Anesthesia and Analgesia

for the Veterinary Practitioner: Canine and Feline

Banfield PET HOSPITAL

Book 4

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Preface

- Individual state practice act requirements and DEA regulations must be met or exceeded in all instances.
- Review Medical Quality Standards. Meet or exceed all Clinical Essentials.

State regulations

- At all times, every medical team must comply with individual state practice acts.
- It is each doctor's responsibility to know and understand the requirements of his/her specific state, as well as Banfield policies and procedures.
- The doctor must ensure compliance with state regulations regarding:
  - Handling and administration of controlled substances
  - Intubation of pets
  - Anesthetic monitoring
  - Drug administration documentation
  - Which hospital associates can legally perform dental prophylaxis and all other medical procedures
  - Off-label usage of medications

This publication may contain information that is not within the current FDA-approved labeling for several products for companion animals.

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Clinical essentials

Clinical Essentials are standards of practice that constitute the minimum acceptable level of care. Practice below this level of care is below expectations. Failure to provide at least this level of care, or clearly document sound reasons for not providing this care, can result in disciplinary consequences.

General

Veterinarians or trained associates under the direct supervision of a veterinarian perform anesthetic procedures[2]

Sedate or anesthetize brachycephalic pets with brachycephalic-specific protocols and monitoring[6, 10, 15, 23]

Offer referral of critical or unstable pets when appropriate and in the best interests of the pet[1, 3]

Current CPR recommendations are reviewed, and CPR training is provided to all associates at least annually. A CPR team is available during normal hours of operation[2, 25]

Do not administer vaccines to an anesthetized patient unless there is a significant pet or associate safety concern to vaccinating a fully conscious pet[33]

Document all perianesthetic physical examination findings, changes in physical status and anesthetic procedure complications in the medical record[7]

Administer all anesthetic medications "to effect" and do not exceed maximum drug dosages[6, 7, 27]

Utilize multimodal analgesic therapy. Identify and address presurgical, immediate and postoperative pain[7]

Administer IV fluids with every general anesthetic event lasting >10 minutes unless patients are hypervolemic[2]

Place an endotracheal tube with every general anesthetic event and/or procedure in which loss of protective airway reflexes occurs[2]

Assisted ventilation is available for every anesthetic procedure[2, 21]

Equipment

Utilize the Anesthesia Machine Checklist for every general anesthetic event and have the checklist verified by the attending veterinarian prior to induction[6,17,21]

A crash cart containing emergency drugs and equipment is readily available, in a designated place, portable, clearly labeled and appropriately stocked[2, 25]

Thoroughly clean, disinfect, dry and store personal anesthesia equipment in a manner that prevents contamination prior to each use[7, 21]

Anesthetic machines and equipment are tested and maintained on a regular basis and a permanent log of maintenance is kept. Anesthetic events are postponed until all equipment is fully functional[7, 16, 26]

Preanesthetic

Assign and document an ASA status to each pet undergoing general anesthesia and address status appropriately as part of the preanesthetic evaluation. Document discussion of increased risks of anesthesia for pets with an ASA status of ≥III with owner and postpone, cancel or refer anesthetic procedures when indicated[3, 7, 8, 10, 15, 24]

Obtain and review clinical pathology data prior to general anesthesia. Verify, document and address all clinically significant abnormalities prior to premedication, communicate to the team, and discuss all abnormalities with the client. Dismissal of abnormal results is not permitted[6, 7, 18, 24]

Perform a thorough physical exam prior to any anesthetic event, including an accurate weight. Verify, document and address all clinically significant abnormalities prior to premedication, communicate to the team, and discuss with the client. Dismissal of abnormal findings is not permitted[6, 7, 24]

Review the medical history of each pet and pre-emptively identify patient-specific factors that may influence anesthesia (e.g., signalment, adverse drug reactions). Adjust protocols appropriately[21, 31]

Perform a physical examination (including all cardiovascular parameters) post-premedication and pre-induction for every general anesthetic event[7, 24]

Institute pre-emptive warming measures for those pets below 100°F or for those at greater risk for developing hypothermia (e.g., poor body condition)[21, 31]

Address and resolve physical examination abnormalities that may negatively impact anesthesia (e.g., dehydration, obesity) prior to anesthesia when possible, especially with elective procedures[6]

