most common form is anaphylactic shock. It is induced by allergens or antibodies in the donor's plasma.

  Symptoms: rash, hives, itching, fever, headache, respiratory problems, diarrhoea, chills, nausea.

  First aid: Stop the transfusion, call a doctor, measure the physiological functions, prepare the medications and aids for IV injection.

- ***Transmission of infection*** – for example, hepatitis A, B, C, and HIV. The consequences, i.e. severe disease, take effect later.

Task

- Find out how to proceed in the event of being sprayed with the patient's blood.
- Study blood composition and function.
- Find out the conditions under which it is possible to donate blood.
- Find out the conditions for autotransfusion.

Risks:

The nurse is at risk during contact with blood as biological material – transmission of infection from the patient during blood sampling, when inserting a cannula etc. The nurse must always use personal protective aids when handling blood.

Control questions

- What transfusion preparations do you know?
- What are the blood and blood preparations transport packaging called?
- When are the donor and recipient blood groups tested, using the diagnostic kit at the bedside (sanguine test)?
- For how long and where is the remaining blood stored (blood bag and transfusion set) after termination of the transfusion?
- What is the storage temperature for blood plasma?
- What is the storage temperature for erythrocyte preparations?
- What is the storage temperature for platelet preparations?
- What is the expiration time for blood plasma when stored correctly?
- How are the erythrocyte preparations transported to the ward?
- How long can the platelet preparations be stored from the date of collection (expiration time)?
- How long can the erythrocyte preparations be stored from the date of collection (expiration time)?
- What are the indications for transfusion?
- What reassurance tests are carried out on donor and recipient blood before the transfusion?
    - Increased medical supervision at the beginning of the transfusion
    - Verification of the blood group using a diagnostic kit (sanguine test) at the bedside
    - Compatibility test conducted in the laboratory
    - Patient identification

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14. COLLECTION OF BIOLOGICAL MATERIAL

Objectives:

After studying this chapter, you should be able to:

- Explain the basic terms – human biological material, laboratory tests;
- Describe and be able to determine the role of the nurse in the biological material examination;
- Explain and justify compliance with the general principles of biological material collection;
- Apply the general principles and methodology of biological material collection in the prevention of viral hepatitis and HIV
- Explain to the patient the principles of preparation for the collection of biological material;
- Demonstrate skills in sampling different types of biological materials in children and adult patients in standard and emergency care;
- Appropriately handle the sampled material;
- Apply professional communication skills when dealing with a patient during the collection of biological material;
- Respect the age and individual specific needs of the patient when providing healthcare;
- Monitor the laboratory test results.

Theoretical notes

Biological material that is collected for analysis can refer to blood, urine, stools, sputum, gastric, duodenal and pancreatic juice, nasal secretions, saliva, vomit, bile, sweat, cerebrospinal fluid, bone marrow, fluid (synovial, pleural, ascitic), pus, amniotic fluid, vaginal secretions, semen, tissues, bile and urinary stones etc.

Stages of biological material examination

Any examination of biological material has three stages:

- **Preanalytical stage** - important in terms of the professional activities of the nurse; it includes the preparation of the nurse, the aids and the patient as well as the working procedure, identification, pre-processing, transport and storage of biological material.
- **Analytical stage** - involves the analysis of samples and the calculation of results using microscopic techniques and procedures, subject to the material and technical equipment in the workplace and human resources.
- **Interpretation stage** - involves comparing the result with the reference values.

Fig. 14-1: Laboratory

Preparation by the nurse

Nursing methodology

When collecting biological material, the nurse proceeds in accordance with the provisions of the established quality system, monitoring each patient from a broader nursing perspective. For example, the nurse must indicate on the request form for specific examinations, the type and period for which the patient has been taking antibiotics, anticoagulants or chemotherapeutic agents.

- The nurse proceeds according to the time schedule and the methodology procedures which are determined by the staff from the biochemistry, haematology and microbiology laboratories; during collections in which special testing procedures are required, the nurse manages the preparation, collection and transport based on consultation with the laboratory and the relevant workplace.
- The nurse's work performance must be focused and smooth; this involves the arrangement of the work space during the preparation of aids preventing the patient to directly monitor the handling of a needle and syringe (thus minimizing the patient's negative feelings and fear of the procedure; limits the sounds of the instruments, so that the patient does not only focus on negative feelings; the nurse also maintains professional communication to avoid any discomfort; makes sure the procedure progresses smoothly, with the aids (enough) always at hand; in order to achieve optimal cooperation from the patient, the nurse keeps visual and verbal contact; the planned course of the procedure is completed with monitoring patient responses to the collection of biological material and records everything in the nursing documentation,
- The nurse uses disposable aids, ensures their own safety and the safety of the work environment, so that any biological material is considered infectious; wears protective clothing, uses personal protective equipment - disposable latex gloves or protective mask and goggles, adheres to aseptic procedures prior to each collection and afterwards, provides hands hygiene; the nurse does not touch their own eyes, nose , mucous membranes, skin, or does not consume food; prevents injuries, does not underestimate minor injuries which occur in connection with the collection of biological material; in the event of injury, the nurse observes the wound treatment procedure: The wound is allowed to bleed for a few minutes, then it is thoroughly washed with soap and water for 5 – 10 minutes and disinfected with antiseptic; in the occurrence of small wounds, skin cuticles which almost do not bleed, the wound must be immediately washed. The head of department or outpatient surgery must record each injury. In the event of contamination of the injury with biological material, it is recommended to be tested for HIV antibodies and HBSAg, with the first test usually carried out within 3 days after the injury and the next tests after 3, 6 and 12 months,

- The nurse minimizes the generation of aerosols, splashing or spillage of biological material; must not bend, brake the needle or put the needle cap back on needles which are intended for waste; the used items are disposed of in a designated waste container that can be used for active aerosols; positions the labelled waste containers as close as possible to the place of use; removes full containers safely covered and secured according to the internal regulations of the workplace, so that they do not become a source of contamination; in the case of spillage of biological material, the nurse progresses so that the contaminated area is cleaned with cellulose cotton, washed with hot water and detergent, further decontaminated with disinfectant. The nurse plans all activities so as to avoid human and environmental contamination; devalued biological material in the test tube is discarded in the designated waste container.

Aids for collection of biological material

The complete set of aids required for the collection of biological material is prepared according to the type of collection:

- Syringes, needles, lancets; sterile,
- glass or plastic test tubes and vacuum systems (various sizes) – clean, mostly closed with plastic cap (in some collections of biological materials, e.g.: for microbiological blood or follicular fluid they must be sterile; it is desirable to prevent airborne contamination of non-pathogenic microorganisms that can affect the results and determination of the pathogenic organism),
- vacuum sampling system – syringes and needles are adapted so they form a closed system which limits the contamination of the environment with the biological material,
- Containers for collected biological material - different shapes, are labelled (identification) of the collected biological material; the label is attached prior to collection of the material and placement into the container; the label contains basic identification data (name, surname, personal identification number of the patient, number), department name, date of collection),
- Request forms for the examination of biological material - contain information that is identical to the data on the label, which is attached to the container with the collected material, as well as other additional information about the patients treatment, the requested examination, the ward and the hospital i.d. data, etc.; If the test result is required immediately, the request form will state this with the word STATIM (immediately, within 1.5 - 2 hours) or VITAL INDICATION (life-threatening, within 20 minutes), including the exact time of collection and the telephone number of the ward to ensure smooth communication; at the present time, some healthcare facilities require a doctors signature and a stamp on the request form (according to applicable internal regulations of the ward); There are different types of request forms, adapted for use in information technology and which contain basic information: name, surname, title of the patient, date of birth, social security number (birth number), insurance company number, department identification, healthcare facility, date and time of collection,
- disinfectant, gloves, sterile swabs, tourniquet, protective pad (blood collection),
- small stands for test tubes, test tube tray (container) for temporary storage of the collected material, placed on the countertop or at the place with the exclusion of contamination by other materials or the environment,

- Aids for transporting the collected material.

Care of aids after collection of biological material

The nurse puts the used (infectious) aids and disposable sampling material into sealed containers, into infectious waste. Cleans and disinfects the kidney bowls and trays and when dry, adds the missing sampling material. The nurse will also organize the working environment.

Dispatch and transport of collected biological material

The nurse handles the collected biological material to prevent any degrading. The material must not become a source of infection to anyone and must not be contaminated by outside microorganisms. The preparation for dispatch and transport depends on the type of biological material and on the urgency of the required testing. In terms of time, the nurse ensures the material dispatch:

- Immediately (e.g. Sample for bacteriological examination, cultivation and sensitivity, p02, within 5 minutes after collection),
- Within 30 minutes (e.g. acid-base balance, mineralogram),
- Within 60 minutes (e.g. Blood group, qualitative urine analysis),
- Plasma or serum can be refrigerated until the next day.

Safe packaging labelled infectious material must be used for the transport of biological material outside the healthcare facility.

Patient preparation for collection of biological material

The nurse prepares the patient for collection of biological material:

Mentally, so that the patient:

- Knows the reason and importance of the biological material collection,
- Cooperates in the collection and indicates how they handle the negative emotions,
- Expresses their experiences in coping with the situation based on past experience,
- Expresses readiness to cope with the situation during the collection of biological material (children are accompanied by an adult).

Physically:

- The patient did not eat, smoke, drink coffee, sweetened or alcoholic beverages; in children a light breakfast and plenty of fluids are recommended,
- The patient is empty (except for sampling urine, stool),
- The patient limits their physical exertion, diagnostic and therapeutic procedures are emphasised,
- The outpatient rests in the waiting room for 20-30 minutes,

- During collection, the patient is in a half-sitting position or is lying down to prevent fall and injury (including accompanying people); with children, the accompanying adult or the nurse holds the child in the required position,
- The patient is informed of any possible reactions that can be expected in connection with the collection and how to proceed in such a situation.

Control questions

(One answer is correct)

Biological material does not include:

- Removed elastic bandage
- Saliva
- Tears
- Sweat
- Gallstones

What is the correct principle adopted by a nurse to limit the risk to their own health during the collection of biological material:

- Puts the cap back on the used needle that is to be discarded
- Used needles and other disposable sampling aids and material are disposed of in the municipal waste
- Used sampling needles are disposed of freely with the infectious waste
- Used needles and other disposable sampling aids and material are put into a kidney bowl
- Used needles are put into the sealed containers

The use of protective gloves for the collection of biological material:

- Is questionable considering the increase of financial costs for departmental operation and the minimum risk of injury to the nurse
- Is part of compliance with the general principles and methodological procedure for sampling biological material
- The patient's diagnosis is determined when collecting biological material
- It also depends on the type of material being collected
- It for the person who is collecting the biological material to decide

Which step will the nurse take to ensure the transport of biological material into the laboratory?

- The nurse does not handle the biological material after its collection

- The nurse handles the collected material to avoid any deterioration; transport depends on the type of biological material and on the urgency of the examination results
- The nurse will notify by phone all the heads of laboratories that the biological material is on its way
- The nurse regularly carries the collected material to the laboratory (as ordered by the methodological guideline)
- The nurse on a trial period regularly carries the biological material to the laboratory

The appropriate and correct way to overcome the fear of biological material collection is, for example:

- Absolute compliance with the principles of patient communication
- Loud recommendation by the nurse that every patient can handle it
- Point out another patient who is not afraid
- Explain to the patient the procedure and importance and listen to the patient - their negative experiences, explain the individual steps of the procedure that will follow
- Recommend the patient to come at another time

14. 1 Blood collection for testing

Blood testing is the most common collection of biological material.

There are three types of blood samples collected for the examination of blood parameters and values:

- ***Venous blood*** (venous blood is collected most frequently, e.g. for erythrocyte sedimentation rate test)
- ***Arterial blood*** (e.g. examination and determination of blood gases)
- ***Capillary blood*** *(e.g. blood glucose, ASTRUP)*

Laboratory analyzes:

- ***Whole blood*** (e.g. biochemical blood testing)
- ***Plasma*** (e.g. blood coagulation factors test)
- ***Serum*** (e.g. for hepatitis B virus test)

Antiplatelet agents:

If it is necessary to prevent haemostasis after collection of blood, *anticoagulants* are used.

The blood volume must be accurately determined. A larger blood volume than it is determined would cause subsequent haemostasis. If the sample contained more anticoagulant agent than is required, it would cause haemolysis due to the failure of osmotic conditions.

The vacuum system test tubes contain an antiplatelet agent in the desired quantity already supplied by the manufacturer.

The most commonly used anticoagulants include:

- 3.8% solution of sodium citrate in the ratio 1: 10; it is used, for example, for erythrocyte sedimentation rate test, blood coagulation factors test,
- Heparin
- Sodium or potassium salt

Biochemical blood testing

Biochemical blood analysis, plasma and serum are standard blood examinations. The analysis determines the values of fats, sugars, proteins, minerals and nitrogen compounds, bile pigments, enzymes and hormones.

Acid-base balance

The acid-base balance test – assessment of blood gases according to Astrup

Collection of:

- Capillary blood: into 2 heparinized capillary tubes,
- Arterial blood: 1 ml of native blood into heparinized syringes.

Transport: In a horizontal position with crushed ice

Basic parameters: pH, pO2, pCO2, SaO2, HCO3.

Haematology tests

Haematology clinical laboratory tests are carried out in the form of the basic haematology test of venous, arterial or capillary blood and a special haematology test of bone marrow, spleen and lymph nodes.

Important principles

- When collecting blood the following conditions must be strictly observed – minimal injury and accumulation of blood, the exact ratio of reagents and blood, selection of appropriate and clean test tubes, fast transport (analysis within two hours).
- No more than 30 ml of blood is collected at once; the collection is by using the intended catheters (because of possible contamination by tissue components).

Immunohematology examination

Immunohematology testing requires the collection of 2 – 5 ml of native venous blood.

- *Blood group* – determination of the blood group using the ABO test
- *Rh factor* – Rh positive, negative
- *Antibodies* – natural, innate - anti-A, anti-B, anti-A1, anti A2, Anti –H acquired, immune – at first have the character of IgM, and then IgG
- *Compatibility* – large cross-examination of the compatibility between the sample from the donor and recipient, ordering blood transfusion product.
- *Blood count (BC)*
    - Immunohematology testing requires the collection of 2 ml of native venous blood. The blood is collected using a test tube containing an anticoagulant agent (coated with Chelaton III or containing a K2EDTA or K3EDTA solution.
    - *BC (large)* - (2 ml of blood) erythrocytes (Ery-RBC), haemoglobin (Hb-HGB), hematocrit (Ht-HCT), mean volume Ery (MCV), mean weight Hb in one Ery (MCH), mean Hb concentration in Ery (MCHC), leukocytes (Le - WBC), differential CBC, platelets (Tr - PLT)
    - *BC (small)* - (2 ml of blood) same as in large BC, without platelet and difer. BC
    - *BC plus diff, the* differential - (2 ml of blood) leukocyte differential

File	Laboratory parameter	Sample	Reference interval				Note
Blood count - BC	Erythrocytes - Ery -RBC	2 ml native blood to test tube with Wintrob mix	4.2	-	5.8	1012/l	V
			4.6	-	5.5		
	Haemoglobin -Hb - HGB		120	-	160		
			130	-	160		
	Hematocrit - Ht - HCT		0.37	-	0.44		
			0.42		0.52		
	Leukocyte - Le -WBC Platelets - Tr - PLT		4,1	-	10,9		
			130	-	370		

Fig. 14.1-1: Blood count (BC)

3. *Coagulation factors*

A total of 4.5 ml of venous blood must be collected into a test tube containing 0.5 ml of sodium citrate for the *haemostasis and coagulation* test. To determine the time of bleeding, a total 3 mm of capillary blood must be collected from the fingertip or ear lobe (examination by Duke). A total of 3 ml of venous blood must be collected to determine the clotting time (examination by Lee-White).

File	Laboratory parameter	Sample	Reference interval				Note
Hemo-coagulation factors	Prothrombin time - thromboplastin time - Quick test (PT, PČ)	blood sodium citricum and 4.5 ml native	75	-	130	%	Indication of external prothrombin activation. Checked in treatment by Pelentan Anti-dotum of vitamin K
	Activated partial thromboplastin time - (partial thromboplastin time – PTČ-PTT)- aPTČ - aPTT		25		38	s	Indication of internal prothrombin activation. ..

File	Laboratory parameter	Sample	Reference interval				Note
Hemo-coagulation factors	Thrombin time (TT - TRČ)		15	-	20	s	Indication of fibrinogen to fibrin conversion. Checked in Heparin treatment, antidotum protaminsulphate
	Fibrinogen (FI),		1.5	-	3.5	g/l	I. Plasma coagulation factor
	Recalcification time		60	-	120	s	Checked in Heparin treatment

Fig. 14.1- 2: Haemocoagulation factors

5. Erythrocyte sedimentation rate

A total 1.6 ml of venous blood must be collected for examination of the erythrocyte sedimentation rate with an added 0.4 ml of sodium citricum.

File	Sample	Reference interval				Note
Erythrocytes sedimentation	0.4 ml sodium citricum and 1.6 ml of native blood	10	-	20	mm/h	F
		5	-	10	mm/h	M
		-	to	20	mm/h	Slightly increased
		-	to	50	mm/h	Significantly high
		-	to	90	mm/h	Strongly increased
		-	more than	90	mm/h	Strongly increased
		-	under	3	mm/h	Decreased

Fig. 14.1- 3: Erythrocyte sedimentation rate

Note

If the doctor prescribed a blood collection to be sent for more tests, it is recommended to take the samples in the following order:

- Acid-based balance
- Mineralogram
- Erythrocyte sedimentation rate
- Haemostatic parameters

Some laboratory practices may differ (even in the reference range) with slight variations due to the laboratory instrumentation.

Method of collection

Blood for biochemical, haematological and other tests is collected in several ways. The form of collection, i.e. an *open or closed (vacuum) system* is decided based on the conditions of the workplace and according to the patient's capabilities.

Blood collection using a closed (vacuum) system

Fig. 14.1-1 Aids for blood collection using a closed system

Aids

- Vacuette closed sampling system
- Protective gloves
- Protective pad
- Sterile gauze swabs or squares
- Antiseptic disinfectant solution
- Esmarch bandage, tourniquet
- Kidney bowl
- Plaster tape
- Waste bin (container)
- Labelled plastic or glass tubes, completed request forms, stand, tray

(The listed basic aids set is prepared for each blood collection, therefore it will not be detailed in the remaining parts of the textbook again)

This collection method requires the use of a closed tube system. This procedure eliminates direct contact with the patient's blood. The specific aids are produced on the basis of a vacuum system; they are safe during storage and transportation, allow easy handling when collecting larger volumes of blood and ensure exact volume sampling. Standardization of the conditions in the pre-analytical phase increases the accuracy of the measured results and prevents the formation of haemolysis by better separation of plasma from blood serum using gel or a filter.

The clinics use collection systems such as Vacutainer, Vacuette, S-Monovette and others.

Blood collection using an open system

This collection method requires the use of disposable sampling aids - needle and syringe or a hemolancet. Blood is sampled from a blood vessel directly into the test tube (glass, plastic), vials, heparinized micro-tubes, micropipettes or on the screening test strips.

