Anesthesia Refresher & New Anesthesia/Analgesic Products

American College of Veterinary Anesthesia and Analgesia

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Acknowledgements

SBCV CVMA-SBCV Chapter

VET STRATEGY

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Objectives

- Sedation versus general anesthetic: what are the considerations?
- Be prepared: Who? What? Where? When? Why?
- Formulate a treatment plan appropriate for patient and type of pain involved
- Brief review of major classes of analgesic drugs
- Reassess and modify pain management plan PRN
- Understand basic monitoring parameter normal values in dogs and cats, perform surgical safety checklist, recognize patient vs monitor issues

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General Anesthesia

- Reversible unconsciousness
- Amnesia
- Analgesia
- Muscle relaxation
- Perform a procedure
  - w/o suffering
  - Safely
    - Patient
    - Veterinary Care Provider(s)

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General Anesthesia Definitions

- Multi-modal approach
  - DO NOT "mask down" (canine/feline) patients!
    - Patient & occupational safety concerns
- MAC (minimum alveolar concentration)

= amount of inhalant needed for 50% of patients non-responsive to supramaximal stimulus

  - Isoflurane: ≈ 1.3% canine, ≈1.6% feline
  - Sevoflurane: ≈ 2.3% canine, ≈ 3% feline
  - allows estimate the amount of inhalant required
    - factors: procedure, patient pre-med response, inhalant

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ASA CLASSIFICATION	DESCRIPTION	EXAMPLES
I	Normal, healthy patient	Healthy young patient presenting for spay/neuter
II	Patient with mild systemic disease	Cutaneous mass removal; uncomplicated orthopedic procedures, well-controlled diabetic or managed asthmatic requiring procedure that may or may not be related to disease
III	Patient with severe systemic disease	Cardiac dysfunction, early renal disease, poorly controlled diabetes mellitus (patient may require procedure possibly unrelated to disease itself), mild anemia
IV	Patient with severe disease that is a constant threat to life	Hemoabdomen, sepsis, intestinal foreign body with potential for bowel rupture, hypovolemic shock, anemia
V	Moribund patient who is not expected to survive	Massive trauma, hemoabdomen with cardiac abnormalities, multi-organ dysfunction, GI foreign body with large amounts of ischemic bowel

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Anesthetic Risks

- ↑ risk of mortality seen with increasing ASA status
  - Importance of patient evaluation and stabilization PRIOR to commencement of procedure
  - Identify risk factors and monitor carefully
- Largest proportion of deaths in post-procedure period
  - Continued patient monitoring & support vital
- Main factor related to anesthetic death = poor health status!
  - Risk of anaesthetic mortality in dogs and cats: an observational cohort study of 3546 cases
  C Bille et al. Veterinary Anaesthesia and Analgesia, 2012, 39, 59–68
- ↑ anesthetic risk with ASA classification
- **> ASA III: 4.77%**
  - ASA III: 2.9%
  - ASA IV: 7.58%
  - ASA V: 17.33%

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Anesthesia-Related Mortality

DOGS
- 5/10 000 (0.05%)
- ↑ age
- nonelective sx
- Pre-anes PE not performed/recorded
- Hct outside RR
- Underweight
  - 15x >

CATS
- 11/10 000 (0.11%)
- ↑ age
- nonelective sx
- SpO2 not monitored/recorded
- ↑ body weight
  - NOTE: not BCS

from Mathews et al. JAVMA 2017

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How can we make anesthesia safe(r)?

Bille et al., VAA (2012 & 2014)

- 1. Emphasize pre-anesthetic medical mgt whenever possible
  - Improve patient's ASA status BEFORE
- 2. Anesthetic Plan:
  - premedication
  - IV induction agent
  - inhalant maintenance
- Monitor & Record: pre, during, post!
- When? Recovery period

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Preparing the Patient

Depends on a number of factors

Patient history

Current health status

Procedure

Complete history + thorough PE key to success, plan lab data based on this info!

Individualize an assessment and workup plan

Is the patient low risk or high?
- Presenting complaint?
- Co-morbidities?

Do specific modifications to the sedation/anesthetic plan need to be formulated?
- Staffing
- Equipment

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Patient Prep: Fear Free Approach

- www.fearfreepets.com
- Benefits:
  - Increased standard of patient care
  - Staff satisfaction
  - Business model

FEAR FREE CERTIFIED Professional

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Pre-PreMeds: Fear Free Pets

Many methods ↓ Fear, Anxiety, Stress (FAS)

www.fearfreepets.com

- Trazodone
  - 3-5 (up to 10) mg/kg q8h
- Gabapentin
  - 10-20 mg/kg q 8h
- Must be administered BEFORE FAS levels high
  - Recommend dosing night before, then morning of dropoff
- Melatonin, CHILL Protocol (melatonin, gabapentin, acepromazine) developed at Tufts University
  - 0.1 mg/kg
  - (0.5-3 mg/cat, 1-6 mg/dog)

*caution when patients are already on other behavioral modifying meds!

FEAR FREE
Taking the pet out of petrified.

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Who Should Have Vascular Access?

