

Cats are Hard!

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This lecture will focus on the unique aspects of the feline species that can make anesthetic management challenging. These wonderful companions come with unique anatomic considerations, unique behaviors, sharp weapons to use against their caregivers, and an ability to hide their ailments.

Learning Objectives:

- How do I evaluate the seemingly healthy feline patient? Are there any tests I should run regardless of the physical examination?
- What are the “best” premedication choices for my feline patient? How much sedation/chemical restraint do I need to place an IV catheter?
- Are induction drug choices and intubation any different from dogs? YES!
- How do I manage recovery, including body temperature and pain management?

Household cats are usually kept solely for companionship to their human keepers. As veterinarians, we should expect to see an increasing number of cats presenting to our clinics for routine and non-routine medical or surgical care. Because of the bond that many cat owners have with their pet, we should also be prepared that owners will expect a high level of care and a sophisticated approach to their animal's veterinary needs, and that many owners will expect to extend a quality lifestyle into the geriatric years for their cat. Most interventional medical procedures, as well as routine prophylactic health care such as dental cleaning, require anesthesia. A thorough understanding of the anesthetic management of cats as well as an excellent array of anesthetic/analgesic drugs and techniques to minimize pain associated with surgery or disease processes is important in quality feline veterinary medicine.

Cats offer unique characteristics and challenges in their anesthetic and analgesic management. Because they are a predatory species, they tend to retract from human company when sick or painful, making rapid identification of declining health challenging for the owner. When presented to a veterinarian for care, cats are often sicker than one might guess from these ‘subtle’ behavioral changes.

Cats present other challenges in their management, not the least of which are their many sharp weapons, e.g. teeth and claws, making restraint by personnel a sometimes life-threatening experience! Thus, many cats require anesthetic or sedative drugs prior to a thorough physical exam or other diagnostics, e.g. ultrasound or radiography. This introduces the risk that drug choices may be contra-indicated in the face of unidentified disease. Cats lack the hepatic glucuronidase enzyme system, so they do not metabolize many drugs to their glucuronide

metabolites. This may result in a prolonged half-life of the active form of the drug, or may reduce the drug's efficacy if the glucuronide metabolite is the more active form of the drug (e.g. morphine). Cats do not metabolize phenolic compounds (e.g. propofol) as rapidly as dogs do and they excrete some drugs (e.g. ketamine) unchanged through their renal system. Finally, the sedative effects of opioids observed in dogs often do not apply to cats, such that cats may become manic or excitable after opioid administration. This should not preclude the use of opioids because this class of drugs does provide reliable analgesia despite the apparent lack of sedation that is sometimes observed in cats.

Pre-anesthetic Evaluation

Like all patients, a thorough physical examination is warranted but may be limited due to the temperament of the cat. Minimally a short auscultation of heart and lungs and a thorough history from the owner should be obtained. It is beneficial to get a PCV/TP and azostick although this may require sedation first. PCV gives information about oxygen carrying capacity and hydration status, TP gives information about hepatic function, hydration status, and possibly the presence of infection (increased globulins). An azostick can be a quick way to screen for renal disease as well as dehydration. Some clinicians advocate obtaining a proBNP in all cats to screen for underlying or non-clinical HCM. Other bloodwork (e.g. CBC, full chemistry) should be performed in cats presenting with known or suspected disease. Thoracic radiographs are indicated if a heart murmur is present, and, if an enlarged cardiac silhouette is seen an echocardiogram is warranted prior to anesthesia.

Anesthetic Protocols

Premedication –

See Table for drugs and doses

Premedication with sedative/tranquilizer and/or opioid combinations provides many advantages, including reduced stress to the cat and its handlers, preemptive analgesia depending on drug choice, greatly reduced inhalant anesthetic requirement, a smoother anesthetic plane, and smoother and pain-free recovery. Premedication is a fundamental concept in the anesthetic management of cats. On first impression this may seem counter-intuitive: Why add more drugs to what may be a debilitated patient? The concept of balanced anesthesia, where small doses of many different drugs are used, all with different mechanisms of action, results in less anesthetic-related morbidity and mortality. In all anesthetized animals, the goal is to minimize reductions in cardiac output, blood pressure, oxygenation, and ventilation. Of all the anesthetic agents available in veterinary medicine, the inhalants isoflurane and sevoflurane cause the most dose-dependent cardiorespiratory depression! Thus, use of premedication allows one to reduce the required inhalant dose, thus sparing the cardiovascular and respiratory systems, and results in a more stable and more physiologic state while the patient is under general anesthesia.

