

## Question

You need to perform emergency splenectomy to remove a mass in the spleen. You want to choose anesthetic agents that do not cause the spleen to enlarge/engorge. With that in mind, which of the following options is the best combination?

- Acepromazine followed by diazepam and ketamine
- Xylazine and thiopental
- Acepromazine and propofol
- A mixture of thiopental and propofol
- Morphine followed by diazepam and ketamine

**Explanation - Acepromazine** can cause splenic enlargement and sequestration of red blood cells in the spleen. This is often striking and evident on radiographic or sonographic exams of animals sedated with acepromazine. **Thiopental** is a thiobarbiturate which induces splenic engorgement; this makes surgical manipulation and removal of the spleen more difficult.

Xylazine, diazepam, ketamine, propofol, and opioids such as morphine do not increase the size of the spleen.

---

## Question

Having just repaired a femoral fracture on an 8 year old male Labrador with mild chronic renal insufficiency, your technician asks you for post-operative orders. Which of these drugs is contraindicated for analgesia in your patient?

- Dexmedetomidine
- Tramadol
- Gabapentin
- Butorphanol
- Carprofen
- Ketamine

**Explanation -** Carprofen is a non-steroidal anti-inflammatory and has analgesic properties but may exacerbate the chronic renal disease by causing decreased blood perfusion to the kidneys by vasoconstricting the afferent arteries by diminishing the effects of prostaglandins.

**Dexmedetomidine** and ketamine can each be used as a constant rate infusion to provide pain control.

**Butorphanol** is an opioid that has partial agonist and antagonist effects on the mu and kappa receptors.

**Tramadol** is a synthetic opioid.

**Gabapentin** is an anticonvulsant that is often used for its analgesic effects, particularly against neuropathic pain.

---

### Question

You are about to anesthetize a 5-year old mixed breed dog for a laceration repair. It has a history of seizures since it was 2 years of age. Which drug should not be used in the anesthesia protocol as it may promote seizures in this predisposed patient?

- Etomidate
- Ketamine
- Propofol
- Diazepam
- Pentobarbital

**Explanation** - The use of ketamine has been associated with seizures in epileptic dogs. Diazepam, propofol, and pentobarbital are more commonly used to treat acute seizure episodes and should not cause them.

---

### Question

A 7 year old Bull Mastiff presents to your clinic with a complaint of lethargy. Physical exam is unremarkable. A CBC shows a markedly elevated white blood cell count of 150,000/ul, consisting mostly of lymphocytes and unclassifiable circulating cells. You are concerned about the possibility of leukemia and elect to perform a bone marrow aspirate. You decide to use propofol for sedation/anesthesia in order to perform the brief procedure. Which of these should you monitor most carefully at induction with this agent?

- Blood pressure
- Heart rate
- Eye position
- Respiration

**Explanation** - Propofol's most common adverse side effect is temporary apnea. You should always be prepared to intubate and ventilate a patient when administering propofol due to the potential for severe apnea. It is certainly not wrong to monitor blood pressure and heart rate to assess anesthetic depth and vital signs, even for a brief procedure; but by far, the most important thing to watch is respiration.

---

### Question

Which of these inhalant anesthetics has the fastest onset of action in the dog?

- Halothane

- Isoflurane
- Diethyl ether
- Desflurane

**Explanation** - The correct answer is desflurane. Speed of action of inhalant anesthetics is most directly related to blood-gas solubility. Desflurane has the lowest solubility and therefore, has the fastest time of action. In order from fastest to slowest, the inhalants are (desflurane, NO, sevoflurane, isoflurane, enflurane, halothane, diethyl ether, methoxyflurane).

Inhalant Anesthetic	MAC % (Potency)	Blood Gas partition coefficient (Solubility)
Methoxyflurane	0.23 % (the most potent)	13 (very soluble - slow induction and recovery)
Halothane	0.9 %	2.3
Isoflurane	1.3 %	1.5
Sevoflurane	2.4 %	0.68 (low solubility)
NO <sub>2</sub>	200 % (the least potent)	0.49 (less soluble – fast induction and recovery)

---

### Question

Which of the following increases an animal's anesthetic requirement?

