General Toxicology

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TOXICOLOGY

Toxicology is the science dealing with properties, actions, toxicity, fatal dose, detection estimation of, interpretation of the result of toxicological analysis and treatment of poison.

FORENSIC TOXICOLOGY

- **Deals with the medical and legal aspects the harmful effects of chemicals on human beings.**
- **POISON-is a substance(solid, liquid or gases)which if introduced in the living body, or brought into contact with any part thereof, will produce ill health or death, by its constitutional or local effect or both.**

EPIDEMIOLOGY

- Epidemiology; poisionig both accidental and intentional are a significant contributor of mortality and morbidity throughout the world.
- According to WHO,threee million acute poisoning cases with 2,22,000 deaths occur annually.

History of Poison

- It stretches over a period from before 4500 BC to the present day. Poisons have been used for many purposes across the span of human existence, especially as weapons, anti-venoms, and medicines. Poison has allowed much progress in the branches of medicine, toxicology, and technology, among others.

MEDICO-LEGAL ASPECTS OF POISON

- Sections,176,193,201,202,284,299,300,304A,309,320,324,326,328 I.P.C and S.39,40 and 175, Cr.P.C deal with offences relating to administration of poisonous substances.
- Section 272 to 276, I.P.C, deal with altered food and drugs.

LAW ON POISONS

- **THE DRUGS AND COSMETICS ACT ,1940**
- **THE DRUGS AND COSMETICS ACT ,1945**
- **PHARMACY ACT, 1948**
- **THE DRUG CONTROL ACT,1950**
- **THE DRUGS AND MAGIC REMEDIES ACT,1954**
- **NARCOTICS DRUGS AND PSYCHOTROPIC SUBSTANCES ACT,1985**
- **PREVENTION OF ILLICIT TRAFFIC IN NARCOTIC DRUGS AND PSYCHOTROPIC SUBSTANCES ACT,1988.**

NATURE OF POISONING

- Ideal homicidal poison
- Ideal suicidal poison
- Stupefying
- Abortion
- Accidental
- Non accidental poisoning
- Cattle poisoning
- Arrow poisoning
- Aphrodisiac

POISON CLASSIFICATION

CORROSIVES

1. STRONG ACIDS;MINERAL ACID(sulphuric acid,nitric,hydrochlroric acid)
2. STRONG ALKALIS;hydrates and carbonates of sodium and ammonia)
3. METALLIC SALTS;zinc chloride,ferric chloride,copper sulphate,silver nitrate,potassum cyanide,chromates, bichromates

Chemical toxicology

- Chemical toxicology is a scientific discipline involving the study of structure and mechanism related to the toxic effects of chemical agents, and encompasses technology advances in research related to chemical aspects of **toxicology**. Research in this area is strongly multidisciplinary, spanning computational chemistry and synthetic chemistry, proteomics and metabolomics, drug discovery, drug metabolism and mechanisms of action, bioinformatics, bioanalytical chemistry, chemical biology, and molecular epidemiology.

Environmental toxicology

- Classically, the term "environmental toxicology" refers to the study of the direct effects of environmental chemicals on human beings, specifically. Whereas "ecotoxicology" has been alleged to be the integration of toxicology and ecology.

Ecotoxicity

- **Ecotoxicity**, the subject of study of the field of ecotoxicology (a portmanteau of Ecology and Toxicology) refers to the potential for biological, chemical or physical stressors to affect ecosystems. Such stressors might occur in the natural environment at densities, concentrations or levels high enough to disrupt the natural biochemistry, physiology, behaviour and interactions of the living organisms that comprise the ecosystem.
- Ecotoxicology has been defined as "the branch of toxicology concerned with the study of toxic effects, caused by natural or synthetic pollutants, to the constituents of ecosystems, animal (including human), vegetable and microbial, in an integral context" (Truhaut, 1977)

Carbon monoxide poisoning

- **Carbon monoxide poisoning** occurs after the inhalation of carbon monoxide gas. Carbon monoxide (CO) is a product of combustion of organic matter under conditions of restricted oxygen supply, which prevents complete oxidation to carbon dioxide (CO_2). Carbon monoxide is colorless, odorless, tasteless, and non-irritating, making it difficult for people to detect.
- Carbon monoxide is a significantly toxic gas with poisoning being the most common type of fatal poisoning in many countries.[1] Symptoms of mild poisoning include headaches, vertigo, and flu-like effects; larger exposures can lead to significant toxicity of the central nervous system, heart and even death. Following poisoning, long-term sequelae often occur. Carbon monoxide can also have severe effects on the fetus of a pregnant woman.
- The mechanisms by which carbon monoxide produces toxic effects are not yet fully understood, but hemoglobin, myoglobin, and mitochondrial cytochrome oxidase are thought to be compromised. Treatment largely consists of administering 100% oxygen or hyperbaric oxygen therapy, although the optimum treatment remains controversial.[2] Domestic carbon monoxide poisoning can be prevented by early detection with the use of household carbon monoxide detectors.