Fig. 14.1-2: Aids used in an open system blood collection

Aids

The basic set of aids is complemented with:

- Disposable syringe of an adequate size to collect the desired amount of blood – typically 5 ml, 10 ml or 20 ml.
- 2 disposable needles with a yellow or pink cone (diameter 19, 20 in adults, and a smaller diameter in children)

Role of the nurse during blood collection

- Verifies the patient's identity with available methods for patients capable or incapable of cooperating (unconscious, psychiatric child patients, foreigners), verification is by the identification bracelet.
- Checks the availability of all the aids required for the collection,
- Determines whether the required dietary restrictions prior to blood collection were respected,
- Checks the doctor's instructions, i.e. for which examination the blood collection is required,
- Checks the identification data on the test tubes, quality of the needles, syringes, test tubes prior to sampling, see above: Preparation of the aids for the collection of biological material
- Enters a record into the medical documentation,
- Explains the collection procedure to the patient,
- Ensures the proper arm position, i.e. outstretched and supported, not flexed in the elbow, in bedridden patients the nurse ensures the correct position to prevent flexion of the elbow, the patient should not be awakened just before blood collection and should not eat or chew during collection,

- Enquires if the patient doesn't have any problems with blood clotting, that they did not suffer any injury to the arm, insertion of infusion etc., which may indicate complications (bleeding after collection...),
- Assesses the condition of the veins that run parallel to the arteries; the veins are visible under the surface of the skin, have a light blue colour and are smooth. Veins filled with blood that are visible, can be palpated and are surrounded by tissue. These are more readily available so are chosen as the injection site more often. Veins protruding above the surrounding tissue at the injection site have a tendency to evade the needle tip. The vessels bleed more if subjected to frequent blood sampling, they are damaged and so if possible, they are not used,
- Palpates the potential injection site, choosing the far end of the blood vessel so that on subsequent repeated sampling, the vessel can be injected at the higher point which was not damaged by the previous puncture. The most common injection sites:
    - ***In adults:*** The cubital region - v. mediana cubiti (v. mediana cephalica, v. mediana basilica), the forearm - v. cephalica, v. basilica, v. mediana antebrachii and v. cephalica accessoria. The injection site must be clear of haematoma, swelling, inflammation, healed burns, venous catheter and condition after breast ablation etc.,
    - ***In infants and toddlers:*** the cephalic veins, e.g. v. frontalis, v. temporalis superficialis,
    - ***In young children:*** v. mediana cubiti and on the forearm v. cephalica, v. basilica, v. mediana antebrachii,
- In adults with prominent veins, the blood can be collected without retraction of the tourniquet (Esmarch). If the tourniquet is attached to increase the venous filling and visibility of the blood vessel, it is placed at least 5 cm above the injection site. The tourniquet is wrapped around the arm, crossing the free ends with a loop, with the free end ready to be released. The patient is asked to support the filling of the veins – by opening and closing their fist; repeated instructions to open and close the fist and call for "pumping" of the arm are inappropriate. The patient is advised not to flex the elbow. The nurse pays attention to the length of time the tourniquet is attached. The time that is considered necessary is the time to clench the fist, insert the needle into the vein and draw the required amount of blood. If the tourniquet remains attached longer, it may lead to a change in the concentration of some of the blood parameters, (enlarging the blood vessel can be achieved by quickly tapping the index finger and the middle finger on the vessel at the point of collection).

<u>Patient preparation</u>

Patient

- The patient sits on a chair in a relaxed position during blood collection with a supported arm which is placed below heart level. Some patients may not like to look at their own blood and the aids, particularly the needle and syringe, therefore they are advised to look away from the injection site,
- The position of the patient in blood collection can also be semi-sitting, in the chair or lying down, depending on their current medical condition.

Working procedure (vacuum system)

- Hand hygiene and disinfection;
- The patient is continuously updated of the individual steps to which they are subjected to.
- The nurse places protective pad under the arm at the injection site,
- Prepares the sampling needle holder and needle,
- Attaches the Esmarch tourniquet,
- Palpates the injection site (the skin is gently pulled with the thumb which helps to stabilize the blood vessel at the moment of puncture and the needle puncture is less uncomfortable),
- Disinfects the injection site; the antiseptic is applied directly to the skin. After disinfecting, the nurse uses a swab to dry the injection site (disinfectant increases the risk of haemolysis),
- The needle held in the position 30–45° with a bevelled needle tip penetrates the skin 0.5 – 1 cm below the point of puncture into the blood vessel,
- After injecting the blood vessel, the position of the needle (the holder) is lowered, it pushes the test tube into the short cannula so as to pierce the rubber membrane of the closed system, the safety valve opens and the precisely defined vacuum in the tube ensures gentle aspiration of the blood, while each test tube draws the determined and constant volume of blood,
- The Esmarch tourniquet is released,
- When replacing the test tubes, the holder is held firmly with the non-dominant hand, while the dominant hand withdraws the filled test tube which is placed into the rack or tray (at this moment the cannula closes itself), then a new test tube is pushed into the holder in the same way, into the short cannula, and begins to draw the required amount of blood,
- The correctly handled blood collection is evidenced by the presence of blood, drawing the blood into the test tube, the absence of pain, haematoma at the injection site,
- The collection is finished by removing the test tube from the holder, attaching a swab on the puncture point (N.B. not on the tip of the needle) and the holder with the needle is removed in the direction of the vessel,
- The holder with the needle is then put into the sealed waste container,
- Pressing the swab on the injection point (2-3 minutes) helps to stop the bleeding while avoiding the formation of haematoma,
- The injection site is then treated with a patch,
- The nurse checks the patient's condition and ensures the relief position,
- The nurse ensures the transport of the blood samples immediately after collection, along with the request form, to the laboratory,
- The procedure is recorded in the documentation.

Patient care after the procedure

The patient is informed of the next treatment procedure (possibly provided with food,...) and of the availability of the blood test results.

Care of aids after use

The aid is cleaned according to standard procedure, see above.

Working procedure (open system)

In the event that the blood sample cannot be collected using the closed system (inaccessible, fragile, damaged blood vessels etc.), the blood is collected using the open system.

- The basic set of aids (see above) is complemented with a disposable syringe and needle, or with a test tube, the next step is the same,
- The difference is in the handling of the syringe, needle and the needle holder. Instead of inserting the test tube and puncturing the rubber membrane as it is in the closed system, the blood is drawn into the syringe by pulling the plunger which will also verify if the needle is in the vein,
- Attention must be paid to the speed of drawing the blood to avoid formation of foam in the syringe, a risk of haemolysis,
- It is possible to let the blood drip, or flow down the walls of the tube freely,
- the next step is the same,
- Correctly preformed blood sampling is evidenced by the presence of blood in the needle hub, then in the syringe or a test tube, by the absence of pain or haematoma at the injection site.

Patient care after the procedure is the same, see the text above

Care of aids after the procedure is the same, see the text above

Risks

- In infants, small children and restless patients, the nurse must expect sudden movements and reactions to the puncture – the presence of another person is required.
- The puncture point is disinfected using the recommended product. It is allowed to dry, and wiped off with a swab, there is a risk of haemolysis and burning sensation at the injection site; another palpation of the injection site after disinfection is unacceptable.
- Haemolysis, destruction of red blood cells, is a problem for most biochemical and haematological blood tests, particularly because many substances were transferred from erythrocytes into serum or plasma and the released haemoglobin colours the serum red.
- Haemolysis is caused by:
    - Contaminated needle or skin with traces of disinfectant
    - Contaminated sampling tubes or vials with traces of detergent

- The use of a too thin needle which forcibly draws blood
- Too rapid blood collection caused by pressure in the syringe
- Sharp injecting of blood from the syringe into the tube
- The blood was allowed to flow over the skin surface
- Violent shaking of blood in a test tube (also inconsiderate blood transport immediately after collection)
- Storage of whole blood in the fridge
- Freezing of the sample
- Extending the period between the blood collection and delivery to the laboratory
- Use of incorrect concentration level of anticoagulant agent.

- If it is not possible to collect a sufficient volume of blood, it is possible to use one of the following procedures: Changes in the needle position; use of another vacuum test tube, release of a too tight tourniquet; repeated needle probing is unacceptable. Timely release of the tourniquet the moment when the blood appears in the test tube or syringe, normalizes blood circulation and prevents bleeding after sampling; the patient releases muscular tension of their arm during blood collection.

Complications

- Haematoma as a result of unsuccessful puncture, or after withdrawal of the needle,
- Phlebitis – in frequently repeated sampling,
- Disruption of limb mobility – nerve disruption,
- Bleeding from the injection site,
- Nausea, fainting of the patient or an accompanying person.

Mistakes made during the venous blood collection that may affect the results

- Unprofessional, imperfect, inadequate information (ignorance of the patient), e.g. patient has not had a drink for a long time before blood collection, the result is dehydration,
- Mistakes in the working procedure for venous blood collection,
- Inappropriate time for blood collection (number of biochemical and haematological values fluctuate throughout the day, therefore blood collections at different times are done as an exception, if the extraordinary outcome may affect urgent diagnostic decision-making),
- The patient was given an infusion during or just before blood collection.

Capillary blood collection

Capillary blood is taken from the fingertips (the best are the 3rd and 4th fingers, from the side of the tip). The collection is alternated between fingers, first from the non-dominant hand excluding thumbs. Another suitable place is an earlobe.

Collection of capillary blood for glucose testing

Determination of the concentration of sugar in the blood is a frequent examination. In particular, diabetics can conduct such tests themselves, repeatedly evaluate blood glucose values and regulate their diet. The testing is done using glucose measuring devices, glucose meters and diagnostic (test) strips. Capillary blood collection is less painful compared with venous blood collection.

Patient preparation (see text above)

Fig. 14.1-3: Aids for capillary blood collection

Aids (sampling system)

- Protective gloves
- Disposable needle, blood lancet or lancing device, glucometer test strip, glucometer or heparinized micro tubes
- Sterile swabs
- Disinfectant
- Kidney bowl
- Sealed container

Fig. 14.1-4 a: Glucometer – set of aids

Fig. 14.1-4 b: Glucometer and test strips

Injection site

- Side of the fingertips (blood circulation in the fingers can be promoted by submerging the fingers in hot water or by gentle rubbing)
- Earlobe
- Lateral surface of the heel and side of the big toe in younger children

Working procedure

- Choose a suitable injection site, assess the skin condition (it must be free of haematoma, swelling, inflammation),
- Promote blood circulation to the injection site,
- Put on protective latex gloves,
- Disinfect the injection site and dry thoroughly before injection,
- Proceed with blood sampling according to the respective sampling system,
- Turn the patient's hand palm up and pierce the skin with a *needle*, the first drop is wiped off (includes tissue fluid admixture, although not always - it depends on the type of glucometer),
- A drop of blood is transferred to the test strip (the entire top surface must be covered with blood) and inserted into the glucometer, or a sensory strip is used instead which draws the required amount of blood itself. The resulting value of the blood glucose is automatically evaluated (in seconds) and the result is recorded in the medical documentation,
- If a blood lancet is used, the protective cover is turned midway, thus partially revealing the retractable needle; the top cap of the lancet is pressed once or a 2-3 mm needle puncture is carried out with the patient's hand turned palm downwards,
- If blood is collected with the test tube, the drops are firmly wiped with the edge of the tube; the blood is not forced out with the pressure (risk of haemolysis and distorted result), A total 3 - 5 drops of blood are required for examination,
- If a larger drop of blood from the total 2/3 of the volume is required, the finger is massaged from the palm towards the fingertip,

- The test tube is closed and the content is mixed by slightly tapping on the wall of the tube; a cotton swab is placed on the injection site,
- Transport of the sample to the biochemical laboratory must be ensured within 30 minutes from collection,
- Disposable aids are disposed of into the designated plastic containers (needles, blood lancets…), or into the infectious waste (gloves, swabs...),
- Kidney bowls, trays and other aids are mechanically cleaned and disinfected,
- The procedure is recorded in the relevant medical documentation

Fig. 14.1-4 c: Glucometer – evaluation of the resulting values

Patient care after the procedure is the same, see the text above

Care of aids after the procedure *is the same, see the text above*

Control questions

(One answer is correct)

Appropriate patient positioning during blood collection is:

- Depends on the number of samples collected
- As a minimum, sitting down in a relaxed position with supported arm, given the current health condition (i.e. the patient may also lie down).
- Depends on the age; elderly patients are recommended to sit down
- Depends on the patient's gender, men are recommended to lie down
- Depends on the number of patients waiting for the blood collection; the outpatient facilities can collect blood from a standing patient

In venous blood collection, the following method is preferred:

- If possible, always using an open system
- If possible, a closed (vacuum) system is preferred
- Depends on the medical facility practice
- As instructed by a doctor
- It is up to the person administering the procedure

The basic set of aids for venous blood collection (closed system) includes:

- Tray, needle holder, sterile needles, closed vacuum tubes, protective disposable gloves, protective pad, sterile gauze swabs or squares, antiseptic disinfectant, tourniquet, kidney bowl, patch, sealed container
- Tray, needle holder, sterile needles, closed vacuum tubes, protective disposable gloves, protective pad, sterile gauze swabs or squares, antiseptic disinfectant, tourniquet, kidney bowl, patch
- Tray, needle holder, sterile needles, closed vacuum tubes, protective disposable gloves, protective pad, sterile gauze swabs or squares, tourniquet, kidney bowl, patch, sealed container
- Tray, needle holder, sterile needles, closed vacuum tubes, protective pad, sterile gauze swabs or squares, antiseptic disinfectant, tourniquet, kidney bowl, patch, sealed container
- Tray, sterile needles, closed vacuum tubes, protective latex gloves, protective pad, sterile gauze swabs or squares, antiseptic disinfectant, tourniquet, kidney bowl, patch, sealed container

Indicate a suitable injection site for capillary blood collection:

- Side of the fingertips (3rd, 4th finger), from the side, excluding thumbs; an earlobe is also suitable
- Anywhere on the fingertips, most often on the thumbs
- Fingertips, most often thumbs on the non-dominant hand
- Fingertips, usually in the middle
- Sides of fingertips, especially on the dominant hand

Venous blood collection (closed system) finishes with:

- Removing the needle holder and the test tube, attach a swab over the injection site
- Removing the test tube, followed by removal of the needle holder, attaching a swab over the injection site
- The order for removal of the needle holder is not important, or first remove the test tube then the needle
- Removing the needle holder and the test tube, attaching a swab on the needle tip at the puncture point
- Removing the test tube, followed by removal of the needle holder, attaching the swab over the injection site, or removing the needle holder and the test tube, attaching the swab on the tip of the needle and the puncture point – according to the guidelines of the relevant healthcare facility.

14.2 Urine collection for testing

Urine examination is an important source of information in a clinical practice. The nurse collects the urine and examines it herself or it is sent to the laboratory for further examination.

The preferred method of collection is by the natural way of urinating rather than urine catheterization. Before collection, the patient is required to carry out their personal hygiene, showering or full wash using soap and water, especially washing and disinfecting the genitals.

Fig. 14.2-1: Basic set of aids for urine collection

Aids

Basic set of aids

- Graduated glass or plastic container
- Urine collection glass
- Plastic or glass tubes
- Protective disposable gloves
- Cellulose wadding (if necessary, a bedpan)

Methods of urine collection

Collecting morning midstream urine

A first or second morning urine sample is required to obtain basic examination results (according to the laboratory requirements). It is assumed that the sample will contain a higher concentration of substances than samples collected during the day.

Procedure:

- Inform the patient of the need and importance of the urine examination. Explain the procedure for the urine examination, stressing the need for hygiene, including thorough genital hygiene. Assess if the patient is able to remember and understand the information and able to collect the urine themselves,
- Explain to the patient that the urine sample must not be contaminated,

- The midstream urine collection method is preferred to the catheterisation method. Although the urine can still be contaminated with bacteria from the skin or mucosa, in terms of the patient, the procedure is safer with no risk of urinary tract infection that can be caused by catheterization.

Patient preparation

- The urethra estuary is disinfected in a circular motion (using suitable disinfectant intended for mucous membranes),
- The patient begins to urinate into the toilet bowl (holding a urine collection glass or another suitable container for urine sampling) with the urine at first washing away dirt from the external urethral meatus,
- Then briefly pauses urinating and then urinates into the glass, collecting 30 - 60 ml of urine,
- The patient finishes urinating into the toilet bowl until their bladder is completely empty,
- The patient washes their hands, passes the glass to the nurse who pours the sample into a designated and labelled test tube.

Patient preparation

- Disinfection of the labia major away from the genitals towards the anus,
- After separating the labia minora, the urethral meatus is disinfected from one side and then from the other side towards the anus, followed by disinfection of the central part across the urethral meatus,
- This is followed by urinating, a brief pause and then the collection of 30-60ml midstream urine 30 – 60 ml into a suitable container; the patient finishes urinating into the toilet bowl.

Aids

- Urine sample from the patient, (a dependent patient is assisted by the nurse) in a suitable collection container
- Disposable set of aids for urine collection, e.g. Vacuette, Sarstedt
- Cellulose wadding
- Protective disposable gloves

Working procedure

- Hand hygiene
- Check the aids
- Check the patient’s i.d., check the test tube and collection container labels
- Put on protective gloves

- Hold the urine collection cone
- Place the urine cone beneath the urine surface
- Pierce the test tube membrane
- Put the test tube on the tray or into the test tube rack
- Dispose the urine collection cone into the waste container
- Store the test tube into the rack, to the transport container, additional specific provision for transport etc.
- The procedure is recorded
- Care of aids

Patient care after the procedure

- The patient is informed of the next treatment procedure and of the availability of the urine test results.

Care of aids after the procedure is the same, see the text above

Collection of urine sample from the urine catheter, collection bag

The urine is drawn out from the permanent urinary catheter with a sterile needle and syringe. The nurse disinfects the injection site on the retention catheter (at the end of the catheter). The urine is gently drawn out at a 30-45°angle and the needle removed. The urine is emptied into the test tube, avoiding the needle touching the test tube surface needle.

Aids: See the above basic set of aids plus added:

- Sterile needle
- Sterile syringe
- Disinfectant
- Swabs

Working procedure

- Washing and disinfection of hands,
- Identification of the patient,
- Check the aids set,
- Put on gloves,
- Disinfect the injection site for the catheter,
- The needle is inserted at a 30-45° angle,
- The urine is slowly drawn into the syringe and the needle removed,

- The urine is emptied into a labelled test tube, avoiding the needle touching the test tube surface,
- The test tube is prepared together with a request form for transport,
- The used syringe, needle, swabs are discarded into the sealed waste container,
- Other aids are cleaned and stored in the usual way,
- The procedure is recorded in the documentation.
- The aids are cleaned according to the standard procedure.

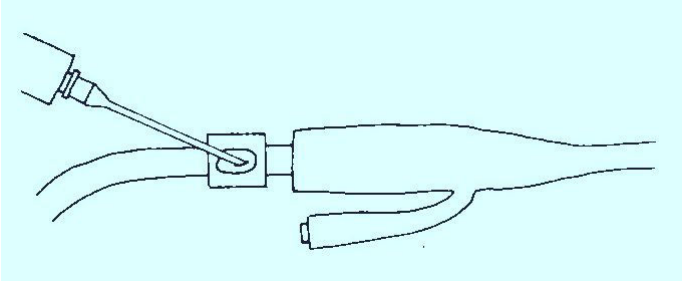

Fig. 14.2-2: Collection of urine sample from the urinary catheter

Patient care after the procedure

The patient is informed of the next treatment procedure and of the availability of the urine test results.

Care of aids after the procedure is the same, see the text above

Note:

In older infants and toddlers, the urine is collected after thorough hygiene and disinfection of the genitals by freely urinating into a sterile test tube or a sterile container - cone. In younger infants, a special plastic collection bag is attached to their genitalia or the urine can be collected about one hour after feeding. After removing the nappy, use two 2 fingers to massage the baby's abdomen in the midline, just above the symphysis. If micturition does not occur within one minute, the whole procedure is repeated after a short break. The midstream urine is collected into a test tube. Baby girls can be subjected to urinary catheterization in the same way as women using a thinner catheter only under exceptional circumstances.

Physical examination of urine

The nurse evaluates the urine volume, colour, odour, turbidity, foaming:

- *Urine volume* – in 24 hrs, hourly diuresis, which is measured in patients with a long-term catheter, is approx. 60 ml/h.
- *Urine co*lour – amber under physiological conditions, but can vary from a straw-yellow to light brown (concentrated urine). Urine colour changes with the occurrence of pathological agents, with food consumption (e.g. beetroot and blackberries) or with drugs (drugs containing iron, or diuretics),
- *Urine odour* – the smell of physiological urine is aromatic. In pathological changes (such as diabetes), the odour of urine is acetone and in urinary tract infections, ammonia.
- *d. clarity/urine turbidity* – fresh morning urine is clear transparent without turbidity. The cloud can only be detected in fresh urine, for example in the presence of alkaline

substances the turbidity is white and pink in the presence of acidic substances; a larger volume of erythrocytes causes a reddish turbidity.

- *Foam in urine* – colourless in a healthy individual, quickly fades after shaking. In proteinuria (protein content) or in glucosuria the urine foam has a white colour which fades slowly. In bilirubinemia (bile pigment) the urine foam has a brown colour.

The urine examination is recorded in the nursing documentation.

Examination of urine volume

The urine volume is usually examined at 6.00 a.m. in the designated room. The collection container is placed on a work surface so that level of urine in the container is at eye level (when assessing the level of urine in a graduated container).

The urine volumes are recorded in the medical documentation.

Examination of specific urine gravity

This examination follows the examination of urine volume. The collected data is evaluated and compared to the reference values.

Specific urine gravity	1. 015 – 1. 025
Isosthenuria	1. 010
Isosthenuria	1. 020 – 1. 040
Hyposthenuria	Up to 1. 020
Hypersthenuria	more than 1. 040

Fig. 14.2-1: Specific urine gravity

Patient preparation

- The patient collects urine into a labelled container (full name, room name, set time),
- The patient is fully informed of the reason and the examination procedure
- Urine collection in immobile patient is ensured by a nurse.

