Anesthetic Drugs, Sedatives & Adjuncts
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SEDATIVES

Dexmedetomidine
- Alpha-2 agonist
- Dose: 1-10 mcg/kg IV, IM; 10-20 mcg/kg OTM
- Onset: minutes; Peak effect: 10-20 min IV, 20-30 min IM; Duration: 40-90 min
- Reversal: atipamezole, equal volume IM
- Indications: premedication, procedural sedation
- Contraindications: MR, DCM, heart failure, uncontrolled diabetes, urinary obstruction
- Effects: vasoconstriction, hypertension, bradycardia, hypotension, hyperglycemia, ↑ urine output, altered thermoregulation

Acepromazine
- Phenothiazine tranquilizer; D2 antagonist & α1 antagonist
- Dose: 0.01-0.1 mg/kg IV, IM; max 1 mg
- Onset: 10-15 min IV, 30 min IM; Duration: 2-6 hr (or more)
- Reversal: none
- Indications: premedication, respiratory distress, post-op sedation, tx hyperthermia
- Contraindications: dehydration, hypovolemia, shock, hemorrhage, coagulopathy, HCM; ↑ sensitivity in patients with MDR1 mutation (avoid or reduce dose)
- Effects: vasodilation, splenic engorgement, ↓ PCV, ↓ PLT aggregation, hypothermia, antiemetic

Midazolam
- Benzodiazepine; potentiates GABA
- Dose: 0.1-0.5 mg/kg IV, IM, SC; 0.2-1.0 mg/kg intranasal, OTM
- Onset: 1 min IV, 10-20 min IM; Duration: 30-90 min
- Reversal: flumazenil 0.01-0.02 mg/kg IV, IM
- Indications: premedication/sedation in pediatric (<6 mo), geriatric & debilitated patients, seizure control
- Contraindications: hepatic encephalopathy, portosystemic shunt(?)
- Effects: anticonvulsive, pain on injection, excitement in young/healthy patients

Diazepam
- Similar to midazolam except:
  - Slightly less potent
  - Longer duration of action
  - Formulated with propylene glycol & ethanol → avoid repeated dosing & infusions
  - IV, OTM, PR; do not administer IM or SC
  - Adsorbs to plastic; do not store in syringes
OPIOIDS

Morphine

- Full mu opioid receptor agonist
- Dose: 0.25-1 mg/kg IV, IM (dogs); 0.1-0.25 mg/kg IV, IM (cats); 0.1 mg/kg (epidural)
- Duration: 2-4 hr
- Reversal: naloxone 0.02-0.04 mg/kg IV, IM
- Indications: painful procedures & conditions, epidural analgesia
- Contraindications: MCT, IM in patients with TBI, brain tumor, fragile eye(s)
- Effects: sedation, dysphoria, vomiting (IM, SC), nausea, histamine release, ileus, urinary retention, panting, hypoventilation, bradycardia, miosis or mydriasis, hyperthermia (cats), ↑pyloric sphincter tone

Hydromorphone

- Full mu opioid receptor agonist
- Dose: 0.05-0.2 mg/kg IV, IM (SC ok in dogs)
- Duration: 2-4 hr
- Reversal: naloxone 0.02-0.04 mg/kg IV, IM
- Indications: painful procedures & conditions
- Contraindications: IM in patients with TBI, brain tumor, fragile eye(s)
- Effects: sedation, dysphoria, vomiting (IM, SC), nausea, ileus, urinary retention, panting, hypoventilation, bradycardia, miosis or mydriasis, hyperthermia (cats), ↑pyloric sphincter tone

Methadone

- Full mu opioid receptor agonist & NMDA receptor antagonist
- Dose: 0.2-0.5 mg/kg IV, IM, SC (dogs); 0.1-0.3 mg/kg IV, IM, SC, OTM (cats)
- Duration: 2-4 hr
- Reversal: naloxone 0.02-0.04 mg/kg IV, IM
- Indications: painful procedures & conditions, chronic or refractory pain, IM in patients with TBI, brain tumor, fragile eye(s), brachycephalic patients
- Contraindications: use with caution in patients at risk of serotonin syndrome (on selegiline, high doses of trazodone, tramadol, history of SS)
- Effects: sedation, dysphoria, less nausea & vomiting than other opioids, ileus, urinary retention, hypoventilation, bradycardia, miosis or mydriasis, ↑pyloric sphincter tone

