Anesthesia & Analgesia Mythbusters

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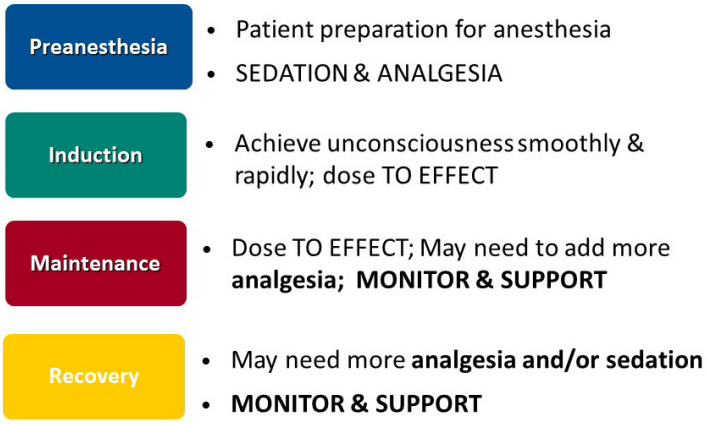
What we were taught, or what we remember, regarding anesthetic and analgesic drugs and techniques may no longer be true. Let's bust some myths!

Myths exist for anesthesia as a whole and also exist in all of the four phases of anesthesia:



Anesthesia Overview

The number one myth in all of anesthesia: *"My breeder said that my dog (or cat) is 'sensitive' to anesthesia"*. The only true breed association that we currently know is the inability of Greyhounds to efficiently metabolize drugs – primarily barbiturates. It may also be true that herding breed dogs like Collies will have an exaggerated response to some sedative/anesthetic drugs like acepromazine due to an alteration in the P-glycoprotein transport system caused by an alteration in the MDR1 gene (test for mutation available at http://vcpl.vetmed.wsu.edu/). There are, of course, breeds that have breed-related disease or anatomical abnormalities that make them more dangerous to anesthetize (eg, brachycephalics, Dobermans with VonWillebrand's disease, etc…) but this does not make them 'sensitive' to anesthesia. There are also size-related concerns (small dogs and cats are at higher risk for anesthesia-related death) but, again, not 'sensitivity'. Of course, some day all medicine will be determined by our unique DNA-makeup – and then we might discover more true anesthetic sensitivities.

For analgesia, an unfortunate persistent myth is that animals don't feel pain. Scientifically we can debunk this since mammals (and many other animal classes). If something is painful to a human, it will incite pain in other mammals. Another common myth is, 'pain is beneficial' in limiting a recovering animal's activity'. Protective pain, the pain that limits movement to protect tissue injury, is necessary – and is not eliminated by most of our analgesic drugs. Pathologic or maladaptive pain, the pain that exists beyond that needed for protection, leads to pain-related adverse effects and should be treated. In reality, animals are more restless when they are in pain (think about how you feel when you are painful) and, again, the pain can cause adverse effects. Furthermore, most animals will move if they want to, whether protective pain is present or not. We have to be good caregivers and limit movement using sedatives, cages, stalls, leashes, cross-ties, etc…. Pain won't limit movement – but we can!

Preanesthesia

Myth: Old or sick patients don't need a premedicant. WRONG. And dangerous. Old and sick patients definitely need a premedicant so that the dose of induction and maintenance drugs can be decreased. They just don't need the same premedicant – or the same dose – as a young, healthy patient.

Sedatives / tranquilizers / analgesic drugs

1. Opioids

- Morphine, hydromorphone, methadone, oxymorphone, fentanyl, butorphanol, buprenorphine
- **Advantages**: provide moderate to profound analgesia; reversible
- **Disadvantages**: may not provide enough sedation when used alone in young, healthy or excited patients; DEA controlled drugs (not really a disadvantage, just something to remember)
- **Myths:**
  1) *Opioids cause profound respiratory depression*. This is actually true in humans but not in veterinary patients.
  2) *Opioids should not be used because they cause vomiting*. Unless the patient has a reason that vomiting is contraindicated (eg, esophageal foreign body or increased intracranial pressure), vomiting empties the stomach prior to anesthesia – which is generally a good thing.
  3) *Butorphanol provides adequate duration analgesia for surgical pain*. Butorphanol is an agonist-antagonist with moderate potency and a very short duration of action (approximately 60 mins in a dog and 90 mins in a cat). Most surgeries last longer than butorphanol-mediated analgesia lasts.
  4) *Tramadol is a potent opioid that is an excellent choice for treating pain*. Tramadol is actually a weak opioid that has a highly variable bioavailability and rapid clearance rate in dogs. It is a decent add-on drug as part of multimodal therapy but is not generally appropriate for pain management when used alone.