- Pregnancy
- Old age
- Hyponatremia
- Hyperthermia

**Explanation** - The correct answer is hyperthermia. Elevated temperature increases the rate of metabolism of anesthetics and thus, increases the amount of anesthetic needed. Hyponatremia, pregnancy, and old age all require decreased amounts of anesthetics to give the same effects.

---

### Question

What is the most appropriate maintenance fluid rate for a dog under anesthesia for routine abdominal surgery?

- 20 ml/kg/hr of hypertonic saline (7.5%)
- 2 ml/kg/hr of lactated ringers
- 10 ml/kg/hr of lactated ringers
- 0.5 ml/kg/hr lactated ringers

**Explanation** - Animals under anesthesia for surgery need **5-10 mls/kg/hr** of an isotonic crystalloid for "**maintenance**". Obviously, this is sometimes not done for short procedures in healthy animals. Note that this is substantially higher than the usual maintenance fluid requirement for a dog of **2-3 ml/kg/hr**. This increased requirement compensates for evaporation during surgery, metabolism of water, and lack of intake.

---

### Question

Which of these drugs is known to cause significant release of histamine?

- Acepromazine
- Ketamine
- Morphine
- Butorphanol

**Explanation** - The correct answer is morphine. Morphine should probably not be used in patients with **mast cell tumors** for this reason. Butorphanol causes no increase in histamine even though it is also an opioid. Acepromazine actually has some antihistamine effect. Ketamine does not affect histamine levels.

---

### Question

A 4-year old female spayed mixed Chihuahua presented to the emergency service at approximately 5am this morning after presumptively being attacked by a coyote. The patient has a flail chest and it is questionable if there is direct communication between the thoracic cavity and the environment (it was difficult to examine the dog due to her fractious nature). Exploration of the wound was performed, and once anesthetized, it was apparent she had a pneumothorax. The patient must be ventilated, as there is no vacuum present in the chest for lung expansion to occur. What pressure should the anesthetist not exceed if manually bagging the patient during anesthesia?

- 24cm H<sub>2</sub>O
- 20cm H<sub>2</sub>O
- 12cm H<sub>2</sub>O
- 8cm H<sub>2</sub>O

**Explanation** - Pressures above **20cm H<sub>2</sub>O** may result in barotrauma. In an otherwise healthy patient it is not recommended to exceed this pressure. In patients with chronic atelectasis, anesthetists will be much more apprehensive about over ventilating or ventilating the lungs too quickly, as acute expansion can trigger re-expansion pulmonary edema, which may then lead to acute respiratory distress syndrome and death.

---

### Question

One of your colleagues has asked you to be the anesthetist for a lung lobectomy in an 8 year old Pug with a lung lobe torsion. He stresses that there will be times in the procedure where it is absolutely critical that the dog stay completely still, including no respiratory motion. Which of the

following drugs could be used to do this while maintaining the dog under a reasonable surgical plane of anesthesia?

- Isoflurane gas and injectable succinylcholine
- Sevoflurane gas and injectable edrophonium
- Sevoflurane gas and a fentanyl infusion
- Isoflurane gas and a lidocaine infusion

**Explanation** - To control all respiratory motion without pushing a dog to an excessive and dangerous plane of anesthesia, a neuromuscular blocking agent would be necessary. You would never use one of these alone for a surgical procedure as they do not provide analgesia or reduce consciousness, which is why an inhalant gas anesthetic is also used to maintain anesthesia in this case. Options include **succinylcholine** which is a depolarizing neuromuscular blocker or one of the nondepolarizing neuromuscular blocking agents such as **pancuronium**, **d-tubocurarine**, and **atracurium**.

Edrophonium is a cholinesterase inhibitor which can be used to reverse neuromuscular blockers. Fentanyl is an opioid and is actually an excellent choice to provide pain control and decrease the concentration of gas anesthetic needed in a procedure such as this one, but it would not accomplish the goal of preventing all motion, including respiration when necessary.

---

### Question

Which anesthetic agent is implicated in malignant hyperthermia?

- Nitric oxide
- Ketamine
- Acepromazine
- Halothane

**Explanation** - The correct answer is halothane. This is mainly an entity in swine but may be seen in other animals. It is a rare induction of a hyper-metabolic reaction in skeletal muscle of susceptible individuals by halothane. The syndrome is characterized by muscle rigidity, increased body temperature, increased oxygen consumption and production of CO<sub>2</sub>.