Fentanyl

- Full mu opioid receptor agonist
- Dose: bolus 2-10 mcg/kg IV, IM, SC; CRI 5-20 mcg/kg/hr (awake CRI 2-10 mcg/kg/hr)
- Duration: 30-60 min
- Reversal: naloxone 0.02-0.04 mg/kg IV, IM
- Indications: painful procedures & conditions, unstable patients (iso reduction)
- Contraindications: use with caution in patients with respiratory depression
- Effects: sedation, dysphoria, pain on injection (IM, SC), antiemetic, ileus (may cause nausea), urinary retention, hypoventilation, bradycardia, miosis or mydriasis, ↑pyloric sphincter tone
Buprenorphine
- Partial mu opioid receptor agonist
- Dose: 0.01-0.03 mg/kg IV, IM (dogs/cats), OTM (cats); 0.12 mg/kg OTM (dogs)
- Onset: 20-30 min; Peak effect 60-90 min; Duration: 4-8 hr
- Reversal: relatively ineffective; naloxone 0.02-0.04 mg/kg IV, IM
- Indications: mildly-moderately painful procedures & conditions
- Effects: sedation, euphoria, agitation, ileus, bradycardia, tachycardia, miosis, mydriasis, hyperthermia (cats)

Butorphanol
- Mu opioid receptor antagonist & kappa opioid receptor agonist
- Dose: 0.2-0.5 mg/kg IV, IM; 0.1-0.2 mg/kg for reversal of full mu opioid agonists
- Duration: 45-60 min (up to 2 hr possible)
- Reversal: naloxone 0.02-0.04 mg/kg IV, IM
- Indications: non-painful procedures, respiratory distress, reversal of full mu opioid receptor agonists
- Contraindications: ↑sensitivity in patients with MDR1 mutation (reduce dose)
- Effects: sedation, ileus, bradycardia, miosis or mydriasis, hyperthermia (rare)

INJECTABLE ANESTHETICS

Propofol
- GABA receptor potentiator
- Dose: 1-6 mg/kg IV; titrate at 1 mg/kg/min to effect
- Onset: 20 sec; Peak effect: 60-100 sec
- Indications: healthy patients, liver disease, intracranial disease, TIVA, short procedures, neonate/pediatric, C-section, laryngeal exam, refractory seizures
- Contraindications: advanced heart disease, heart failure, sepsis, shock, egg allergy
- Effects: unconsciousness, ↓ICP, ↓IOP(?), vasodilation, ↓contractility, ↓HR, hypotension, apnea, hypoventilation, myoclonus, muscle fasciculations, anticonvulsant

Alfaxalone
- GABA receptor potentiator
- Dose: 0.5-2 mg/kg IV; titrate at 0.5 mg/kg/min; 1-4 mg/kg IM (cats, small dogs)
- Onset & peak effect similar to propofol (IV)
- Indications: cardiac disease without failure, unknown cardiac status, IM sedation, neonate/pediatric, C-section, laryngeal exam
- Contraindications: heart failure, fragile eye(s)
- Effects: unconsciousness, ↓ICP, ↑IOP, vasodilation +/- ↓BP, no change or ↑HR, respiratory depression, apnea, muscle rigidity, opisthotonus, nystagmus, poor recovery quality

Ketamine
- NMDA receptor antagonist
- Dose: 2-6 mg/kg IV, IM (see also adjunct doses below)
- Onset: 30 sec; Peak effect: 60 sec
- Indications: painful procedures, windup/hyperalgesia, compensated mitral valve disease
- Contraindications: HCM, DCM, heart failure, hypertension, tachyarrhythmias, advanced liver disease, C-section, +/- intracranial disease (controversial)
- Effects: unconsciousness, ↑ICP (not if used with midazolam), ↑HR, ↑myocardial VO₂, bronchodilation, apneustic breathing, ↑muscle tone, no change or ↑CN reflexes, ↓fetal/neonatal neurologic reflexes, poor recovery quality
Etomidate
- GABA receptor potentiator/agonist
- Dose: 0.5-2 mg/kg IV; bolus 0.25 mg/kg at a time; *pre-treat with midazolam*
- Onset & peak effect similar to propofol
- Indications: heart failure, cardiomyopathy (HCM, DCM)
- Contraindications: Addison’s disease, sepsis
- Effects: unconsciousness, excitement, ↓ICP, vomiting, hypersalivation, myoclonus, adrenocortical suppression, pain on injection, poor recovery quality

ANESTHESIA ADJUNCTS

Ketamine
- See above
- Subanesthetic dose → ↓ central sensitization, windup, opioid tolerance, hyperalgesia
- Bolus 0.25-0.5 mg/kg IV; CRI 5-20 mcg/kg/min
- For CRI, add 120 mg ketamine to 1 L fluids → 5 ml/kg/hr = 10 mcg/kg/min

Lidocaine
- Sodium channel blocker
- Dogs: 2 mg/kg IV before induction → prevention of cough, ↑ICP & IOP during intubation
- Cats: topical on larynx → prevention of laryngospasm, smoother intubation
- CRI 50-75 mcg/kg/min (dogs) → systemic analgesia, ileus prevention, anti-arrhythmic (ventricular), iso reduction

