

CANINE & FELINE ANESTHESIA

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overlooked, is not uncommon

- x In man severe hypoxic brain damage can decrease intelligence following which is apparent to families and friends, and similar happening may occur in
- x

- x A good preanesthetic sedation facilitates smooth induction and has anesthetic sparing effect during maintenance
- x There are many choices available. Sedative/opioid combination (e.g. acepromazine and morphine) is most popular (e.g. acepromazine and morphine) and provides better restraint and analgesia (the combination is synergistic, not merely additive) preanesthetic medication

Acepromazine

- x Provides mild sedation at clinically prescribed dose (0.01 – 0.05 mg/kg IV, IM, SQ)
- x Anti-arrhythmic
- x Requires at least 20 min for good effect even after IV injection, and 30 to 45 min when given IM, and longer for SQ
- x Prolonged duration
- x Premedication dose of 0.04 mg/kg has minimal cardiovascular effect in healthy dogs
- x Will cause hypotension (more so in old, debilitated, or hypovolemic animals) through direct myocardial depression and peripheral vasodilation, and should not be used in these debilitated animals.
- x Decrease seizure threshold, so better to avoid in patients a

Medetomidine

- x Causes less vomiting than xylazine
- x 5-40 mcg/kg IM, SQ have been given to produce sedation. IV administration is associated with more severe form of dysrhythmias, so generally not recommended
- x Sedation lasts approximately for one hour
- x The pharmacologic effects of medetomidine in dogs are very similar to those of xylazine in that it causes bradycardia, hyperglycemia, and increased urine production. A caveat is that it causes arterial hypertension which is dose dependent

Romifidine

- x The most recent alpha 2 agonists
- x Reduces the amount required for the anesthetic induction in dose dependent manner
- x Produces dose dependent cardiovascular depression
- x 10-80 mcg/kg IM, SQ

Opioids

- x Widely used to provide analgesia in dogs
- x Provide better sedation and analgesia when combined with other sedatives
- x Morphine is inexpensive and is used in the dose of 0.25 mg/kg IM, SQ.
- x IV morphine induces histamine release particularly if given as a rapid, but slow administration is less likely to cause problems
- x Oxycodone causes less vomiting than morphine and hydromorphone, so is better choice for patients with head trauma, eye injury and gastrointestinal disorders.
- x Combination of benzodiazepines with butorphanol (or buprenorphine) is a useful alternative to the combination with pure opioids for brachycephalics reducing the risk of respiratory depression
- x Opioids induce minimal cardiovascular depression
- x See pain lecture for other available opioids

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- x It provides rapid induction and is very rapidly eliminated from the plasma.
- x 6 mg/kg IV is calculated dose for the anesthetic induction. Respiratory arrest is not uncommon particularly with rapid IV bolus. It is best given as titrated to effect to produce anesthetic depth just enough to allow endotracheal intubation by slow administration
- x It is non-accumulative and maintenance of anesthesia for prolonged duration can be achieved using a constant rate of infusion.

Inhalation Agents (Isoflurane , Halothane, Sevoflurane, or desflurane)

- x General anesthesia can be induced by administering isoflurane, halothane, sevoflurane or desflurane via a facemask
- x There are two methods incremental or 'crash' induction
- x 'Incremental' induction technique uses 3 min of preoxygenation and then introduction of 0.5 % vapor setting for 30 seconds and then 0.5 % increment for the same period. 'Crash' induction is achieved with 35 % vapor set of isoflurane following preoxygenation. The dog will more likely struggle with the crash induction method
- x It is preferable to use non-rebreathing circuits for quicker induction and then switched to the circle rebreathing systems (efgr animals weighing more than 6)kg

Some sample doses of injectable anesthetics in the dog

Comb. #	Premedication	Dose mg/kg	Induction agents	Dose mg/kg
1	Acepromazine ± Morphine	0.02-0.05 0.25 – 1.0	Thiopental Propofol	15 "to effect" 6 "to effect"
2	Acepromazine ± Butorphanol	0.02-0.05 0.1 – 0.4	Thiopental Propofol	15 "to effect" 6 "to effect"
3	Midazolam ± Morphine	0.1-0.3 0.25 – 1.0	Thiopental Propofol	15 "to effect" 6 "to effect"
4	Midazolam ± Butorphanol	0.1-0.3 0.1-0.4	Thiopental Propofol	15 "to effect" 6 "to effect"
5	Midazolam ± Butorphanol	0.1-0.3 0.1-0.4	Ketamine	5 "to effect"