2. Acepromazine

- **Advantages**: Inexpensive; mild to moderate sedation; long-lasting (good if you want a slow recovery)
- **Disadvantages**: No analgesia; mild to moderate sedation (ie, may need more sedation in some patients); long-lasting (bad if you don't want a slow recovery).
- **Myths**:
  1) *Acepromazine causes seizures*. This myth has been proven wrong by several very good clinical research projects. Acepromazine does not cause seizures and may even be protective against seizures.
  2) *Acepromazine causes hypotension*. Acepromazine causes vasodilation and can cause hypotension if used at high dosages or used in patients that are already prone to hypotension (eg, septic or dehydrated patients) but it does not cause hypotension when used at clinically appropriate dosages in clinically appropriate patients.
  3) *Acepromazine should never be used in patients with heart disease*. Actually, low-dose acepromazine can decrease afterload through vasodilation, which decreases the amount of cardiac work needed to eject blood. So a light dose of ace might be a good choice – unless the patient is hypotensive.

3. Alpha-2 adrenergic agonists (Domitor®, Dexdomitor®)

- **Advantages**: provide analgesia; effects are reversible; can provide anything from light to deep sedation.
- **Disadvantages**: cause cardiovascular changes that are well-tolerated in patients with healthy hearts but are not appropriate for patients with cardiovascular disease.
- **Myths**:
  1) *Alpha-2 agonists are very dangerous and are not appropriate for most patients*. Alpha-2 agonists actually have a very wide safety margin and are appropriate for many patients. Plus they are reversible, which provides a 'safety net' if adverse events do occur. Of course, alpha-2 agonists are not appropriate for patients with cardiovascular disease.
  2) *Alpha-2 agonists cause bradycardia, which causes **hypo**tension*. The bradycardia caused by alpha-2 agonists is actually a normal physiologic reflex that occurs in response to alpha-2 receptor mediated vasoconstriction and **hyper**tension. The decreased heart rate decreases cardiac work, which is a good thing!
  3) *The effects of alpha-2 agonists must always be reversed*. Not true! Reversal is an excellent safety net or convenience factor but many patients (think barking dogs!) benefit from alpha-2 mediated sedation. If

they are recovering well and are in a location where they can be observed, it might be a good idea just to let them sleep. And remember that reversal also eliminates any alpha-2 mediated analgesia.
4) *Alpha-2 agonists should not be administered to patients over 7 years of age*. There is no magic at 7. If the patient could benefit from a potent sedative that is reversible and provides analgesia then the patient should have that sedative no matter what age it is. Only cardiovascular disease – not age – precludes the use of alpha-2 agonists.

4. Benzodiazepines *- Diazepam (Valium®) and Midazolam (Versed®)*

- **Advantages**: minimal to no side effects, reversible
- **Disadvantages**: generally don't provide adequate sedation when used alone in young, healthy or excited patients; no analgesia; DEA Class IV drugs (not really a disadvantage, just something to remember).
- **Myths**:
  Benzodiazepines are great sedatives. Benzodiazepines are actually fairly poor sedatives in animals but can add to sedation – and muscle relaxation – provided by other sedatives. They can cause paradoxical excitement by 'relieving inhibitions' in patients that are 'inhibited' to misbehave.

Induction

1. Propofol

- **Advantages**: rapid induction and recovery; multiple routes of clearance from the body; good muscle relaxation.
- **Disadvantages**: must be administered IV; causes mild to moderate respiratory and cardiovascular depression.
- **Myths**:
  1) *Propofol does not cause any adverse effects, which is what makes it the best choice for critical patients.* Propofol actually causes moderate respiratory and cardiovascular depression but this is dose dependent so be sure to premedicate so that the dose is as low as possible. Propofol is a good choice for critical patients because it can easily be titrated 'to effect' (meaning that we can give the patient exactly the dose it needs for induction – unlikely to overdose when titrating 'to effect') and is cleared by multiple routes, so that organ dysfunction does not cause delayed recovery from the drug.
  2) *Propofol must be discarded after within hours after opening*. That is the recommendation for the propofol without preservatives. There is a new product available that does not require discard for 28 days☺.
  3) *Propofol is dangerous to cats*. The **dose** of propofol (and any other drug) is dangerous to cats – just like it is to dogs – but it is easy to administer propofol to cats without a premedicant because the volume is small so many people administer this way. However, this causes an overdose and it is the overdose – not the propofol – that is dangerous. Neither preservative-free nor preservative-containing propofol is labeled for cats but there is a great deal of data to prove that propofol is both safe and effective in cats.
  4) *The new propofol (Propoflo28) cannot be administered to cats because the preservative in the product kills cats.* The preservative (benzyl alcohol) in Propoflo28® is not at all dangerous to cats when the propofol is administered at clinically relevant dosages (Taylor et al., Evaluation of propofol containing 2% benzyl alcohol preservative in cats. J Feline Med Surg. 2012;14(8):516-26). An overdose could cause toxicity – but an overdose of the propofol is probably more dangerous than an overdose of the preservative.