Fig. 14.2-3: Aids for measuring specific urine gravity

Aids

- Urine collection container
- Graduated urine cylinder
- Urometer – hysterometer

- Protective gloves
- Cellulose wadding
- Kidney bowl

Working procedure

- Put on gloves,
- Pour urine from the collection container into a graduated cylinder (put the cylinder on the work surface at eye level, pour the urine slowly over the rim of the cylinder),
- Measure the urine volume; to be able to measure the specific urine gravity at least 100 ml of urine is required,
- Immerse the urometer slowly into the cylinder, avoid touching the walls of the cylinder,
- The cylinder graduation is at eye level,
- Take care of the aids,
- Wash and disinfect hands,
- The procedure is recorded in the documentation.

Patient care after the procedure

The patient is informed of the next treatment procedure and of the availability of the urine test results.

Care of aids after the procedure is the same, see the text above

Biochemical examination of urine

Biochemical examination detects the occurrence of specific substances.

- *Qualitative* tests show the substances that are present in the urine.
- *Quantitative* tests determine the volume of the analyzed substance.

A total 10 – 15 ml of urine is collected.

Qualitative urine analysis

The sample for the qualitative analysis (presence of protein, glucose, ketones and bile pigments) is collected from the first or second morning urination. The labelled test tube ("urine and sediment") is sent for laboratory *microscopic examination* (erythrocytes, platelets, epithelial cells, urinary casts (hyaline, granular, crystal), bacteria, yeasts, Trichomonas, salts).

Quantitative urine analysis

Urine is collected over time, e.g. 3, 6, 12, 24 hrs.

The patient urinates into the toilet bowl before starting with the urine collection (before 6 a.m.). At the end of the time unit, the patient once again urinates into the collection container (labelled with their name). After completion of the collection, the urine is mixed together and the request form is completed with the time of collection, diuresis, etc. (according to the guidelines of the ward) and the sample is sent to the laboratory.

Laboratory parameter	Sample	Reference interval				Note
Protein	10-15 ml R	-	<	70	mg/l	-
Glucose	24 h	0.3	<	1.1	nmol/l	-
Glycosuric profile	10-15 ml R	-	-	-	tolerance	C + A
	24 h				Up to	(sugar + ace-
					20 g/d	tone
Ketones	10-15 ml R	-	<	0,19	nmol/l	= 20 mg/l
	24 h					
Bilirubin	10-15 ml R	-	-	-	-	
Urobilinogen		-	-	-	traces	
Urinary sediment						
Erythrocytes		0	-	1	in the field	
Platelets		1	-	4	in the field	
Squamous epithelial cells		-	-	-	-	
Renal epithelial cells		-	-	-	-	
Hyaline cast		-	-	-	sporadic	
Bacteria		-	-	-	-	
Yeast		-	-	-	-	
Trichomonas		-	-	-	-	
Salts		-	-	-	-	
Urinary sediment according to Hamburger	10-15 ml R					
Erythrocytes	3 h	-	<	2 000	min	
Platelets		-	<	4 000	min	
Hyaline cast		-	<	60	min	
Osmolality	10-15ml/12 h	-	>	850	-	
Creatinine	10-15ml/24 h	5	-	18	nmol/d	
	10-15ml R	8	-	27	nmol/l	
Urea	10 – 8 m	0.02	-	0.035	g/l	
Uric acid	24 h	1.2	-	6	nmol/d	
17 – keto steroids	10-15 ml	5	-	23	mg/d	M
	24 h	6	-	16	mg/d	F
17 - hydroxysteroids		3	-	10	mg/d	M
		2	-	8	mg/d	F
Vanillylmandelic acid		-		45.5	nmol/d	-

Fig. 14.2-2: Biochemical examination of urine

Control questions

(One answer is correct)

The preferred method of urine collection:

- The midstream urine collection method is preferred to catheterisation.
- Urinary catheterisation is the preferred method of urine collection.
- The preferred method of urine collection depends on the gender
- Urinary catheterisation is the preferred method of urine collection in men.
- Urinary catheterisation is the preferred method of urine collection in women.

Before urine collection, the patient is required to carry out personal hygiene, especially the genitals:

- Applies to all patients
- Applies only to soiled patients
- Only prior urine collection for microbiological examination
- Only in control urine collections for examination
- It is not recommended for bedridden patients

Usually, the first (second) morning urine is collected:

- Not true, it is collected throughout the day
- Yes, it usually contains a higher concentration of substances and is more acidic than urine collected throughout the day
- According to the doctor's instructions
- It is up to the patient to decide when the urine is provided for testing
- According to the laboratory operation

The collection of morning midstream urine sample:

- Is usually sent for biochemical urine examination; it is important to correctly inform the patient
- This urine collection method is not currently not recommended
- It is only suitable in women
- It is only suitable in men
- It is definitely not recommended; it is used exceptionally in school children

The required aids for urine collection:

- Glass or plastic container (cone), urinary disposable cups, bedpan in bedridden patients, urinal bottle, sampling systems for urine collection, test tubes, gloves, cellulose wadding
- Glass or plastic container (cone), urinary disposable cups, bedpan in bedridden patients, urinal bottle, sampling systems for urine collection, gloves, cellulose wadding
- Glass or plastic container (cone), urinary disposable cups, bedpan for bedridden patients, urinal bottle, sampling systems for urine collection, test tubes, cellulose wadding
- Bedpan, urinal bottle, sampling systems for urine collection, test tubes, cellulose wadding
- Glass or plastic container (cone), urinary disposable cups, bedpan in bedridden patients, urinal bottle, cellulose wadding

14.3 Stool collection for testing

Stool examination provides information on digestion, resorption and other biochemical processes in the digestive system, including gastrointestinal bleeding.

Aids

- Bedpan, children's potty
- Blades – stool sample container or Petri dish
- 2 wooden spoons for transferring the sample into the stool sample container
- Labelled container, sterile swabs as appropriate, (swabs, swab sticks glass rods)
- Protective gloves
- Cellulose wadding
- Air freshener

Patient preparation

- The patient is fully informed of the reason and the examination procedure
- Stool sample collection in immobile patients is ensured by a nurse

Working procedure

- Check that the patient understands the instructions and is able to collect the sample. Notify the patient of the need to coordinate urinating and bowel movements (stools must be free of urine and menstrual blood),
- Put on gloves,
- Check the aids ready on the desktop,
- The aids must be placed in a dedicated (suitable) location,
- If necessary, the nurse assists the patient with their hygiene,
- Physical examination of the stool sample,
- The stool sample is transferred using a wooden spoon into the stool sample container. It must not be contaminated by touching the outer, non-sterile wall of the container. The amount of stool required is dependent on the type of examination.
- For microbiological examination, immerse a swab (glass rod) into the middle of the stool and insert the sample into a test tube,
- For other types of examination, a stool sample the size of a hazelnut is collected (using a wooden spoon from the middle of stool - about 2.5 cm) or 15 - 30 ml of loose stool is inserted into a container with a wide neck and thoroughly sealed,
- Empty and clean the bedpan,
- Remove gloves (dispose of the gloves with infectious waste) and wash hands,
- Check the labels and safely transport the stool samples to the laboratory,

- Air freshener is used to limit the odour,
- Care of aids,
- The procedure is recorded.

Patient care after the procedure

- The patient is informed of the next treatment procedure and of the availability of the urine test results.

Care of aids after the procedure is the same, see the text above

Physical examination of stools

- Evaluation of the volume, shape, consistency, colour and odour of stools.
- *Quantity of stools* The usual daily excretion is up to 300g of stools, depending on the quantity and nature of the food consumed. The volume of stools will vary during illness, e.g. in pancreatic insufficiency, the stool quantity is usually large.
- *Shape and consistency of stools.* A formed stool is the optimal physiological finding.
- The shape of stools changes due to delayed resorption, e.g. strips, ribbon shape.
- The stools can be textured, cylindrical soft, semi-rigid or excessively rigid. A round hardened stool is called a scybala. Stool consistency is assessed during digestive disorders, e.g. watery and thinner diarrhoea with a mixture of blood, oily – paste like, dry or rigid.
- *Colour of the stools* depends on the amount of bile pigments, which have undergone oxidation and reduction. A physiological stool has a brown colour. If it lacks bile pigments, it is light – acholic. In perforation of peptic ulcer, the blood in the stool is black – *melena*, in cancerous processes in the small intestine, the blood is bright red – *enterorrhagia.*
- Stool *odour* is caused by skatole and indole, due to the red putrid fermentation and activity of bacteria.
- The nurse evaluates the odour of the stool sample for its aroma.
- Putrid dyspepsia causes a putrid smell, fermentative dyspepsia or sweet foods cause an acid odour. The stool odour is sharp and pungent (e.g. melena) with the presence of blood in the stools.

Methods of stool collection

Collection for the Haemoccult test

- The stool sample is sent for biochemical examination for hidden - occult bleeding (a symptom of pathological changes in the colon). The patient receives 3 envelopes, which contain additional envelopes with two red framed boxes. The name of the patient and date of the stool sample collection from the first, second and third stools are entered on the back of the parcel.

- A sample is collected from each stool (3x in total) using the enclosed paper scoop and smeared in the left field. A new scoop from the same stool but from different place is sampled and smeared in the right field.
- The envelope is closed and placed in the parcel. The same method of stool sampling takes place in the coming days.
- The Haemoccult test is evaluated either on the ward or in the laboratory. During screening, the patient should not eat or drink foods containing iron: Leafy vegetables, liver, meat, mineral water containing iron, or some drugs e.g. Ferronat C.

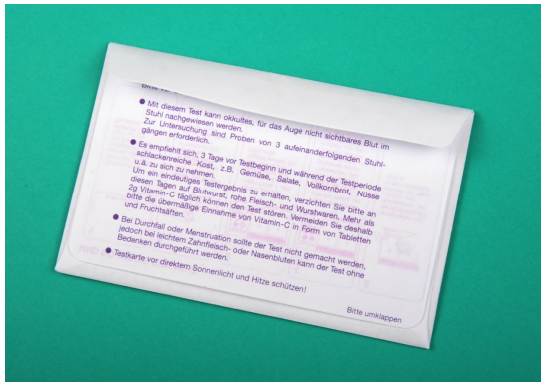

Fig. 14.3-1 a: Haemoccult test – Parcel with 3 screening envelopes

Fig. 14.3-1 b: Haemoccult test

(3 screening envelopes with enclosed paper scoops)

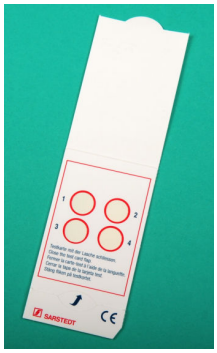

Fig. 14.3-1 c: Haemoccult test – envelope with two red framed boxes

Microscopic examination of stool:

- Microscopic examination is used to detect the occurrence of various substances such as yeast, undigested food, muscle fibres, starch, fats, etc. A small sample is collected from inside the stools.
- A sample is collected from the stools using a scoop which is part of the lid for the plastic container. The container is sealed, labelled and sent together with a request form to the laboratory.

Microbiological and parasitological stool examination:

- The same method is used to collect a sample of stool that is to be examined for the presence of parasites (roundworm, tapeworm) in the gastrointestinal tract.
- Adhesive tape is removed from the laboratory glass and attached to the anus to collect a sample for examination of pinworm presence. The aim is to obtain the eggs of the pinworms. Sampling is carried out in the morning before leaving the bed. After collection, the tape is removed and attached back to the laboratory glass.
- The sample is marked and together with a request form is sent to the laboratory for parasitological examination.
- The microbiological examination also includes a stool sample swab from the rectum. A swab (designed for this type of test) is gently inserted in a helical movement as far as the end of the swab is coloured by the faeces (about 5 cm). The swab is then placed in a sterile labelled test tube and sealed. It is frequently conducted in patients with diarrhoea who have a suspected bacteriological, viral or mycological disease. It is usually collected 3 times consecutively.
- The patient is provided with privacy during stool collection.

Control questions

(One answer is correct)

Physical examination of the stool – evaluation of the:

- Volume, shape, consistency, colour and odour
- Shape, consistency, colour and odour
- Volume, shape, consistency and colour
- Volume, shape and odour
- The stool is assessed according to the patient's medical diagnosis

Melena is:

- Brown
- A stool with blood
- A diarrheic stool
- A black stool with typical odour
- A ribbon shape stool

Collection for the Haemoccult test is for:

- Biochemical examination of the stool for hidden – occult bleeding
- Microbiological examination
- Physical examination
- Special examination of children
- Parasitological examination

14.4 Other collections of biological material

Sputum collection for testing

Sputum (phlegm) is a mucous secretion which must be distinguished from saliva - secretion of the salivary glands. The patient must cough to expel mucus from the lungs into the collection container.

The sputum is then subjected to microscopic and microbiological examination in the laboratory.

Aids

- Labelled plastic collection containers
- Disinfectant and swabs (to clean the outer wall of the container, cellulose wadding for drying)
- Aids for transport to the laboratory, plastic boxes
- Oral hygiene aids
- Protective gloves (if handled by a nurse)

Fig. 14.4-1: Plastic collection container

Patient preparation

- The patient is fully informed of the reason and the examination procedure.
- Sputum collection in an immobile patient is ensured by a nurse.

Working procedure

- The patient is informed of the method of collection and if in pain when coughing, techniques that would ease the coughing or limit the pain are recommended by the nurse (e.g. the patient can hold the surgical wound when coughing),

- The patient is encouraged to take a deep breath and cough up the sputum into a container, (sputum must not end up outside the container to prevent the spread of microorganisms into the environment) app. 15 – 30 ml; the nurse (must wear gloves) assists any patient who is unable to cough up the sputum,
- Physical assessment of sputum,
- The sampling container must be closed immediately after collection,
- Any changes in the patient's breathing must be monitored,
- The external walls of the container are cleaned with a swab and disinfectant,
- The sputum sample is put into a transport container,
- The patient rinses their mouth and performs oral hygiene,
- The procedure is recorded.

Patient care after the procedure

The patient is informed of the next treatment procedure and when the test result is available.

Care of aids after the procedure is the same, see the above text.

Physical examination of sputum

The sputum is assessed for volume, colour, appearance and odour.

- The average daily excretion of sputum from the respiratory system is 100 - 150 ml.
- Increased volumes are recorded (e.g. in bronchitis, bronchopneumonia, due to smoking).
- The colour of sputum is usually yellow; in cancer it can be pink to red, green-yellow, purulent…).
- The consistency and appearance of sputum – may be watery or thick, in asthma attacks it has mucus appearance and serous appearance in pulmonary edema.
- Sputum odour. The sputum can have a putrid to fishy odour in the event of inflammatory diseases of the respiratory system.

Other methods of sputum collection:

Sputum can also be collected by nasopharyngeal suction using a catheter and suction device or after postural drainage, where the sputum collection is via positioning drainage and gravitation. The patient may be given drugs to help release the mucus before drainage. Sputum can also be obtained via laryngeal swabs and bronchoscopy examination.

Microscopy examination of sputum

Sputum is examined for the presence of bacteria, lymphocytes, eosinophils and other cellular components. Sputum is collected in the morning (before the patient drinks and performs oral hygiene).

The patient is asked to cough the sputum into a sterile container (with a cap and label) which is sent to the laboratory along with a request form.

Microbiological examination of sputum

The sputum is sent for examination – cultivation and sensitivity (C + S); it is important to collect the sputum before starting antibiotic treatment.

The microbiological examination usually requires the collection of sputum on 3 consecutive days.

Swabs and smears

The swab is taken from mucous membranes (e.g. oral cavity, nose, nasopharynx, larynx, tonsils, vagina and rectum) and from the skin surface. A sterile swab wrapped in sterile packaging is used to collect the sample. The swab is then returned back to the sterile packaging. The swabs are usually sent for microbiological and cytological examination.

Mouth swab

The patient must not brush their teeth, eat, drink and smoke before the mouth swab. The sample is collected in the morning after waking up. After collection, the swab is inserted into a test tube, preferably with a transport medium.

Nasal cavity swab

The sample is collected before application of ointment or nasal drops, usually in the morning after waking up. The swab is inserted deep into the nose and swirled around. After collection, the swab is inserted back into the test tube with the transport medium.

Smear of tonsils

The smear must be from the tonsils, not from the root of the tongue or palate. The tongue is held down with a tongue depressor and the tonsils are smeared with a swab. The patient preparation is the same as in oral swabs.

Wound and skin surface smears

The wounds are smeared to remove the pus or a typical part of the pathological process. Swabs and smears are usually taken from the skin defects, conjunctivitis, nasal cavity and ears.

Gastric content sampling

Samples of gastric and duodenal juices are obtained for biochemical, microbiological and cytological examination. The sample is sent to the laboratory in a wide neck sterile tube. The sample is collected by:

- Syringe aspiration through a gastric tube
- Removal of a sample from a kidney bowl when vomiting
- Endoscope aspiration during endoscopic examination

Puncture

A puncture involves inserting a puncture needle into the appropriate body cavity or organ. A puncture has a therapeutic or diagnostic purpose. Obtaining bodily fluids or samples and the subsequent analysis can contribute to the diagnosis. The puncture is usually carried out in rooms designated for minor surgical procedures. The collected samples are immediately sent to the laboratory for examination. The puncture is preformed by a doctor and an assisting nurse.

Patient preparation is important. *Physical preparation* involves thorough personal hygiene; the *psychological preparation* involves an explanation of the procedures and of the process carried out by a doctor and nurse.

The *puncture tissue or fluid* (*transudate* – extravascular fluid with low protein content, clear, containing proteins and *exudate* - inflammatory effusion, cloudy with a higher content of inflammatory proteins).

Cerebrospinal fluid puncture

Cerebrospinal fluid is collected strictly aseptically from the spinal canal, i.e. the *lumbar puncture*, performed by a doctor and assisting nurse. The patient signs their consent to the examination (part of the medical documentation), which informs the patient of any potential complications. The lumbar puncture involves the insertion of a needle into the subarachnoid area of the spinal canal in order to obtain the cerebrospinal fluid (CSF). The needle puncture is between the third and fourth or the fourth and fifth lumbar vertebrae.

A lumbar puncture requires a sterile procedure. The CSF must not be drawn by force; it is allowed to drip into a sterile test tube (5 – 7 ml) and immediately sent for testing. The temperature of the CSF must be kept at 37°C until it is processed by the laboratory, therefore immediate dispatch is necessary. The cerebrospinal fluid is normally clear and colourless. It is usually sent for macroscopic, microscopic, microbiological, virological, biochemical and cytological examination.

The position of the patient in a lumbar puncture – on the side

Just before the procedure, the patient is put into a side position with their head bent over their chest, the knees drawn up to the abdomen and the spine aligned with the edge of the bed or examination table. The head is supported with a small pillow to maintain the horizontal position of the spine. This position with a bent spine opens up the space between the vertebrae allowing for better insertion of the puncture needle. The side position is chosen especially for patients with expected nausea or fainting. *The second possible position is sitting on a chair* – the patient sits astride a chair, the head resting on the folded arms which are placed on the

back rest of the chair. *(Currently, the lying position on the side is preferred to the sitting position which requires the patient's cooperation).*

The lumbar puncture is essentially preformed using *two types of puncture needles:*

- A SPROTTE atraumatic needle that has a special ending which minimizes damage to the surrounding tissue
- A commonly used YALE needle.

After inserting both types of needle, the CSF plug is formed to prevent subsequent bleeding.

The patient is constantly monitored and prevented from moving *during the procedure.*

Patient care after the procedure

After completion of the puncture, the injection site is treated with a sterile dressing. The patient is put on a bed in the prone position, without a pillow, for about 30 minutes. After 30 minutes, the patient may turn on their back. If the patient has a problem with urinating into a bedpan or urine bottle, they are allowed to get up and go to the toilet after 8 hrs. (The patient can get up and go to the toilet even earlier than after 8 hours if an atraumatic needle was used for the lumbar puncture). The patient is given at least two litres of fluid (preferably water or tea; currently also recommended is Coca Cola). The nurse monitors that the patient has drunk the provided liquids or assists the patient. The overall condition of the patient is monitored, including the injection site.

Sampling fluid from the peritoneal cavity

Abdominal paracentesis involves drawing fluid from the peritoneal cavity in the event of accumulation - *ascites* (e.g. liver cirrhosis). The aim is to obtain a sample of fluid for laboratory examination and to relive the pressure on the abdominal organs.

