



Ten Tips to Improve Anesthesia in Your Practice

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Anesthesia is an everyday occurrence in most veterinary practices, and many practitioners and veterinary staff rely on the same anesthetic methods they always have used. However, for the good of the patients being treated and in the pursuit of best medicine, challenge yourself to improve your anesthetic standards. The following 10 tips are a great place to start.

1 Expect More

The anesthesia mortality rate for dogs and cats is approximately 1:1000.¹ For a general veterinary practice that performs 2 or 3 surgeries per day (approximately 500–750 surgeries/year) this equates to 1 anesthetic death either every year or every other year. For a busy veterinary practitioner, those numbers do not seem remarkable or even worrisome.

However, if we compare those expectations to those of human medicine—where anesthetic mortality has fallen to almost 1:1,000,000—it sounds less impressive.² With such a low mortality rate, a veterinarian would likely go an entire career without experiencing an anesthetic death. This huge difference in mortality should inspire veterinarians to ask: why do we lose more patients and what can we do about it?

One stark contrast is that in human medicine, anesthesia is administered by people trained and dedicated to that endeavor. Furthermore, for

people, there are mandates regarding the use of monitoring equipment. Since it is unlikely that there are enough behavioral, physiologic, or anatomic differences to account for why human mortality rates are that much lower, we must entertain the idea that training of personnel and monitoring of patients affects mortality rates (see **Tips 4 and 5**).

These facts should motivate veterinary professionals to raise their expectations and be willing to dedicate resources (people, time, and money) to decreasing anesthetic mortality rates.

2 If Analgesia Is Good; More Than One Type of Analgesic Is Even Better

Veterinary medicine has progressed past the idea that animals don't feel pain and don't need analgesics. In fact, most veterinarians routinely use and prescribe analgesics for their patients. However, based on the consult calls I receive, they rarely use more than 1 class of analgesic at a time.

When trying to modify the pain pathway, it is useful to contemplate the anatomic and physiologic components and identify which components can be attenuated. In brief, for a noxious stimulus to be recognized as pain there has to be:

1. **Transduction:** The point where somatic or visceral nociceptors change stimuli into an action potential.
2. **Transmission:** The ascending movement of the action potential toward the cerebrum.
3. **Modulation:** Noxious information is attenuated or

WHAT IS CENTRAL SENSITIZATION?

Central sensitization (wind-up pain) is a maladaptive state that occurs when neurons in the dorsal horn of the spinal cord have exaggerated or amplified responses to sensory input. Patients that have intense (eg, burns) or chronic (eg, neoplastic) stimulation are at risk of developing central sensitization, which generally responds poorly to conventional analgesics (eg opioids). The NMDA receptor has been implicated in the formation of wind-up pain and NMDA receptor antagonists (eg ketamine) have been shown to interrupt and/or break the sensitization.

Read Dr. Mark Epstein's article, *Ketamine: To Use or Not to Use for Pain Management* (July/August 2011, available at todaysveterinarypractice.com), to discover more about using ketamine in companion animal veterinary medicine.

amplified most commonly at the dorsal horn of the spinal cord.

4. **Perception:** Perception of pain occurs only when the stimulus reaches the cerebral cortex.
 - Drugs that work at the point of nociception include nonsteroidal anti-inflammatory drugs (NSAIDs) (to decrease inflammation), local anesthetics (to decrease neuronal transmission), and morphine (for peripheral places that have morphine receptors, such as joint capsules).
 - The dorsal horn of the spinal cord is rich with opioid (eg, morphine), alpha-2 (eg, dexmedetomidine), and *N*-methyl-D-aspartate (NMDA) receptors (eg, ketamine), all of which decrease transmission of pain signals.
 - The cerebrum has a similar population to the dorsal horn of the spinal cord but there is evidence that some NSAIDs also have a central analgesic effect.³

In addition, the perception of pain may become a multidimensional experience that includes fear, anxiety, distress, and autonomic and neuroendocrine responses that may contribute to patient morbidity and even mortality. Decreasing transmission of pain in more than 1 part of the pathway not only provides better analgesia, but is potentially safer because it results in smaller doses of drugs for shorter periods of time, lowering the risk of adverse side effects.

3 Why Are You Doing Peri-Anesthetic Blood Analysis?

Routinely performing peri-anesthetic blood analysis is controversial and veterinarians routinely argue about its necessity and/or benefit.