- ALL anesthetized patients
- Titrated-sedation patients
- "Choose your own adventure" patients
  - Top-ups likely or warranted
  - Difficult IV access patients
- GOAL – individualized plans! (pt mgt (type, size, location access), drugs, etc.)
  - prepare & anticipate possible complications
  - Ensure good outcomes

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Intravenous Access

- Benefits
  - Increased patient comfort overall
  - Increased patient safety – emergency situations!
  - Ability to administer fluids, transfusions, medications
  - Access to draw blood samples (in some instances)
  - Hemodynamic monitoring – i.e. CVP (in some instances)
- Potential concerns:
  - Hemorrhage
  - Infection – systemic v phlebitis
  - Vascular trauma – scarring, phelbitis

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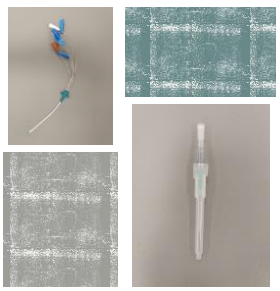
Types of Vascular Access

More common:

- Intravenous catheter
  - Peripheral (most common)
  - Central line
  - Sampling line
- Intra-arterial catheter

Less common: (but certainly options to consider!)

- Vascular Access Ports
- Intra-osseous catheter (situation, species dependent)



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Premed & Induction: Neuroleptanalgesia

- Recommended approach for pre-anesthetic medication

= sedative + opioid

- synergistic effects
  - use less of both drugs with greater effect
  - higher safety margin, lower side effects
  - ↓ stress and provides analgesia

1+1 > 2!

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Premed: Opioid + Sedative

OPIOIDS

- Pure mu agonists
  - Morphine, hydromorphone, fentanyl
- Others
  - Butorphanol
  - Buprenorphine

SEDATIVES

- Phenothiazines
  - Acepromazine
- Alpha-2 agonists
  - Dexmedetomidine
- Benzodiazepines
  - Midazolam
  - Diazepam

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Induction: Propofol & Alfaxalone

- Amount of induction agent 1/∞ to level of sedation!
  - You can always add more, but can't take it away…
  - Hypotension, dose-related resp depression → apnea
  - Entire dose rarely needed in ASA ≥ III
- Propofol
  - 0.5-4 mg/kg IV SLOW
- Alfaxalone
  - 0.25-2m kg IV SLOW

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Induction: How much to give?

Signs to consider:

- Muscle relaxation
- Palpebral reflex
  - Negative LATERAL
  - Keep in mind (+) medial into surgical plane
- Eye position – rotated ventromedially
- Jaw tone – check it LAST!

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Induction: ketamine + benzo

Ketamine + benzodiazepine

- Premed 1st : opioid + sedative
- Induce:
  - Ketamine 5 mg/kg
  - Diazepam or midazolam 0.25 mg/kg
- Give it all?
  - It depends…

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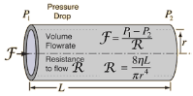
Induction: Endotracheal Tubes for GA!

- Size: palpate the trachea
  - 3 tubes ready: 1 you need, 1 bigger, 1 smaller
- Diameter: BIGGER IS better!
  - Poiseuille's law
    - ↓resistance to flow, ↓work of breathing
- Length: SHORTER is better!
- Cuff inflation: MINIMAL!
  - Inflate air as someone is bagging to 20 cmH2O
  - AVOID BLIND FILLING & SQUEEZING!
  - AFTER tube tied in
  - BEFORE turning on inhalant!
- Steps for proper cuff check:
  - Close APL (pop-off) valve
  - Fill reservoir bag to 20 cmH2O

Q	Flow rate
P	Pressure
r	Radius
η	Fluid viscosity
l	Length of tubing

$$Q = \frac{\pi \Pr^4}{8\eta l}$$



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Induction: Use a Laryngoscope

Larygnoscope!

- Placement
  - Base of tongue
  - IN FRONT of epiglottis
  - Why? Better visual, larger ETT
  - do NOT grab epiglottis & push down → fx hyoid apparatus
- Light bulb gets hot when left on – burns reported
  - Get LED if possible

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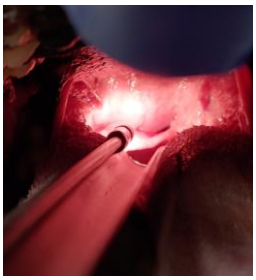

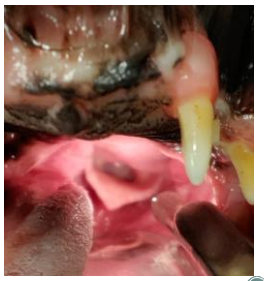

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GA: Vaporizer Settings

- MAC = Minimum Alveolar Concentration
  - Amount of inhalant needed to render 50% of patients unresponsive to noxious stimulus
  - Studies done with just inhalant, no premed/ind agents
- 1.2-1.4x MAC for most procedures
  - Healthy, elective
  - LESS, MUCH LESS for patients with comorbidities, high risk anesthesia, other drugs (i.e. analgesic CRIs) coadministered
- Isoflurane
  - Dog: 1.2-1.3%, Cat: 1.4-1.6%
- Sevoflurane
  - Dog: 2.2-2.3%, Cat: 2.6-3.2%
- **GOAL: to minimize inhalant use in high-risk cases**
  - Multimodal drugs, analgesic CRIs, locoregional anesthesia
  - VENTILATION over increasing vaporizer settings!