The procedure is administered strictly aseptically with a puncture needle which is used to draw fluid into a syringe and immediately sent to the laboratory. If the accumulated ascites is being drawn from the cavity at the same time, the sample for laboratory examination is drawn just before removing the puncture needle.

Before puncture, the patient is clearly instructed on the importance of the procedure carried out by the doctor and assisting nurse; the procedure is administered on an empty stomach and the patient must be emptied. The patient signs their consent to the examination (part of the medical documentation), which informs the patient of any potential complications.

The patient assumes a semi-sitting position to allow the fluid to accumulate in the bottom of the abdominal cavity. It is necessary to maintain contact with the patient, because if the procedure involves drawing the ascites it can lead to hypovolemic shock, caused by the loss of large volumes of fluid.

After the procedure, the injection site is protected with a sterile square and plaster. This is followed by a check of the overall condition of the patient and physiological functions.

Sampling fluid from the pleural cavity

Thoracentesis is a collection of fluid or air from the pleural cavity. The accumulated fluid is extracted for diagnostic or therapeutic reasons.

The procedure is carried out by a doctor and assisting nurse with a puncture needle which has a three-way valve attached to prevent air penetrating into the pleural cavity. If the procedure involves extraction of a larger volume of fluid, an airtight container with a negative pressure or a suction unit are used. The syringe is attached to the puncture needle via the three-way valve. Approx. 15 ml of fluid is drawn and sent to the laboratory. The puncture sample is usually sent for microscopic and biochemical examination.

Before puncture, the patient is clearly instructed on the importance of the procedure carried out by the doctor and assisting nurse; the procedure is preformed on an empty stomach and the patient must be emptied. The patient signs their consent to the examination (part of the medical documentation), which informs the patient of any potential complications.

The patient takes a semi-sitting position with an elevated upper limb, thereby making the ribs accessible. The puncture is mostly carried out from the lower part of the chest.

It is necessary to maintain contact with the patient throughout the procedure and secure their position to prevent lung injury.

After the procedure, the puncture site is covered with a sterile swab and the patient's physiological functions, overall condition and puncture point are checked.

Biopsy

A biopsy involves examination of cells or tissue samples from a living human organism. Samples are usually sent for histological and cytological examination.

Biological material for biopsy is obtained e.g. via an excision (cut out) or a puncture. The sample is placed in a fixative solution.

The biopsy is performed by a doctor and an assisting nurse in the designated room for minor surgery.

Bone marrow sampling

A bone marrow sample is used to determine the composition of blood components, which reveal blood disease. The most common place for a bone marrow biopsy is the sternum. Sampling is conducted under sterile aseptic conditions.

Before the procedure, the patient is explained the reason and the course of the procedure. The patient signs their consent to the examination (part of the medical documentation), which informs the patient of any potential complications. The patient’s physiological functions (BP, P) are measured and then they are put into a supine position.

The patient is safeguarded (held) throughout the procedure and notified of the feeling of pressure and sometimes of the sound of needle penetrating and “crunching” the bone. Verbal contact is maintained with the patient who is also monitored for signs of going pale, sweating or fainting. The doctor administers local anesthesia and inserts a biopsy needle supplied with a mandrin through the skin and bone. After penetration of the needle into the bone marrow, the doctor removes the mandrin, attaches a 10 ml syringe and aspirates 1 - 2 ml of marrow.

After sampling, the mandrin is inserted back to the needle, the needle is removed and the puncture site covered with a sterile swab. The patient's physiological functions and injection site are checked. The marrow samples are immediately sent to the laboratory in sterile tubes.

Kidney tissue sampling

A renal (kidney) biopsy is a diagnostic examination conducted under strict aseptic conditions. The sampling is performed by a doctor and an assisting nurse.

The patient fasts *before the procedure* (does not eat, drink and smoke from midnight) and is emptied. The patient is informed of the procedure and its importance in determining the treatment. The patient signs their consent to the examination (part of the medical documentation), which informs the patient of any potential complications. The current value of the blood clotting and platelet count is assessed before the renal biopsy.

The patient is in the prone position, slightly supported *during the procedure.* Verbal contact is maintained throughout the procedure, including monitoring the patient's condition, skin colour, state of consciousness and ability to cooperate. The doctor uses ultrasound to determine the position of the kidneys and mark the best puncture point. After disinfection and local anesthesia, the doctor inserts the biopsy needle. The renal tissue remains in the needle after it is withdrawn. The tissue is sent immediately in the sterile test tube to the laboratory. The puncture point is gently compressed with a sterile swab and dressed with a patch.

The patient must rest on a bed for 24 hrs *after the procedure*. The patient's physiological functions are monitored in 30 minute intervals until stabilized. The patient must drink plenty of fluids (about 2000 ml) in order to check the urine colour and detect potential complications – (hematuria).

Liver tissue sampling

A liver biopsy is usually carried out for diagnostic purposes in liver disease. The procedure is performed under sterile aseptic conditions using a sterile biopsy kit.

The patient is informed of the procedure and its importance in determining the treatment. The patient signs their consent to the examination (part of the medical documentation), which informs the patient of any potential complications.

The patient fasts *before the procedure* (does not eat, drink and smoke for at least two hours before the procedure) and is emptied. The patient is examined (physiological functions) and also if they are able to hold their breath for about 10 seconds, which is important when inserting a biopsy needle. The current results of the prothrombin time and platelet count must be available before biopsy, because liver disease is associated with blood clotting disorders and a tendency to bleed.

The patient is placed in a comfortable supine position. After proper disinfection and local anesthesia, the patient is asked to take several deep breaths and to hold their breath after the last exhale for about 10 seconds.

The doctor inserts a biopsy needle and aspires the liver tissue. The needle is inserted between two loser ribs on the right side or through the abdomen below the right costal arch. After withdrawing the needle, the puncture point is firmly covered with a sterile swab and bandage; in order to stop the bleeding an ice compress is placed on the bandage.

The patient is advised that they can start breathing.

The liver tissue samples are sent immediately to the laboratory in sterile tubes.

After the collection, the patient is helped to take the position on their side with a pad under the biopsy site where they remain in this position for several hours. The physiological functions are checked in 15 minute intervals through the first hour following the procedure, until stabilized. The injection site is closely monitored for bleeding and indicated abdominal pain.

Control questions

(One answer is correct)

Sputum is collected:

- Usually in the morning (before the patient drinks and performs oral hygiene).
- After breakfast
- Throughout the day
- Depending on the usual practice on the ward
- As instructed by the laboratory

Physical examination of sputum includes:

- Depending on the doctor's instructions
- Assessment for volume, colour, appearance and odour.
- Assessment of volume
- Assessment for volume, appearance and odour.
- Assessment of the time when the patient coughs up the sputum (day, night, evening…)

Patient treatment after a lumbar puncture includes:

- Absolutely nothing is administered per os
- The patient is encouraged to drink at least 2 litres in total
- The patient is encouraged to drink, but a maximum of 400 ml in total
- The patient is offered liquids, but a maximum of 250 ml in total
- The patient is offered only ice cold fluids to drink, max. 300 ml in total

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Laboratory examination

15. PAIN AS A NURSING PROBLEM

Objectives:

After studying this text, you should be able to:

- Define the term "pain";
- Clarify the concept of pain scale and properly assess the intensity of pain using the most commonly used scales;
- Correctly select and use non-pharmacological methods of pain treatment;
- Explain the three-level diagram by WHO – pharmacological methods of pain treatment.

Theoretical notes

Definition of pain by the World Health Organization: "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage…" (WHO definition, in Trachtová et al., 1999)

A medical professional must believe the patient whenever they complain about pain or says that they feel pain or that it hurts. Pain is a subjective experience, often accompanied by objectively measurable physiological reactions. It is influenced by culture, emotional and cognitive reactions, by expectations and previous experiences of pain, by the context in which the pain occurs, etc. Pain is accompanied by a symptom of disease or injury; its purpose is a warning signal indicating a dangerous situation or protecting against harmful influences.

The perception of pain is based on nociception involving all processes provoked by activation of the nociceptors, which are special receptors sensitive to injury, located in the skin or in the walls of the intestinal organs. Nociceptors use nerve impulses to transmit messages to other nerves that send out the message of pain to the spinal cord and brain. This process activates an involuntary reaction. Nociception may not always lead to a painful sensation, and pain can be present without nociception. This can occur in patients who experience severe pain without obvious pathology.

Pain can be divided according to different criteria:

- Point of origin (topology and pain mechanism)
- Affective quality (nuisance)
- Sensory quality (intensity)
- Duration and incidence

Pain divided according to character:

- *Acute*
- *Chronic*

Acute pain occurs suddenly, often from full health with a sudden onset and a predictable end. Acute pain is usually accompanied by the following symptoms: tachycardia, tachypnea, changes in blood pressure, sweating, mydriasis - dilated pupils, vasoconstriction, intestinal paralysis, urinary retention etc. It has a physiological significance, helps to escape from

stressful situations, helps to heal and rebuild damaged body tissue. First, the cause of pain must be diagnosed – e.g. abdominal pain can be a warning sign.

Chronic pain is pain lasting longer than three months. It does not have a signal and protective significance. Chronic pain most often occurs in problems with the musculoskeletal system, but it also includes headache, migraine, neuralgia, cancer, phantom pain, post traumatic pain. In general, chronic pain is of a malignant origin (tumour) and a benign origin. Patients in chronic pain often experience frustration, despair and depression, sleep and behaviour disorders.

Chronic pain changes the way of a person's life, it becomes a separate disease. Patients experience changes such as feelings of low self-esteem, lack of confidence and own strength. Chronic pain affects the social sphere, because patients often act aggressively, they are hostile or they isolate themselves. Chronic pain affects the living conditions of the patient, thus deteriorating the overall quality of life (financial security, loss of job, etc.). It is also important to keep in mind that patients experiencing chronic pain may feel suicidal.

Pain is from the nursing point of view, a diagnosis because it is a problem for the patient and is related to the basic physiological needs of each individual - to be without pain. In order to assess the pain, it is important to obtain the pain anamnesis and conduct a physical examination. When obtaining the pain anamnesis, the nurse is attentive to the patient's verbal and non-verbal cues.

Pain anamnesis

Pain assessment is conducted as part of the medical examination in each hospitalized patient. Pain anamnesis involves obtaining information concerning:

- *Localization*
- *Intensity*
- *Quality and type of pain*
- *Factors that cause pain*
- *Accompanying symptoms*
- *Previous experience*, etc.

Localization of pain

Localization of pain by asking: "Where does it hurt?" Superficial pain can be located easier than pain in deeper tissue. It is also easier to locate acute pain rather than chronic pain. To assess the location and intensity of pain a questionnaire of the global quality of pain is used. The patient is asked to draw into the diagram of the human body the locations of pain (see Fig. 15-1).

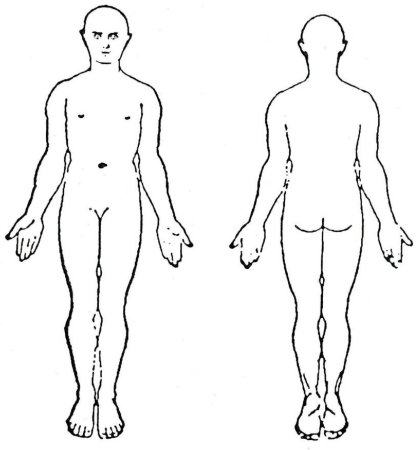


Fig. 15-1: Map of pain

Intensity of pain

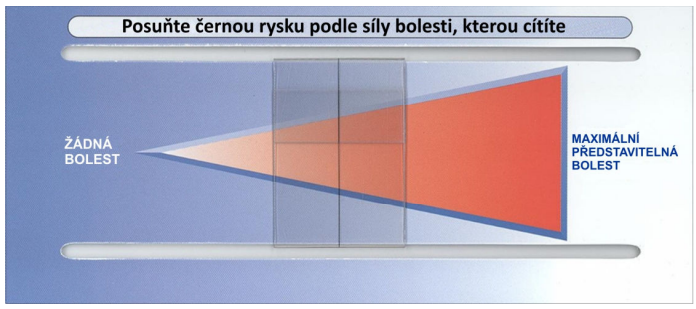
The intensity of pain is expressed by the question "How much does it hurt?" It is not easy to assess pain as it is a subjective symptom. We can not objectify the intensity of pain or measure the strength of the impulse in a particular patient. Experiencing pain is influenced by many internal and external factors. The nursing staff should monitor the overall behaviour of the patient, especially the quality of sleep, appetite, communication with other patients, family members, staff etc. Pain intensity can fluctuate during the day, changing under the influence of events, so it is important to monitor pain during 24 hrs and to identify the factors that affect it. Pain intensity is assessed as follows:

- *Mild* – if it can be forgotten when focusing attention on something else, such as work.
- *Moderate* – if it still attracts attention and prevents concentration on work. Affects sleep and the pleasure of entertainment, it is haunting.
- *Severe* – if the pain prevents any activity, one can only concentrate on the pain. The vegetative symptoms of severe pain are: Lacrimation, sweating, mydriasis, tachycardia, hypertension, deceleration or acceleration of the stomach and intestine peristalsis, vomiting. Vasomotor changes in the face – redness, discoloration. Sphincters may stop constricting (e.g. the patient can wet themselves).
- *Intolerable* – if the patient moans out loud, cries, screams, is exhausted, goes into shock. If the pain is not managed, the patient may even die.

The assessment of pain intensity depends on the perception of pain by the patient. A number of rating scales have been used to assess the intensity and unpleasantness of pain, e.g.

- *Categorical scales*,
- *Visual analogue scales* (VAS) - see Fig. 15-2 and 15-3,
- Questionnaire of global quality of pain,
- *Visual analogue scales* - see Fig. 15-4,
- *EDIN (Échele Douleur Incomfort Nouveau-Né) SCALE* – Scale of long-term pain for monitoring the intensity of pain in preterm neonates,
- *FLACC scale* – scale for monitoring the pain intensity in patients from 1 month to 6 years of age in a postoperative state,

- *NIPS* – assessment scale for monitoring pain intensity in full-term neonates (0 to 12 months) at ICU,
- *COMFORT* – scale for monitoring pain intensity in patients up to 18 years old, especially suitable for patients on ventilation in ICU/ARD; monitors pharmacological attenuation,
- RAMSEY – scale for monitoring pain intensity in adults, especially ventilated patients at JIP/ARD, monitors pharmacological attenuation,
- *Categorical analogue scale* allows the patient to determine the intensity of their pain using a ruler with slider. The ruler is marked with the following criteria: No pain, slight pain, difficult pain, disruptive pain, terrible pain, excruciating pain. The patient moves the slider to indicate their subjective feeling. On the other side of the ruler the nurse or the doctor can see the number that corresponds to the assessment of pain intensity by the patient. Another categorical assessment scale is the *Melzack scale* for pain assessment on a scale from 0 to 10. The patient is asked to indicate on a 0 – 10 scale the intensity of their pain, which is recorded in the patient's documentation.
- The most frequently used method of assessing pain intensity is the ***VAS*** (Visual Analogue Scale). It is a simple and straightforward method which consists of a 10 cm long linear scale, i.e. a horizontal, vertical or oblique line rising from left to right at a 45 degree angle expressed in two extreme points, i.e. no (zero) pain and the maximum (strongest) possible pain. Graphical representation depends on ward practice (see Fig. 15-2, 15-3). The nurse assists those patients who are not able to indicate the number on the scale or cannot speak by slowly counting the numbers and the patient may nod or blink when they hear the corresponding number.



Move the black mark according to the strength of the pain you feel

NO PAIN MAXIMUM IMAGINABLE PAIN

Fig. 15-2: Visual analogue scale – front

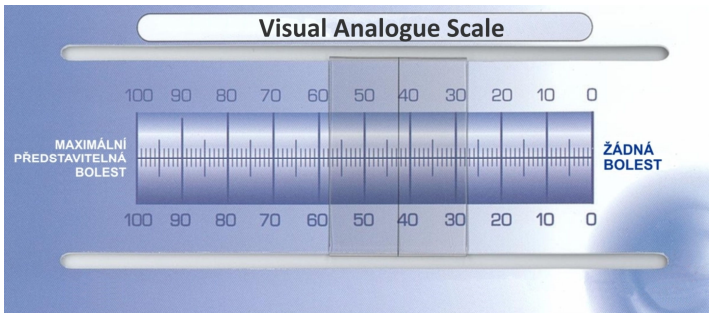


Fig. 15-3: Visual analogue scale – back

The best known *graphic symbol scale* is a scale of drawings of children's faces. There are 8 of the most commonly used expressions from smiling to a painfully anxious face (see Fig. 15-4).

Given that pain changes the values of physiological functions in a patient, it is recommended to record the value of BP, the pulse and breathing during the assessment of pain intensity using the VAS.

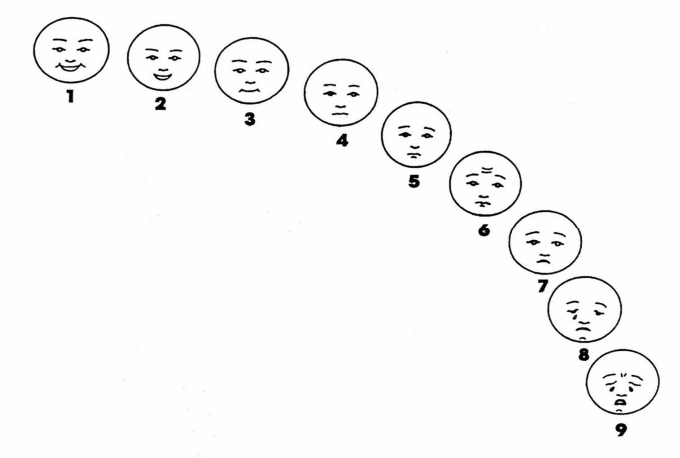


Fig. 15-4: VAS used in the youngest children

(Copied from Trachtová et al., 1999, p.133)

Type of pain

When assessing pain, the patient tries to describe the pain (to the question: "How much does it hurt?" or "What is the pain like?") with words such as blunt, sharp, shooting, stabbing, wrenching. It is however problematic to assess pain in children and in adults who are having difficulties to express themselves.

Types of pain:

- *Somatic pain* is clearly demarcated, sharp, sensitive and tender to palpation with sensitive skin. It occurs through irritation of the spinal nerves in the abdomen.
- *Visceral (vegetative) pain* is usually perceived as dull, with uncertain localization, felt in the midline. It occurs through a sympathetic stimulation, in the abrupt margin of smooth muscle in the abdominal area.
- *Colicky pain* is severe pain with growing intensity, unbearable at its peak. It is caused by spasms of smooth muscle in the affected organ, e.g. in renal colic or biliary colic.
- *Ischemic pain* occurs in muscle tissue in connection with hypoxia, e.g. in angina pectoris, claudication pain.
- *Inflammatory pain* is perceived as throbbing, twitching pain. It occurs in painful stretching of the affected organ.
- *Neuropathic pain* is pathological pain that occurs in connection with the impairment of the peripheral or central nervous system. The stimulation of pain receptors as in nociceptive pain is not needed in this type case; however simultaneous stimulation may intensify the pain.

Pain treatment

Pain and treatment is a complex issue. If a patient complains of pain, the cause of pain is determined, followed by the treatment. In the event of severe pain in a patient (level 4 – 6 on the VAS) according to the ward standards, the treatment of pain must be initiated within 15 minutes according to the doctor's prescription. In hospitalized patients, the pain is assessed by a doctor at least once a day who also records it in the daily report.

- The treatment of pain differs by the type of pain, i.e. whether we treat acute or chronic pain. Some literature suggests that pain is inadequately treated worldwide. The most important is the systematic increase of pain awareness, its mechanisms, treatment options and lifestyle related prevention approaches.
- *Treatment of acute pain* is mainly focused on a multimodal approach. It uses pharmacotherapy – analgesics administered orally, transdermal and rectal therapy. Analgesics with a rapid onset can also be used. The treatment should be individual in terms of choice of analgesics and dosage. It is important to monitor effectiveness and side effects. Patients with postoperative pain can be under the care of an algesiologist (a pain treatment specialist).
- *Treatment of chronic pain* is multidisciplinary; patients with chronic pain use a team of specialists, e.g. algesiologist, neurologist, psychiatrist, rehabilitation doctor and psychologist. In the treatment of chronic pain, drugs are administered according to the schedule to prevent the development of pain. The therapy includes administration of non-opioid and opioid analgesics in combination with adjuvant drugs.
- *Treatment of cancer pain* is related to the degree of adaptation by the patient to the situation related to oncological disease. Treatment of cancer pain consists of pain relief and maintaining the maximum functioning of the patient. The prognosis for life expectancy is related to the need of a comprehensive palliative approach. A chronic painful condition indicates patient admittance to a ward specialising in pain treatment. *Research and pain therapy centres and outpatient facilities* provide comprehensive algesiological care.