In *healthy cats*, with normal cardiovascular, renal, and hepatic function based on physical examination and screening blood work, premedication combinations of acepromazine or dexmedetomidine with butorphanol or buprenorphine for mildly painful procedures, such as a

dental prophylaxis is appropriate. For more painful surgeries, substitute a pure agonist opioid, such as hydromorphone, for the butorphanol or buprenorphine. The resulting sedative effect after the agonist opioid may be unpredictable: some cats become more tractable and 'sexy', kneading their paws and purring, while others may become somewhat agitated. If 'chemical restraint' is desired, ketamine can be added to the cocktail to provide the dissociative effects of the ketamine. Alternatively, alfaxalone can be given intramuscular in addition to the sedative and opioid. This will result in a large volume of injectate due to the concentration of alfaxalone. However, alfaxalone will be a better choice if the cat is suspected to have renal or cardiac disease.

Generally, administer premedications IM and wait at least 20 minutes for their full effect. If venous access is already established, then premedications can be given IV and titrated to the desired effect (usually inclusion of ketamine or alfaxalone is unnecessary in this instance). As far as dose ranges are concerned, keep in mind that every drug effect (desired and undesired) is dose dependent. Thus, if strong preemptive analgesia is desired, choose the higher dose of the pure μ agonist opioids. Similarly, if the animal cannot tolerate vasodilation (e.g. dehydrated) then acepromazine should be avoided or used at the lowest possible dose. The use of anticholinergics such as glycopyrrolate and atropine as premedication is controversial. While these drugs reduce salivation caused by ketamine, they make salivary secretions thick and difficult to clear from the airways. They also increase heart rate, often to values over 200 beats/minute. This degree of tachycardia causes a huge increase in myocardial oxygen consumption and may cause compromised myocardial oxygen delivery. Current recommendations are to omit the anticholinergics from the premedication combination and monitor heart rate and blood pressure to assess when, or if, bradycardia is of significant concern.

Induction –

See Table for Drugs and Doses

Secure venous access should be established via a catheter. Propofol, alfaxalone, or ketamine-diazepam/midazolam are all appropriate choices. Propofol can be given as a constant rate infusion (0.1 – 0.6 mg/kg/min) to prolong anesthesia under injectables. Alfaxalone can also be given as a constant rate infusion to maintain anesthesia without inhalant (0.06 – 0.15 mg/kg/min). This protocol is useful for short procedures where inhalant anesthesia is inconvenient. The popular induction combination for cats of diazepam or midazolam mixed with ketamine should be used cautiously in cats with hypertrophic cardiomyopathy, hyperthyroidism, or acute or chronic renal failure.

Intubation –

Cats are prone to laryngospasm upon intubation. A convenient way to reduce laryngospasm is to spray a few drops of 2% lidocaine on the vocal cords after induction and before intubation. Care should be taken when intubating cats. An appropriate sized laryngoscope should always be used to view the larynx and if a stylet is used to direct the endotracheal tube then caution should be exercised that the stylet or tube do not puncture the tracheal mucosa. Subcutaneous or mediastinal emphysema are clinical signs of a tracheal tear. Tracheal tears can also occur if the intubated cat

is moved (e.g. from side to side or from lateral to dorsal) with the endotracheal tube connected to the anesthetic circuit. If moving the cat, quickly disconnect the ETT from the circuit during movement, then reattach once the cat is repositioned. Also, many commercially available endotracheal tubes in sizes appropriate for cats (i.e. 3 – 5 mm ID) are too long, making it easy to intubate down a bronchus and thereby putting the cat at risk for significant hypoxia. This is usually immediately obvious as cyanosis will be apparent right after intubation despite delivery of oxygen. In this case, back the tube out until the cyanosis resolves. An easy way to avoid this is to “premeasure” the tube to the thoracic inlet prior to intubation.

Anesthetic Maintenance and Monitoring –

Either isoflurane or sevoflurane are appropriate for use in cats. Anesthetic circuits used for small cats (< 2kg) are generally non-rebreathing systems such as the Bain circuit with a 1L/min oxygen flow. The anesthetic concentration in these small volume circuits changes quickly with vaporizer adjustment, so keep in mind that the small circuit volume and small animal size will allow anesthetic depth to change rapidly, particularly in sicker patients where the response to inhalants is usually more profound and sudden. For cats larger than 2 kg, a pediatric circle system can be adequate. If the cat is very compromised, a circle system may impose too much work of breathing, so in this instance a non-rebreathing system should be used, or the cat’s ventilation should be supported by either manual or mechanical ventilation.