Arsenic poisoning

- **Arsenic poisoning** kills by allosteric inhibition of essential metabolic enzymes, leading to death from multi-system organ failure. It primarily inhibits enzymes that require lipoic acid as a cofactor, such as pyruvate and alpha-ketoglutarate dehydrogenase.
- Because of this, substrates before the dehydrogenase steps accumulate, such as pyruvate (and lactate). It particularly affects the brain, causing neurological disturbances and death.

Samples

- **Urine**
- A urine sample is quick and easy for a live subject, and is common among drug testing for employees and athletes. Urine samples do not necessarily reflect the toxic substance(s) the subject was influenced by at the time of the sample collection. An example of this is THC from cannabinoid (for example, marijuana) use, which in heavy users can be detected in urine for up to 14 days following use. Note also that it can take as long as 8 hours until a given substance can be detected. Specific to workplace drug testing, urine collection MUST be directly observed due to the prevalence of substance abusers "beating the test" via sample substitution or adulteration.

Blood

- A blood sample of approximately 10 cm^3 is usually sufficient to screen and confirm most common toxic substances. A blood sample provides the toxicologist with a profile of the substance that the subject was influenced by at the time of collection; for this reason, it is the sample of choice for measuring blood alcohol content in drunk driving cases.

- **Hair sample**
- Hair is capable of recording medium to long-term or high dosage substance abuse. Chemicals in the bloodstream may be transferred to the growing hair and stored in the follicle, providing a rough timeline of drug intake events. Head hair grows at rate of approximately 1 to 1.5 cm a month, and so cross sections from different sections of the follicle can give estimates as to when a substance was ingested. Testing for drugs in hair is not standard throughout the population. The darker and coarser the hair the more drug that will be found in the hair. If two people consumed the same amount of drugs, the person with the darker and coarser hair will have more drug in their hair than the lighter haired person when tested. This raises issues of possible racial bias in substance tests with hair samples.

- **Oral fluid**
- Oral fluid is the proper term, however Saliva is used commonly. Saliva is a component of oral fluid. Oral fluid is composed of many components and concentrations of drugs typically parallel to those found in blood. Sometimes referred to as ultra filtrate of blood, it is thought that drugs pass into oral fluid predominantly through a process known as passive diffusion. Drugs and pharmaceuticals that are highly protein bound in blood will have a lower concentration in oral fluid. The use of oral fluid is gaining importance in forensic toxicology for showing recent drug use, e.g in clinical settings or investigation of driving under influence of substances.

OTHERS

- **Other**
- Other bodily fluids and organs may provide samples, particularly samples collected during an autopsy. A common autopsy sample is the gastric contents of the deceased, which can be useful for detecting undigested pills or liquids that were ingested prior to death. In highly decomposed bodies, traditional samples may no longer be available. The vitreous humour from the eye may be used, as the fibrous layer of the eyeball and the eye socket of the skull protects the sample from trauma and adulteration. Other common organs used for toxicology are the brain, liver, spleen and stomach contents.

COMMON HOUSEHOLD POISONS

- Did you know that even these common household items can poison little children?
- detergents
- automatic dishwasher detergents
- furniture polish
- perfume & aftershave
- mouthwash
- gasoline, kerosene, and lamp oil
- paint and paint thinner
- mothballs
- alcoholic beverages
- miniature batteries
- flaking paint
- cigarettes, tobacco products
- rat and mouse poison

General Classes of Poisons

- **Gases**
- **Metallic Poisons**
- **Volatile Organics**
- **Non-volatile Organics**
- ***- the major category here is what is known as an <u>alkaloid</u>, a drug that mimics human neurotransmitters or hormones and therefore interferes with normal body chemistry***
- ***Alkaloids are derived from plants…***

