**Whisker of Truth: Fact & Fiction Anesthesia & Analgesia in Cats**

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**Abstract:** The statement that cats are not small dogs applies not only to life, but also anesthesia & analgesia. The differences between cats and dogs may not be large, but they can have a large impact if cat-specific anesthesia/analgesia concerns are not addressed.

**Key Words: cat, feline, anxiety, pain, anesthesia, analgesia**

**Cats Facts**

- Often nervous or fractious: Increased circulating catecholamines and increased Fear/Anxiety/Stress (FAS) = Increased dose of anesthetic drugs required
- Small body size: May be difficult to dose, to fit to monitoring & anesthetic equipment & to keep warm
- Species-specific drug metabolism: May not metabolize drugs the same as dogs do (eg, NSAIDs): Species-specific response to drugs; may respond differently than dogs do (eg, opioids sometimes)

These differences add to the fact that cats are at higher risk than dogs for anesthesia-related deaths (risk factor of 0.11% vs 0.05%, respectively, in healthy patients and 1.33% vs 1.4%, respectively; Brodbelt 2009).

**Preanesthesia**

As with other species, patients should be stabilized prior to anesthesia and premedication should be utilized to improve the safety of anesthesia by allowing a decrease in the dosages of induction and maintenance drugs. Anxiolytics are often very helpful to decrease FAS.

**Common Previsit Pharmaceuticals**

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| Gabapentin | 100-200 mg/cat 2 hours before leaving home +/- night before leaving home |
| Trazodone | 50-100 mg/cat, same timing as gabapentin, can administer with gabapentin |

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| Maropitant | 1-2 mg/kg orally 2 hours before leaving home, nausea/vomiting can cause FAS |

**Preoperative drugs or drug classes and key cat points:**

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| Opioids | Excellent choice for all cats. Moderate to profound analgesia, minimal adverse effects, reversible effects. Many drug and delivery options. Cat specific opioids: Simbadol® (24-hr duration) & Zorbium® (4-day duration, transdermal). |
| Alpha-2 Agonists | Excellent choice for many cats. Mild to profound sedation with analgesia. Effects are reversible. Contraindicated in some forms of cardiovascular disease but may be beneficial in left ventricular outflow tract obstruction because of decreased heart rate. Causes emesis, prevent with maropitant. |
| Acepromazine | Often a good choice. Provides 4-8 hours of light to moderate sedation, which is a benefit, especially for many hospitalized cats. No analgesia, effects not reversible. |
| Benzodiazepines | Minimal adverse effects, minimal sedation in young, active patients. Can be effective, especially when combined with an opioid, in very young/very old/sick cats. Midazolam would be the most likely benzo to be used as a premed since it can be administered IM. Anxiolytic☺. |
| Ketamine | Often administered IM as part of an anesthetic protocol – so not really a premed but administered concurrently with premeds (usually dexmedetomidine and an opioid). |
| Alfaxalone | Can be used at a low dose (0.5-2.0 mg/kg) IM for moderate sedation of 20-45 mins in very young/old or sick cats (in general, not enough sedation for healthy or excited cats). Better sedation when combined with an opioid. |

**Cat facts vs myths & misconceptions for the premedication phase of anesthesia**

Opioids can cause hyperthermia in cats The hyperthermia is usually – but not always - mild and self-limiting. Body temperature should be monitored postoperatively and any cat that seems agitated in recovery should be checked for hyperthermia. There is evidence that the degree of hyperthermia may be related to the degree of HYPO-thermia during the maintenance phase of anesthesia.