Assessment of pain relief

- From a nursing point of view, it is also important to assess the effectiveness of the treatment, e.g. using a pain relief scale. The nurse checks the analgesic effect of the treatment. If the pain persists after intervention and does not drop below VAS 3 or down to the specified value according to the assessment scale, the nurse must inform the attending doctor.
- The following degrees can be deduced on a scale assessing pain relief: 0 no, 1 small, 2 moderate, 3 significant, 4 total (relief).

The approach of the healthcare professionals can substantially affect pain relief. A kind and professional approach reduces the feeling of pain in the patient (see the psychotherapeutic effect of a good relationship between a healthcare professional and patient). Soreness of every treatment or diagnostic procedure is more tolerable if the patient is informed of the reason, the course and the stages of the procedure and recovery. The pain is treated by pharmacological and non-pharmacological means.

Non-pharmacological treatment of pain

Non-pharmacological methods include rehabilitation and psychological approaches.

Rehabilitation

The rehabilitation procedures related to nursing include for example, physical therapy, positioning of the whole or parts of the body, etc.

Physical therapy relieves the pain, reduces muscle spasms, induces relaxation and reduces inflammation.

The means of physical therapy include:

- Hydrotherapy
- Heat therapy
- Cryotherapy (cold therapy)
- Exercise
    - *Hydrotherapy* uses the healing effects of water which relieves pain, soothes, provides support for the musculoskeletal system and floats the submerged parts of the body. Immersion reduces strain on various parts of the body, especially the joints, muscles and other connective tissues. Depending on the patient's problem, the beneficial effects of hot, warm or cold water in the liquid, solid (ice) or a vapour form are used. Hydrotherapy is often used in the treatment and first aid of burns.
    - *Heat therapy* uses the application of dry or wet heat to relieve pain and muscle spasms, to relieve stiffness, improve circulation and increase the pain threshold. The therapy utilizes the effect of heat on the human body (increase of blood flow, metabolism in the tissues and decrease of vasomotor tone). Heat produces analgesia by affecting free nerve endings.
    - Localized heating (heat applied to certain parts of the body) may bring immediate pain relief, but often only temporarily.
    - *Cryotherapy (cold therapy)* uses the effects of cold on the human body. In addition to reducing fever, the therapy may also reduce pain, swelling, blood flow at the site of application, reduce bleeding or minimize bruising. It is used in acute pain caused by e.g. sport (muscle strain), also in pain caused by acute trauma, joint pain, headaches, muscle spasms. Cryotherapy (cold therapy) uses cold wraps, gel bags, ice massage - (see Chapter 6.2 Hot and cold therapy
    - *Exercise*
    - A lack of exercise, as a lifestyle choice, is often a source of pain, e.g. in the musculoskeletal system. Therefore treatment is often accompanied by exercise, i.e. therapeutic sport activity as part of the rehabilitation. Exercise helps to overcome the depression that often accompanies chronic pain. Exercise helps to release endorphins, dynorphins and enkephalins, i.e. endogenous opioids. Exercise improves overall fitness and performance (see chapter 6. Mobility and immobility).

Three basic types of exercise for the treatment of pain in the musculoskeletal system:

- Type : Exercises to maintain the range of motion in joints – stretching
- Patients should exercise 2-4 times a day, repeating each type of exercise 3-10 times
- Type: Exercise to prevent mass muscle loss – fitness exercise
- Type: Aerobic exercise – strengthens the muscles, increases flexibility and the hearts ability to supply muscles with blood (swimming, walking and cycling, dance etc.) (Rokyta et al., 2009)

Rehabilitation procedures support the body's ability to resist the pain and are part of a comprehensive approach to treatment and prevention of pain. Complex therapy includes important changes in the body position - positioning.

Psychological methods used to reduce pain

A psychological approach has an effect on the fear, anxiety and helplessness of the patient and thus affects the perception of pain. Methods of supportive psychotherapy help to relieve stress, improve moods, aid sleep and the patient may feel that they have the pain under control. It is appropriate that each patient with chronic pain is examined by a psychologist and psychiatrist to ensure comprehensive care. (Rokyta et al., 2009)

The selected techniques that can help to manage pain include:

- *Placebo effect*
- *Suggestion*
- *Hypnosis*
- *Relaxation*
- *Biofeedback (BFB)*
- *Psychotherapeutic effects of a good relationship between the health professional and the patient,* and others.
- *Placebo effect* uses the patient's expectation that they have received an effective cure. The effect is also related to strengthening the patient's belief in the effectiveness of the cure and that the therapist believes in the effect of their technique.
- *Suggestion* i.e. induced certain ideas, thoughts, approaches, beliefs etc. Autosuggestion – the process by which a person induces self-acceptance of an opinion, or belief; heterosuggestion is a suggestion from a source outside an individual's mind The method of communication between the patient, therapist and nurse, and the suggestive influence of the staff can all have a positive effect in relieving pain.
- *Hypnosis* is a state of mind similar to sleep, artificially induced, where the human mind responds to external suggestive stimuli. Chronic pain can be relieved through hypnosis and reduce analgesic doses. It is used to release psychogenic pain, headaches, toothaches, after burns or in oncological patients.
- *Relaxation* means deprivation of tension, easing, calming. The most frequently used relaxation techniques are Schultz's autogenic training, Jacobson's progressive relaxation and meditative techniques. Relaxation methods have been successfully used in hypertension, stomach problems, chronic headaches and vertebrogenic pain syndrome.

- *Biofeedback* (BFB) is used by specialized departments.
- *Psychotherapeutic effects of a good relationship* between the health professional and the patient are well known. Pain affects *awareness*. If the patient does not know what to expect, they may feel anxiety and fear. Negative emotions increase pain, therefore we strive for a positive relationship between the patient – nurse (doctor), which has a significant influence on the perception of pain. An example of a positive relationship is *compliance* – a harmonious relationship and mutual understanding. The patient's pain reduces *empathy, haptics* (hand shaking, stroking etc.), *suggestive effect, strengthens the patients own activity* (encouragement, praise, evaluation behaviour) willingness to listen, acceptance of the patient and others.

Other non-pharmacological approaches to pain treatment:

- *Local electroanalgesia* uses electricity to ease pain; an electrical device with a frequency from 2 to 200 Hz and an amplitude of 0-20 mA. Electroanalgesia is used in trigeminal neuralgia and phantom pain.
- *Acupuncture and acupressure* are methods that use reflective irritation of certain points on the body. Acupuncture uses special needles for stimulation or electro-stimulation. Stimulation of acupuncture points increases the secretion of endorphins and increases the pain threshold. Acupuncture also induces the balance of autonomic nerves.
- *Alternative (additional) therapy* can relieve some types of pain with unclear causes that do not respond to traditional methods, e.g. chronic back pain.
- *Aromatherapy* is used in headaches, muscle pains, arthritis, herpes and premenstrual problems.
- *Music therapy* uses rhythmic sound for relaxation, a relaxed feeling. Music therapy can have different forms (listening to or writing music, singing, dancing and imagination exercises). It is used by various healthcare facilities - hospitals, mental health centres, psychiatric clinics, after-care centres, hospices, etc.
- *Massage* is the manipulation of superficial and deeper layers of muscle with a therapeutic effect. Therapeutic massage is mainly used for stress reduction and relaxation. Massage can positively affect many problems, such as muscle spasms, headaches, arthritic joints, back and shoulder pain etc. Massage can also work on scars that may be causing pain.

Experiencing pain is also influenced by the following factors:

- Physiological and biological (age, pain physiology, developmental factors, illness)
- Psycho-spiritual (personality, mood, positive and negative feelings, fear, anxiety, hostility, frustration, etc.)
- Socio-cultural (education, social dependency, loneliness, ethnographic influences, social and family status)
- Environment (cold, heat, ultraviolet or infra-red radiation)

Some specifics in relation to pain:

- Age specifics, e.g. babies respond to pain better when they are with a parent or someone close
- Gender, e.g. girls are able to express pain more openly than boys (men don't cry)
- Social factors, e.g. presence of another person can change the patient's reaction to pain

Pharmacological treatment of pain

- Pharmacotherapy of pain is based on a three-degree scheme according to the WHO:
- Degree: *Administering non-opioid analgesics*
- Analgesic-antipyretics
- Non-steroidal anti-inflammatory drugs
- Adjuvant drugs from other drug groups
- If pain persists or intensifies:
    - Degree: Mild opioid analgesics
    - Adjuvant drugs
    - Non-opioid analgesics
- If pain persists or intensifies:
    - Degree: Strong opioid analgesics
    - Adjuvant drugs
    - Non-opioid analgesics
    - Mild opioid analgesics

Pain treatment departments

- If the pain cannot be treated using standard medical methods, the situation can be consulted in specialized departments of the hospital or according to usual practice
- Outpatient pain treatment
- Centre for treatment and research of painful conditions

Patient interview procedure – pain anamnesis

- Questions that help to assess the patient's pain:
- Where does it hurt? (Localization)
- On the scale 0-10, how would you determine the level of your pain? (Intensity)
- How would you describe the pain (stabbing, burning, biting, blunt or jabbing)? (Type of pain)
- When did it start to hurt? How long has it been hurting? How long are the periods without pain? (Time course of the pain)

- What causes the pain to start? What is the worsening of pain related to? (Precipitating factors)
- What painkillers have you been taking? What helps you to ease the pain? (Factors to ease the pain)
- Further questions given to the patient:
    - Associated symptoms (nausea, dizziness, etc.)
    - How does the pain affect the patient's daily activity
    - Past experience with pain and painkillers
    - Activities carried out by the patient to ease the pain
    - Feelings that are provoked by pain – fear, anxiety, fatigue, etc.

Principles of the doctor's (nurse's) behaviour when dealing with a patient in pain:

- Observation of the patient's non-verbal cues.
- The patient is informed before a painful procedure what to expect (pushing, pulling, pinching), where and for how long.
- Before a painful procedure, agree with the patient how they should indicate (verbally, non-verbally) that the pain exceeded the acceptable limit.
- Do not trivialize ("it's nothing").
- Do not rush if the patient tries to tell you that something hurts them.
- Do not call the patient a "hypochondriac", a "wimp" or "hysterical" etc.
- When dealing with a patient come across as confident.
- Accept the patient and support their own initiative in overcoming the pain (coping).

Procedure risks

- Electroanalgesia must not be used in patients with pacemakers.
- Parenterally administered drugs are absorbed faster than orally administered drugs. Therefore it is necessary to act very responsibly when preparing and administering parenteral drugs prescribed by a doctor. The administering method must be strictly adhered to as confusion could put the patient's life at risk. Parenteral administration of a drug requires theoretical knowledge, manual dexterity and adherence to aseptic procedures.
- When administering a drug by injection, the following principles must be adhered to.
- Always conduct a triple drug check.

Complications and prevention

- Treatment of pain is aimed at eliminating or reducing the pain in the patient, while it is important to minimize the side effects of such treatment. Risks associated with administration of analgesics – see pharmacology.

- The most commonly reported side effects of analgesics are nausea, vomiting, constipation, allergies, risk of fall and others.
- Prevention – e.g. administration of antiemetics, laxatives etc.

Control questions

- What scales of pain intensity assessment do you know?
- How would you ask to determine the intensity, location and type of pain that the patient is in?
- What non-pharmacological approaches to pain treatment do you know?
- Describe the three-degree scheme of pain treatment by pharmacological means according to the WHO.
- What are the side effects of pain treatment using pharmacological means?
- Provide the analgesic effects of hot and Cryotherapy (cold therapy).
- What is the procedure when interviewing a patient to determine pain anamnesis?

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Odborná směrnice č. IIOS_3/2007-3 Hodnocení a léčba bolesti ve Fakultní nemocnici v Motole

List of Figures:

Keywords:
Pain
Pharmacological treatment of pain
Non-pharmacological treatment of pain
Nociception

16. ADMINISTERING OXYGEN TREATMENT

Objectives:

After studying this chapter, you should be able to:

- Describe the basic principles of oxygen administration on a standard hospital ward;
- Define the basic terms: Oxygen therapy, hypoxia, hypoxemia etc.;
- Explain the causes and symptoms of hypoxia;
- Describe the principles of oxygen administration;
- List safety precautions when administering oxygen;
- Describe the methods of oxygen distribution on the ward;
- List the most commonly used oxygen applicators;
- Explain the term and indication of long-term home oxygen therapy (LTOT);
- Clarify the specifics of oxygen administration at hyperbaric oxygen therapy (HBOT).

Purpose

Oxygen is administered for therapeutic purposes in its deficiency in the body. The lack of oxygen in the body or body part is referred to as ***hypoxia***; low partial pressure in arterial blood is referred to as ***hypoxemia.*** The oxygen supply in the body is negligible and in particular, the brain is totally dependent on oxygen. The anaerobic metabolism is limited so it is essential to ensure a supply of oxygen in acute situations, such as in the context of cardiopulmonary resuscitation.

Theoretical notes

Oxygen (oxygenium) – is a colourless, tasteless and odourless gas. It is a biogenic element, essential for the human body to obtain energy (burning nutrients, aerobic metabolism and respiratory chain).

Lack of oxygen in the body can be caused by:

- Damage to the CNS (impaired blood supply, trauma, tumour, poison)
- Acute and chronic bronchitis and pulmonary tissues
- Obstruction (occlusion) of the airways (such as by a foreign body)
- Anaemia
- Haemoglobin inability to bind oxygen (due to saturation of haemoglobin with other gases, e.g. carbon monoxide, when a carboxyhemoglobin complex is formed)
- Lack of oxygen in the air (mines, fire, high altitude, etc.)
- Insufficient blood circulation, or sudden cardiac arrest (SCA)

Lack of oxygen is indicated by:

- Tachycardia, tachypnea, dyspnea (shortness of breath), shallow breathing
- Disorientation, restlessness, dizziness
- Retraction of the substernal or intercostal space; in children often in combination with flared nostrils in strenuous breathing
- Cyanosis
- The most important manifestation of a lack of oxygen in the body is ***shortness of breath*** – an unpleasant (subjective) feeling of difficult and laboured breathing and lack of air. It occurs during an imbalance between the demands of the body and the actual oxygen supply to the body. Shortness of breath can be acute and chronic. Acute shortness of breath occurs suddenly or within hours, not longer than for a few days. It is a symptom of an acute condition such as myocardial infarction, pneumothorax, pulmonary embolism, aspiration of a foreign body, left-sided heart failure, pneumonia, poisoning, acidosis and hypoventilation syndrome. Chronic shortness of breath may be stationary or it may progress slowly over months to years, e.g. Asthma, COPD and cardiac decompensation.

Oxygen therapy – is often part of the medical treatment and nursing procedures. A prerequisite for successful oxygen therapy is functional breathing. Breathing may be affected by circulatory problems, hematologic and metabolic systems.

Oxygen therapy is prescribed by a doctor who determines the *oxygen concentration (FiO2)*, method of administration and oxygen flow (litres/minutes). The nurse initiates oxygen therapy for acute conditions such as: Cardiopulmonary resuscitation, acute myocardial infarction, shock, polytrauma.

Reference values of saturation (SpO2):

- Normal values: 99% (100%) - 94%
- Slight decrease: 90 - 93%
- Significant decrease: Below 90%
- The doctor must be informed in the event of the saturation value decreasing below 90%

Indications for oxygen therapy:

- Cardiopulmonary resuscitation
- Respiratory insufficiency, chronic obstructive pulmonary disease (COPD)
- Bronchopneumonia, chronic bronchitis
- Acute myocardial infarction
- Atelectasis
- Thromboembolism of the pulmonary vascular bed
- Severe trauma, non-traumatic pneumothorax
- Increased respiratory effort during exacerbation of bronchial asthma, in airway stenoses

- Shock state
- Sepsis
- Severe anaemia and a severe blockade of haemoglobin – dyshemoglobinemia (caused by carbon monoxide poisoning, nitrite, etc.)
- Surgery under general anesthesia and immediate postoperative period
- Foetal distress during labour

Safety precaution during administering and handling oxygen

- Avoid contact with a naked flame
- Do not smoke
- Minimize static sparks
- Do not use oil or alcohol-based hygienic products (greasy hand cream)
- Familiarize yourself with the location and use of fire extinguishers

Principles of administering oxygen

- Observe the oxygen concentration prescribed by a doctor.
- Only *humidified* oxygen is administered in oxygen therapy.
- The oxygen should always be *humidified and heated* when making the airways viable.
- **Note:** 100% oxygen can only be administered for the necessary period.
- *Cold/unheated* gas mixture is *strictly* administered in the early stage after extubation or in acute respiratory difficulty – laryngitis (in non-intubated patients)

Positions to make breathing easier (see Positions of patients)

- *Fowler's position* – provides optimal ventilation of the lungs. The patient is in a semi-sitting or sitting position on the bed with back and feet supported.
- *Orthopneic* position – increases the vital capacity of the lungs, improves ventilation, the patient may engage auxiliary respiratory muscles. The patient sits in the armchair or on the chair with their arms resting on the headboard, desk or table.

Methods of administering oxygen to the patient:

- *Central distribution of medical gases*
- *Via pressure (oxygen) cylinders*
- *Via cylinders with an integrated valve (aka LIV cylinders)*
- *Liquid oxygen system*
- *Oxygen concentrator*

The ***central distribution*** is currently the most common method of oxygen distribution in hospitals. Oxygen is distributed to the patient's bedside from the oxygen station in the hospital outside the ward.

Oxygen is under constant (permanently monitored) pressure, distributed to the patient rooms via a panel with a main shut-off valve and fast coupling, (see Fig. 16-1), which enables the oxygen flow-meter to be connected. The oxygen supply to the patient is controlled using a pressure reducing valve, which can also include a simple flow nebulizer to humidify oxygen. The humidifier is filled with distilled water in the range between the minimum and maximum indicated on the container at the bottom of the flow-meter (see Fig. 16-2).

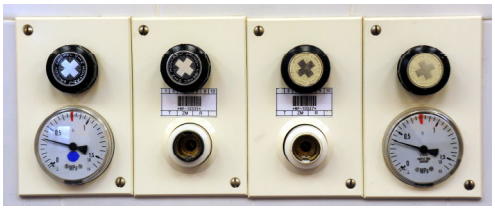

Fig. 16-1 Central oxygen distribution panel

(The main shut-off valve is indicated by a white centre – on the right)

Fig. 16-2: Flow-meter with a simple flow nebulizer filled with distilled water

To transport a *patient with oxygen therapy*, a mobile source of oxygen is required, usually a LIV 2 l cylinder with integrated valve (see Fig. 16-3). The cylinder must be secured against falls, attached to the transport port. It is used for short transport (e.g. for examination, to the operating theatre, etc.).

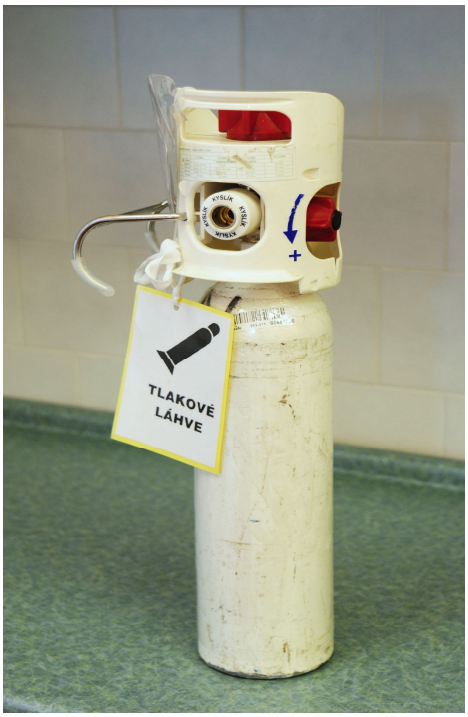

Fig. 16-3: Oxygen cylinder with integrated valve (LIV)

Pressure (oxygen) cylinders are used on the standard wards of large hospitals more frequently as a backup source during failure of the central oxygen distribution system. They are thick-walled metal cylinders for storing medical gases.