Trazodone
- Serotonin antagonist & reuptake inhibitor (SARI) → antidepressant & anxiolytic
- α1 antagonism → potential for hypotension
- 2-10 mg/kg PO Q8-24 hr or 50 mg/cat; allow at least 1 hr for onset
  - 8 mg/kg 2 hr before anesthesia ↓ isoflurane requirement by 17%
- Give upon arrival or have owner give in AM

Gabapentin
- Calcium channel antagonist → tx partial seizures, neuropathic pain
- Sedation, possible efficacy in acute pain?
- 3-20 mg/kg PO Q6-12 hr or 50-100 mg/cat; allow at least 1 hr for onset
- May cause excessive sedation, vomiting; reduce dose then increase gradually

Maropitant
- NK-1 receptor antagonist → anti-emetic +/- visceral analgesia
- 1-2 mg/kg SC, PO, IV SID; allow 30-60 min for onset
- ↓Nausea & vomiting from opioids, anesthesia, surgical manipulation, ileus, etc
- Better recovery, faster return to eating

Metoclopramide
- Serotonin & dopamine antagonist → prokinetic
- 0.4-1 mg/kg IV, IM, PO Q6-8 hr
- ↑Gastric emptying, ↓GER & regurgitation; less effective anti-emetic than maropitant
- Neurologic effects at high doses
EXAMPLE PROTOCOLS

Dog - young, healthy

- Premed (IM; halve doses for IV)
  - Opioid: Hydromorphone 0.1-0.2 mg/kg or butorphanol 0.3 mg/kg
  - Sedative: Acepromazine 0.03 mg/kg or dexmedetomidine 3 mcg/kg
- Induction (IV): Propofol 2-6 mg/kg or [Ketamine 2-6 mg/kg + Midazolam 0.2 mg/kg]**
- Adjuncts: Trazodone 3-8 mg/kg PO in AM, maropitant 1-2 mg/kg SC or PO in AM

**For all patients: caution with ketamine induction following dexmedetomidine sedation; ↑↑HR in the face of vasoconstriction → ↑↑ myocardial O₂ demand; titrate carefully or use propofol

Dog - geriatric

- Premed (IM; halve doses for IV)
  - Opioid: Hydromorphone 0.1-0.2 mg/kg or butorphanol 0.3 mg/kg
  - Sedative: Acepromazine 0.02 mg/kg or midazolam 0.2 mg/kg
- Induction (IV): Alfaxalone 0.5-2 mg/kg or [Ketamine 2-6 mg/kg + Midazolam 0.2 mg/kg]
- Adjuncts: Trazodone 3-5 mg/kg PO in AM, maropitant 1-2 mg/kg SC or PO in AM

Dog - fractious; young, healthy

- Premed (IM)
  - Opioid: Hydromorphone 0.1-0.2 mg/kg or butorphanol 0.3 mg/kg
  - Sedative: Acepromazine 0.05 mg/kg or dexmedetomidine 5 mcg/kg
  - Other: Ketamine 2 mg/kg IM
- Induction (IV): Propofol 2-6 mg/kg or [Ketamine 2-6 mg/kg + Midazolam 0.2 mg/kg]
- Adjuncts: Trazodone 5-10 mg/kg, gabapentin 10-20 mg/kg and maropitant 2 mg/kg PO in AM

Dog - fractious; geriatric or sick

- Premed (IM)
  - Opioid: Hydromorphone 0.1-0.2 mg/kg or butorphanol 0.3 mg/kg
  - Sedative: Acepromazine 0.02 mg/kg or midazolam 0.2 mg/kg
  - Other: Ketamine 2 mg/kg IM
- Induction (IV): Alfaxalone 0.5-2 mg/kg or [Ketamine 2-6 mg/kg + Midazolam 0.2 mg/kg]
- Adjuncts: Trazodone 3-5 mg/kg, gabapentin 10 mg/kg and maropitant 2 mg/kg PO in AM

Dog with mitral valve disease (low risk of CHF)

- Premed (IM; halve doses for IV)
  - Opioid: Hydromorphone 0.1-0.2 mg/kg or butorphanol 0.3 mg/kg
  - Sedative: Acepromazine 0.03 mg/kg or midazolam 0.2 mg/kg
- Induction (IV): Alfaxalone 0.2-2 mg/kg
- Adjuncts: Trazodone 3-8 mg/kg PO in AM, maropitant 1-2 mg/kg SC or PO in AM

Dog with mitral valve disease (high risk of CHF)