The argument revolves more around the reason for performing testing, not about whether testing should be done. That is—are you recommending or requiring blood analysis to make sure the patient is a safe anesthetic risk or as a screening tool for good medical care? Most veterinarians agree that sick patients should have routine blood

testing, but the patient that is not systemically ill (eg, cruciate ligament repair) or has an emergent but nonphysiologic issue (eg, penetrating corneal foreign body) presents a philosophical gray area.

A recent study determined that performing peri-anesthetic blood analysis rarely alters the anesthetic plan in dogs.⁴ Good thoracic auscultation and history are more likely to identify a problem that would be significant under anesthesia than would a blood test. However, the blood test might reveal a different problem that should be evaluated in a patient, such as mild renal insufficiency in a cat having a routine dental prophylaxis.

Although it is not common to find a significant problem on routine blood analysis; when you do, you are providing excellent medical care, which should always be the goal. Furthermore, although the anesthetic protocol would not likely change for a patient with mild renal insufficiency, it certainly would change the amount and duration of fluid therapy for that patient. My own physician recommends yearly blood analysis despite normal vital signs and history; I believe that is good medicine.

4 Train, Train, & Retrain

Imagine that you are scheduled for a surgical procedure and the anesthetist placing your IV catheter, administering propofol, and monitoring your physiologic parameters is a high school student with little to no anesthesia training. Frightening scenario, isn't it?



Figure 1. Use of multipurpose monitor for dog undergoing anesthesia

I believe 1 of the reasons that human anesthesia has a lower mortality rate is the fact that it requires advanced training of both nurses and physicians who perform anesthesia on top of the fundamental training they've already received. While not

all states require that anesthesia be administered and monitored by licensed veterinary technicians, it makes sense that educated employees generally provide superior care.

Fortunately, there are many opportunities for the veterinary team to brush up on anesthetic drugs, techniques, and monitoring. I routinely see veterinarians and their staff take classes and workshops together so they can implement new/ better techniques into their practices. Everyone on the team needs to be on board to raise the standard of care.

When I graduated from veterinary school, propofol, dexmedetomidine, sevoflurane, carprofen, or even portable physiologic monitors were not yet marketed or widely available. Surely drugs and techniques have changed since you graduated too. Training and retraining is often the only way for veterinary staff to become familiar with new drugs or monitors (**Figure 1**) and how to properly use them.

5 Knowledge Is Power

Anesthetic complications cannot be prevented or treated if you don't know they exist. A profound example is in the use of pulse oximeters. This simple and fairly inexpensive device has greatly decreased mortality in humans undergoing anesthesia. A study showed that the use of pulse oximeters decreased mortality by 20× in the United Kingdom.⁵

Now imagine if you incorporate other devices or simply manpower to monitor anesthesia and how they could identify and treat complications before they became significant or fatal. It is also important to remember that all complications do not initially result in death.

For example, the cat with mild renal insufficiency undergoing a dental prophylaxis is also hypotensive (unbeknownst to you if you don't routinely measure blood pressure). Three days postsurgery, the cat presents in renal failure. While this is a complication that occurred during anesthesia, if the cat dies, it would not be considered an anesthetic death.

6 Treat Each Patient as an Individual

There is definite safety in doing the same thing the same way all the time. Unfortunately, our patients are not the same with regard to age, breed, species, or illness. Using the same anesthetic and analgesic plan for each patient does not provide best medicine.

It is reasonable to have a plan for patients undergoing routine surgeries (eg, ovariohysterectomy/castration in young, healthy dogs and cats). However, it is important to be able to adjust these protocols for patients that are older and/or ill, procedures that fall outside routine surgery (eg, nonpainful radiographs,

painful degloving wound), or complicating medical concerns (eg, liver, cardiac, or renal disease). Follow Tip 4—pursue continuing education (CE) to learn how to individualize anesthetic and analgesic protocols.



Figure 2. Administration of an infraorbital dental block

7 Local Nerve Blocks

Local blocks are one of the easiest and inexpensive ways to improve analgesia in your practice. While there are some more technically difficult local blocks, such as epidurals, there are dozens of simple nerve blocks that can be done for almost all surgeries or painful procedures.

Administering a local block before a painful procedure, allows attenuation of the pain pathway. By preventing full activation of the pain pathway, total analgesic needs are decreased and central sensitization (see **What is Central Sensitization?**) is avoided. Furthermore, local blocks do not produce central nervous system or organ depression, allowing patients to recover more quickly.