---

### Question

Which of these is a sign of anesthesia being too deep in a dog?

- Swallowing
- Hypertension
- Elevated PaCO<sub>2</sub>
- Deep breathing
- Lacrimation

**Explanation** - The correct answer is elevated PaCO<sub>2</sub>. As anesthetic depth increases, hypoventilation occurs due to shallower breathing. Lacrimation, hypertension, and swallowing are all signs of inadequate anesthetic depth depending on the procedure being performed.

---

### Question

A 43 kg male castrated Rottweiler presents to your practice for surgery to repair a ruptured cranial cruciate ligament. Preoperative bloodwork and thoracic radiographs are within normal limits. What is an appropriate fluid rate of LRS to maintain this dog at while under anesthesia for the 2 hour procedure?

- 90 ml/hr
- 360 ml/hr
- 45 ml/hr
- 180 ml/hr

**Explanation** - Animals under anesthesia for surgery need **5-10 ml/kg/hr** of an isotonic crystalloid for "maintenance". In this case, a 43 kg dog needs between 215-430 ml/hr to be in this range. Therefore 360 is the best answer as it corresponds to about 8.4 ml/kg per hour. You will not be allowed to use a calculator at your exam, and you should be able to evaluate these numbers without one. The easiest way to do this is to say that 10 ml/kg per hour would be 430 ml/hr for this dog and therefore, half of that (215 ml/hr) would be the lower end of this range.

Note that anesthetic maintenance rates of fluids are substantially higher than the usual maintenance fluid requirement for a dog of 2-3 ml/kg/hr. This increased requirement compensates for evaporation during surgery, metabolism of water, and lack of intake.

---

### Question

You have a 7 year old female Great Dane patient that presents with a 2 cm dermal mass. Because she has a history of multiple benign dermal masses, you elect to perform a quick marginal excisional biopsy. You expect this to be a brief, 5 minute procedure, but you do need the dog to be anesthetized fully. Which of these is the barbiturate with the shortest duration and time to onset of action?

- Morphine
- Pentobarbital
- Phenobarbital
- Thiopental

**Explanation** - The correct answer is thiopental. Morphine is an opioid. The rest of the drugs are barbiturates. Thiopental is an **ultra-short acting barbiturate** used for induction of anesthesia. Pentobarbital is intermediate acting and phenobarbital is long acting, so these drugs are used for long term sedation and seizure control.

---

### Question

Which of the following can be used to reverse the effects of medetomidine?

- Xylazine
- Atipamezole
- Naloxone
- Atropine

**Explanation** - The correct answer is atipamezole. Medetomidine is an alpha 2 agonist sedative/analgesic often used for premedication to general anesthesia, chemical restraint, and for epidural anesthesia/analgesia. Atipamezole is a potent alpha 2 antagonist that reverses the effects of alpha 2 agonists. Other alpha 2 antagonists include yohimbine and tolazoline.

---

### Question

For what type of surgery would nitrous oxide be contraindicated for use as part of an anesthetic protocol in a dog?

- Splenic surgery
- Open chest surgery
- Renal surgery
- Gastrointestinal surgery
- Hepatic surgery

**Explanation** - The correct answer is **gastrointestinal surgery**. Nitrous oxide moves into closed gas spaces such as the intestines. As such, its use is contraindicated in **bowel surgeries**.

You should also be aware that nitrous oxide decreases fractional inspired oxygen levels although this can be managed and monitored in most instances. Nitrous oxide is contraindicated when pathology such as pulmonary bullae are present.

---

### Question

Which of the following has the least effect on heart rate?

- Propofol
- Morphine
- Ketamine
- Thiopental

**Explanation** - The correct answer is propofol. Ketamine causes an increase in heart rate and blood pressure. It is considered seizureogenic and has poor muscle relaxation effects, however it provides good analgesia. Thiopental is an ultra-fast acting thiobarbiturate that causes an increased

heart rate, increased blood pressure, and decreased in cardiac contractility. It is also an arrhythmogenic agent. Morphine is an opioid that causes bradycardia. Propofol does not result in any significant cardiac changes. It is ultra-short in duration, can cause apnea and myoclonus, and is considered anticonvulsive. It may cause a mild bradycardia but you mainly see that when used in combination with other opiates. More recently propofol has been associated with myocardial depression and hypotension in critically ill dogs and may not be the induction agent of choice as a result. Despite these findings, propofol still has the least effect on heart rate.