Safety precautions for administering oxygen from pressure cylinders:

- The gas cylinders must be:
  - Safely stored (at least 1.5 m from the source of heat)
  - Secured against falls
  - Out of contact with direct sunlight and fire
  - Duly marked empty cylinders are replaced with a full one in a designated room
  - Ordered based on documentation – exchange of empty cylinders for full
  - Sufficiently filled
  - Stored only in a limited quantity and according to the directive
  - Storage rooms must be marked on the door stating the number of cylinders and the type of media.

Safer than the pressure (oxygen) cylinders is the ***liquid oxygen system***. This is used for oxygen therapy in both hospitals and home care. The liquid oxygen is filled into a stationary container. A portable tank filled from the stationary container is used when transporting the patient, see Fig. 16-4.

Fig. 16-4: Liquid oxygen – filling a portable tank from a stationary container

Oxygen concentrators are primarily designed for home care oxygen therapy. The device receives oxygen from the surrounding air from which it is sucked and filtered (see Fig. 16-5).

Fig. 16-5: An oxygen concentrator suitable for use in a home environment

Long-term home oxygen therapy (LTOT)

Portable oxygen concentrators or liquid oxygen systems are used for long-term home oxygen therapy.

Indications for long-term home oxygen therapy:

- Chronic respiratory disease (chronic obstructive pulmonary disease, cystic fibrosis, heart rhythm disorders associated with arterial hypoxemia, condition after pulmonary embolism, etc.).
- The nurse educates the patient and family before discharge into home care on the safe operation of the device (highlighting the risk of fire, burns). The nurse explains to the patient the care of the airways and the aids. Provides the patient with a telephone contact for consultation.

Hyperbaric oxygen therapy (hyperbaroxy – HBO)

This is a method of administering oxygen under increased atmospheric pressure. The treatment increases blood oxygenation. In the HBO, the inhaled oxygen concentration reaches 100%, i.e. 5x higher than in the air. In practical terms, this is administered by the *hyperbaric chambers*.

Currently, there are two types of *hyperbaric chambers*:

- *Single* (for one patient) – these are usually filled with pressurized oxygen which the patient breathes directly.
- *Multi-seat* (for 2 to 16 seated patients) – these are supplied with pressurized air and the patient breathes through a special device (a ventilator or oxygen helmet). The multi-seat chambers mostly have a cylindrical shape.

The most modern chambers are rectangular shaped (like a room); the equipment is *identical with the bed equipment at the ICU* for treating critically ill patients.

The most commonly used pressure in treatment is *2.5 to 3 times* greater than atmospheric pressure, a pressure corresponding to an immersion depth of 15 meters below the water surface. The time to achieve the desired pressure is 10 – 15 minutes. The time for decompression, i.e. reducing the pressure after treatment is between 10 – 15 min. One session usually lasts 90 minutes.

Oxygen applicators

In order to maintain spontaneous breathing activity, non-invasive methods of oxygen administration are used.

- *Oxygen mask* (see Fig. 16-7, 16-8, 16-9) – snugly fits over the nose and mouth of the patient. Depending on the type of mask, the oxygen concentration that can be administered is FiO 30 – 60% at a flow rate of 5 – 8 litres of oxygen per minute. When using a mask without rebreathing, the administered oxygen concentration can be FiO2 80 – 100% at a flow rate of 10 – 15 litres/min. The advantage of the oxygen mask is the relatively precise control of the amount of oxygen administered, allowing greater FiO2 than in an oxygen nasal cannula. It is used in conscious patients, who generally breathe in dyspnea through their mouth. It is made of plastic and fastened around the head with a

rubber band. Some patients cannot tolerate an oxygen mask, because they cannot speak, eat or drink. Another disadvantage of the mask is the risk of pressure sores. Administering oxygen through the mask increases the risk of aspiration and rebreathing carbon dioxide.

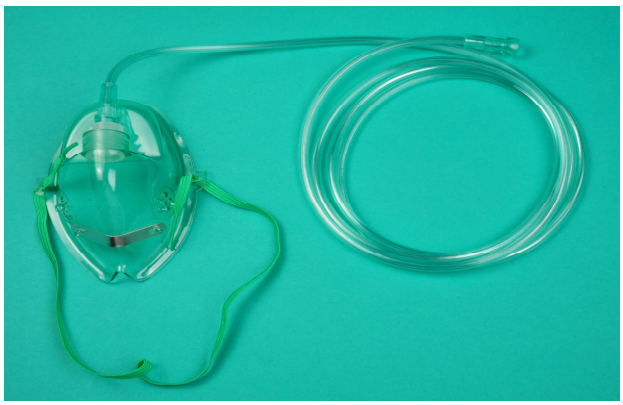

Fig. 16-7: Simple oxygen mask

Fig. 16-8: Oxygen mask suitable for intensive care

Fig. 16-9: Oxygen mask with nebulizer

Oxygen nasal cannula (see Fig. 16-10) – the most commonly used applicator, well tolerated by patients. It consists of a rubber or plastic tube with two lugs which are inserted into the

nostrils. The ability of the oxygen concentration is 24 – 45% depending on the set flow rate of 2 – 6 litres per minute. The drawback of this system is difficult dispensability of the fed oxygen.

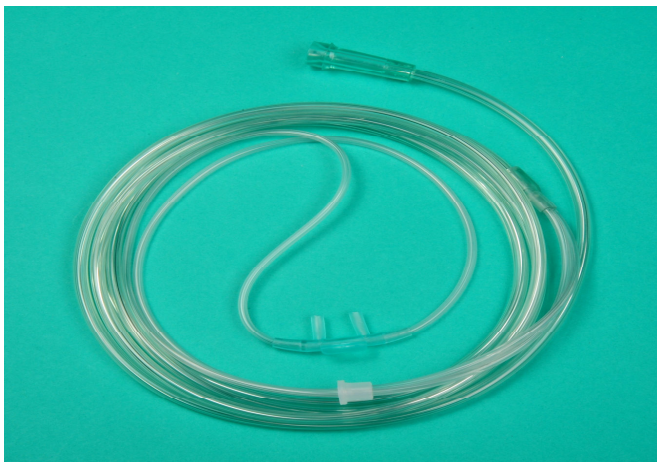

Fig. 16-10: Nasal cannula

Nasopharyngeal catheter – Nelaton catheter with holes at the end.

Venturi mask – allows precise dosing of oxygen. It is a high flow rate system allowing a concentration of 24-60%.

Incubator – allows maintaining the required temperature, humidity and oxygen concentration in premature newborns.

Oxygen case – requires a large flow of oxygen (8 – 10 litres/min.) and reaches a maximum of 40% oxygen concentration. The operation of the case is noisy and does not provide sufficient gas exchange.

Hyperbaric chamber

Artificial lung ventilation (ALV)

Patient preparation

Before administering the oxygen, the nurse monitors:

- Overall mental and physical condition of the patient
- Breathing of the patient - assesses the frequency, rhythm, depth and accompanying sound phenomena, (stridor, crackles, wheezing, snoring, loud breathing, the involvement of the intercostal muscles)
- Dyspnea – if the patient suffers from the disease
- Cyanotic skin coloration – if present (central or peripheral)
- Other physiological functions (PF) – as prescribed by a doctor
- O2 (SpO2) saturation – pulse oximeter is used to measure SpO2 (see Fig. 16-6)

Fig. 16-6: SpO2 and pulse measuring with pulse oximeter

Nursing:

- Ensure the patient has clear airways
- Phlegm suction – nostrils cleaning
- Invasive procedure – sterile suction from the lower respiratory tract
- Non-sterile suction is possible using a Trach Care closed suction catheter
- Inform the patient of the need and importance of oxygen therapy
- Explain the safety rules
- Help the patient into Fowlers position or another comfortable position
- Familiarize the patient with a suitable type of applicator
- Check the functionality of the system (sufficiently tight joints, filling of the nebulizer with distilled water, check that the oxygen cylinders are adequately filled)

Preparation of aids

The aids needed for administering oxygen while maintaining spontaneous breathing include:

- Oxygen source (usually the central distribution system)
- Oxygen flow-meter with integrated pressure reducing valve (when administering from the central distribution system)
- Reduction valve (when administering from the pressure cylinder) and flow-meter
- Oxygen tubing (connecting tubing)
- Oxygen applicator (e.g. oxygen nasal cannula, oxygen mask)
- Flow nebulizer, humidifier (may be included with the flow-meter)
- Aqua pro injectione or distilled water (for humidification of oxygen)
- Nursing documentation

Working procedure for administering oxygen via the central distribution system

- The nurse checks the *oxygen concentration, method of administration and flow rate* (l/min), as per the doctors instructions
- *Preparation of humidifier* – filling the container with an adequate volume of distilled water and connecting to the bottom part of the flow-meter
- Connection of the tube for oxygen humidifying
- Joining the connecting tubing of the suitable applicator with a humidifier
- Connection of the flow-meter to the panel with the wall mounted central oxygen distribution via a fast coupling with a firm push
- Adjustment of the oxygen flow rate (l/min.) as prescribed by a doctor
- *Check of the system passability*, i.e. the oxygen flow to the patients airways, (if the oxygen flows through water, it forms bubbles in the humidifier). The nurse also checks the end of the tubing for the oxygen flow
- The nurse shows the patient the appropriate type of applicator (helps the patient to use it and to get used to its peculiarities, e.g. oxygen masks – simultaneously covers the nose and mouth). The nurse educates the patient to breathe normally.
- If necessary, it is advisable to adjust the applicator to achieve the desired effect – snug fitting, sealed and avoiding skin irritation where the applicator rests on the skin (e.g. with gauze squares).
- *During oxygen therapy, the nurse regularly monitors the patient's:*
  - Overall condition and records changes in the documentation
  - Skin and mucous membrane colour
  - Physiological functions
  - Breathing (if the patient suffers from dyspnea), the nurse identifies the strain at which it worsens and how quickly after administering oxygen or after increasing the oxygen concentration the breath shortness fades, etc.
  - SpO2 using pulse oximetry – monitors symptoms of hypoxia or signs of an oxygen overdose
  - Clinical sings of hypoxemia – the nurse takes blood for blood gas analysis (ASTRUP)
  - Possible unrest of the patient
- After the oxygen therapy, the nurse records the relevant data into the patient’s medical records (details of the oxygen administration, the values of vital signs and the results of the patient observation).

Care of aids

The aids are decontaminated after completing the oxygen therapy. The humidifier, nebulizer, flow-meter and fast coupling and other equipment intended for repeated use are decontaminated according to standards – hospital disinfecting programme. Applicators and the connecting tubing are usually intended for single use – the nurse puts them into the recycle waste.

Complications and prevention

Long-term administration of oxygen which was not humidified can cause:

- *Dryness of mucous membranes in the respiratory tract*
- *Subsequent bleeding of the mucous membranes in the respiratory tract*
- *Crusting*
- *Inflammation*

Prevention is the administration of humidified oxygen.

A complication during administration of 100% oxygen is oxygen toxicity which can cause:

- *Damage to the lungs (atelectasis formation)*
- *CNS damage*
  - Symptoms: Headache, burning behind the breastbone, nausea, confusion, agitation, spasms.

In preterm infants, oxygen therapy can cause eye damage which is called *retrolental fibroplasias.*

- Prevention: 100% oxygen can only be administered for the necessary period.
- Administration of a higher oxygen concentration than the patient needs may increase pCO2

Insertion of a nasal catheter, endotracheal cannula can cause:

- Mucosal injury
- Introduction of an infection

Procedure risks

- Failure to observe the safety precautions when handling oxygen may result in the ignition of the gas and burns to the skin and mucous membranes
- Failure when administering liquid oxygen can cause frostbite

Additional task

- Study the anatomy of the respiratory tract
- Practice administering oxygen to the patient on the standard hospital ward
- Find out what are the indications for hyperbaroxy

Control questions

- How is the patient assessed before administering oxygen?
- What information is given to the patient before oxygen therapy?
- Name two oxygen applicators used on a standard hospital ward for patients who can breathe spontaneously.
- What data is recorded during oxygen therapy in the nursing documentation?
- How many breaths per minute are there with tachypnea?
- What is a lack of oxygen in arterial blood called?
- What is a lack of oxygen in the tissue called?
- Name two positions, which make breathing easier.
- Select from the following options, the normal SaO2 values:
  - 90 – 93 %
  - 94 – 99 (100) %
  - 85 – 92 %
- How is oxygen modified which is to be administered for more than two hours?
- What is the purpose of a nebulizer?
- What risks and complications in oxygen therapy do you know?

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List of Figures:

Keywords:

Administering oxygen
Hypoxia
Hypoxemia
Oxygen
Oxygen therapy

17. PATIENT NUTRITION

Objective

After studying this chapter, you should be able to:

- Justify the principles of serving food to patients;
- Explain the importance of individual food components;
- Serve food in different ways;
- Demonstrate this procedure using a model or simulator in the laboratory and later in clinical practice;
- Assess the risks of potential complications.

Purpose

- Influences adverse pathological conditions;
- Therapeutic effect of food;
- Replaces substances missing in the body;
- Supports patient recovery.

Theoretical notes

The basic diet components are water, carbohydrates, proteins, fats, vitamins and minerals.

Sugars (carbohydrates) – consist of three elements – carbon, hydrogen and oxygen. Simple monosaccharides (glucose, fructose and galactose), oligosaccharides, are distinguished which also include disaccharides (sucrose, maltose, lactose), polysaccharides (starch, cellulose etc.) and complex carbohydrates, which also contain protein or fat. Sugar alcohols (polyols) are also carbohydrates.

Fibre – is predominantly vegetable polysaccharide which is not dissolve by the enzymes in the digestive tract. Fibre cannot be digested and is a large food component. The end product of carbohydrate digestion is monosaccharide. The key enzymes necessary for the digestion of carbohydrates include ptyalin, pancreatic amylase, disaccharides (lactase, sucrose, maltase…). In a healthy person, almost all digested carbohydrates are absorbed in the small intestine, of which 89% are in the form of glucose. Glucose is a basic carbohydrate of the body's metabolic reactions. The lack of glucose, as well as the lack of oxygen, causes brain damage and subsequent death. Some other organs are dependent on a continuous supply of glucose. The transport of glucose across cell membranes is increased by insulin – a pancreas hormone. In the absence of insulin, the amount of glucose that diffuses into cells is much less than the amount needed to satisfy the energy supply. Glucose metabolism is therefore affected by insulin production in the pancreas. Glucose received from food is either used immediately by the body, or the excess is stored into glycogen, or it is further metabolized into the fat stores of the body. Liver glycogen creates a glucose reserve, which is continuously released during the time without intake. The process of the formation of glycogen is called glycogenesis; the process of splitting glycogen back into glucose is glycogenolysis. Glycogenolysis is activated by two hormones, glucagon (from the alpha cells of the pancreas) and adrenaline (from the

adrenal medulla). Excretion of glycogen occurs when the blood glucose concentration drops to a low value. Adrenalin is released during sympathetic stimulation. (For more see: Kozierová et al, 2005, p. 987-989)

Proteins– are organic substances which are transformed by hydrolysis or digestion into amino acids. Proteins consist of hydrogen, carbon, oxygen and nitrogen. Proteins are the structural components of cells and tissues, and have a number of specific biological functions. This includes processes such as neurotransmission, movement, transport of metabolites and many more. According to the chemical structure, proteins can be divided into simple and compounds. Simple proteins (e.g., lactalbumin, serum albumin and creatinine) are composed of amino acids or their derivatives. Compound protein (e.g. haemoglobin, mucin) consists of a single protein and non-protein component. Another division is that of amino acids into essential and nonessential. The body is unable to create essential amino acids (such as lucine, phenylalanine, and five more, in children six more) as part of the metabolic process and so it must obtain it from the protein received that is contained in our diet. Our body obtains and also produces non-essential amino acids from food. The non-essential amino acids are glycine, aspartic acid, alanine, tyrosine, glutamic acid etc. The amino acids are absorbed from the intestine and enter the portal circulation. Upon entry into cells, and with the effect of intracellular enzymes, they are involved in metabolic processes. The distribution of amino acids is regulated by certain hormones such as insulin, growth hormone, glucocorticoid, thyroxine and others. Plasma proteins (albumins, globulins and fibrinogen) are formed in the liver and rapidly replenish tissue protein.

Fats (lipids) – are organic substances which are insoluble in water. They are formed from the same elements as carbohydrates, but have higher hydrogen content. The basic building block for fats is fatty acids. Fatty acids are either saturated or unsaturated. Saturated fatty acids are mainly present in fats of an animal origin. The natural sources of unsaturated fatty acids are usually oils, as well as fish. Trans fatty acids, which are formed by hydrogenation of unsaturated fatty acids are unfavourable to the body. Fats are also chemically divided into several different groups. Most of the fats consist of triglycerides contained in food, but also important for the body are the phospholipids or the lipoproteins, glycolipids found in blood etc. Cholesterol accompanies fats but belongs to a different chemical group.

The fats are primarily digested in the small intestine. The enzymes cleaving the fats include lipase, produced in the pancreas. After absorption of the cleaved fats, these are involved in metabolism. They are deposited into fat reserves with an increased food intake. Fats are the most abundant source of energy and are vital components of nutrition.

Vitamins and minerals - fat-soluble vitamins include vitamins A, E, D and K. Water soluble vitamins include vitamin C and B complex, pantothenic acid and biotin. The most abundant mineral substances include calcium and phosphorus, which make up to 80% of the body mineral components. Other belonging to this group are sodium, potassium, magnesium, chloride and sulphur. The group of trace elements comprises of iron, zinc, manganese iodine, fluorine, copper, chromium, selenium, silicon and molybdenum. (For more see Kozierová, 2005, p 992-996)

Diet therapy – therapeutic nutrition is often part of patient treatment. Diet significantly affects human health. In some diseases, such as diabetes mellitus, peptic ulcer, hyperlipoproteinemia, diet alone has the function of one of the most important therapeutic factors. Food must be supplied to the body in sufficient quantities and in the right proportion to other nutrients. The energy obtained from food must meet the needs of a healthy or sick individual. The diet of a healthy person should contain approximately 15% protein, 30% fat and 55% carbohydrates. It is important to try to keep the diet biologically appropriate, containing proteins, fats,

carbohydrates, vitamins and minerals in the right proportion. Foods differ in their *nutritional value* (the content of nutrients in a given amount of food). Nutrients have three basic functions: To supply energy for the processes occurring in the body, to secure the building material for tissues and to regulate body processes. The amount of energy that the nutrients supply to the body represents their *energy content.* One calorie is a unit of heat energy.

Nutritional treatment consists of dietary measures that contribute to the influence of various pathological conditions. A diet prescribed by a doctor to a patient will have omitted or reduced nutrients, while others will be increased. In case where a medical condition requires a more complex nutritional approach, then consultation with a nutritional therapist is required. The diet regime has the same importance in the treatment of a disease as other parts of the treatment. The diet should be prescribed to each patient on an individual basis.

Meals for patients are provided by the department of medical nutrition and diet. Hospitals provide a *unified nutritional dietary system* (see Table 17-3) which can be modified according to the type and site of the medical facility. This depends on the nature of the diseases treated by the hospital. One of the most important requirements in compiling a hospital diet is the digestibility of food and the processing technology. From this aspect, the meals are classed into the following groups:

- Mechanical soft diet – these dishes have to be soft, with easy to digest components, therefore tougher food is minced, mixed and whipped.
- Chemically restricted diet – the diet excludes hot spices, aromatic food, meat broths, too sweet or sour foods, deep fried meals, alcohol, coffee and drinks with high levels of CO2.
- Diet stimulating appetite.

The meals are ordered according to the practice of the hospital ward. The meals are ordered by the head nurse who prepares a request form with the number and type of required meals which is then entered into the hospital central computer system. Changes in the number of meals and indicated diets must be reported in time throughout the day to the institutional kitchen. The meals are prepared according to the working procedures for the preparation of diet meals as well as under strict hygiene requirements. The preparation and quality of meals is supervised by a nutritional therapist.

The basic requirements for food transportation include:

- Hygienic food packaging;
- Simple and fast transport;
- Food temperature – in order to maintain the value which is reduced by reheating the meal.

Ready and cooked meals are served on individually numbered trays, depending on the diet. Preheated plates are inserted into the warmed packaging. Trays are stacked in special containers for transportation of meals. This transportation system is referred to as the diet tablet system. (See Fig. 17-1). The efficiency and success of a nutritional diet is the perfect preparation of the meal, including the temperature, tasteful serving and good time distribution.