2. Ketamine

- **Advantages**: inexpensive; can be administered IM; mild respiratory depression; no cardiovascular depression in heart-healthy patients.
- **Disadvantages**: very poor anesthesia and no muscle relaxation when use alone - must be combined with a sedative such as valium, medetomidine or dexmedetomidine; DEA Class III drug (not really a disadvantage, just something to remember).

- **Myths**:
  1) *Ketamine is an old drug that has no place in modern veterinary medicine*. Ketamine is an excellent induction drug (see advantages above) and can be used in an infusion to help provide analgesia.
  2) *Ketamine cannot be used in certain dog or cat breeds*. Absolutely wrong. There is way too much inappropriate and incorrect information on the internet!

3. Telazol®

- **Advantages**: potent; rapid induction; can be administered IM
- **Disadvantages**: recoveries can be prolonged and rough (especially in dogs); fixed ratio of tiletamine:zolazepam; DEA Class III drug (not really a disadvantage, just something to remember).
- **Myths**:
  Maybe none, but the combination is similar to ketamine/diazepam so myths might be similar.

4. Alfaxalone

- **Advantages**: rapid induction and recovery; can be administered IM.
- **Disadvantages**: causes mild to moderate respiratory and cardiovascular depression; can cause hyper-reactivity in recovery; must be discarded 6 hours after opening vial; DEA Class IV drug (not really a disadvantage, just something to remember)
- **Myths**:
  1) *Alfaxalone is safer than propofol.* Actually, the physiologic effects caused by alfaxalone are very similar to those caused by propofol. Both drugs excellent choices when the drugs are titrated 'to effect' to patients that have been premedicated with drugs that lower the necessary induction dose.
  2) *Alfaxalone is a great choice for IM administration in cats.* It is an okay choice if used at low dosages in combination with other sedatives. The volume is too large if the IM label dose is used (10 mg/kg outside US – not on US label). Best IM use is for small mammals ('pocket pets') and small 'exotic' pets, not cats.

***5.* Etomidate**

- **Advantages**: no cardiovascular changes
- **Disadvantages**: expensive; poor muscle relaxation; vocalization
- **Myth**:
  Etomidate is the only drug that can safely be used to induce patients with cardiovascular disease. This is the drug preferred for patients with very severe heart disease but most patients with mild to moderate disease can be safely induced with an opioid/benzodiazepine/low-dose propofol or alfaxalone combination.

***6.* Mask Induction or box induction**

- **Drugs**: Isoflurane, sevoflurane or desflurane
- **Myth**:
  Induction to anesthesia with an inhalant alone is the safest way to induce patients to anesthesia.
  WRONG. In fact, using an inhalant for both induction and maintenance with no other drug on board is a risk factor for anesthesia related **death** (Brodbelt 2009). Induction to anesthesia with inhalant anesthetic drugs alone ('masking' or 'boxing') should be avoided in all but the direst circumstances. Here are the reasons that induction to anesthesia with inhalant anesthetic drugs alone is not recommended for most patients:
- Masking / boxing down is **dangerous to the patient**
  - The dose of the drug is extremely high and adverse effects are dose-dependent; excitement causes increased need for drugs so the induction dose has to increase even more; excitement causes adverse physiologic effects
- Masking/boxing down is **dangerous to the staff**
  - Chronic exposure to anesthetic gases can cause health problems

Maintenance

Anesthetic Drugs:

1. Isoflurane - moderate cardiovascular and respiratory depression, small % metabolized
2. Sevoflurane – physiologic effects similar to isoflurane but faster induction, recovery and change of anesthetic depth
3. Desflurane – physiologic effects similar to isoflurane but even faster changes in anesthetic depth than sevoflurane, very expensive vaporizer

- **Advantages of inhalants in general**: easy to administer; relatively inexpensive; are eliminated with minimal metabolism; require oxygen for delivery; generally require intubation for delivery.
- **Disadvantages of inhalants in general**: contribute significantly to hypoventilation, hypotension and hypothermia. MONITOR, MONITOR, MONITOR.
- **Myth (inhalants in general)**:
  Inhalant anesthetics are very safe, no matter what dose is delivered by the vaporizer. Inhalant anesthesia is generally the safest and most effective way to maintain anesthesia that will last 30 minutes or more – but inhalants are only as safe as the anesthetist is. Inhalant anesthetic drugs should never be used as the sole anesthetic since **this group of drugs causes significant DOSE-DEPENDENT hypotension, hypothermia, and hypoventilation**. Our goal should always be to keep the vaporizer at the *lowest possible setting*. We often need to add extra analgesia to allow a decrease in the vaporizer setting.