Provide a minimum of 3 minutes of pre-oxygenation by face mask (flow-by is acceptable if mask is not tolerated), prior to and during the induction process to all pets who will tolerate the procedure[7, 18, 34]

Keep all pets that have been administered preanesthetic medication under visual observation at all times[6]

Induction & intubation

Coat endotracheal tube cuffs with sterile, water soluble lubricant[7, 22]

Fill endotracheal tube cuffs to the amount required to provide a complete seal and deflate prior to removal (unless otherwise directed by veterinarian)[21]

Keep endotracheal tubes in place until protective, vigorous laryngeal reflexes return without applying noxious stimuli[7]

If patient repositioning is necessary, disconnect intubated pets from the breathing circuit prior to movement and reconnect after attaining proper positioning[7]

Monitoring & recovery

Assign and document at least one hospital associate with the sole responsibility of dedicated, continuous patient monitoring and dedicated recovery to every immobilization or general anesthetic procedure. If there is not a trained, dedicated associate, the procedure must be rescheduled[3, 6, 7, 10, 21]

Continuously measure temperature, heart and respiratory rates, blood pressure, ECG, SpO2, and end-tidal CO2. Document at a minimum of every 5 minutes (or more frequently as clinically indicated) for every general anesthetic event from the time of induction until full recovery[7, 21, 24]

Identify, verify, communicate to the anesthesia team, and address abnormal patient monitoring parameters and trends. Presumptions of malfunctioning equipment and dismissal of abnormal parameters are not permitted. Document findings and treatments on anesthesia form[6,7,21,31]

Abort, as able, elective anesthetic procedures in cases of worsening or refractory patient physical parameters (e.g., hypotension, hypothermia)[6,24]

Keep all patients recovering from an anesthetic procedure under visual observation at all times until full recovery[6, 24]

A final postanesthetic evaluation of each patient is performed by the veterinarian prior to discharge from hospital[6, 7]

IV catheter & multi-dose vial usage

Aseptically place a sterile IV catheter and T-port for every patient receiving IV fluids and for every anesthetic event[12,14,20]

Mark fluid bags with date, time and all additives when initially accessed or when administration sets are attached (fluid bags are spiked), using the appropriate label[13]

Use aseptic technique when placing or accessing patient IV lines, multi-use vials and fluid bags[12, 14, 20]

- Use a sterile needle and syringe
- Use alcohol to clean ports on IV lines, fluid bags and multi-use vials, allowing to dry before inserting needle
- Discard needle and syringe after use

Change extension sets between each patient undergoing general anesthesia. Use a new, sterile extension set for each patient receiving IV fluids[12, 13]

Discard ALL used fluid bags and administration sets at the end of the day[12, 32]

Discard fluid bags and administration sets upon discontinuation of fluid therapy and replace with new in ANY of the following[11, 14, 20]

- If backflow of blood into any portion of the fluid line is noted
- After fluids have been used on a pet with a known infection
- If any supplemental therapeutics have been injected into the bag or administration line
- If fluid bags and administration sets are used to deliver a fluid which may promote microbial growth

Clamp administration sets closed in between procedures (within day of use window) and place new, sterile needle with cap in place over end of

administration set. Hang administration set when not in use so as to not contact patients, tables, or other materials[13, 14, 28]

Best practices are standards of practice that meet or exceed an expected level of care and encompass a scale of care from "desirable" to "aspirational."

General

Designate dedicated anesthetic induction and recovery areas7,21,26

Review anesthetic human safety hazards annually with all hospital associates2

Equipment

Utilize esophageal instrumentation to provide further means of patient monitoring7

Preanesthetic

Identify, discuss, and address genetic conditions that may impact anesthesia[7]

Utilize the Preanesthetic Timeout Checklist for every general anesthetic procedure[7]

Utilize the Anesthesia Machine Checklist for every general anesthetic procedure

Monitoring & recovery

Train all hospital associates in the appropriate use of pain scales and recognizing pain in pets. Bring concerns of patient analgesia to the attending veterinarian's attention. Review pain recognition annually[5, 16]

Utilize advanced analgesic therapies (soaker catheters, spinal blocks, etc.) appropriately to contribute to pet safety and comfort[16]

Encourage and pursue additional training in advanced anesthetic administration and monitoring for hospital associates[7]

Utilize and follow an anesthetic recovery form with all general anesthetic procedures[3, 6]

Surgical day preparation

A successful anesthesia day begins with the pet owner prior to arrival at the hospital. Clearly communicated recommendations and instructions can lead to a safer and more relaxed visit for our patients.