Alkaloids

- **Common Examples:**
- **Amphetamines – stimulants that provoke euphoria; these drugs mimic catecholamines in the human body (adrenaline, etc)**
- **Cocaine – natural stimulant that acts as a mimic to catecholamines; metabolites are detected in urine for as many as 3 days**
- **Opiates – depressants that reduce muscle activity, heartbeat, respiration, and the inclination to sleep; effective pain relievers and euphoria producing; opiates mimic endorphins in the human body**
- **Cannabinoids – fast acting plant alkaloid; body mimic is unknown; metabolites can be detected in urine for months**

Methods of Detection

- **Color test**
- **Microdiffusion test**
- **Chromatography**
- **a. thin-layer chromatography (TLC)**
- **b. gas chromatography (GC)**
- **c. high performance liquid chromatography (HPLC)**
- **Spectroscopy**
- **a. UV light** **d. X-ray**
- **b. visible light** **e. infrared**
- **c. microwave**

Classification of toxins

Anesthetic (ethanol)
Asphyxiant (carbon monoxide)
Carcinogen (asbestos)
Hemotoxin (benzene)
Hepatotoxin (carbon tetrachloride)
Irritant (ozone)
Nephrotoxin (lead)
Neurotoxin (mercury)
Pneumotoxin (cadmium)
Sensitizer (formaldehyde)
Teratogen (ethylene oxide)

- There are common household substances that are poisonous to humans. Take caution when using these items. Some chemicals become toxic when mixed together, others are poisonous when used as directed. **Mixing Bleach and Ammonia**
- In case your mom didn't tell you, it's a very bad idea to mix bleach and ammonia. The gas that results from these two chemicals is such a strong poison, it was used in the past as a chemical warfare agent. **Carbon Monoxide Poisoning**
- Carbon monoxide is a colorless, odorless gas that displaces oxygen in the bloodstream. Carbon monoxide can leak from any gas motor; lawn mowers, cars, boats, etc. It can also occur from gas burning appliances that are not calibrated correctly. **Pesticides**

Decontamination

- If the toxin was recently ingested, absorption of the substance may be able to be decreased through gastric decontamination. This may be achieved using activated charcoal, gastric lavage, whole bowel irrigation, or nasogastric aspiration. Routine use of emetics (syrup of Ipecac) and cathartics are no longer recommended.
  - Activated charcoal is the treatment of choice to prevent absorption of the poison. It is usually administered when the patient is in the emergency room. However, charcoal is ineffective against metals, Na, K, alcohols, glycols, acids, and alkalis.
  - Whole bowel irrigation cleanses the bowel, this is achieved by giving the patient large amounts of a polyethylene glycol solution. The osmotically balanced polyethylene glycol solution is not absorbed into the body, having the effect of flushing out the entire gastrointestinal tract. Its major uses are following ingestion of sustained release drugs, toxins that are not absorbed by activated charcoal (i.e. lithium, iron), and for the removal of ingested packets of drugs (body packing/smuggling).[4]

- Gastric lavage, commonly known as a stomach pump, is the insertion of a tube into the stomach, followed by administration of water or saline down the tube. The liquid is then removed along with the contents of the stomach. Lavage has been used for many years as a common treatment for poisoned patients. However, a recent review of the procedure in poisonings suggests no benefit.[5] It is still sometimes used if it can be performed within 1 h of ingestion and the exposure is potentially life threatening.
- Nasogastric aspiration involves the placement of a tube via the nose down into the stomach, the stomach contents are then removed via suction. This procedure is mainly used for liquid ingestions where activated charcoal is ineffective, i.e. ethylene glycol.
- Emesis (i.e. induced by ipecac) is no longer recommended in poisoning situations.[6]
- Cathartics were postulated to decrease absorption by increasing the expulsion of the poison from the gastrointestinal tract. There are two types of cathartics used in poisoned patients; saline cathartics (sodium sulfate, magnesium citrate, magnesium sulfate) and saccharide cathartics (sorbitol). They do not appear to improve patient outcome and are no longer recommended.

- Organophosphates are some of the most deadly poisons in the home. Most pesticides, including lice shampoos, either have organophosphates in them or have similar characteristics. Pesticide poisoning creates a reaction that quickly leads to death if untreated. Organophosphates are currently used as nerve gas by some militaries. Use these chemicals with great care and always follow the manufacturers' recommendations. **Food Poisoning**
- Food Poisoning is not really poisoning at all, but a foodborne bacterial illness. Most food poisoning is not life-threatening, but vomiting and diarrhea can lead to dehydration.