- Full opioid agonists (bind to mu and kappa) receptors are slightly more likely to cause excitement in cats than in dogs. Combine with a sedative to decrease excitement.
- Buprenorphine and butorphanol are unlikely to cause excitement but are less potent (especially butorphanol) than full mu agonists.
- Butorphanol only lasts about 90 minutes in the cat (Lascelles BD, Roberston SA. AJVR 2004;65(8):1085-1089); buprenorphine lasts 4-6 (MAYBE 8 with mild pain) hours.
- Oral transmucosally (OTM) administered buprenorphine results in lower serum concentrations of the drug. Increase the dosing range to 0.01-0.05 mg/kg BID-TID.
- Simbadol® is buprenorphine in a higher concentration (1.8 mg/ml) than 'regular' buprenorphine that is FDA-approved for cats. It is labeled for subcutaneous administration (regular buprenorphine is very poorly absorbed after SQ administration) that provides analgesia for 24-hours. It is a DEA Class III drug, just like regular buprenorphine (which is not FDA-approved in animals).
- Zorbium® is buprenorphine that was just approved by the FDA for cats. It provides 4 days of analgesia following transdermal administration. DEA Class III.
- Dexmedetomidine is also FDA-approved for use in cats. Alpha-2 agonists provide analgesia and a range of sedation levels (depending on the dose), can be administered IM and the effects are reversible with atipamezole. If you aren't using alpha-2 agonists in cats, you are missing out on a great drug class.
- Alpha-2 agonist mediated vasoconstriction causes increased cardiac work, which is why these drugs are contraindicated in many types of cardiovascular disease. However, the slowed heart rate can be beneficial in relieving left ventricular outflow tract obstruction (Lamont et al. JAVMA 2002;221(9):1276-81).
- Alpha-2 agonist mediated bradycardia is a reflex that occurs secondary to vasoconstriction mediated hypertension. This allows decreased cardiac work and is a beneficial reflex. Don't increase the heart rate unless the patient is bradycardic AND hypotensive.
- Should NSAIDs be administered to cats as premedications? Cats have pain of inflammation. Both meloxicam and robenacoxib are approved for preoperative use in cats and NSAIDs are generally most effective if used preemptively. However, NAIDs block the prostaglandin effect of vasodilation that occurs in some organs (eg, kidneys)

during states of low-flow. Cats seem to be more likely than dogs to suffer NSAID-related adverse renal effects so administration of NSAIDs postoperatively, after turning off the inhalant so hypotension is unlikely, is also a good option.

**Induction drugs and key cat points**

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| Propofol | Can easily be titrated 'to effect'. Cleared by multiple routes. Causes mild to moderate dose-dependent cardiovascular and respiratory depression. Can be administered with a benzodiazepine or ketamine ('ketafol') to decrease propofol dose. IV only. |
| Alfaxalone | Can easily be titrated 'to effect'. Causes mild to moderate dose-dependent cardiovascular and respiratory depression. Can be administered with a benzodiazepine to decrease alfaxalone dose. Can be administered IM or IV. |
| Ketamine | Can be administered IM or IV. Minimal to no respiratory changes, provides mild to moderate increase in heart rate and blood pressure (through stimulation of the sympathetic nervous system). Cleared in part unchanged in the urine. MIGHT contribute to sympathetically-driven arrhythmias? No muscle relaxation, administer with a benzodiazepine or alpha-2 agonist. CRI for analgesia. |
| Tiletamine/ Zolazepam | Physiologic effects similar to ketamine/benzodiazepine. Very potent, small volumes easy to dose – and to overdose if not careful. |
| Inhalants | Not the safest choice for induction. Dose is very high – increases risk for anesthesia-related death. Staff are exposed to gases so human health concerns as well as cat health concerns. |

**Cat facts vs myths & misconceptions for induction drugs**

- Propofol can be safely used in cats with hepatic lipidosis (Posner LP, et al. JAVMA 2008;232(12):1841-3), even though propofol itself is a lipid.
- The preservative in the 'newer' propofol (Propoflo28) is NOT toxic to cats (Taylor PM, et al. J Feline Med Surg 2012;14(8):516-26). This type of propofol is preferred to the old propofol because the preservative allows the bottle to be used for 28 days after opening whereas the old propofol without a preservative could only be used for 6 hours after opening. This propofol CAN BE USED IN CATS! It isn't FDA approve in cats, but most drugs aren't☹.
- Alfaxalone is an excellent option in cats for both sedation and induction. It causes dose-dependent cardiovascular and respiratory depression similar to that of propofol but absorption after IM administration is an advantage in cats and small dogs.
- KETAMINE IS NOT CONTRAINDICATED IN ANY CAT BREED (eg, Savannah or Maine Coons). The presence of cardiac disease, which these breeds may be more prone to, could maybe be a contraindication – but not the breed. Because of their traditionally high anxiety, these breeds often benefit from a 'ketamine stun' dose added to premeds. Ketamine infusions are extremely low-dose and not a concern even with cardiac disease.
- Inhalant induction (mask or chamber induction) is a risk factor for anesthesia-related death and should NOT be the routine method of induction to anesthesia in cats (Brodbelt 2009).