---

### Question

Which of the following gas anesthetic agents will result in the quickest recovery?

- Sevoflurane
- Halothane
- Isoflurane
- Ether

**Explanation** - The correct answer is **sevoflurane**. The reason for this is that it has a very low blood-gas partition coefficient. This means that sevoflurane does not readily dissolve in the blood. As a result, the alveolar concentration is close to the same concentration present in the brain, and the concentrations will reach equivalence very rapidly. This is in contrast to ether, which is very soluble in blood, resulting in accumulation of ether in other tissues. This accumulation results in longer times for a patient to fall asleep and wake up. Halothane and isoflurane are not as soluble as ether, but sevoflurane has the least solubility. Do not confuse solubility with MAC (minimum alveolar concentration). Remember, MAC represents the concentration at which half the population would be anesthetized. For example, the MAC of sevoflurane is approximately 2.4 whereas that for Halothane is 0.89.

---

### Question

Which inhalant anesthetic that might be used for a cat may break down to a nephrotoxic metabolite?

- Sevoflurane
- Nitrous oxide
- Halothane
- Isoflurane

**Explanation** - The correct answer is **sevoflurane**. A break down product of sevoflurane is **Compound A**, which can be nephrotoxic.

---



### Question

When considering a dog that is hypoventilating you realize that the dog is in \_\_\_\_\_.

- Metabolic alkalosis
- Respiratory acidosis
- Metabolic acidosis
- Respiratory alkalosis

**Explanation** - The correct answer is respiratory acidosis. There is bound to be some sort of acid-base question on the exam. This question might look tricky, but it is truly simple. Think about the information you are given; all you know is the dog is hypoventilating. So there is buildup of CO<sub>2</sub>; in effect the dog is in respiratory acidosis. Remember, CO<sub>2</sub>=Acid. Since you have no other information, there is no way to diagnose a metabolic acidosis or alkalosis. Some causes of respiratory acidosis include airway obstruction, open pneumothorax or flail chest, neuromuscular disease, abdominal enlargement, pleural space disease, and bicarbonate therapy.

---

### Question

You are performing one of your first myelograms on a 6-year old Dachshund dog. On recovery from anesthesia, the dog starts to seizure. What should be your first intervention?

- Give 0.05 mg/kg acepromazine IV
- Give a loading dose of potassium bromide (KBr) IV
- Give 0.5 mg/kg diazepam IV
- Re-anesthetize the dog

**Explanation** - It is likely that the radiographic contrast used in the myelogram has caused this seizure. **Diazepam** (or midazolam) is the first drug you should reach for in a seizing dog.

Re-anesthetizing the patient may not stop the seizure activity. KBr is loaded over several hours and would not be effective acutely; in addition, this is not a patient that should need maintenance therapy for seizures, and therefore would not benefit from a loading dose of KBr.

---

### Question

Dopamine is often used for which of the following reasons?

- To increase contractility of the heart
- To increase heart rate
- To decrease blood pressure
- To increase arterial blood pressure

**Explanation** - The correct answer is to **increase blood pressure**. High doses of dopamine are used as an alpha agonist to increase peripheral resistance and increase blood pressure. It is often used **during anesthesia** and **emergency situations to alleviate hypotension**.

---

### Question

What is the expected PaO<sub>2</sub> in a healthy dog at sea level, anesthetized with halothane in 100% oxygen?

- 1000 mmHg
- 300 mmHg
- 100 mmHg
- 500 mmHg

**Explanation** - The correct answer is 500 mmHg (**5X the inspired concentration of oxygen**). If receiving pure oxygen (100%) at sea level, the dog's PaO<sub>2</sub> should be >450 mm Hg. Since room air is 21%, the arterial O<sub>2</sub> should be 105 mmHg when breathing room air.

---

### Question

Which of these drugs can be used to reverse anesthesia induced by xylazine in a cat?