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General Anesthesia: O_2 flow

- Rebreathing Systems
  - Circle/Universal F
    - Induction & Recovery: 50-100 mL/kg/min O_2
    - Maintenance: 20-50 mL/kg/min O_2
- Nonrebreathing Systems
  - Mapleson F
  - Bain (Modified Mapleson D), Universal Arm
  - ≥ 200-300 mL/kg/min O_2

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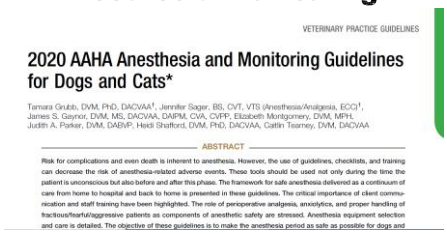
Anesthesia Monitoring



VETERINARY PRACTICE GUIDELINES

2020 AAHA Anesthesia and Monitoring Guidelines for Dogs and Cats*

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ABSTRACT

Risk for complications and even death is inherent to anesthesia. However, the use of guidelines, checklists, and training can decrease the risk of anesthesia-related adverse events. These tools should be used not only during the time the patient is unconscious but also before and after this phase. The framework for safe anesthesia delivered as a continuum of care from home to hospital and back to home is presented in these guidelines. The critical importance of client communication and staff training have been highlighted. The role of perioperative analgesia, anxiolytics, and proper handling of fractious/fearful/aggressive patients as components of anesthetic safety are stressed. Anesthesia equipment selection and care is detailed. The objective of these guidelines is to make the anesthesia period as safe as possible for dogs and

https://www.aaha.org/aaha-guidelines/2020-aaha-anesthesia-and-monitoring-guidelines-for-dogs-and-cats/anesthesia-and-monitoring-home/

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Anesthesia Monitoring: AAHA Guidelines

- Patient preparation
- Individualized anesthetic plans
- Constant monitoring:
  - Cardiovascular
  - Respiratory
  - Central nervous system
- Adjustments based on patient status

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Anesthesia Monitors

PARAMETER:	MONITOR:	INFORMATION:
Oxygenation	Pulse Oximeter	SpO_2, pulse rate (PR)
Ventilation/Respiration	Capnometer/Capnograph	Respiration rate, $ETCO_2$
Blood Pressure	Doppler w sphygmomanometer; Oscillometeric Direct Arterial Line (invasive)	SAP (systolic arterial pressure) MAP(mean)w calculated SAP;DAP SAP, MAP, DAP (diastolic), PR
Pulse rate	Pulse oximeter, Doppler Oscillometric* ECG	Pulse by pulse, audible info * not real time with oscillo Electrical impulses of heart
Temperature	Thermometer	Rectal or esophageal temperature

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Anesthesia Monitoring

The Big 3

- SpO_2
- $ETCO_2$
- BP

Then,

- ECG, T°, eye lube

- Anesthesia-dedicated RVT, record q5 min

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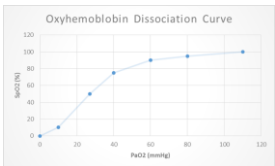
Pulse Oximetry: Why is it important?

- Sigmoid shape
- FiO_2 21% PaO_2 : 80-110 mmHg
- FiO_2 100% PaO_2: 400-500 mmHg
- SpO_2: PaO_2 benchmarks



SpO2 (%)	PaO2 (mmHg)
100	> 100 (up to 500)
95	80
90	60
75	40

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Pulse Oximeter

- From induction through recovery (GA)/ entire sedation procedure whenever possible!
- Oxygen desaturation events
  - SpO_2 < 95%
  - Please NEVER ignore!
  - Induction: esophageal intubation, endobronchial intubation, oxygen supply problem
  - Maintenance: hypoventilation
  - Recovery: hypoventilation, VQ mismatch

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Capnography

- Parameters:
  - Real-time respiratory rate (RR)
  - End-tidal CO_2 ($ETCO_2$)
- Normal ranges:
  - $ETCO_2$ 35-45 mmHg
  - RR: Dogs (≈ 8-20 bpm), cats (≈10-30 bpm)
  - Recall, $V_m = V_t * RR$
- Advantages:
  - Affordable, noninvasive, portable, valuable info

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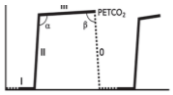
Capnography

- From induction (intubation) to recovery (extubation)
- Hypoventilation events
  - $ETCO_2$ > 45 mmHg
    - Common causes: too deep (inhalant), obese, opioid/sed
    - (-): respiratory acidosis
    - You have control!
- Hyperventilation events
  - $ETCO_2$ < 35 mmHg
    - Dilutional effects?
    - Is the patient: light, painful, hot/opioids, acidemic, hypoxemic?



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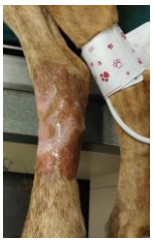
Blood Pressure Monitoring



- Parameters:
  - Pulse rate (PR)
  - Arterial pressure (SAP, MAP, DAP in mmHg)
- Normal ranges:
  - MAP ≥ 60 mmHg: normal, healthy, young pts
    - Doppler BP ≥ 90 mmHg
  - MAP > 80 mmHg: geriatric, renal, hypertensive pts
    - Or ideally, within 20 mmHg of awake BP if possible
- Sedation
  - Acepromaine: ↓SVR (vs) Dexmedetomidine: ↑ SVR, reflex bradycardia
- General Anesthesia
  - Inhalant: ↓ CO, ↓ SVR
- From start of procedure until …?
  - Patient monitoring should end once the patient has vitals WNL!
    - TPR, BP, SpO_2, +/- $ETCO_2$

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Blood Pressure Monitoring

Oscillometric
- Popular, easy to apply, automated
- MAP measured
  - BP cuff ≈ 40% the circumference of the limb to machine attached to tubing → auto-inflate → system deflates slowly until oscillations in the arteries are detected when blood flow is first terminated, then when it returns
  - Oscillations terminate w/normal blood flow →MAP
  - SAP, DAP calculated using a computer algorithm
- (-) ↓accuracy: hypotension, hypertension, tachycardia, bradycardia, very small patients

Other options: direct BP (IBP/art line), Doppler

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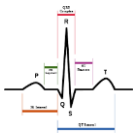
ECG: Electrocardiogram



- Parameters:
  - Cardiac electrical activity
  - HR
    - Canine: 60-160 bpm
    - Feline: 120-220 bpm
- When to use?
  - Normal pts: after the "big 3": pulse oximeter, capnograph, BP monitor
  - Place in advance of anesthetic induction in patients where cardiac arrhythmia concern
    - i.e., hx cardiac dz, hemoabdomen, GDV, septic shock
- Why is it important?
  - Under abnormal circumstances, electrical activity does not result in appropriate cardiac contraction
    - ↓ CO, circulation, perfusion
    - i.e. AV block, VPCs, V tach, etc.