There are many opportunities to help reduce fear, anxiety and stress in our patients. Options include preparation at home prior to arrival at the hospital and utilization of low-stress techniques during their stay. This begins with educating the client on what they can and should do to make a better experience for their pet. One part of this is ensuring the veterinarian has recommended pre-visit anxiolytics. The client should also have received the medication and have been educated on how to administer the medication appropriately. Utilizing pheromone therapy is also recommended and can be applied in the carrier, in the car or as a collar depending on the patient.

Home administration of medications

The use of home-administered sedatives/anxiolytics is an often-underutilized opportunity to decrease fear, anxiety and stress for pets, clients, and hospital associates. Many fractious pets are actually displaying a fear response. Decreasing anxiety by providing medication at home is one step to improving their visit. Per AAHA Anesthesia Guidelines, it is strongly recommended that anxiolytics be administered to every fearful, aggressive or stressed patient and should be considered for patients that develop any level of fear, anxiety or stress during their visit. Depending on the procedure being performed, consider the addition of a pre-visit pain medication (opioid), for any pets that may have painful conditions affecting their behavior(arthritis).

Feline anxiolytics

Drug	Dose	Route
Gabapentin	50–100 mg/cat 150 mg/large cat	2–3 hrs prior to travel
Buprenorphine	0.03 mg/kg oral/transmucosal	60–90 min prior to travel
Buprenorphine + Injectable Acepromazine	0.03 mg/kg oral/transmucosal + 0.05–0.1 mg/kg oral/transmucosal	1.5–2 hrs prior to travel

Helpful tips:

- Reduce Gabapentin to 50mg/cat in older or petite cats
- For highly anxious cats, begin Gabapentin the night before. Give another dose in early morning
- For cats that will only allow for one time Gabapentin administration, give one dose 2-3 hours prior to travel
- These medications are not to be used as the pre-anesthetic protocol prior to their anesthetic procedure. Additional medication is needed prior to IV catheter placement and to ensure smooth transition to inhaled anesthesia
- Do not rely on oral gabapentin with patients of unknown health status, acute illness, or respiratory compromise. Unknown health conditions may exacerbate these problems. Instead, rely on low-stress handling techniques and pheromone use

Canine anxiolytics

Drug	Dose	Route
Trazodone	5–15 mg/kg PO	1 hour prior to travel
Gabapentin + Injectable Acepromazine	20–40 mg/kg PO + 0.025–0.05 mg/kg oral transmucosal	2–3 hours before travel + 30 min. prior to travel
Gabapentin + Trazadone	20–40 mg/kg PO + 5–15 mg/kg PO	2–3 hours before travel + 90-120 minutes

Helpful tips:

- Paradoxical excitation is uncommon with trazodone, trial doses are still recommended prior to day of visit.
- Gabapentin can be given the night before and repeated in the morning with the acepromazine
- Gabapentin has been noted to not be as effective in medium to large size dogs

Travel

Pets should be comfortable within their carrier, and it should not be an unfamiliar item utilized only on the day of a veterinary visit. It is best that this is kept within the pet's environment and can be where the pet receives rewards or meals. The carrier should be clean and large enough for the pet to stand up, turn around, and lay down. Consider including an item from home that can also be pre-treated with pheromones.

The hospital team should recognize if a pet arrives showing signs of fear, anxiety, or stress. Signs to look for would be dogs not wanting to walk on their leash or refusing to get on the scale. Cats may be howling or hiding at the back of the carrier. If any of these signs are noted, the anesthesia team should be notified immediately to prevent further escalation.

Home instructions for chronic medications

For those pets on chronic medications, a discussion should be had regarding when medications should be discontinued prior to anesthesia and when next doses can be given again. Below is a general guideline for some of the more common medications. Each decision is at the veterinarian's discretion.