- Premed (IM; halve doses for IV)
  - Opioid: Hydromorphone 0.1-0.2 mg/kg or butorphanol 0.3 mg/kg
  - Sedative: Midazolam 0.2 mg/kg
- Induction (IV): Midazolam 0.2 mg/kg + Etomidate 0.25-2 mg/kg
- Adjuncts: Trazodone 3-5 mg/kg PO in AM, maropitant 1-2 mg/kg SC or PO in AM, ketamine CRI (10 mcg/kg/min)
Dog with diabetes

- Premed (IM; halve doses for IV)
  - Opioid: Hydromorphone 0.1-0.2 mg/kg or butorphanol 0.3 mg/kg
  - Sedative: Acepromazine 0.03 mg/kg or midazolam 0.2 mg/kg
- Induction (IV): Propofol 2-6 mg/kg
- Adjuncts: Trazodone 3-8 mg/kg PO in AM, maropitant 1-2 mg/kg SC or PO in AM

Cat - young, healthy

- Premed (IM; halve doses for IV)
  - Opioid: Buprenorphine 0.02-0.03 mg/kg or butorphanol 0.2 mg/kg
  - Sedative: Acepromazine 0.05 mg/kg or dexmedetomidine 5-10 mcg/kg
- Induction (IV): Propofol 2-6 mg/kg or [Ketamine 2-6 mg/kg + Midazolam 0.2 mg/kg]
- Adjuncts: Gabapentin 100 mg PO in AM, maropitant 1-2 mg/kg SC or PO in AM, topical lidocaine on larynx

Cat - geriatric

- Premed (IM; halve doses for IV)
  - Opioid: Buprenorphine 0.02-0.03 mg/kg or butorphanol 0.2 mg/kg
  - Sedative: Acepromazine 0.03 mg/kg or midazolam 0.2 mg/kg
- Induction (IV): Alfaxalone 0.5-2 mg/kg or [Ketamine 2-6 mg/kg + Midazolam 0.2 mg/kg]
- Adjuncts: Gabapentin 50 mg PO in AM, maropitant 1-2 mg/kg SC or PO in AM, topical lidocaine on larynx

Cat - fractious; young, healthy

- Premed (IM)
  - Opioid: Buprenorphine 0.02-0.03 mg/kg or butorphanol 0.2 mg/kg
  - Sedative: Acepromazine 0.05 mg/kg or dexmedetomidine 10 mcg/kg
  - Other: Ketamine 4 mg/kg
- Induction (IV): Propofol 2-6 mg/kg
- Adjuncts: Gabapentin 100 mg, trazodone 50 mg, and maropitant 1-2 mg/kg PO in AM, topical lidocaine on larynx

Cat - fractious; geriatric or sick

- Premed (IM)
  - Opioid: Buprenorphine 0.02-0.03 mg/kg or butorphanol 0.2 mg/kg
  - Sedative: Acepromazine 0.02 mg/kg or midazolam 0.2 mg/kg
  - Other: Alfaxalone 1-3 mg/kg
- Induction (IV): Alfaxalone 0.5-2 mg/kg
- Adjuncts: Gabapentin 100 mg and maropitant 2 mg/kg PO in AM, topical lidocaine on larynx

Cat with HCM

- Premed (IM; halve doses for IV)
  - Opioid: Buprenorphine 0.02-0.03 mg/kg or butorphanol 0.2 mg/kg
  - Sedative: Dexmedetomidine 5 mcg/kg or midazolam 0.2 mg/kg
- Induction (IV): Alfaxalone 0.5-2 mg/kg
- Adjuncts: Gabapentin 100 mg PO in AM, maropitant 1-2 mg/kg SC or PO in AM, topical lidocaine on larynx

REFERENCES AVAILABLE UPON REQUEST
Join us for our next Lakeshore CE Events!

**CE Seminars**
Thursday, September 26th, 2019
“Oncology Services”
Rachel Reiman, DVM, DACVIM
Time: Reception 6:00pm, Lecture 7:00pm
Location: TBD – Racine/Oak Creek Region

Thursday, November 14th, 2019
“Current Techniques in CPR”
Elke Rudloff, DVM, DACVECC, cVMA
Time: Reception 6:00pm, Lecture 7:00pm
Location: Holiday Inn Milwaukee Riverfront | 4700 N. Port Washington Rd, Milwaukee, WI

**Monthly Technical CE Events**
Monday, May 20th, 2019
“Recognizing and Reducing Patient Stress in Your Hospital”
Carol Haak, DVM, DACVECC
Time: 7:00pm
Lakeshore Veterinary Specialists, Glendale

Monday, June 17th, 2019
“Oncologic Emergencies”
Rachel Sternberg, DVM, DACVIM
Time: 7:00pm
Lakeshore Veterinary Specialists, Oak Creek

Monday, July 15th, 2019
“Urinalysis”
Mandy Nonnenmacher, CVT
Time: 7:00pm
Lakeshore Veterinary Specialists, Glendale