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Temperature Support

- Temperature monitoring +/- heat support should be provided in all sedated/GA pts
- Hyperthermia
  - ↑ metabolism, ↑ ETCO2, ↑anesthetic drug need
  - T > 108ºF (42.2ºC) → multiple organ failure and death
- Hypothermia
  - T < 96ºF (35.6ºC): ↑ infection and bleeding risks
  - T < 94ºF (34.4ºC): prolonged and poor quality recovery
    - ↓ drug metabolism
    - shivering → discomfort, ↑ oxygen consumption

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Why manage pain?

- Optimize patient well-being
  - Reduce stress
  - Optimize healing
  - Prevent unwanted behaviors
  - Allow rest – patient AND client
- Prevention of enhanced pain states
  - Peripheral Sensitization
  - Central Sensitization

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Progression of Pain

Injury
↓
Inflammation — Peripheral, Physiologic
↓
Peripheral Sensitization/1º Hyperalgesia
↓
Wind-up
↓
Central Sensitization — Central, Chronic, Pathologic

Pathologic

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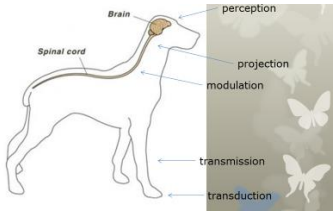

Acute Pain

- Transduction: noxious stimulus at peripheral nociceptors
- Transmission: triggers A-δ and C fibers information from periphery to SC
- Modulation: → SC dorsal horn amplifies or inhibits ascending transmission from SC to CNS (brainstem)
- Perception: CNS (cortex)

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Pain Sensitization

- Maladaptive pain
  - No biologic function (not protective)
  - Self-perpetuating and stressful
- Sustained sensory input modifies inhibitory descending (antinociceptive) processes
- Central & peripheral sensitization of nociceptive pathways
  - Brain, spinal cord, dorsal horn
  - Aka "wind-up"
  - Neuroplasticity → anatomic changes → exaggerated pain!

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Pain Recognition and Evaluation

- Pain Behaviors
  - Posture and activity
- Vocalization
  - Nonspecific, species differences
- Appetite
- Appearance
- Response to Manipulation
- Urinary and Bowel Habits
- DIFFERENCES IN SPECIES AND TYPES OF PAIN!

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Objective and Categorical Pain Assessment

- Difficulties:
  - Species differences
  - Validation of scale (species, type of pain)
  - Physiological factors not dependable
    - Fear, anxiety, anesthesia, etc
  - Behavioral assessment can be subjective
    - Subtle changes
    - Individual differences

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Pain Scale Use

- Measure of patient's pain intensity at a specific time point
  - Objective, repeatable
  - Type, severity, duration → diagnose, treat, reassess!
- Ensure that pain is assessed and treated in EVERY patient (please reassess frequently!)
- PAIN = 5th vital sign
  - Use in conjunction with patient evaluation and complete PE
- ALL pain scales have limitations
  - Use appropriate scale for type of pain
- If in doubt, try analgesic trial based on individual needs
- GOAL = low pain score + comfortable patient!

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What are our challenges in assessing pain?

- Species differences
- Validation of scale (species, type of pain)
- Physiological factors not dependable
  - Fear, anxiety, anesthesia, etc
- Behavioral assessment can be subjective
  - Subtle changes
  - Individual differences

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Options for assessing ACUTE pain in DOGs

- Glasgow Composite Measure Pain Scale (CMPS) Canine
  - Morton CM, Reid J, Scott EM, Holton LL, Nolan AM. Application of a scaling model to establish and validate an interval level pain scale for assessment of acute pain in dogs. Am J Vet Res. 2005 Dec;66(12):2154-66. doi: 10.2460/ajvr.2005.66.2154. PMID: 16379662
- Glasgow Composite Measure Pain Scale –Short Form (CMPS-SF) Canine
  - Reid J, Nolan AM, Hughes JM, Lascelles D, Pawson P, Scott EM. Development of the short-form Glasgow Composite Measure Pain Scale (CMPS-SF) and derivation of an analgesic intervention score. ANIMAL WELFARE-POTTERS BAR THEN WHEATHAMPSTEAD-. 2007 May 1;16:97
- Colorado State University (CSU) Pain Scale
  - not validated, but widely used

Hofmeister EH, Barletta M, Shepard M, Brainard BM, Trim CM, Quandt J. Agreement among anesthesiologists regarding postoperative pain assessment in dogs. Vet Anaesth Analg. 2018 Sep;45(5):695-702. doi: 10.1016/j.vaa.2018.04.001. Epub 2018 May 22. PMID: 30078533

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SHORT FORM OF THE GLASGOW COMPOSITE PAIN SCALE

Rescue for Dogs:

- Non-Ambulatory ≥ 5/20
- Ambulatory ≥ 6/24

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Options for assessing ACUTE pain in CATs

- Glasgow Composite Measure Pain Scale (CMPS) Feline
  - Reid J, Scott EM, Calvo G, Nolan AM. Definitive Glasgow acute pain scale for cats: validation and intervention level. Vet Rec. 2017 May 6;180(18):449. doi: 10.1136/vr.104208. Epub 2017 Jan 27. PMID: 28130405
- UNESP-Botucatu
  - Brondani JT, Mama KR, Luna SP, Wright BD, Niyom S, Ambrosio J, Vogel PR, Padovani CR. Validation of the English version of the UNESP-Botucatu multidimensional composite pain scale for assessing postoperative pain in cats. BMC Vet Res. 2013 Jul 17;9:143. doi: 10.1186/1746-6148-9-143. PMID: 23867090; PMCID: PMC3722032
  - Belli M, de Oliveira AR, de Lima MT, Trindade PHE, Steagall PV, Luna SPL. Clinical validation of the short and long UNESP-Botucatu scales for feline pain assessment. PeerJ. 2021 Apr 12;9:e11225. doi: 10.7717/peerj.11225. PMID: 33954046; PMCID: PMC8048399
- Feline Grimace Scale
  - Evangelista, M.C., Watanabe, R., Leung, V.S.Y. *et al.* Facial expressions of pain in cats: the development and validation of a Feline Grimace Scale. *Sci Rep* **9**, 19128 (2019). https://doi.org/10.1038/s41598-019-55693-8
- Colorado State University Feline Acute Pain Scale (CSU-FAPS)
  - Shipley H, Guedes A, Graham L, Goudie-DeAngelis E, Wendt-Hornickle E. Preliminary appraisal of the reliability and validity of the Colorado State University Feline Acute Pain Scale. J Feline Med Surg. 2019 Apr;21(4):335-339. doi: 10.1177/1098612X18777506. Epub 2018 May 31. PMID: 29848148
    - ***Conclusions & Relevance:*** *The CSU-FAPS showed moderate-to-good inter-rater reliability when used by veterinarians to assess pain level or need to reassess analgesic plan after ovariohysterectomy in cats. The validity fell short of current guidelines for correlation coefficients and further refinement and testing are warranted to improve its performance*

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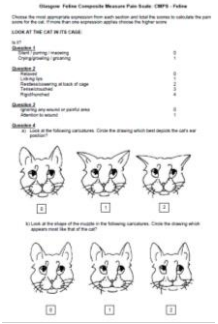

Glasgow Feline Composite Measure Pain Scale - CMPS - Feline

Choose the most appropriate expression from each section and total the scores to calculate the pain score for the cat. If more than one expression applies choose the higher score

LOOK AT THE CAT IN ITS CAGE:

Is it?

Question 1
Quiet / purring / relaxing 0
Crying/growling / groaning 1

Question 2
Relaxed 0
Licking face 1
Head drooping at back of cage 2
Twitches/touched 3
Flight/bunched 4

Question 3
Ignoring any wound or painful area 0
Attention to wound 1

Question 4
If Look at the following caricatures. Circle the drawing which best depicts the cat's ear position?

0 1 2

In Look at the shape of the muzzle in the following caricatures. Circle the drawing which appears most like that of the cat?

0 1 2

APPROACH THE CAGE, CALL THE CAT BY NAME & STROKE ALONG ITS BACK FROM HEAD TO TAIL

Question 5
Does it?
Respond to stroking 0

Is it?
Unresponsive 1
Aggressive 2

IF IT HAS A WOUND OR PAINFUL AREA, APPLY GENTLE PRESSURE 5 CM AROUND THE SITE. IN THE ABSENCE OF ANY PAINFUL AREA APPLY SIMILAR PRESSURE AROUND THE HIND LEG ABOVE THE KNEE

Question 6
Does it?
Do nothing 0
Swish tail/flatten ears 1
Cry/hiss 2
Growl 3
Bite/lash out 4

Question 7
General expression
Is the cat?
Happy and content 0
Disinterested/quiet 1
Anxious/fearful 2
Dull 3
Depressed/grumpy 4

Pain Score ... /20

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Rescue for Cats ≥
5/20

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Feline Grimace Scale

https://www.felinegrimacescale.com/

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Limitations to Use of Pain Scales

- Clinical judgement shall prevail
- Validated pain scales are an additional tool
- Behavioral challenges
- Severe FAS
- Dysphoria
- Sedation – effects of other peri-anes meds

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What's in our PAIN toolbox?

DRUG	ACUTE PAIN	Portion of Pain Pathway Affected	CHRONIC PAIN	(-) effects
Opioids	++	Transduction, modulation, perception	+/-	Tolerance
NSAIDs	+/-	Transduction, Modulation	++	Toxicity
Alpha-2 Agonists	+	Modulation, perception	-	Sedation
NMDA Angatonists	+	Modulation	++	Sedation
Local Anesthetics	+++	Transduction, transmission	-	Loss of Motor, toxicity
Serotonin & Bradykinin Antagonists	-	Transduction	+	Serotonin syndrome risk (?)

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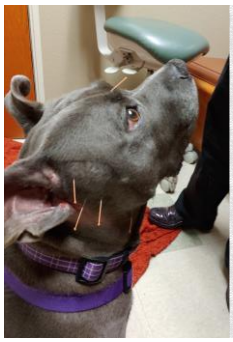

What's in our alternative tx toolbox?