Medications to continue	Discontinue day of anesthesia	Administer based on recommendation
■ Thyroid: supplements or methimazole ■ Behavioral drugs ■ Oral anxiolytics ■ Cardiac medications: pimobendan, furosemide ■ Antibiotics ■ Steroids	■ Antihypertensive medications, especially ACE inhibitors: enalapril, benazepril ■ Anticoagulants: up to 2 weeks prior depending on risk of bleeding	■ Insulin: full dose should not be administered to fasted patients

Pre-surgical fastings

The purpose of fasting before surgery is to decrease the risk of regurgitation and vomiting. Fear of complications related to aspiration of gastric contents has led to continued, conservative, preoperative fasting standards. The historic recommendation of "no food overnight" and restricted water does not take into account differences in gastric emptying or the varying times of surgery.

Reflux is influenced by several factors including: the volume and acidity of gastric contents, age, surgical procedure, drugs used for premedication and/or anesthesia and preoperative fasting. Positioning on the surgical table has not shown to influence incidence of regurgitation for those pets without pre-existing conditions.

There is evidence that an increased duration of preoperative fasting is associated with an increased incidence of reflux in dogs. Decreasing the fasting times and providing a small meal, can decrease the reflux episodes.

The following guidelines supported by AAHA, may help decrease regurgitation episodes seen in surgical patients. This is a guideline only and recommendations should be tailored to the needs of each patient and the resources of each hospital.

Patient status	Withhold water (Hrs)		Withhold food (Hrs)				Feed pâté consistency wet food
	0*	6–12	1–2	2–4	4–6	6–12	
Healthy	✓				✓		
<8 wks of age or <2 kg	✓		No longer than 1–2 hr				In pre-op period
Diabetic	✓			✓			1/2 meal 2–4 hrs prior
History of or at risk for regurgitation		✓				✓	Consider feeding 10%–25% of normal amt. 4–6 hr prior to induction
Emergent		ASAP					

* 0hrs = allow free access to water

The preanesthetic process

The preanesthetic protocol should be the entire process from the time the patient arrives at the hospital until intubation. There are multiple steps to this process:

- A thorough history, physical exam, ASA, and pain score
- Evaluation of bloodwork, urinalysis, radiographs, BP, ECG, etc.
- Communication with the pet owner to update all normal and abnormal findings, prognosis, and risk
- Preparation of all equipment, fluids, and medications
- Administration of additional premedication/sedation/analgesia
- The beginning of any monitoring as the patient allows
- IV catheter placement
- Preoxygenation for at least 3–5 minutes

Reviewing bloodwork

Blood analyzers do not take into consideration the guidelines recommended by the International Renal Interest Society (IRIS). To improve patient safety prior to anesthesia, it is recommended to review blood work results compared to any previous values we may have on record. A rising trend in creatinine and/or an elevated creatinine per IRIS guidelines on a fasted patient may indicate underlying early kidney disease and may warrant further investigation prior to anesthesia.

IRIS CKD staging guidelines

Stage	Blood creatinine			
	Canine		Feline	
	µmol/l	mg/dl	µmol/l	mg/dl
1	<125	<1.4	<140	<1.6
2	125–250	1.4–2.8	140–250	1.6–2.8
3	251–440	2.9–5.0	251–440	2.9–5.0
4	>440	>5.0	>440	>5.0

Premedication and monitoring

Route of administration

IM injections are the preferred route of administration for premedication. They are the least stressful and most reliable route of administration for most patients. Skeletal muscle has a consistent blood supply, and is less likely influenced by factors such as hypotension, hypothermia, and dehydration vs. SC injections.

SC injections are unpredictable in their timing of peak effect. If the patient is well hydrated and there is sufficient time available prior to the desired effects, SC injections are a low-stress option.

IV injections are the fastest route to peak effect, and a predictable way to ensure the patient received the entire dose. Increasing anxiety and stress with heavy restraint to achieve an IV injection is not recommended. Any preinduction struggling and excitation can lead to increased doses of induction drugs, predisposing to hypotension and arrhythmias.

- Allow the appropriate amount of time before induction for the medication used. Peak effect occurring after induction can lead to rapid hypotension and bradycardia.

Decisions should be made by the veterinarian, based on patient safety, and individualized for each situation.