Endotracheal intubation

- x Tracheal intubation in dogs are relatively easily achieved. They can have the mouth wide open and the laryngeal structures are easily viewed
- x Use of laryngeal scope may facilitate the intubation
- x The laryngeal spasm is uncommon, but animal still needs to be adequately anesthetized to avoid head shaking or excessive coughing reflex
- x Following intubation, correct placement can be confirmed by cough, feeling air coming out of the ET tube in synchrony of movement of the chest wall, reading of CO_2 by a capnography is a useful method to confirm the correct position of the tube
- x Endotracheal tube sizes are proportional to the body weight, typically used for average 12-24 kg dogs. Brachycephalics tend to have hypoplastic trachea and an English bull dog weigh as much as 25 kg could only accept ET tube of 6 mm
- x

- x This is no longer marketed in the US, and has been largely displaced by isoflurane
- x As anesthesia is deepened by increasing halothane concentration, CO and arterial pressure decrease further. HR usually remains constant.

Isoflurane (Aerrane®, Forane®, IsoFlo®)

NSAIDs are most popular (toxicity associated with this agent is much less than in cats) (see

- x Starvation for about 12 hours usually ensures that cats will have an empty stomach and water need only be deprived of about 2 hours prior to anesthesia
- x Laboratory evaluation can provide useful prescreening information about the general health status of the patient prior to anesthesia, and minimum database are PCV, TP, BUN and glucose
- x A thorough physical examination to determine any abnormalities must be carried out. Auscultation for cardiac dysrhythmias and murmurs, or abnormal lung sounds will provide useful information regarding preexisting cardiopulmonary disease.
- x Stabilize animal's physiology in debilitated animals (e.g. fluid deficit, base abnormality)
- x IV catheterization placements not as easy as in dogs so heavier premedication may be required for cooperation
 - o The common site of venous catheterization is cephalic
 - o Other veins for venous catheter placement include the saphenous and jugular veins
 - o For jugular catheterization 16 – 18 G and 2-inch long catheters suitable for most cats

Preanesthetic agents

- x A good preanesthetic sedation facilitates smooth induction and has anesthetic sparing effect during maintenance
- x There are many choices available. Sedative/opioid (midazolam and hydromorphone), or dissociative/sedative (e.g. ketamine and midazolam) combination most popular and they provide better restraint and analgesia than that achieved by single drug administration with less side effects (e.g. ketamine induced muscle rigidity or opioid induced mania)

Acepromazine

- x Provides mild sedation at clinically prescribed dose (0.02 – 0.1 mg/kg IV, IM, SQ)
- x Anti-arrhythmic
- x Requires at least 20 min for good effect even after IV injection, and 30 to 45 min when given IM, and longer for SQ
- x Prolonged duration
- x A young, fit cat can tolerate the premedication dose of 0.05 mg/kg with minimal

- x Because of its minimal cardiopulmonary depression, it can be a suitable premedicant for cats with underlying cardiopulmonary diseases
- x 0.1 – 0.5 mg/kg IV, IM, SQ for diazepam and 0.1 to 0.3 mg/kg IV, IM, SQ for midazolam
- x Diazepam is more irritant to the tissue so recommended not to be administered IM

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- x Side effects seen with ketamine and diazepam can be seen (emergence delirium)
- x Typically used to provide deep sedation in intractable cat
- x Other sedatives and opioids can be mixed to make the constituent more potent so as to increase sedation, analgesia and duration of effect, and reduce side effects (e.g. emergence delirium)

Thiopental

- x This IV injectable, barbiturate anesthetic is prepared in 1.25 % for use in cats
- x Induction in unpremedicated cat can be achieved at the dose of 15 mg/kg IV given the half dose as a rapid bolus and the remaining given titrated to effect
- x In lightly premedicated cats 7 mg/kg is sufficient to induce anesthetic induction
- x Recovery is through redistribution of the agent from the brain into the other tissues

Propofol

- x Advantages and disadvantages of propofol for dogs as described above similarly apply to cats, but there are some unique differences
- x Cats are deficient of glucuronyl transferase, so the compound is less likely to get metabolized than in dogs, and it has been shown that repeated dosing is associated with some side effects ranging from Heinz body formation, delayed recovery, anorexia, diarrhea, and malaise
- x However, a single IV anesthetic induction dose will bear minimal risks
- x 6 mg/kg IV is administered slowly titrated to effect to induce anesthesia