- Nutraceuticals and Herbs
- Physical Rehabilitation
  - Cryotherapy, thermotherapy, aqua therapy, massage, ROM, stretching, exercise, TENS, laser, therapeutic ultrasound, static magnet, etc.
- Acupuncture

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Meet Sugar!

- Sugar
- 6 y/o FS Canine
- PitBull Terrier
- PC: RPL mass removal – open wound
- Hx: unknown mass excised elsewhere, incomplete closure, managed as open wound
  - Referred to SAGE via neighboring ER clinic
- Current meds: Clavamox, deracoxib

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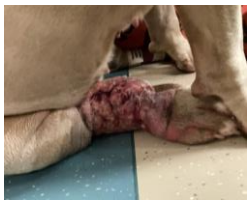
Sugar: 4 days post-op at referral



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Sugar's Amputation Surgery

- Pre-op:
  - CBC/Chem/lytes: NSF
  - CXR (3v) no evidence of metastasis
- Premed?
- Induce?
- Maintenance? CRIs?
- Locoregional anesthesia?
- Recovery concerns?
- Post-operative pain management?
- TGH analgesia?

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Sugar's Anesthesia Plan

- Pre-premed: maropitant 1 mg/kg IV
- Premed: hydro 0.1 mg/kg + dexmed 1 mcg/kg IV
- Induce: midazolam 0.2 mg/kg IV, followed by propofol up to 4 mg/kg IV slow
- Maint: iso + O2, fentanyl CRI, ampicillin-sublactam IV q 90 min, LRS at 5 mL/kg/h
- Locoreg: intra-op nerve blocks (bupivacaine) + LE bupivacaine (Nocita)
- Post-op analgesia: fentanyl CRI, deracoxib once eating, fentanyl patch 50 mcg/h, gabapentin 300 mg PO q8h

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Sugar's Evaluation

0730, October 18, 2022: 1d post-op

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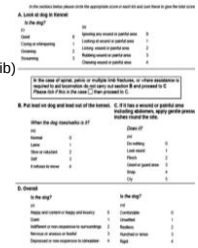
Sugar's Evaluation

0730 rounds

- Fentanyl CRI d/c, oral meds given (gabapentin, deracoxib)
- Nurse reports that patient has been demonstrating
  - Bruxism
  - Wakes from a sound sleep, jumps up & tries to bite at R flank
  - Glasgow Composite Score: /24
    - 0+1+1+2+0+0

= 4!?! What to do?



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Sugar's Plan?

- Remain in hospital for an additional day
- Ketamine load 0.5 to 1 mg/kg IV, followed by CRI at 2-5 mcg/kg/min (dilute to 5 mg/mL)
  - Run CRI 12-24h
- Hydromorphone 0.05 mg/kg IV q 4-6h PRN
- TGH, add: amantadine 3-5 mg/kg PO q 12-24h x 21d

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Considerations for New Product Integration?

- Efficacy
- Safety
  - Patient
  - Staff
  - Clients
- Supporting data
  - How many studies? Peer reviewed? Sample size? Sample population?
- Cost
- Availability
- Caseload?

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Zenalpha ® (medetomidine + vatinoxan HCl)

- Company: Dechra USA
- Formulation: medetomidine 0.5 mg/mL + vatinoxan 10 mg/mL
- Availability: 10 mL vial, multi-dose glass vials
- Label use: canine intramuscular injection
- Indication: sedation (and analgesia) for dogs
  - Clinical examinations
  - Clinical procedures
  - Minor surgery
- Recommended use: ASA I-II
  - Healthy, low risk

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Zenalpha ® (medetomidine + vatinoxan HCl)

- Pharmacology
  - Medetomidine = alpha-2 agonist
  - Vatinoxan = alpha-2 antagonist
- Why consider Zenalpha?
  - HR & BP closer to normal range
  - Minimal vomiting
  - Shorter onset and duration than dexmedetomidine
- Dosage and Administration
  - IM only, DOGS only
  - Chart = m^2: single agent; young, healthy dogs → reduction for clinical use in most cases

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Zenalpha ® (medetomidine + vatinoxan HCl)

Medetomidine

- α-2 agonist
- Previous formulation Domitor
- Racemic mixture of 2 optical stereoisomers
  - dexmedetomidine + levomedetomidine (50/50)
- Profound sedation, mild analgesia
- Same patient concerns as dexmedetomidine
  - i.e. avoid in patients: renal disease, hepatic disease, cardiac disease, DM

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Zenalpha ® (medetomidine + vatinoxan HCl)

Vatinoxan

- α-2 antagonist
- Unable to cross BBB
  - Permits sedative effects
- Peripheral side effects minimized
  - BP, HR
- (-) effect on analgesia?!?

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Zenalpha ® (medetomidine + vatinoxan HCl)

- Onset time: 5-15 minutes*
- Duration of action: ≈ 45 minutes*

*sedation

- Monitor during sedation: HR, BP, RR, T° (and record!)
  - Tachycardia may be seen during recovery
- Flow by O_2
- Side effects: pronounced cardiovascular effects (alpha-2 agonist)
  - Hypertension, reflex bradycardia
  - Less severe than with traditional α-2s

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Zenalpha ®
(medetomidine + vatinoxan HCl)

- Manufacturer recommends to AVOID in patients with:
  - Cardiac disease
  - Respiratory disorders
  - Shock
  - Hypoglycemia
  - Heat or cold stress, fatigue
  - Preexisting hypotension, hypoxemia, bradycardia
- Adverse effects:
  - Diarrhea, muscle tremors

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Zenalpha ® (medetomidine + vatinoxan HCl)

IM dose volume based on body weight:

Dog body weight		Dose volume
lbs	kg	mL
4.4 to 7	2 to 3	0.3
7.1 to 9	3.1 to 4	0.4
9.1 to 11	4.1 to 5	0.6
11.1 to 22	5.1 to 10	0.8
22.1 to 29	10.1 to 13	1.0
29.1 to 33	13.1 to 15	1.2
33.1 to 44	15.1 to 20	1.4
44.1 to 55	20.1 to 25	1.6
55.1 to 66	25.1 to 30	1.8
66.1 to 73	30.1 to 33	2.0
73.1 to 81	33.1 to 37	2.2
81.1 to 99	37.1 to 45	2.4
99.1 to 110	45.1 to 50	2.6
110.1 to 121	50.1 to 55	2.8
121.1 to 132	55.1 to 60	3.0
132.1 to 143	60.1 to 65	3.2
143.1 to 154	65.1 to 70	3.4
154.1 to 176	70.1 to 80	3.6
>176	>80	3.8

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Zenalpha ® (medetomidine + vatinoxan HCl)

Field Study:

- N = 208, 6 vet clinics, IM Zenalpha v dexmedetomidine
  - Zenalpha – shorter onset, shorter duration
    - 14 m v 18 m
    - 38 m v 90 m

Tip & Tricks for use:

- SIGNIFICANT dose-reduction from label dose PRN!
- Even more significant dose reduction when opioid co-administered!
- Use of additional reversal agents not likely needed
  - Goal = save time in your day, save clients $

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Zorbium™ (buprenorphine transdermal solution)

- Company: Elanco USA
- Formulation: buprenorphine 20 mg/mL, 2 sizes:
  - 0.4 mL: 2.6-6.6# (1.3-3 kg)
  - 1 mL: > 6.6-16.5# (> 3-7.5 kg)
  - Solvent, permeation enhancer, buprenorphine
- Label use: transdermal application onto cervical area
- Indication: post-operative analgesia in cats
- Onset time: apply 1-2h prior to surgery
- Duration of action: up to 4 days
- Recommended use: management of post-operative pain in cats

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Zorbium™ (buprenorphine transdermal solution)

- Pharmacology of buprenorphine
  - PARTIAL mu (μ) agonist
  - Effective for mild to moderate pain in cats
  - Duration of action: 6-8h, onset ≈30 m
  - Dose range: 10-30 mcg/kg (0.01 - 0.03 mg/kg)
  - Route(s) of administration: IV > IM > PO > SQ
    - *Stegall et al., *Pharmacokinetic and pharmacodynamic modelling of intravenous, intramuscular and subcutaneous buprenorphine in conscious cats*. Vet Anaesth Analg. 2013 Jan;40(1):83-95.
  - Naloxone may be inadequate for reversal!
- Other formulations
  - Injectable 0.3 mg/mL
  - Simbadol

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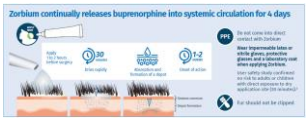

Zorbium™ (buprenorphine transdermal solution)

FIELD STUDY

- N = 222 (113 tx, 109 control)
- Multi-center, randomized, blinded study
- Cats, age 4 mo-5y, 1.1-5.7 kg, elective surgical sterilization + thoracic limb onychectomy
- Monitor regularly during anesthesia, continue to monitor temperature post-operatively
- Common adverse effects (1st 96h)*: *see insert for full details
  - During anesthesia: ↑ hypoxemia (SpO_2 < 90%), bradycardia, hypotension
  - Post-operative: ↑ hyperthermia (day 0-4), sedation (day 1)

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Zorbium™ (buprenorphine transdermal solution)

- Side effects (most common):
  - Hyperthermia
  - Sedation (< 1h)
  - Dysphoria (< 3h)
  - Mydriasis, euphoria 10-12h

- Manufacturer recommends to AVOID in patients with:
  - Debilitation, renal, hepatic, cardiac, or respiratory disease
  - Pregnant/lactating, < 4 months old, outside of weight ranges
  - Opioid hypersensitivity, intolerance to vehicle; abN skin at application site

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Zorbium™ (buprenorphine transdermal solution)

A note on hot cats… (aka FELINE DRUG-RELATED HYPERTHERMIA)

- Multi-factorial, moderate, self-limiting hyperthermia (106F, 5h)
- Hydromorphone, morphine, butorphanol, buprenorphine, ketamine
- Maximum temperature seems to be inversely proportional to cat temperature at extubation
- NO morbidity resulting from the hyperthermia has been reported

(Posner, 2007 & 2010)

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Zorbium™ (buprenorphine transdermal solution)

- Why consider Zorbium?
  - Difficult to administer oral meds to some cats
  - mild-to-moderate analgesia needs for up to 4d
- Dosage and Administration
  - PPE: gown, gloves, goggles
  - Schedule III opioid

Pounds of Body Weight	Kilograms of Body Weight	Dose of ZORBIUM
2.6 to 6.6	1.2 to 3	0.4 mL (8 mg) pink tube
>6.6 to 16.5	>3 to 7.5	1 mL (20 mg) green tube

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Zorbium™ (buprenorphine transdermal solution)

Tip & Tricks for use:

- Buprenorphine comfort - historically, test dose IV or IM 1st
  - i.e. Kitty magic, then Zorbium either immediately or 6h post
- Aggression seen more in repeated dosing
  - Likely compound plasma effect 4d w/o analgesia w/residual plasma levels
  - Reapply 5-6d – palliative, reassess based on individual
- Off label use for nonsurgical pain, may see more side effects
  - Prep owners! Day of application. Perhaps round down dose
  - 2 small cat doses 0.4 vs 1 mL (20 mg) - so can play with dosing