Monitoring and preoxygenation

Monitoring should begin as soon as tolerated.

- BP
- SpO2
- Check temperature
- ECG

Oxygen should be provided as tolerated by the patient. Deliver oxygen by face mask, for 3-5 minutes prior to and during the induction process. If there are delays during induction, return mask to the face and continue oxygen delivery to prevent hypoxemia. Delivery of 100% oxygen for at least 3 minutes provides approximately 6 minutes of complete saturation of oxygen with hemoglobin. This is even more critical in patients with airway disease, breathing difficulty, restricted thoracic movement, and in patients with an expected difficult intubation.

Notes

Troubleshooting

The following section provides quick reference lists for some of the most common complications seen during anesthesia. These lists are only a guide. Continued patient monitoring, signalment, medications used and procedures being performed all need to be taken into consideration when troubleshooting complications.

Acute Bradycardia

Check:	Do:
■ Pulse – matches ECG? ■ Pop-off valve ■ Depth of anesthesia ■ Body temperature ■ ECG – AV block? ■ Recent movement – vagal event? ■ BP ■ Assess for hemorrhage ■ Hyperkalemia? Hypercalcemia?	■ Adjust ECG ■ Open valve – provide assisted ventilation if needed ■ Decrease inhalant ■ Provide warming measures ■ Anticholinergics (was dexmedetomidine given?) ■ Reverse dexmedetomidine if possible ■ Treat underlying cause if found (stop hemorrhage, administer tx, etc)

Acute Hypotension (MAP < 60 mm Hg)

Check:	Do:
■ BP cuff placement and body position ■ Depth of anesthesia ■ HR and Temperature ■ Fluid status ■ Check for blood loss	■ Reposition and monitor ■ Decrease inhalant and increase O2 ■ Provide analgesia ■ Provide warming measures ■ Anticholinergics: • < 60 large canine • < 80 small canine • < 90 feline ■ Reversal drugs if applicable ■ Fluid bolus ■ Vasopressors if above not working

Hypoxemia (SpO2 <95%)

Check:	Do:
■ Assess probe placement ■ Verify intubation – check for one-lung intubation ■ Verify oxygen source and supply	■ Moisten gauze on lingual probe ■ Change tank or abort procedure ■ If extubated, provide flow-by, mask or nasopharyngeal O2

Hypothermia (T < 100°F)

Check:	Do:
■ Warming devices on and working ■ Depth of anesthesia ■ Length of surgical prep ■ Length of anesthesia ■ Wet from dental – wet blankets/towels? ■ Open body cavity	■ Forced warm air, circulating warming water devices ■ Warm saline lavage in body cavity ■ Decrease inhalant if possible ■ Stage procedure if possible

Body positioning

Risk factors during anesthesia, sedation, and surgery related to body position:

Tracheal damage	■ Always disconnect from the breathing circuit prior to any repositioning
Respiratory difficulty	■ Patients positioned with their head below their heart can have difficulty ventilating
Pain	■ Avoid overstretching joints. Provide appropriate padding on table edges, pressure points and areas of trauma
Compromised airways	■ Sternal recumbency is vital during the recovery period to prevent respiratory emergencies
Vagal events	■ Acute bradycardia from stimulation of the parasympathetic system. Can be caused by handling the neck during moving

Quick protocol reference guide

Quick protocol reference guide

Anxiolytics/sedatives

Drug	Species	Healthy dose	Timing	Dose adjustments
Trazadone	**Canine**	5–15 mg/kg PO	90-120 mins prior to travel	Start with lower dose in larger dogs
Gabapentin	**Canine**	20–40 mg/kg	2–3 hrs prior to travel	Noted to not be as effective in medium and large dogs
	Feline	50–100 mg/cat PO	1hr prior to travel	Reduce to 50 mg in ill or geriatric cats Increase to 150 mg in large cats
Trazadone + Gabapentin	**Canine**	5–15 mg/kg PO + 20–40 mg/kg PO	1hr prior to travel 2–3hrs prior to travel	
Gabapentin + Acepromazine (Inj)	**Canine**	20–40 mg/kg PO + 0.025–0.05 mg/kg transmucosal	2–3 hrs prior to travel 1hr prior to travel	
Buprenorphine	**Feline**	0.03 mg/kg transmucosal	1–2 hrs prior to travel	
Buprenorphine + Acepromazine (Inj)	**Feline**	0.03 mg/kg transmucosal + 0.05–0.1 mg/kg transmucosal	1–2 hrs prior to travel	