Analgesic drugs & techniques:

Myth: *Analgesia is not necessary while the patient is under general anesthesia.* In fact, analgesia in anesthetized patients is extremely important for both improving the safety of anesthesia (because the patient can be maintained at a lower concentration of inhalant anesthetic) and decreasing the degree of postoperative pain (the more aggressive we are at treating intraoperative pain, the more comfortable the patient will be postoperatively). Aggressive treatment of acute pain may also lead to a decreased incidence of chronic pain. Intraoperative analgesia can be supplied by using boluses, infusions or local injections.

1) Boluses of opioids or alpha-2 agonists: Easy to administer; may provide only short duration analgesia

2) Infusion of opioids, lidocaine, ketamine or alpha-2 agonists
- **Advantages**: Can provide anything from mild to profound analgesia for any duration necessary
- **Disadvantages**: Requires a little more work than bolus administration
- **Myth**: *Infusions are hard and expensive.* Infusions are EASY (all you need is a dosing sheet or spreadsheet so that you don't have to do math) and CHEAP.

3) Local anesthetic drugs
- **Advantages:** Easy to use, effective, inexpensive;
- **Disadvantages:** Really none
- **Myth**: *Local blocks are hard to do and there will be adverse effects if I miss the injection spot.* Local blocks are EASY! Just use your knowledge of anatomy (and look in a book that describes local blocks☺. And if you miss the injection spot, the analgesia won't be very good but it is VERY UNLIKELY that the local anesthetic was deposited anywhere that it might cause harm. Just don't overdose – as with any drug, overdose can cause adverse effects.

Recovery

Recovery is an oft-overlooked phase of anesthesia and yet it is equally as important as the other 3 anesthesia phases.

Myths:

1) *Once the vaporizer is turned off, the patient is fine.* Actually, most deaths occur in the recovery phase of anesthesia☹. WHY? The patient may be a little deeper than we think – especially if it is very young, very old, or diseased (these groups of patients require lower dosages of anesthetic drugs). In recovery we tend to remove all monitoring and support so a patient that was doing 'okay' under anesthesia may suddenly decompensate without support (oxygen, fluids, etc…) and we aren't monitoring to know that it is happening. We can greatly improve this statistic by spending a little extra time in recovery!

2) *Hypothermia isn't a big deal.* Hypothermia is not at all benign and actually causes a variety of complications including clotting dysfunction, increased risk of infection, tissue hypoxia, acidosis, abnormal cardiac electrical conduction, myocardial ischemia, etc... (Noble 2006). Hypothermia also causes cerebral effects that decrease the patient's anesthetic needs. Unfortunately, the decreased anesthetic need is not always recognized and the delivery of anesthesia is not changed, resulting in an overdosage of anesthetic drugs. Although shivering in recovery may increase the body temperature, the intensive muscle movements associated with shivering causes discomfort and increases oxygen consumption by as much as 200% (Sessler 2002). In fact, in human medicine, an active area of research centers on prevention of shivering in the postoperative period. Finally - and importantly - hypothermia is the main cause of prolonged recoveries from anesthesia in small animal patients.

3) *Excitement in recovery is normal.* A BRIEF period of mild to moderate dysphoria right at extubation may be normal as the patient goes back through Stage II of anesthesia (the normal excitatory phase). But prolonged (>1-2 mins) or severe excitement is not normal and should not be tolerated. Is it pain or dysphoria? It doesn't matter – for the sake of the patient, the other patients within earshot and the owners/technicians/veterinarians/staff that are in ear shot – TREAT IT!!! First address analgesia and consider an opioid, but if the opioid isn't effective – or if an opioid has recently been administered, use alpha-2 agonists. This 'rescue' from bad recovery is one of my favorite uses of the alpha-2 drug class. These drugs are sedative/analgesics so it doesn't matter if the patient is experiencing dysphoria or pain – we are treating both! Dose for this use: 1-3 microg/kg IV or 3-5 microg/kg IM (higher end of either dose for cats) will achieve 10-30 mins of light-moderate sedation and analgesia.

4) *It is better for a patient to be painful than risk the adverse effects of NSAIDs since this is not a very safe drug class*. In fact, when compared to the number of dosages used, the number of adverse effects is VERY low. And because this drug class treats pain at its source (inflammation), it is a very powerful drug class.
   - ***Non-steroidal anti-inflammatory drugs***
     - **Advantages**: CONTROL INFLAMMATION! Easy to use, not controlled
     - **Disadvantages**: Not appropriate for patients with renal, hepatic or GI disease

5) *NSAIDs should not be administered to cats*. This appears to be 'true' only in the US. Cats in the rest of the world do very well on NSAIDs. Could it be that we aren't dosing NSAIDs properly in the US?