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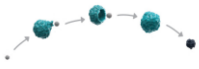
Synovetin [Homogeneous Tin (^{117m}Sn) Colloid]

- Company: Exubrion Therapeutics USA
- Formulation: Tin (^{117m}Sn) stannic colloid in ammonium salt
- Label use: 2–4 mCi (74–148 MBq)/mL suspension for intra-articular (IA) injection
- Indication: radioisotope → long-lasting reduction of inflammation & pain associated with elbow arthritis
  - Medical radiotherapy
- Duration of action: up to one year
- Repeated treatments: ok after 12+ months



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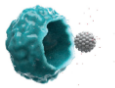
Synovetin [Homogeneous Tin (^{117m}Sn) Colloid]



- Side effects: joint soreness post-injection (up to 3d)
- Sedation: required for intra-articular injection by DVM
- Day-patient case

Radiation concerns MINIMAL:

- Facility requirements: federal or state license to use internal radiation-based medical therapies
- Home care: avoid co-sleeping for 2-6 weeks
- Additional note: 1 dog/household/yr

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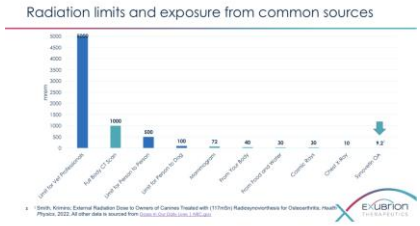
Synovetin [Homogeneous Tin (^{117m}Sn) Colloid]



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Synovetin [Homogeneous Tin (^{117m}Sn) Colloid]

Startup costs:

- Equipment, radiation (RAM) license, safety officer: approximately $13k

Startup needs:

- Authorized veterinarian
  - Online modules (6-8h)

Synovetin OA

Synovetin cost to vet office:

- 2 Injections = $1,541
- Vials are NOT to be shared between patients!

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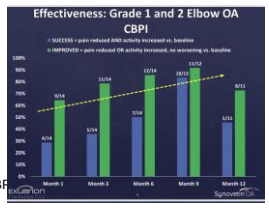
Synovetin [Homogeneous Tin (^{117m}Sn) Colloid]

Pilot Study

- Grade I and II elbow OA
- N = 23
- Force plate (1°); CBPI, elbow goniometry (2°)
  - Pretx, 1, 3, 6, 9, 12 mo
- No adverse effects, improved scores

Additional study

- Grade III elbow OA
- Clinical (2)
- N = 14
- Pain assess @ baseline, then q90d for 1y CBPI
- Significant reduction in pain and lameness



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Synovetin [Homogeneous Tin (^{117m}Sn) Colloid]

Tip & Tricks for use:

- Patient selection = earlier OA is better
  - grade 1&2 elbow dysplasia
    - See chart (next slide) re: improvement and timing
    - Later tx still helpful, but need to set reasonable treatment goals and set expectations

Questions being investigated:

- Repeated dosing
- Joints other than elbows

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Solensia™(frunevetmab injection)

- Company: Zoetis USA
- Formulation: frunevetmab SQ injection
  - 7 mg / mL solution, single-use 4 mL glass vial
- Availability: EU since May 2021, now also in US – correct pkg 2023
- Label use: monoclonal antibody therapy administered control feline osteoarthritis (OA) pain
- Indication: feline OA
- Duration of action: month (q28d)

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Solensia™(frunevetmab injection)

- Pharmacology: binds nerve growth factor (NGF) to block effects
  - such mAbs = anti-NGF mAbs
- Field effectiveness studies

1. N = 126, 14 US Vet Clinics, 56d
2. N = 275, 21 US Vet Clinics, 112d
   - Outcomes: Client Specific Outcome Measures, Owner Global Assessments, Orthopedic Score

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Solensia™(frunevetmab injection)

- Use: feline pain osteoarthritis
- Dosage: 1 (to 2.8 mg/kg)
- Dosing Chart

Weight of Cat (lb.)	Weight of Cat (kg)	Volume	Number of Vials*
5.5-15.4	2.5-7 kg	1 mL	1
15.5-30.8	7.1-14 kg	2 mL	2

*1 mL frunevetmab injection per vial

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Solensia™(frunevetmab injection)

- Adverse effects:
  - Immunogenicity (therapeutic protein)
  - Dermatitis or alopecia
  - GI (V&D)
- Cost: $$$
- Tip & Tricks for use: ?

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Thank you!

SBCV
CVMA-SBCV Chapter

VET STRATEGY

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NAVAS 2023 Symposium Program - May 6th and 7th

mynavas.org

NAVAS
North American Veterinary Anesthesia Society

Saturday: Advanced Stream

- Management of the Difficult Airway Rachel Reed
- Fluid Therapy: Lydia Love
- CPR and Anesthesia: Veronica Salazar
- Anesthesia for Advanced Cardiac Procedures: Khursheed Mama
- Capnography: Waveform Interpretation & Troubleshooting Abnormalities - Alyssa Ann Stair
- ECG Interpretation & Common Dysrhythmias - Tracey Lawrence

Sunday: General Stream

- Pain Physiology & Pathophysiology: Tami Grubb
- Regional Anesthesia for the Abdomen: Diego Portela
- Alternative Analgesic Modalities: Cornelia Mosley
- New & Updated Drugs: Odette O
- Pulse Oximetry: Claire Woolford
- Blood Pressure Monitoring & Hypotension: Bonnie Lockridge

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