Premedication drug combinations

Drug option	Species	Level of sedation	Health status	Examples
Opioid	**Feline**	Light	Healthy	Butorphanol 0.2–0.4 mg/kg IM/IV
Opioid Benzodiazepine	**Canine**	Light–Moderate	Healthy & Compromised	Butorphanol 0.2–0.4 mg/kg IM/IV Midazolam 0.2 mg/kg IM/IV
	Feline	Light–Moderate	Compromised	Butorphanol 0.2–0.4 mg/kg IM/IV Midazolam 0.2 mg/kg IM/IV
Opioid Tranquilizer	**Canine**	Moderate	Healthy	Butorphanol 0.4 mg/kg IM Acepromazine 0.01–0.03 mg/kg IM
	Feline	Moderate	Healthy	Butorphanol 0.4 mg/kg IM OR Buprenorphine 0.02 mg/kg OTM Acepromazine 0.025–0.1 mg/kg IM
Opioid Alpha-2 Agonist	**Canine**	Moderate	Healthy	Butorphanol 0.4 mg/kg IM Dexmedetomidine 3–7 **mcg**/kg IM
	Feline	Moderate	Healthy	Butorphanol 0.4 mg/kg IM OR Buprenorphine 0.02 mg/kg OTM (cat) Dexmedetomidine 3–10 **mcg**/kg IM

Premedication drug combinations

Drug option	Species	Level of sedation	Health status	Examples
Opioid Tranquilizer Alpha-2 Agonist	**Canine**	Moderate	Healthy	Butorphanol 0.4 mg/kg IM Acepromazine 0.01–0.03 mg/kg IM Dexmedetomidine 3–7 **mcg**/kg IM
	Feline	Moderate	Healthy	Butorphanol 0.4 mg/kg IM OR Buprenorphine 0.02 mg/kg OTM Acepromazine 0.01–0.03 mg/kg IM Dexmedetomidine 3–10 **mcg**/kg IM
Alpha-2 Agonist Alfaxalone	**Canine**	Heavy	Healthy	Dexmedetomidine 7–15 **mcg**/kg IM Alfaxalone 1–2 mg/kg IM
Opioid Benzodiazepine Alfaxalone	**Canine**	Heavy	Compromised	Butorphanol 0.2–0.4 mg/kg IM Midazolam 0.2 mg/kg IM/IV Alfaxalone 1–2 mg/kg IM
	Feline		Compromised	
Alpha-2 Agonist Dissociative Opioid	**Canine**	Heavy	Healthy	DKT 1:1:1
	Feline		Healthy	

Helpful hints:

- Patient response to handling in the hospital is ultimate determination of dose
- Consider any prior treatment with anxiolytics prior to dosing

Opioid analgesics

Drug	Species	Dose	Duration	Notes
Buprenorphine	**Canine**	0.01–0.03 mg/kg IM, IV	6–8 hours	Slower onset even with IV injection
	Feline	0.01–0.02 mg/kg IM, IV 0.02–0.03 mg/kg PO		
Buprenorphine (long acting)	**Feline**	0.18 mg/kg SC	24 hours	Dose on lean weight Monitor for hyperthermia
Buprenorphine (transdermal)	**Feline**	Size dependent tube	96 hours	Dose on lean weight Monitor for hyperthermia
Butorphanol	**Canine**	0.2–0.5 mg/kg IM, IV	1–2 hours (mostly sedation)	Antitussive Poor analgesic Mild sedative
	Feline			
Fentanyl	**Canine**	Loading dose: 2–10 **mcg**/kg CRI: 2–10 **mcg**/kg/h	1–2 hours if no CRI	Rapid onset, short duration
	Feline			