Fig. 17-1: Hospital diet tablet system

Factors affecting patient nutrition

Factors affecting patient nutrition include:

- Individual medical condition – digestive disorders, surgery, disease processes – liver, pancreas or malignant diseases as well as insufficient dental and oral care etc.
- Mental condition – loss of appetite, stress, fear of disease, environment, separation from family, fear of the future, etc.
- Culture and religion – ethnicity sometimes determines favourite foods. There are differences in food preferences between cultures (e.g. Chinese, Japanese prefer rice, green tea, Vietnamese, Italians – pasta). Religion also influences the patient's diet and nutrition (e.g. Islam religion forbids the consumption of pork, Orthodox Jews must have their meals "kosher" – some foods are consumed only after they have been examined by a rabbi and prepared according to strict dietary rules).
- Social groups – differing by age, gender, interests, social status.
- Lifestyle and opinions on nutrition - following the fashion trends in nutrition.
- Effects of drugs – drugs can affect appetite, distort the perception of taste or interfere with the resorption of nutrients. Nutrients can also influence the utilization of medicinal substances, some may reduce drugs resorption but others may accelerate it (such as calcium in milk inhibits the resorption of tetracycline, but increases resorption of erythromycin; acetylsalicylic acid reduces the levels of folic acid in serum, increases excretion of vitamin C, thiamine, potassium (see more Kozierová , 1995. ECR 1005). Excessive alcohol consumption facilitates the development of nutritional deficiency.
- Personal preferences - everything a person likes and dislikes significantly affects eating habits. The popularity of certain foods is often transmitted from childhood to adulthood. Personal food preferences are significantly affected by some tastes, smell, type, character, temperature, colour, shape and size of meals.

Assessing the nutritional condition of the patient

One of the methods used to assess the nutritional condition of a patient is the "ABCD" method.

A (Anthropometry): Collection of anthropometric values that provide information about body size and composition. These include: height, weight, measurements of secondary non-dominant arm circumference, skin fold thickness measurements, BMI and other physical parameters and indexes. The above data is used to assess the current nutritional condition of the patient, body composition, compared with reference data from the rest of the population.

BMI (Body Mass Index) – indicates if the patient's weight is proportionate to their height. It is calculated according to the formula - *patient's weight (kg): height ^{2} (m)*. (See Table 17-1 and17-2). It is important to remember that a nutritional condition cannot be anthropometrically assessed from just single data – the weight of the person.

B (Biochemistry): Assessment of biochemical parameters – blood and urine samples, e.g.:

- Assessment of haemoglobin and hematocrit; increased hematocrit may be a sign of dehydration;
- Determination of the albumin level (forms more than 50% of the body protein, helps to maintain fluid and electrolyte levels) is an indicator of prolonged losses and a lack of protein;
- Total number of lymphocytes – decreases in the absence of protein, energy, in malnutrition;
- Detection of nitrogen balance – a patient in a catabolic state loses more nitrogen than they receive (this indicates an inadequate intake of protein containing nitrogen and increased degradation of body protein, which is a key indicator of protein malnutrition);
- Other parameters.

It is necessary to know the patient's clinical condition to be able to assess the biochemical findings. The values of some parameters are also changed in connection with an underlying disease in the patient and thus they may not be related to their nutritional condition.

C (Clinical parameters): Examination of the clinical parameters of the nutritional condition - nutrition affects most body systems; therefore, the examination may reveal nutritional problems. The assessment begins with a physical examination of the patient upon hospital admission. The patient's hair, skin, eyes, tongue, mucous membranes, muscles, overall vitality etc are assessed. (For more see Kozierová, 1995, p 1008)

D (Documentation): Obtaining nutritional history - see chapter - Documents upon admission, nursing anamnesis.

Patient malnutrition

Poor nutrition (malnutrition) brings a number of negative aspects for both treatment and further patient prognosis. It is reported that the frequency of complications of the disease in these patients is 27 % higher; the mortality of these patients is 12.4 % higher, hospitalization time is 7 – 13 days longer and the cost of treatment is 210% higher. According to

international studies, 40% of hospitalized patients and 40-80 % of institutionally treated elderly patients are at risk of malnutrition (for more see http://www.tensoval.cz/bmi.php).

Hospital patients with malnutrition should be identified early and provided with a sufficiently nutritional diet. For this purpose a nutritional risk score was created, which is stipulated by decree at the University Hospital in Motol. Every patient admitted to the hospital must be subjected to the nutritional risk score. If a risk is identified, a nutritional therapist is called in who will further assess the patient's nutritional condition and give further nutrition recommendations.

Tables used to assess the patient nutritional conditions (see Table 17-1, 17- 2)

TABLE OF IDEAL WEIGHT DEPENDING ON BODY TYPE							
Women				Men			
Body type				Body type			
height	Tall	medium	Small	**height**	Tall	medium	Small
147	47-54	44-49	42-45	**157**	57-64	54-59	51-55
150	48-56	45-50	43-46	**160**	59-66	55-60	52-56
152	50-58	46-51	44-47	**162**	60-67	56-62	54-57
155	51-59	47-53	45-49	**165**	61-69	58-63	55-59
157	52-60	49-54	46-50	**168**	63-71	59-65	56-60
160	54-61	50-56	48-51	**170**	65-73	61-67	58-62
162	55-63	51-57	49-53	**173**	67-75	63-69	60-64
165	57-65	53-59	51-54	**175**	69-77	65-71	62-66
168	58-66	55-61	52-56	**178**	71-79	66-73	64-68
170	60-68	56-63	54-58	**180**	72-81	68-75	66-70
173	62-70	58-65	56-60	**183**	75-84	70-77	67-72
175	64-72	60-67	57-61	**185**	76-86	72-80	69-74
178	66-74	62-69	59-64	**188**	79-88	74-82	71-76
180	67-76	64-71	61-66	**190**	80-91	76-84	73-78
183	70-79	66-72	63-67	**193**	83-93	78-86	75-80

Fig. 17-1: BMI index in men and women

BMI	Weight category	Health risk
18.5 or less	Underweight	Risk of anorexia
18.5 to 24.99	Normal weight	Minimal
25 to 29.99	Overweight	Medium high
30 to 34.99	1. degree obesity	High
35 to 39.99	2. degree obesity	High
40 or more	3. degree obesity	Very high

Fig. 17-2 : BMI index and evaluation (source: http://www.tensoval.cz/bmi.php)

HOSPITAL DIET SYSTEM			
0	Liquid diet	6,000 kJ	This is prescribed for a short period of time after oral cavity surgery, after tonsillectomy, with diseases, injuries and burns to the mouth, pharynx and gullet, with all changes cause narrowing of the gullet. Temporarily during severe febrile conditions or with some poisoning.
1	Mashed diet	11,000 kJ	After surgery of the digestive system after the first realimentation (mash, hash). For a longer period prescribed in severe, post-traumatic changes in the oral cavity (burns to the gullet, esophagitis, stenosis, achalasia and esophageal cancer). It is also suitable in the acute stage of painful ulceration of the stomach and duodenum.
2	Restricted diet	12,000 kJ	In digestive system disorders with a long course, which do not require changes in the energy supply or in the proportion of essential nutrients or any specific rules - gastric malfunction, secretion disorders, chronic gastritis, stomach ulcers, gallbladder chronic disease and duodenum chronic disease in the illness recuperation period. Also in febrile disease, conditions after myocardial infarction and conditions after the acute phase of infectious hepatitis or in chronic liver disease.
3	Rational diet	12,000 kJ	All diseases which do not require special modification of the diet.
4	Reduced fat diet	11,000 kJ	In gallbladder diseases after the acute stage resolution and in chronic disease of the gallbladder and pancreas. This diet regime is also prescribed for the transient time after gallbladder surgery and in the reduced functional ability of the pancreas. It is also indicated for a transient time in patients who suffered viral hepatitis. It is suitable for the period of subsiding dyspepsia, intestinal catarrh, unless accompanied by severe diarrhoea.
5	Non-residue protein diet	12,000 kJ	After acute diarrhoea and chronic diarrhoea diseases, such as irritable bowel syndrome, functional diarrhoea, chronic enteritis and ulcerative colitis in the stage of decompensation.
6	Low-protein diet	10,000 kJ	This diet is indicated for patients with renal disease, i.e. in acute disability and chronic kidney disease.
7	Low cholesterol diet	9,000 kJ	It is usually served for patients with hyperlipoproteinemia type IIa and IIb, with arteriosclerosis complications (conditions after

			myocardial infarction, cerebral vascular accident, with arteriosclerosis obliterans of peripheral vascular and in patients with a family history).
8	Reduction diet	6,000 kJ	In obese patients with hyperlipoproteinemia or diabetes, who need to lose weight (other sources state only 4000 kJ).
9	Diabetic diet	8,000 kJ	Suitable for most hospitalized diabetics. It is also served to patients with hyperlipoproteinemia type IV or III and V. The carbohydrate intake is prescribed by a doctor (150, 200, 250).
10	No salt diet	10,000 kJ	For patients with heart diseases and blood vessels decompensation and all diseases in which there is fluid retention. It is also suitable in pregnancy, for swellings and for some patients with high blood pressure.
11	Nutritional diet	14,000 kJ	In all diseases in which the patient must quickly gain physical strength and increase their body weight, unless a special diet is prescribed. Most often served during convalescence after infectious diseases, after some surgeries, pulmonary TB in the period of compensation, cancers during cytostatics therapy, radiation, X-ray or radio therapy.
12	Toddlers diet	8,000 kJ	For children from 1.5 to 3 years old.
13	Older children's diet	11,000 kJ	For children from 4 to 15 years old.
Special diets			
0S	Tea diet		The patient is only served tea on a teaspoon
1S	Liquid	12,000 kJ	Served where patients can only ingest food in liquid form, but it is also necessary to increase energy intake. To further increase the energy content, the diet can be supplemented with glucose or other drugs administered as an intravenous infusion.
2S	Minced		Condition where a patient cannot bite.
4S	Strict reduced fat diet	7,000 kJ	This diet is given to patients in the acute stage of infectious hepatitis, inflammation of the gallbladder, the first days after a gallstone attack, the first days after a cholecystectomy in patients with acute pancreatic necrosis in the first days after fasting. Suitable for patients in the acute period of myocardial infarction.
9S	Diabetic restricted	9,000 kJ	For diabetics with chronic disease of the digestive tract (peptic ulcer disease, gallbladder disease, liver, dyspeptic syndrome, chronic inflammation of the pancreas etc.)
9	Diabetic restricted,		In diabetic patients after myocardial infarction with

SK	minced		gallbladder and pancreas disease.
9 SN	Diabetic restricted and no salt diet		For diabetics with heart and blood vessel diseases
Standard dietary practices			
	Gluten-free diet		Served to child patients with celiac disease and to adult patients with sprue disease.
	Pancreatitis diet		This diet is prescribed after gradual realimentation (0S, dry mashed potato, 4S) possibly for dyspeptic syndrome or chronic pancreatitis.
	Chronic renal failure diet		Served if a patient is not included in the dialysis or transplantation programme.
	Lactose intolerance diet		For all conditions with a suspected lactose deficiency. Patients who are lactose intolerant and can only drink soy milk.
	Detecting occult bleeding diet		For detecting occult bleeding in the digestive tract. Served three days before the examination. Meals are free of foods affecting the colour of the stool.
	Schmidt diagnostic diet		Served three days before examination of the digestive tract. Endurance diet.
NP O	Nil per os		The patient must not eat or drink anything.
	Strict reduction diet	2,000 – 4,000kJ	Low calorie foods.
	Vanilmandelic diet		Served in order to determine vanilmandelic acid in the body.

Fig. 17-3: Unified nutritional dietary system

Clinical nutrition

Clinical nutrition is used if food intake is not possible or clinically insufficient. Clinical nutrition is exactly specified in its composition and it is intended for enteral or parenteral administration.

<u>*Sipping*</u> – drinking special nutritional products (Nutridrink, Fresubin, Cubison and others). Sipping usually supplements a normal patient diet.

<u>*Monitoring of fluid balance and food intake*</u>

Some patients need be monitored for daily fluid intake and urine output, i.e. monitoring the fluid balance. The findings are recorded in the daily report or on a separate form, depending on the ward standards. The record must be as accurate as possible, therefore it is necessary to know the content of glasses, cups, soup bowls etc. All fluids are recorded, including soup. The volume is recorded in ml for a fixed period of time (12 or 24 hrs). The total volume of ingested fluids is added up, as well as the total volume of urine and the resulting values are compared. Weakened, malnourished patients, suffering from a loss of appetite etc. have their daily food intake monitored. Patients suffering eating disorders are visited by a nutritional therapist, who assesses their current nutritional condition and after consultation with a doctor adjusts or adds any required food supplements to their diet. In addition to the patients at

nutritional risk, the nutritional therapist also addresses the current nutritional problems of other patients.

The administration of various therapeutic teas can be considered as a dietary supplement. Tea is prepared according to the instructions on the packaging. The most common method of tea preparation is decoction and infusion.

Decoction is prepared by pouring boiling water over dry crushed herbs and simmering for a while, then left to stand for few minutes to allow the herbs to drop to the bottom, strain and serve.

The infusion is prepared by pouring boiling water over a mixture of dried herbs, then cover with a lid and leave to infuse for about 15 minutes, then strain and serve.

The most frequently prepared is urology tea (the patient should drink the tea 1 - 21 times a day), gall tea (drunk hot, 3 times daily before meals), lung tea (drunk lukewarm, 3 times daily), laxative tea (1 cup of lukewarm tea in the evening), chamomile tea (served throughout the day).

General principles for serving food

Nutrition supplements the patient's treatment process. If indicated, the administration of food is as important as the administration of drugs!

- Each patient must receive their prescribed diet.
- Food must be warm enough and of adequate quality.
- Food should be served regularly, at a reasonable time, so as to maintain a reasonable interval between meals (breakfast 7.30 - 8.00 a.m., a morning snack at about 10.00, lunch at about 12.00, afternoon snack at 15.00, dinner 17.30 - 18.00).
- The patient must be provided with a sufficient amount of fluids.
- The nurse must wear a protective white coat, designated exclusively for serving food.
- The nurse must conduct thorough hand hygiene prior to serving meals!

Preparation of aids

Utensils for serving food are stored in the kitchen in each department. When using the tablet system, all the necessary utensils are ready on a tray. An integral part of the tables in the lounge are washable tablecloths, clean table settings, unobtrusive and reasonably tasteful decoration on each dinner table, the overall room decor includes pastel coloured walls. Part of a quality meal is also a regular check of the technical condition of the tables, chairs and dining tables.

When preparing to feed a bedridden, dependent patient, the following aids are required:

- Dining table;
- Tray with aesthetically served food, cutlery, glass, straw or tube to drink the liquid, napkins;
- Linen cloth to protect the patient's clothes;

- Kidney bowl for patients with dentures, rubber gloves for inserting/extracting dentures, tooth brush, tooth paste;
- For patients with oral cavity ulcers – aids for the treatment of the oral cavity (see the chapter on oral care).

Patient preparation

- Put the patient into the appropriate position, i.e. semi-sitting, a slightly raised back part of the bed – depending on the patient's health.
- The chosen position must be comfortable and pleasant for the patient.
- The nurse adjusts the linen cloth which is to protect the patient's clothes.
- Prepare the necessary aids within the patient's reach.
- If the patient does not have their dentures in their mouth, the nurse rinses them and puts them into their mouth.

Working procedure

The method of food administration is according to the current medical condition of the patient. The usual food administration is in the following order:

Mobile patients – eat their meals in the communal room with clean and tastefully set tables.

Mobile patients requiring the nurse's assistance – the patient is seated at the table in their room.

Immobile, self-sufficient patients – the patient sits on their bed and their meal is served on the portable dining table.

Immobile, insufficient patients – the nurse serves these patients last to give herself enough time to administer the food in a calm environment.

- Hand hygiene.
- Minimize any subjective feelings of lost appetite – by adjusting the setting, limiting the odour in the room, positive approach, serving food to the patient in a cultural manner.
- Prepare all necessary aids within reach.
- Communicate with the patient; let them to express their feelings related to food quality, temperature, popularity of dishes, a sense of taste, loss of appetite, etc.
- Allow the patient to wash their hands.
- Check the accuracy of the dietary marking.
- Support self-sufficiency by letting the patient do tasks they can manage themselves, have the strength and the skill to do.
- Always cut, spread, pour and adjust the food as required in front of the patient.
- Spoon the soup and only offer the next spoon once the patient has swallowed the previous one.
- Cut rolls and bread into small pieces and feed them to the patient.

- Wait until the patient bites, chews a mouthful and then offer them the next one.
- If the patient cannot bite, break the bread into their coffee or milk.
- Let the patient decide in what order and how much of food they will eat.
- Try to keep to the patient's eating habits.
- Do not rush when feeding the patient.
- Offer fluids throughout the meal.
- Give the patient sufficient time to consume tougher portions of food.
- Encourage and praise the patient.
- When the patient has finished with their meal, perform oral hygiene allow the patient to rinse their mouth.
- Check the amount of food the patient consumed and the volume of fluid intake.
- If required, record this information in the nursing documentation.
- Remove all leftovers away from the room immediately. Put the tray into the collection containers designated for transporting tablet trays.
- Record all special events with regards to the food and fluid intake in the nursing documentation.
- Record any special dietary requirements (e.g. exclusion of pork meat, eliminating meat from the diet on certain days).
- Record the patient's current motor ability to ingest food.
- Record any loss of appetite, refusals to eat, reduced need to drink fluids etc.

Care of aids

The aids are treated according to the set hygienic standard regime. When using the tablet system, the utensils are washed, disinfected, rinsed and dried in a separate part of the central kitchen. The leftovers are managed outside the department.

Task

- Practice serving meals to bedridden, insufficient patients at a clinical practice.
- Identify nursing diagnoses related to eating disorders in patients.
- Practice inserting dentures into a patient's mouth.

Control questions

- What diet is suitable for patients with acute conditions of infectious hepatitis, cholecystitis and gall bladder attack or during acute myocardial infarction period?
- Which diet is chosen for hyperlipoproteinemia, arteriosclerosis, myocardial infarction, or a stroke?
- What is the standard diet procedure for children with celiac disease?

- Calculate the patient's BMI with the following parametric data to two decimal places and determine the BMI category.

Patient weight	80 kg
Height	165cm
BMI	Add
Category	Add

- Which two hormones trigger glycogenolysis?
- What type of diet is best in the presence of swelling, such as decompensation in heart disease, blood vessels?
- What diet is prescribed to determine occult bleeding?
- Which diet is referred to as endurance?

17.1 Nutrition specifics in children

Objective

After studying this chapter, you should be able to:

- Describe the basic nutrition scheme for infants;
- Justify the benefits of breastfeeding;
- Handle a baby bottle and teat;
- List the nutritional products for children;
- Demonstrate feeding infants and toddlers using a model or simulator under laboratory conditions and later in clinical practice;
- Assess the risks of potential complications.

Theoretical notes

The child's age can be divided into periods:

Infant period – lasts from birth through to the first year of life. The first 28 days are referred to as the *neonatal* period, the first 7 days as the *early neonatal period;*

Toddler period – the period of the second and third year of life;

Preschool period – includes fourth to sixth year of age;

School age period - begins with the seventh year and ends with the end of compulsory schooling;

Puberty – from 15 – 18 years of life;

Nutrition in the infant period

Infant nutrition can be divided into two periods. In the first period (to the end of the 6th month) the best nutrition for the baby is breast milk. The infant's diet in the second period (6 - 12 months) is expanded with non-dairy nutritional components. The infant consumes in the first six months of age, with the exception of the neonatal period, about 150 ml/kg/day, but the need for a feed further decreases per unit of weight. The growth and development of a child primarily depends on an adequate nutritional intake in proportion to their needs for growth, development and physical activity. Breast milk is the natural diet for infants. Breastfeeding is a natural form of feeding until weaning. If a baby cannot for some reason be breastfed, it is important to replace the natural nutrition with artificial nutrition, i.e. modified cow's milk which is fed to the baby with a bottle with a teat. The artificial nutrition products are called formula.

Natural nutrition – breast milk

Breast milk is irreplaceable for a baby in the neonatal period. In the first days after birth, the mother's mammary gland begins to produce colostrums, which in the second week turns to mature breast milk. The composition is ideal nutrition for a baby, especially in the first six months of life. (See Table 17.1-1) Breastfeeding also has a positive effect on the mother. It

supports the mother-child bond, accelerates uterine contraction after labour back to the original state and protects women against breast cancer, ovarian cancer and osteoporosis. More frequent breastfeeding stimulates lactation. It is recommended to breast feed a baby from both breasts during lactation. Breastfeeding should take no more than 15 minutes.

Breast milk properties:

- Contains the ideal composition of all nutrients;
- Contains nutrients that protect the baby from infection;
- Is easily digestible;
- Is sterile;
- Has the appropriate human body temperature.