- Flumazenil
- Medetomidine
- Yohimbine
- Naloxone
- Tiletamine

**Explanation** - The correct answer is yohimbine. Xylazine is an alpha-2 agonist. Yohimbine is an alpha-2 antagonist. Medetomidine is also an alpha-2 agonist. Tiletamine is a dissociative anesthetic similar to ketamine. Naloxone is an opioid antagonist. The alpha-2 agonists are xylazine, clonidine, detomidine, romifidine, and medetomidine. Alpha-2 antagonists are yohimbine, tolazoline, and atipamezole. Flumazenil reverses benzodiazepines such as midazolam.

---

### Question

A 3-year old male castrated domestic short hair cat is given a large dose of oxymorphone for analgesia. Shortly after intramuscular administration of the drug, the cat is excessively sedate and barely rousable. Which drug can be used to reverse the oxymorphone?

- Buprenorphine
- Naloxone
- Yohimbine
- Morphine

**Explanation** - The correct answer is naloxone. Butorphanol can also be used to reverse mu agonists like oxymorphone (but it wasn't in the list of choices). It is a partial mu antagonist, kappa agonist. Morphine is a mu agonist and would have a similar effect on the cat as oxymorphone. Buprenorphine is a partial mu agonist, kappa antagonist and would not effectively reverse the effects of pure mu agonists. Yohimbine is used to reverse alpha 2 agonists such as xylazine. Naloxone is the only opioid antagonist amongst the choices that can be used to effectively reverse the mu agonists.

---

### Question

Propofol is a good choice as an anesthetic agent in practices that do significant amounts of anesthesia in cats for which of these reasons?

- Propofol can be effectively administered to fractious cats by intramuscular injection
- Cats usually recover from propofol anesthesia rapidly and smoothly
- Propofol can be safely used in debilitated cats because it does not cause respiratory depression
- Propofol can be safely used in cats that require repeated anesthetics (i.e. daily bandage changes) for several weeks in contrast to other agents which can accumulate
- Even though cats require small volumes of propofol, it has a long shelf life once opened and can be reused for up to a six months if stored properly

**Explanation** - Propofol is rapidly distributed and cleared in dogs and cats which allows for rapid and smooth induction and recovery in most cases.

Repeated propofol use has been shown to cause **Heinz body anemia** and signs of illness in cats.

Because propofol is in an emulsion that can grow bacteria, it must be used within 6 hours of being opened unless you have the new formulation which can last up to 28 days (Propoflo 28).

Propofol can only be given intravenously.

Apnea is the most common side effect of propofol administration.

---

### Question

Your colleague is preparing to perform a punch biopsy of a dermal mass in a cat under local anesthesia. He adds epinephrine to his lidocaine before administering the local anesthetic. What is the rationale for adding epinephrine?

- Epinephrine, when given by this route, has a sedative effect on cats
- Epinephrine acts as a pharmacologic antagonist to the systemic effects of lidocaine, which cats can be particularly sensitive to

- Epinephrine neutralizes the acidic pH of lidocaine, decreasing the pain on injection
- Epinephrine prolongs the duration of lidocaine's effects

**Explanation** - Epinephrine is used with lidocaine to cause local vasoconstriction, preventing rapid systemic absorption. This is typically done to prolong the duration of local anesthetic effects of lidocaine by maintaining it at the site. It can decrease systemic uptake and toxicity, but it is not a lidocaine antagonist.

Epinephrine does not neutralize the pH of lidocaine; sodium bicarbonate is sometimes added for this purpose.

---

### Question

Which is not a possible cause of low PaO<sub>2</sub> in an anesthetized cat?

- Hyperventilation
- Low inspired oxygen
- Diffusion impairment
- Ventilation/perfusion mismatch

**Explanation** - The answer is hyperventilation. Hyperventilation will not cause reduced PaO<sub>2</sub> although hypoventilation can if severe enough. The causes of hypoxemia are low inspired oxygen, hypoventilation, V/Q mismatch, shunt, or diffusion impairment.

---

### Question

You need to heavily sedate a 3-year old fractious cat for an ear exam. You would like to use an alpha-2 adrenergic agonist. Which drug can you use?

- Yohimbine
- Medetomidine
- Acepromazine
- Thiopental
- Atipamezole

**Explanation** - Medetomidine is a strong sedative that causes peripheral vasoconstriction and bradycardia as side effects. Acepromazine is a phenothiazine sedative. Yohimbine and atipamezole are reversal agents for alpha-2 adrenergic agonists (they are alpha-2 adrenergic blockers), and thiopental is a barbiturate.