- x In heavily premedicated or debilitated cats, face mask induction can be carried out without excitement or struggling and is the preferred method of choice
- x The 'incremental' or 'crash' induction technique used for dogs can be adopted for cats (see above)

Some sample doses of injectable anesthetics in the cat

Comb. #	Premedication	Dose mg/kg	Induction agents	Dose mg/kg
1	Acepromazine ± Morphine	0.04-0.1 0.1 – 0.2	Thiopental Propofol	15 "to effect" 6 "to effect"
2	Acepromazine ± Butorphanol	0.04-0.1 0.1 – 0.4	Thiopental Propofol	15 "to effect" 6 "to effect"
3	Midazolam ± Ketamine	0.1-0.3 5	Thiopental Propofol	15 "to effect" 6 "to effect"
4	Diazepam ± Ketamine	0.1-0.4 5	Thiopental Propofol	15 "to effect" 6 "to effect"
5	Midazolam ± Hydromorphone	0.1-0.3 0.05– 0.1	Thiopental Propofol	15 "to effect" 6 "to effect"
6	Midazolam ± Butorphanol	0.1-0.3 0.1-0.4	Thiopental Propofol	15 "to effect" 6 "to effect"
7	Medetomidine	0.005-0.04	Diazepam Ketamine	0.25 + 5 "to effect"
8	Midazolam ± Buprenorphine	0.1-0.3 0.005-0.01	Ketamine	5 "to effect"
9	Xylazine ± Butorphanol	0.5-1 0.1-0.4	Diazepam + Ketamine	0.25 + 5 "to effect"
10	Medetomidine ± Butorphanol	0.005-0.04 0.1-0.4	Thiopental Propofol	10 "to effect" 4 "to effect"
11	Midazolam ± Hydromorphone	0.1-0.3 0.05-0.2	Thiopental Propofol	15 "to effect" 6 "to effect"

Endotracheal intubation

- x The laryngeal spasm is easily provoked, so use of lidocaine spray or short acting muscle relaxant will facilitate the intubation
- x In deep anesthesia laryngeal spasm does not occur, but this is not recommended as a routine procedure. However, where emergency intubation is required following accidental overdose of anesthetic, it is never necessary to use lidocaine spray or muscle relaxant
- x Attempts to carry out forceful intubation through tightly apposed vocal folds, even if initially successful, will result in damage to the mucous membrane with edema and the danger of postextubation airway obstruction

x

- x Pulse oximetry and/or arterial blood gas analysis provide information of the ventilatory efficiency
- x Ocular reflexes are used to monitor the central nervous system. The palpebral reflex is lost at light planes of anesthesia in ruminants, so it is of little value during anesthesia of these species.
- x Ophthalmic ointment should be applied to the eyes during anesthesia to prevent corneal injury.
- x Body temperature is also an important parameter to monitor during anesthesia. Because of the tendency for anesthetized animals to lose body heat, supplemental heat sources are often required to maintain adequate body temperature (102.5°F).

Perioperative pain management

- x Traditionally use of opioids in cats within the perioperative period has not been as widespread as in dogs. However, with more research and better pharmacologic understanding, veterinarians have increased prescribing opioids in cats
- x The CNS excitement can be minimized with concurrent administration of sedatives. Other side effects such as respiratory depression, vomiting and dysphoria are still possible
- x Behavioral changes associated with pain include decreased appetite, aggression, indifference to the surrounding and avoiding human contacts (see Pain notes)
- x In addition to opioids, α_2 adrenergic agonists, local anesthetics and nonsteroidal anti-inflammatory drugs (NSAID's) can be used to provide analgesia. Since cats are more susceptible to develop NSAID related toxicity, careful selection of dosing and choice of drugs is necessary to avoid complications

Recovery

- x Cats are prone to develop hypothermia during recovery due to their small size and this can significantly prolong the recovery and increase oxygen demand of the muscle tissues.
- x Forced warm air blanket, circulating warm water blanket are very effective to keep the body temperature, but other means such as hot rice socks, used warm fluid bags, hair dryer and infrared lamps are useful external heat sources
- x If animals pretreated with reversible agents, recovery can be expedited by reversing the drugs with specific antagonists. Atipamezole and naloxone are two primary examples and they are best used titrated to effect. Close observation should continue to avoid the animal relapsing into sedation which may expose the animal to potential danger of aspiration or airway obstruction