There are many websites, books, and CE demonstrations to help the practitioner become proficient in dental (**Figure 2**), incisional, ring, and joint blocks in addition to others. When used properly (perineural; at the correct dosage), lidocaine and bupivacaine are quite safe in dogs and cats and fairly inexpensive.

8 Capnometry: The Unsung Hero

Capnometry and capnographs are incredibly useful monitors that are less frequently used in veterinary medicine. Although the devices are quite easy to use (simply by adding a connection into the breathing circuit, **Figure 3**), interpretation can be difficult. However, the



Figure 3. Connection of a capnometer

information obtained is incredibly valuable.

These devices serve as an:

- Indicator of ventilation (amount of CO₂ exhaled)
- Indirect measure of cardiac output (circulatory system moves CO₂ to the lungs for exhalation).

A capnometer that has a capnograph can provide information, such as:

- Airway obstruction (clogged endotracheal tube)
- Airway constriction (asthmatic and chronic obstructive pulmonary disease complications)
- Expired CO₂ absorbant
- Cardiovascular collapse.

Training and CE can allow you and your team to safely interpret the capnograph wave and number, resulting in exceptional care for your anesthetized patient. Many of the multiparameter physiologic monitors have a capnograph option available; I would strongly recommend using that option.

9 Decrease the Dose of Propofol; Decrease the Side Effects

Propofol has likely become the most common induction agent in small animal practice. It is well liked because it provides a smooth induction, allows quick control of the airway, and is metabolized quickly.

It should be noted, however, that this drug produces myocardial depression, vasodilation and, with large dogs, can require large volumes (> 20 mLs). A simple and effective way to decrease the volume of propofol—either to decrease the volume (use of only 1 bottle) or cardiovascular side effects—is to administer another CNS depressant immediately before propofol administration, which can substan-

tially decrease the amount of propofol used.

In the NCSU Teaching Hospital, dogs and cats are routinely sedated, have an IV catheter placed, and then receive midazolam, 0.25 mg/kg, or fentanyl, 5 mcg/kg, administered IV. After approximately 1 minute, the patient is induced with propofol to effect. In general, this allows for the total volume of propofol to be decreased (approximately $\frac{1}{3}$ following midazolam and $\frac{1}{2}$ following fentanyl).

Since neither midazolam nor fentanyl produce significant myocardial depression (aside from lowered heart rate with fentanyl), the patients who receive smaller doses of propofol have less myocardial depression and generally maintain better blood pressure.

10 Premedications Are About More than Providing Sedation

Veterinarians use premedicants (ie, sedatives, analgesics, anticholinergics) for a variety of reasons. The most common reason cited is to produce sedation for restraint during IV catheterization and/or IV injection. Although this is true, there are other useful reasons:

- **Medication amount:** Premedicants can decrease the amount of induction agent needed to allow intubation as well as decrease the amount of inhalant agent needed to maintain general anesthesia.
- **Cost and safety:** Using less induction agent decreases drug cost and increases safety (by using less drugs that cause CNS and cardiovascular depression).
- **Vasodilation:** Gas inhalants cause vasodilation; by decreasing the amount of inhalant required to keep your patient asleep, vasodilation is decreased and blood pressure is better preserved.
- **Analgesia:** Analgesic premedicants (ie, opioids, alpha-2 agonists, NSAIDs) also provide pre-emptive analgesia,⁶ which decreases central sensitization and total amount of analgesics needed as well as helps mitigate the post-operative pain experience.
- **Sympathetic stimulation:** By decreasing stress and pain, it is possible to decrease sympathetic stimulation. Increases in sympathetic tone can:⁷
 - Increase cardiovascular needs (increased myocardial work and oxygen demands) and respiratory demands (increased CO₂ production and need for elimination)
 - Slow gastrointestinal motility
 - Interfere with renal control of water balance
 - Slow healing (by increasing cortisol)
 - Increase morbidity (people with inadequately treated pain are hospitalized longer and return to function later or not at all).



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Many veterinarians still adhere to the dogma of using fewer drugs in systemically ill patients. However, by using smaller amounts of various sedatives, analgesics, and general anesthetics (balanced anesthesia), the anesthetist can produce stable anesthesia with less side effects, morbidity, and mortality. ■

CE = continuing education; CNS = central nervous system; NMDA = *N*-methyl-*D*-aspartate; NSAID = nonsteroidal anti-inflammatory drug

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