Opioid analgesics

Drug	Species	Dose	Duration	Notes
Hydromorphone	**Canine**	0.05–0.2 mg/kg IM, IV, SC	4 hours	Panting, vomiting, diarrhea, bradycardia Consider pretreatment with maropitant Less vomiting with IV use
	Feline	0.02–0.05 mg/kg IM, IV, SC		
Methadone	**Canine**	0.1–0.5 mg/kg IM, IV, SC	6–12 hours	Reduced nausea vs other opioids Cost limits use to cats and small dogs Reduced inhalant need, monitor for respiratory depression
	Feline			
Morphine	**Canine**	0.5–1.0 mg/kg IM, SC	4–6 hours	Sedation, vomiting, diarrhea, bradycardia Hypotension and bronchoconstriction (histamine release IV) Consider pretreatment with maropitant
	Feline			

Key reversal drugs

Drug	Reverses	Dose
Naloxone	Opioids (partial butorphanol and buprenorphine)	0.01–0.04 mg/kg IV
Flumazenil	Benzodiazepines	0.01 mg/kg IV
Atipamezole	Alpha–2 agonist	equal volume IM

Other analgesics

Drug	Species	Dose	Duration	Notes
Dexmedetomidine	**Canine**	2–10 **mcg**/kg IM, IV combined with opioid	Variable	Reversible Avoid in Caesarean sections, heart disease, acute illness, or severe injury
	Feline			
Ketamine	**Canine**	0.02–1.0 mg/kg IM, SC, PO Combined with opioid	4–6 hours	Very low doses potentiate opioids Agitated and prolonged recovery (dose dependent) Avoid in severe heart, renal or liver disease
	Feline			
Carprofen	**Canine**	4 mg/kg SC	24 hours	Avoid presurgical, unless chronic use Avoid with GI disease, renal disease, bleeding, or dehydration
Meloxicam	**Canine**	0.2 mg/kg SC day 1, then 0.1mg/kg PO	24 hours	Avoid presurgical, unless chronic use Avoid with GI disease, renal disease, bleeding, or dehydration
	Feline	0.3 mg/kg SC once OR 0.1 mg/kg SC day 1, then 0.05mg/kg PO		Avoid presurgical Avoid with GI disease, renal disease, bleeding, or dehydration **HIGH RISK**
Robenacoxib	**Feline**	2 mg/kg SC	24 hours	Wide safety margin (overdosing less dangerous) vs other options

Dispensed analgesics

Drug	Species	Dose	Duration	Notes
Acetaminophen	**Canine**	10 mg/kg PO	8–12 hours x 7 days	Toxic to cats Used for mild to moderate pain Do not use in patients with liver disease
Codeine	**Canine**	1–2 mg/kg PO	8 hours	Moderate to severe pain and cough suppressant Bad taste, can cause dysphoria Minimal toxicity
	Feline			
Carprofen	**Canine**	2–4 mg/kg	12–24 hours (dose dependent)	Potential for GI ulceration, renal failure and idiosyncratic hepatic dysfunction Avoid in bleeding or dehydrated patients
Deracoxib	**Canine**	1–2 mg/kg/d	24 hours	Avoid with GI disease, renal disease, bleeding, or dehydration
		3–4 mg/kg/d	24 hours x 7 days max	
Firocoxib	**Canine**	5 mg/kg	24 hours	Avoid with GI disease, renal disease, bleeding, or dehydration

Dispensed Analgesics

Drug	Species	Dose	Duration	Notes
Meloxicam	**Canine**	0.1 mg/kg PO	24 hours	Avoid with GI disease, renal disease, bleeding, or dehydration **HIGH RISK** in cats
	Feline	0.05 mg/kg PO	24 hours x 3 days max	
Robenacoxib	**Feline**	2.5–6 kg: 6 mg tablet PO >6 kg: 2 × 6mg tablet PO	24 hours x 3 days max	Palatable for most cats Avoid in cats with renal or liver disease or coagulopathy Best absorption when given **WITHOUT** food
Tramadol	**Canine**	2–8 mg/kg PO	4–8 hours	Controversial - lack of data for efficacy in dogs for acute pain Best if used as adjunct to NSAIDs (chronic pain)
	Feline	2–4 mg/kg PO	12 hours	

Drug updates

Alfaxalone

Alfaxalone is a neurosteroid (alters neuronal excitability) derived from progesterone and used as an induction and/or maintenance agent to induce general anesthesia. Similar to propofol, alfaxalone has a rapid onset, lack of accumulation with short and effective duration while also having dose dependent cardiovascular and respiratory depression. It is a class IV-controlled substance with an FDA label for IV administration in the US. There are multiple formulations and use of the multi-dose vial is recommended due to the 28-day shelf-life.