	Proteins	Sugars	Fat	Salts	kJ
Colostrum	2.7	5.3	2.9	0.34	252
Mature breast milk	1.3	7.2	3.5	0.25	294
Cow's milk	3.4 – 3.5	4-5	3.5	0.75	294

Fig. 17.1.-1 – Composition of selected types of milk in g/100ml

Source: KRIŠKOVÁ, Anna, et al. *Ošetrovatelské techniky : metodika sesterských činností*. Martin : Osveta, 2006. 780 s. ISBN 80-8063-2023-2.

General recommendations to support breastfeeding

- Inform all pregnant women of the benefits and management of breastfeeding.
- Help mothers to initiate breastfeeding within half-hour after birth.
- Show mothers how to breastfeed and how to maintain lactation if they are separated from their baby.
- Do not feed newborn infants any other food or drink than breast milk unless medically indicated.
- Practice roaming-in.
- Encourage breastfeeding on demand.

Artificial nutrition

If the mother is unable to breastfeed for some reason, the breast milk is replaced with milk products – formula. The replacement of breast milk is called artificial nutrition. It is based on modified cow's milk. The hospital prepares infant formula in the milk kitchen. The feed is dispensed into sterile, pre-labelled bottles under strict aseptic conditions. After they are closed with sterile tops, they are placed into the refrigerator at the nursing unit until ready to use. The bottle is labelled with the child's name, type of formula and volume.

Artificial nutrition products

Artificial nutrition products are classed into two basic groups.

Dairy products – artificial dairy products are usually made from cow's milk and can be classed into first stage and follow-on milk. The first stage formula is intended for newborns and infants from 0 to 6 months who cannot be breastfed. These are indicated with the number 1, and contain vitamins and minerals whose ratio and representation is adapted to the breast milk composition. The protein content, especially the ratio of whey protein and casein, is very important (it can significantly vary for individual products). If the formula is labelled as "forte" or "plus", they have a higher filling effect. In terms of sugars, the formula contains lactose or lactose with the addition of other sugars. Medical dietary dairy formulas with reduced or zero quantity of this sugar are produced for children who are lactose intolerant. A new formula introduced in the recent years is an initial anti-reflux milk formula thickened with rice starch or fibre to prevent reflux in young infants.

Follow-on milk – intended for children from 6th months (completed) to 36 months. The follow-on formula is marked with a number 2 and is used in infants from 6 to 12 months; follow-on formula marked with a number 3 is intended for children from 10 to 36 months of age. These milk formulas are not suitable if the infant is exclusively on a milk diet. They can be served from the time the child starts to receive baby food. These formulas have a lower protein content which is given to children in the form of a complementary food. Raw cow's milk is totally unsuitable for infants, mainly due to its health and high allergy risk. Children should not even be given long-life milk, condensed milk or pasteurized milk with a reduced fat content. The reason is the unsuitable composition – either an excess of some components (e.g. protein) or a lack of them (e.g. vitamins, iodine, iron, essential fatty acids). Babies with a low birth weight need more energy and protein, which is why the formula has adjusted the protein ratio. The formula is enriched with fatty acids, vitamins and some minerals. Administration of these products must be supervised by a doctor. Soya milk is most commonly used in allergies to cow's milk, in vegetarian diets and in lactose intolerance – milk sugar.

The milk formulas are sold by pharmacies in the form of dried powders. The first stage formula – for example Sunar Baby, Nutrilon Premium. The follow-on formula – for example Sunar Plus, Beba 2 and others (see Fig. 17.1-1, 2).

Fig. 17.1-1: Examples of milk formulas I

Fig. 17.1-2: Examples of milk formulas II

If the baby thrives, the diet should only consist of milk formula until the 4th-6th month of life. Baby food should be administered only at the end of the 4th month but no later than at the end of the 6th month. Baby food is spoon fed. The first complementary food should be fruit or vegetable puree, with no added sugar. Each new type of food should be served at 3-4 day intervals to detect any intolerance. Further baby foods include fruit and vegetables or meat-vegetable foods. During the next, i.e. the 5th month it is recommended to mix the baby fruit puree with unsweetened yogurt. During the 5th – 6th month the baby diet can be enriched with another dish in the form of gluten-free milk porridge. Each serving of baby food replaces one serving of milk. The vegetable baby food is prepared from various types of vegetables which are free of nitrate. The most suitable are carrot, potato, turnips, celery, spinach, tomatoes, parsley etc. Well cleaned vegetables are stewed until soft and then pureed. It can be slightly sweetened. Vegetable soup is prepared from various types of vegetables which are boiled and pureed, and 2 tablespoons of pureed vegetables are added into 200 ml of vegetable stock. One or two teaspoons of cooked and pureed lean meat (preferably chicken, veal), can sometimes be added to the soup. The soup must be salt free. An egg yolk can be added to the soup from the 8 month, but it must be boiled in the soup. After the 7th month, the baby food can contain gluten (semolina porridge, oat porridge, rice pudding, biscuits). The instant porridge is prepared by adding hot water, or according to the instructions on the packaging. The porridge should not be served with cocoa until 1 year of age. Baby food does not need salt or any other flavouring.

The food consistency should be gradually amended from mushy to minced and chopped to whole. A one year old child should be eating the same food as an adult.

Preparation of milk formulas

When preparing formula from powder, follow the manufacturer's instructions; follow the serving recommendations, the preparation instructions which are printed on the packaging of each type of milk product.

Preparation of aids

Powder milk formula, boiled lukewarm water which is harmless to health for infants, container for mixing the formula, measuring scoop, fork for mixing, sterile baby bottle, sterile baby bottle cap.

Performing the procedure

- Boil the required amount of water that is harmless to infants.
- Add the required quantity of milk powder into a small volume of cooled water (30-50°C). Dissolving takes longer in cold water, hot water causes lumps to form.
- Pour the remaining boiled water into the bottle containing the milk mixture and the mix.
- Fill the baby bottle with the prepared formula.
- When given to the baby, the bottle contents must be approximately the same as human body temperature (37°C).

Feeding a baby from an infant bottle with a teat

Baby preparation

- Change the baby's nappy before feeding.
- Clean the baby's nose to ensure a clear nasal passage.

Preparation of aids

- Prepare a baby bottle with the appropriate content.
- Check the baby's name, type and volume of administered formula.
- Put on a sterile teat so as not to touch the part that is inserted into the baby's month.
- The shape of the teat is to simulate a real nipple. It should have the correct orthodontic shape, should allow breathing through the nose and proper development of the teeth and jaws (Fig. 17.1-3).

Fig. 17.1-3: Spare teats

- Choose the size of the teat hole according to the feed consistency. The child should suck the feed, i.e. the content should not flow freely under its own weight as it can cause fast drinking and the baby could inhale the feed.
- Check the feed temperature with a drip on the inside of your wrist (suitable temperature of the feed should not burn). Healthcare facilities use baby milk heaters. They are filled with distilled water and the thermostat of the device is set to 40°C. The heater switches off automatically. The advantage is the maintenance of constant temperature; the feed does not overheat and remains reasonably warm throughout the feeding of all babies in the nursing ward.

Performing the procedure

- Place a protective cloth under the baby's chin.
- Hold the baby in a slightly elevated position with a supported head.
- Hold the baby bottle tilted so that the teat and the bottle neck are not filled with air.
- If you cannot feed the baby in your arms, put the baby into the required elevated position in the crib.
- Observe the baby's behaviour during feeding.
- Observe how fast the baby drinks, if it starts coughing, interrupt the feeding, remove the teat from the baby's mouth and let the baby rest for a while.
- After feeding, raise the baby in an upright position which will allow any air that got into the baby's stomach during sucking to exit.
- Then put the baby into bed on their side.
- Observe the baby for any reflux, reactions, satisfaction etc.
- Record the food intake – volume, time, the baby's reaction during and after feeding.
- Monitor the total fluid intake in 24 hrs.

Baby spoon feeding

- Prepare the heated feed.
- Put it on the table at a safe distance so the child is not at risk from burns.
- Put a protective cloth under the baby's chin.
- Put the baby on your lap so that it is in an elevated position and can safely swallow.
- Older children can be put in the special high chairs designed for feeding.
- Do not rush the feeding.
- Spoon feed the baby with the food inserted at the base of the tongue.
- Wait until the baby swallows a mouthful.
- Do not forget that proper feeding technique teaches the baby good eating habits.
- Observe the baby during feeding and how they receive the feed.
- Do not force the baby to eat and do not distract it.
- Do not interrupt the feeding of the baby.
- Record into the nursing documentation the amount of digested feed, appetite, refusal, etc.

Task

- Practice baby positioning during feeding at the clinical practice. Explain the reasons for the positions.
- Research the term "regurgitation" in the professional literature and explain the meaning.

- The child expresses its feelings by crying. Name the possible causes of crying.
- Research the term “aspiration” in the professional literature and consider its relation to baby feeding.

Control questions

- What is the name of the first stage milk formula thickened with rice starch or fibre to prevent reflux in infants?
- From which completed month of the baby’s age can follow-on milk formula be given?
- At what age should a child start to receive the same diet as an adult?
- What does regurgitation mean?

17. 2 Gastric tube insertion

Objectives:

After studying this chapter, you should be able to:

- Explain the basic terms, content, procedure, reason and method for the procedure;
- Define the role of the nurse when inserting the gastric tube and prepare the aids;
- Explain the importance of the procedure as well as the need for the patient's cooperation;
- Encourage the patient to obtain and justify their cooperation;
- Explain to the patient the relevance of the procedure to minimize complications;
- Demonstrate expertise, skill, independence during insertion of the gastric tube;
- Always communicate professionally with the patient;
- Respect the age, and individual specific needs of the patient during the procedure;
- Administer nursing care for the patient with inserted gastric tube;
- Solve any potential problems arising from the insertion of gastric tube.

Theoretical notes

Formation and significance of gastric juice

Gastric juice is a liquid secreted by the glands in the lining of the stomach (1 – 3 litres daily), containing free or bound hydrochloric acid which most significantly contributes to the acidity of the gastric juice. Hydrochloric acid (HCL) activates pepsinogen into the enzyme pepsin; the tissue increases in volume between the muscle bundles, therefore supporting digestion, converts the trivalent iron to divalent, changes the calcium carbonates to calcium chlorides making them readily absorbable, and the acidic reaction destroys the germs and protects vitamins C, B1 and B2.

Further components are gastric juice pepsin (begins to break down proteins), chymosin (breaks down milk protein), mucin (mucus that protects the stomach lining from the effect of HCL), intrinsic factor (absorption of vitamin B12).

The *secretion of gastric juice* is managed by neurohormonal control. Neurohormonal control constitutes unconditional and conditional reflexes through the vagus nerve. Neurohormonal control consists of gastrin, formed in the pyloric part of the stomach and duodenum; gastrin increases the production of HCL. Secretion of gastric juice is influenced by many factors, e.g. genes, diet, daily routine, stress, smoking and alcohol.

Methods of gastric juice collection

The direct (invasive) method is used to examine the gastric chemistry – a collection of gastric juice via an inserted gastric tube, or by an indirect method of estimation i.e. examination of urine with the Acidotest. The indirect method was used especially in the past and is rarely seen in the present day.

It is used in children, as it is less intense for the patient. Examination of gastric chemistry has only a limited diagnostic value compared to the currently preferred endoscopic diagnostic method.

A gastric tube is inserted:

- If the patient is unable to receive sufficient food and fluid volumes orally;
- As prevention of nausea, vomiting and stomach distension in certain diseases in the digestive tract and after some surgical procedures; with continuous drainage of gastric juices;
- For sampling stomach contents for laboratory examination;
- In gastric lavage in poisoning or drug overdose.

The gastric tubes are made from flexible latex, polyurethane or silicone material, in various circumference sizes, diameter and length. Numbering is in Fr., i.e. the same as in urinary catheters (see short-term bladder catheterization). The tubes are in sterile packaging, labelled with the exact size and type.

The most frequently used gastric tubes are:

- *Levin tube* – flexible, made of plastic or rubber, with a single lumen and small inputs at the end of the tube.
- *Salem sump tube* – has a double lumen, the larger lumen allows for easy suction of gastric contents and the smaller lumen allows for air to be drawn into the tube which equalizes the vacuum pressure in the stomach; this prevents the suction eyelets from adhering to the stomach lining.

Patient preparation

The mental preparation of the patient and a thorough explanation of the procedure are required before inserting the gastric tube. The procedure is not painful, but unpleasant, because it activates a vomiting reflex. Most commonly, the tube is inserted through one nostril, via the nasopharynx into the stomach or small intestine. In some cases, the tube can be inserted through the mouth and pharynx. The tube is kept in the fridge for easier insertion. Consent must be obtained from the patient.

Aids

- Nasogastric tube (kept in the fridge before application);
- Wadding squares;
- Local anesthetic – Mesocain gel (other gel, or Xylocain spray);
- Hydrofile gauze – squares;
- Protective gloves;

- Kidney bowl;
- Protective drape;
- Tape to attach the tube;
- Pean, clip or pin to close the tube;
- Collection bag;
- Glass of water;
- Janet syringe for aspiration of gastric contents;
- Stethoscope;
- 20 ml syringe for auscultation check on the correct insertion of the tube.

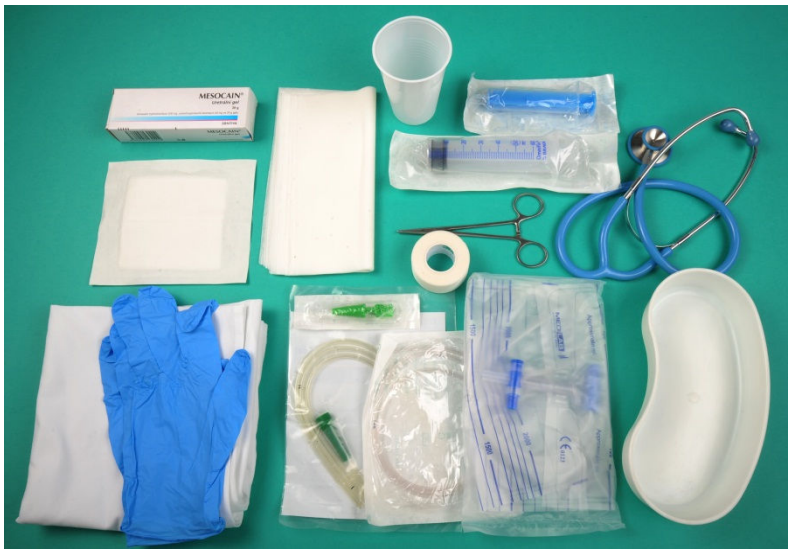

Fig. 17. 2- 1: Aids for inserting a gastric tube

Gastric tube insertion through the nose

Working procedure

- Hand hygiene and disinfection;
- Check the doctor's prescription in the patient documentation;
- Check if the aids for inserting the gastric tube are ready and within reach and near the patient;
- Verify the patient's identity by accessible means;
- Explain to the patient the reason, content and method of procedure and encourage the patient to cooperate (highlighting the importance of cooperation – the positive influence on the success of the procedure);
- The patient is placed in a comfortable semi-sitting position (easy for swallowing while the gravity facilitates easier insertion of the tube);
- Check that the nasal passages are unobstructed;

- The patient is explained the breathing methodology, swallowing during insertion of the tube;
- Protect the patient's clothing with a drape;
- If possible, the patient holds the kidney bowl;
- Put on protective gloves;
- The approximate length of the tube is determined by measuring from the tip of the nose to the earlobe and to the end of the sternum - this length determines the approximate distance from the nasal passage to the stomach;
- Apply anesthetic gel to the end of the tube (local anesthetic - Mesocain gel);
- The tube is inserted during patient permanent swallowing with a small amount of water (according to their health condition, the patient inhales, exhales and swallows, the tube slowly shifts by 5-10 cm with each swallowing up to the marker);
- If the patient begins to experience nausea, the insertion is interrupted and the patient is asked to take deep breaths;
- Constantly monitor the oral cavity so that the tube does not curl up inside;
- Proper insertion of the gastric tube is confirmed by the aspiration of gastric juices using the Janet syringe by air insufflation and subsequent control of auscultation with a stethoscope (*the most reliable method* of verifying the location of the tube is by X-ray);
- *Inappropriate* – to immerse the end of the tube under water and to watch for an air leak;
- The tube is attached with a strip of tape to the nose or the cheek of the patient;
- The end of the tube is closed or led into a collection bag;
- Washing and disinfection of hands;
- The procedure is recorded.
- In the event of complications with insertion of the gastric tube, terminate the procedure and inform a doctor;
- The aids are cleaned according to the standard procedure.

Gastric tube insertion through the mouth

The insertion of the gastric tube through the mouth is unpleasant because it can induce vomiting.

Working procedure

- Hand hygiene and disinfection;
- Check the doctor's prescription in the patient documentation;
- Check if the aids for inserting the gastric tube are ready and within reach and near the patient;
- Verify the patient's identity by accessible means;

- Explain to the patient the reason, content and method of the procedure and ask the patient to cooperate;
- The patient is then put in a comfortable sitting position;
- The patient opens their mouth and their tongue is held down with a tongue depressor;
- The tip of the tube is rested on the tongue and the patient is asked to inhale, exhale and swallow; the tube is gently inserted at the exhale behind the tongue root; this is repeated several times while the tube is slowly inserted into the digestive tract;
- The next procedure is the same as for insertion through the nose.

Patient care after the procedure

- The patient is put back in the original and comfortable position
- The patient receives information about the next steps with respect to their health condition, the inserted gastric tube, and the doctor's prescription

Care of aids after use

Used disposable aids are discarded with other infectious waste; kidney bowls are put into disinfectant and other aids are cleaned and stored according to standard procedure.

Complications

The following complications may occur with the insertion of the gastric tube:

- The tube may curl up in the patient's mouth during insertion; therefore the nurse monitors the patient's cavity; if it does occur then pull the tube back slightly until aligned and the insertion can continue;
- Obstruction of the tube;
- Insertion of the tube into the respiratory tract;
- *Awake patient* – starts to cough immediately, the tube must be removed immediately;
- *Unconscious patient* – the correct insertion can be verified by injecting a small amount of air into the tube (about 20 ml) while listening to insufflation in the epigastrium;
- Tube orifice blocked with gastric content – if the gastric juice does not aspire, it may indicate a blocked tube with gastric contents; the tube is never rinsed with water but always with air while listening to insufflation in the epigastrium.

Removing the gastric tube

The tube is exchanged after 3 – 5 days to avoid formation of pressure ulcers on the mucous membrane. A thin tube can remain inserted for a longer period.

Patient preparation

The patient is informed of the procedure of removing the gastric tube and asked to cooperate.

Aids

- Wadding squares;
- Kidney bowl;
- Protective gloves;
- 50 ml syringe;
- Protective drape;
- Glass of water.

Working procedure

- Hand hygiene and disinfection;
- Check the doctor's prescription in the patient documentation;
- Verify the patient's identity by accessible means;
- Explain to the patient the procedure for removing the gastric tube;
- The patient is then put in a comfortable sitting position;
- The patient is given a kidney bowl and wadding squares to dry their mouth after removing the tube;
- Aspiration of the tube content;
- Release the tube – remove the attached tape;
- The tube compressed with pean (closed with a pin) is slowly removed and rolled into the hand while wiped with wadding held in the other hand;
- The patient is offered a glass of water to rinse their mouth;
- The aids are cleaned and disinfected according to the standard procedure.
- Washing and disinfection of hands;
- The procedure is recorded.
- Eventual complications must be reported to a doctor.

Patient care after the procedure

- The patient is put back in the original and comfortable position;
- The patient receives information about the next steps with respect to their health condition and the doctor's prescription.

Care of aids after use

See the above text

Control questions:

(One answer is correct)

The appropriate position for the patient during insertion of a gastric tube is:

- Lying down
- In men lying down, in women sitting up
- In bedridden patients lying down, in mobile patients standing up
- Sitting, semi-sitting
- Always standing up

The approximate length for the insertion of the nasogastric tube is determined by measuring:

- From the tip of the nose to the earlobe and to the end of the sternum
- From the tip of the nose to the end of the sternum
- From the tip of the nose to the stomach
- From the mouth to the end of the sternum
- From the mouth to the tip of the nose to the earlobe and to the end of the sternum

The most reliable method of verifying the insertion of the gastric tube is:

- X-ray
- Aspiration of gastric contents
- Injection of a fluid into the tube and subsequent aspiration
- Free leakage of gastric contents through the tube
- Immersion of the end of the tube under water and monitoring any air leak

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