**Cat specific information on intubation:**

- Intubate carefully (not cat-specific but cats are more difficult to intubate than most dogs).
- Apply a drop of lidocaine on each arytenoid. Cats are more prone than dogs to laryngospasm. Lidocaine reduces the likelihood of laryngospasm. Lidocaine does not cause adverse effects – cetacaine does.
- If still difficult to intubate, administer more induction drug. Don't intubate an awake cat.

- Inserting an endotracheal tube was a risk factor for anesthesia-related death in cats (Brodbelt 2009) – but it isn't the tube that is a risk factor, it is poor intubation that is risky.
- Laryngeal mask airways are an excellent option for cats. They are easy to place, do not damage the airway and come in a variety of sizes.
- Disconnect patients from breathing systems before repositioning them – especially cats. The twisting of the tube in the trachea as the patient is repositioned can cause tracheal damage.
- Don't use a rigid mouth gag for intubation (or for dentistry, or anything else) in cats. These mouth gags cause excessive opening of the mouth which can cause occlusion of the maxillary artery, which is the main source of blood supply to the retina and brain in cats (Martin-Flores M, et al. Vet J 2014;200:60-64). Occlusion of this artery secondary to mouth gag use has been linked to blindness and neurologic dysfunction, some of which led to euthanasia (Stiles J, et al. Vet J 2012: 2012;193(2): 367-73).

**Cat facts vs myths & misconceptions for the maintenance phase of anesthesia**

- As with other species, inhalant anesthetic drugs are commonly used for procedures lasting > 30 mins. Nothing cat specific.
- Injectable drugs are also commonly used in cats for short procedures. These are often administered IM since really small cat veins can make IV injection difficult. Common protocols include:
    - Ketamine + an opioid + an alpha-2 agonist
        - Common combination: 0.1-0.2 MLS per 4.5 kg of cat of the following 3 drugs: dexmedetomidine, ketamine, buprenorphine (or 10 mg/ml butorphanol). Combine all 3 drugs in same syringe and administer IM. Use low-end of dose for deep sedation and high-end for anesthesia. Increase or decrease the dose if cat is larger/smaller than roughly 4.5 kg. This combination ('kitty magic') takes effect in 5-10 mins and provides 20-30 mins of anesthesia.
    - Tiletamine/zolazepam alone (not ideal – no sedation or analgesia)
    - Tiletamine/zolazepam opioid + an alpha-2 agonist

        - Common combination: Reconstitute the Telazol with 2.5 mls butorphanol (10 mg/ml) and 2.5 mls ketamine (sometimes called 'TTDex'). Dose the combination at 0.005 mls/kg for mild sedation, 0.01 ml/kg for moderate sedation, 0.02 ml/kg for profound sedation and 0.035-0.04 ml/kg for surgical anesthesia (Ko and Berman. Top Comp Anim Med 2010;25(2):92-97.
- Analgesia
    - To decrease the dose-dependent impact on cardiovascular and respiratory function, keep the inhalant DOSE LOW! The best way to do that is to use analgesia. Use opioids, local blocks and infusions. Lidocaine infusions are controversial in cats but lidocaine -or any other local anesthetic – used as a locoregional block is very effective.