Multiple studies have been performed showing efficacy and safety when given IM. If used IM, do not switch to propofol for induction; continue to use alfaxalone as the induction drug.

Tips for IV induction with alfaxalone:

- Alfaxalone is similar to propofol and can have similar side effects when given rapidly
- Administer 0.5 mg/kg IV every 30 seconds until the patient relaxes and becomes less responsive to stimuli
- Provide O2 supplementation by face mask as soon as tolerated
- Most patients will need between 1-2mg/kg total dose depending on differences in premedication drugs/doses, health status, and age
- If the patient still has a pronounced cough/swallow reflex at intubation, continue with an additional alfaxalone 0.5 mg/kg to help smooth the transition to inhalant.
- Additional incremental 0.5 mg/kg IV doses of alfaxalone may be administered, if required during the transition period, to inhalant anesthesia.

Tips for IM sedation with alfaxalone:*

- Should be combined with an opioid +/- benzodiazepine
- Short procedures are more likely to have rough recoveries (paddling, myoclonus, rolling, flailing), more pronounced when used alone
- Large volume needed for IM sedation will limit use to cats and small dogs
- Should not be painful on injection
- Ideal for stressed/fearful cats with unknown health status

Maropitant

The anesthesia outcomes that occur most frequently in human anesthesia are pain, nausea, and vomiting. Nausea may not result in vomiting and this clinical sign may be overlooked in our patients. Maropitant (Cerenia) is a selective neurokinin-1 receptor antagonist which blocks the binding of the neurotransmitter Substance P (SP). SP is found in high concentrations in both the chemoreceptor trigger zone and the vomiting center and is the key neurotransmitter involved in vomiting. Cerenia is most commonly utilized in the treatment of motion sickness, nausea and vomiting. Studies show that there is some benefit beyond these common ailments and the application of Cerenia in anesthetic protocols is becoming more common.

Anesthesia and Surgical applications of maropitant:

- Administration of maropitant prior to routine spays, decreased the amount of inhalant anesthetic needed during visceral stimulation (pain) including stimulation of the ovaries and ovarian ligaments
- Maropitant administration prevents nausea and vomiting commonly seen after use of hydromorphone and morphine
- Maropitant treated dogs are significantly more likely to eat within 3 hours of extubating compared to dogs who received opioids alone
- Smoother recovery from anesthesia

High risk patients for vomiting and aspiration pneumonia:

- Opioid administration (Hydromorphone, etc.)
- Brachycephalic, especially bulldog breeds
- GI disease
- Increase intraocular/intracranial pressure

*extra-label use in United States

- History of motion sickness, vomiting, regurgitation

Maropitant Use in Cats

Subcutaneous administration of maropitant in cats is effective in decreasing, but not eliminating, vomiting and signs of nausea prior to morphine or dexmedetomidine premedication. Feline patients exhibit significant aversive behaviors and pain upon SC injection, and therefore oral administration at least 2–3 hours prior to opioid premedication may be a more humane option. Oral maropitant significantly decreases but does not eliminate vomiting and signs of nausea associated with morphine or dexmedetomidine premedication in cats.

Buprenorphine – Transdermal (Zorbium)

Zorbium is a Schedule III opioid, indicated for the control of post-operative pain associated with surgical procedures in cats. It is a one-time administration, applied in the veterinary hospital, providing analgesia for 4 days. . Zorbium can be applied 1-2 hours prior to surgery as a premedication for surgical pain. Transdermal buprenorphine has similar side effects to other buprenorphine products; monitor for dysphoria, hyperthermia, and constipation.

Tips for application:

- Wear latex or nitrile gloves
- Twist to open the applicator tube, the top will not come off
- Do not clip the fur and do not apply to injured/diseased skin
- Part the fur and apply the tube directly to the skin at the base of the head/neck ONLY, emptying the entire contents
- Allow 30 minutes of dry time
- **DO NOT** send home with clients to apply
- Should only be administered by veterinarians or certified technicians who have been trained in handling opioids

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