The most important aspect to anesthetic management is monitoring of physical status! This should include heart rate, respiratory rate, temperature, pulse oximetry, and indirect blood pressure measurement as a minimum. The non-invasive Doppler blood pressure monitor is an inexpensive tool and provides a close estimate of the *mean* arterial pressure in cats. Alternatively, some veterinary specific oscillometric blood pressure machines (e.g. Cardell, Surgivet) offer technology that accurately measures blood pressure in these small patients.

Supportive Care –

In general, crystalloid fluids should be administered to any cat undergoing anesthesia for more than 20-30 minutes. Any balanced isotonic electrolyte fluid (e.g Plasmalyte, LRS) is appropriate. Recommended fluid rates for normally hydrated cats are 3-5 ml/kg/hour. Dehydrated cats may need a small fluid bolus (e.g. 5 ml/kg over 15 minutes) given 2-3 times to increase blood pressure.

Cats lose a lot of body heat under anesthesia, and circulating warm water blankets under the patient are inadequate for maintaining normothermia. A Bairhugger® or similar external warming unit should be used and rectal temperature should be monitored and maintained at 99 – 100 °F. It has been proven that cats that become cold under anesthesia are more likely to become hyperthermic (temperatures more than 105°F!) hours after they recover, especially if opioids were used.

In compromised cats undergoing major surgery, particularly if they will be on IV fluids post-op, a fentanyl constant rate infusion is a very useful, effective, and safe way to titrate analgesia. The CRI can be started prior to surgery at a rate of ~ 5 mcg/kg/hour, increased as needed during surgery, then titrated down in the post-op period to ~ 2-3 mcg/kg/hour depending on the cat’s

analgesic needs. Fentanyl has a very short duration of action, so the CRI can be titrated very effectively, or discontinued when desired without lasting opioid effects.

Another useful adjunctive analgesic is a ketamine CRI. Ketamine is particularly helpful in cats undergoing dental procedures that are difficult to maintain at a stable plane of anesthesia because it is an excellent somatic analgesic. If the cat was not induced with ketamine, give a loading dose of 0.5 mg/kg IV and then start the CRI between 5 – 25 mcg/kg/minute. The ketamine can be stopped near the end of the procedure and will still help to provide some post-operative analgesia.

Recovery –

At recovery, the normothermic cat should be kept under a blanket or other insulation and, ideally, recovered away from barking dogs or other chaos. Cats are prone to laryngospasm at recovery as well, especially if extubation occurs when the cat is more awake and has a full and strong gag. Therefore, extubate as soon as the cat flicks an ear in response to tickling, licks its tongue, has a strong palpebral reflex, and is breathing well. If the cat is hyperthermic, remove all blankets and heating devices, wet the paws with tepid water, and gently blow a fan over the animal. Sedation with acepromazine will also help calm the cat and cool it down.

What if the cat is blind on recovery?? Cats have a unique blood supply to the cerebral cortex, provided entirely by the maxillary artery. Dogs, in contrast, have collateral blood supply via the circle of Willis. It has been shown that mouth gags used in cats during dental procedures will limit or occlude blood flow from the maxillary artery, especially if the cat is also hypotensive. Therefore, *do not use mouth gags* in cats!

Table of Drugs and Dosages

PREMEDICATIONS	DOSE (MG/KG)	ACTION	COMMENTS
acepromazine	0.01-0.05	sedative	hypotension, long-acting
midazolam	0.1-0.2	mild sedative	anxiolytic, 'safe'
dexmedetomidine	0.001 – 0.010	profound sedative	bradycardia, decreased cardiac output, hypoV
butorphanol	0.2-0.5	mild analgesia	only 45 min. duration!
buprenorphine	0.01-0.04	mod. analgesia	6-8 hours duration
oxymorphone	0.05-0.1	great analgesia!	3-4 hours duration
hydromorphone	0.1-0.2	great analgesia!	3-4 hours duration
morphine	0.1	analgesia?	useful in cats?glucuronidation...
ketamine	5-15	dissociative	renal excretion, tachycardia
alfaxalone	0.5-2	anesthetic	Use higher doses for IM premedication
fentanyl	2-25 mcg/kg/hour	analgesia	IV CRI
INDUCTION DRUGS			
propofol	2-6	injectable anesth	single-use vials, phenol, apnea
ketamine/diazepam	5/2.5 to effect	injectable combo	Small volume, tachycardia
etomidate	1-2	Injectable	\$\$, no CV effects
alfaxalone	2-4	injectable	Like propofol
INHALANTS			
	AVG [] FOR SX		
isoflurane	1.7%	profound CV/resp depression	decrease inhaled % after premeds or analgesics
sevoflurane	2%	profound CV/resp depression	decrease inhaled % after premeds or analgesics