---

### Question

Which of these drugs is used as a premedication prior to anesthesia to decrease salivary secretions, facilitating intubation in cats?

- Midazolam
- Atropine
- Acepromazine
- Morphine

**Explanation** - The correct answer is atropine. Atropine is an anticholinergic drug sometimes used as a premedication in order to decrease secretions. It also is frequently used to counteract some of the effects of other drugs on the heart.

---

### Question

A cat arrives at your clinic in hypovolemic shock. After your initial assessment you decide to administer a shock dose of crystalloid fluids. How many mls/kg will you give?

- 80-90 ml/kg
- 10-15 ml/kg
- 50-55 ml/kg
- 120-125 ml/kg

**Explanation** - The correct answer is **50-55 ml/kg** (blood volume of a cat). Volumes higher than this can overload your patient. Remember, cats cannot handle large volumes of fluid as well as dogs. 10-15 ml/kg is simply not enough for a cat in hypovolemic shock.

---

### Question

You need to perform a CBC and take thoracic radiographs on a somewhat fractious cat. You sedate the cat with an intramuscular injection of medetomidine. While on the X-ray table, you become concerned that the cat is not doing well and you decide you want to reverse the effects of medetomidine. What should you give the cat?

- Xylazine
- Atropine
- 2-pralidoxime
- Flumazenil
- Atipamezole

**Explanation** - Atipamezole (trade name: Antisedan), an alpha-2 antagonist, is the reversal agent for medetomidine (trade name: Dormitor). Medetomidine is an alpha-2 agonist.

Xylazine would be another example of an alpha-2 agonist. Yohimbine is its reversal agent. Other alpha-2 agonists are clonidine, detomidine, dexmedetomidine and romifidine

2-pralidoxime is a reversal agent for cholinesterase inhibitors.

Flumazenil is a reversal agent for benzodiazepines

Atropine is a muscarinic antagonist of acetylcholine and may be dangerous to use after administration of alpha-2 agonists. This is because alpha-2 agonists cause marked vasoconstriction and high afterload on the heart. Giving atropine and increasing the heart rate can place further stress on the heart. You do not want to set in motion peripheral vasoconstriction and compensatory bradycardia brought on by the alpha-2, then increase the heart rate against that high afterload. This could make for an unhappy heart in the event underlying subclinical heart disease is present.

---

### Question

You are performing a fracture repair of the tibia and fibula in a 4-year old Siberian Husky. Which of the following would provide at least 12 hours of analgesia after the procedure?

- 10 ug/kg of fentanyl given intravenously intraoperatively and immediately postoperatively
- 0.1 mg/kg of hydromorphone given subcutaneously intraoperatively and immediately postoperatively
- 4 mg/kg lidocaine given epidurally
- 0.1 mg/kg preservative free morphine given epidurally

**Explanation** - Epidural morphine is an effective analgesic for 12-24 hours, while lidocaine lasts only several hours. Fentanyl is a short acting opioid and would only be effective over 12 hours if given repeatedly or as a constant rate infusion (CRI). The effects of hydromorphone last only 4-6 hours.

---

### Question

A 2-kg kitten is being spayed at the humane society; she is intubated and is on isoflurane gas for maintenance. She is on IV fluids at 10 mL/hr. Her blood pressure starts to drop during the procedure. You have already given her a bolus of fluids. Which of the following should you do first to try to increase her blood pressure?

- Turn down the anesthetic gas
- Give a dose of atropine
- Turn off the heat support to prevent peripheral vasodilation which decreases blood pressure
- Give a 90 ml/kg bolus of a crystalloid fluid intravenously

**Explanation** - Anesthetic gas is a potent vasodilator and causes profound hypotension, especially in small patients. Decreasing the vaporizer setting in addition to crystalloids and colloids can help to facilitate getting the blood pressure up. If the pressure cannot be managed by these simple

measures, drugs such as **dobutamine** may be needed to help with blood pressure during the procedure.

A dose of **atropine** will not increase blood pressure directly; it will only increase heart rate. Good heat support actually helps to keep the blood pressure more stable and is especially important in small patients to prevent hypothermia. A 90 ml/kg bolus would be a "shock dose" of fluids for a dog but is too much for a cat, and this cat is hypotensive for other reasons.

---