**Monitors/Monitoring & key cat points**

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| ECG | Can be hard to detect the **small complexes**. Increase the tracing amplitude. |
| Blood pressure - oscillometric | Can be hard to get a reading. Blood pressure is the same as in the dog, but the **small vessels** can be hard to detect. Be sure that the cuff is not too large (cuff width should be approximately 40% of limb/tail circumference) and positioned over the largest artery possible. The cuff should fit snugly on the limb. Too big or too loose = falsely low BP. Same comment on MAP vs SAP as described for the Doppler. |
| Blood pressure - Doppler | Usually the best way to get a blood pressure reading in really small patients. Systolic blood pressure as determined by the Doppler **may be closer to MAP than SAP in cats** (Caulkett et al. Vet Surg 1998;27:370-377). Author note: **Assume it as systolic and carefully assess the cat.** Treat if necessary. |
| $SpO_2$ | Great! But cats are very likely to get cold (small body size) and **vasoconstriction** decreases likelihood of getting a reading. Reposition the probe to an area of better blood flow (eg, base of tongue). But first check the patient and make sure it is breathing normally! |

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| ET $CO_2$ | **Sidestream may provide average $CO_2$ rather than true end-tidal** reading in patients with small tidal volumes and high respiratory. rate. Can use an adapter that extends down into the ET tube to increase accuracy. |

- Support

  Be careful with fluids!

  - Administration of fluids was listed as a risk factor for anesthesia-related death (Brodbelt 2009). But it isn't the fluid – it is the amount of fluid - that kill cats.
  - Calculate – and administer – the volume of fluids very carefully. Best to draw up the desired amount in a syringe vs trying to deliver a small volume from a fluid bag. Can also use rate-limiting tools like syringe pump or burette.
- Cats are very likely to be hypothermic – be aggressive with warming - & monitor body temperature
  - Prevention is easier than rewarming. Temperature starts dropping AT INDUCTION
  - Forced air blanket most effective
  - Warm patient's environment - Surgery room, recovery cage, etc…
  - Use warm fluids, warm scrub solution (and MINIMAL scrub solution), warm lavage solution, etc…
  - **Minimize anesthesia time.**

**Cat facts vs myths & misconceptions for the recovery phase of anesthesia**

Most unexpected anesthetic deaths occur in recovery (Brodbelt D, Vet J 2009;182:152-161).

| **Timing of Death** | **% of cats that died (number of cats)** |
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| After Premedication | 1% (14) |
| Induction | 8% (53) |
| Maintenance | 30% (30) |
| Recovery | 61% (106) |
| 0-3 hours after Recovery | 66 total cats |

- Continue monitoring and supporting the patients until they are safely awake. Make sure cats are warm – but not hyperthermic.
- Also need to address pain and dysphoria. A rough recovery is not acceptable as it can lead to injury, high FAS and can contribute to hyperthermia. Think pain first and re-dose the opioids. May need to include a sedative. Alpha-2 agonists are excellent because they provide both sedation AND analgesia.
- Of course, we can also reverse the effects of the reversible drugs if necessary – but be sure to address analgesia! There are numerous myths regarding atipamezole in cats. Atipamezole at ½-full volume of dexmedetomidine (0.5 mg/ml) IM or very slowly IV. Readdress analgesia even when using a lower volume as a full reversal can still occur depending on how much of the drug has been metabolized.
- Discharge drugs: NSAIDs, buprenorphine, maybe gabapentin or other drugs. Long duration buprenorphine (24-hr injectable and 4-day transdermal) should be considered to decrease care-giver burden and ensure cat gets its medications.

**Further Reading**

Grubb T, Sager J, Gaynor JS, Montgomery E, Parker JA, Shafford H, Tearney C. 2020 AAHA Anesthesia and Monitoring Guidelines for Dogs and Cats. J Am Anim Hosp Assoc. 2020 Mar/Apr;56(2):59-82. Open access: https://www.aaha.org/aaha-guidelines/2020-aaha-anesthesia-and-monitoring-guidelines-for-dogs-and-cats/anesthesia-and-monitoring-home/

Robertson SA, Gogolski SM, Pascoe P, Shafford HL, Sager J, Griffenhagen GM. AAFP Feline Anesthesia Guidelines. J Feline Med Surg. 2018 Jul;20(7):602-634. Open access: http://www.aapma.com/resources/2018_FelineAnesthesiaGuidelines.compressed.pdf#:~:text=%20%20%20Title%20%20%20AAFP%20Feline,%20%20Created%20Date%20%20%20180619092007Z%20

Simon BT, Steagall PV. Feline procedural sedation and analgesia: When, why and how. J Fel Med Surg 2020;22(11):1029-1045. Open access: https://journals.sagepub.com/doi/pdf/10.1177/1098612X20965830