

2024 SPOTLIGHT ON ANESTHESIA AND ANALGESIA IN REPTILES

Javier G. Nevarez, DVM, PhD, DACZM, DECZM (Herpetology)
LafeberVet RACE Program #1124336

- I. Introduction
 - a. Definitions
 - i. General anesthesia
 - ii. Sedation
 - iii. Tranquilization
 - iv. Analgesia
 - 1. Local analgesia
 - 2. Regional analgesia
- II. Objectives
 - a. Balanced anesthesia
 - b. Preemptive analgesia
- III. Anatomy and physiology
 - a. Poikilothermic species
 - b. Cardiopulmonary system
 - c. Renal-portal system
- IV. Signs of pain
 - a. Change in normal behavior
 - i. Aggression in passive animal
 - ii. Passive behavior in normally aggressive animals
 - b. Reluctance to move
 - c. Abnormal ambulation
 - d. Dull, closed eyes
 - e. Anorexia
 - f. Hunched posture
 - g. Elevated, extended head
 - h. Lameness
 - i. Decreased tendency to coil (snakes)
 - j. Aerophagia
 - k. Color changes (darker or paler)
- V. Analgesia
 - a. Pure mu agonist
 - i. Morphine

1. Increased tolerance to thermal stimulus in red-eared sliders (RES), bearded dragons (BD), tegu, crocodiles and anole lizards, and electrical in iguanas and BD
 2. Decreased duration of limb retraction in formalin test in Speke's hinged tortoise
 3. Associated with severe (up to 80%) respiratory depression in RES
 4. Dosage: 1.5-5 mg/kg q24h; 10-20 mg/kg in BD
 - ii. Hydromorphone
 1. Increased tolerance to thermal stimulus in RES
 2. Plasma levels in BD
 3. Dosage: 0.5 -1 mg/kg
 - a. Sedation at higher doses
 - iii. Fentanyl
 1. Plasma concentrations detectable in ball pythons and prehensile-tailed skinks with fentanyl patch
 2. No evidence of efficacy in snakes using patches
 3. Dosage
 - a. 0.05 mg/kg in RES and black-bellied slider
 - b. 2.5-12.5 mcg/h
- b. Weak mu agonist
- i. Tramadol
 1. inhibits reuptake of serotonin and norepinephrine
 2. Increased tolerance to thermal stimulus in RES, and to electrical stimulus in BD
 3. Plasma concentrations determined in sea turtles, bearded dragons
 4. Respiratory depression in RES was less than with morphine
 5. Falling out of favor with anesthesiologists due to lower clinical effects in practice
 6. Dosages in RES 5-10 mg/kg q 72 h PO
- c. Nonsteroidal anti-inflammatory drug, cyclooxygenase (COX)-2 specific inhibitor
- i. Meloxicam
 1. Increased the tolerance to electrical stimulus in BD at 0.4 mg/kg IM
 2. Did not change physiologic parameters in ball pythons at 0.3 mg/kg, or hematological and biochemical parameters in iguanas at 0.2 mg/kg
 3. Plasma concentrations determined in RES and iguanas
 4. Dosage 0.5 mg/kg q 24 h
- d. Regional analgesia/anesthesia
- i. Intrathecal spinal analgesia in RES
 1. Lidocaine – 1h
 2. Bupivacaine – 2h
 3. Morphine – 48h

4. Preservative free formulations

- VI. Indications for Tranquilization
- a. Restraint of fractious animals
 - b. Ultrasound
 - c. Radiographs
 - d. Transport
 - e. Venipuncture
 - f. Fine-needle aspirates (FNA)

- VII. Indications for Sedation
- a. Restraint of fractious animals
 - b. Ultrasound
 - c. Radiographs
 - d. Transport
 - e. Venipuncture
 - f. FNA
 - g. (Minimally invasive procedures combined with local analgesia)

- VIII. Indications for Anesthesia
- a. Surgery
 - b. Endoscopy
 - c. Invasive procedures
 - d. Injectable Agents
 - i. Ketamine
 - ii. Dexmedetomidine
 - iii. Midazolam
 - iv. Propofol
 - v. Alfaxalone
 - 1. Neuroactive steroid agent
 - 2. Rapid induction and recovery
 - 3. IV and IM routes
 - 4. Induction (5-10mg/kg), maintenance CRI and bolus
 - 5. Minimal cardiorespiratory depression
 - e. Inhalational Agents
 - i. Isoflurane
 - 1. Minimal metabolism, eliminated by lungs
 - 2. Right-to-left cardiac shunting might result in mismatch concen. gas and anesthetic depth
 - 3. Dose-dependent cardiovascular depression
 - 4. Minimum anesthetic concentration (MAC) 1.8-2.1% iguana, 1.37-1.71% monitors, 1.31-2.49 % rat snake
 - 5. Induction variable %, maintenance 2-3%
 - ii. Sevoflurane
 - 1. Faster induction and recovery than isoflurane in iguana, but similar recovery in monitors

- 2. No significant cardiopulmonary differences with isoflurane in iguanas
- 3. Less irritant to airways than isoflurane
- 4. MAC 3.0-3.2% iguana, 2.05-2.97% monitors, 1.85-2.99% rat snakes
- 5. Induction variable %, maintenance 3.5-4.5%
- f. Premedication via combination of:
 - i. Ketamine
 - ii. Dexmedetomidine
 - iii. Midazolam
 - iv. Propofol
 - v. Alfaxalone
 - vi. Hydromorphone/morphine
- g. Induction
 - i. Propofol
 - ii. Alfaxalone
- h. Maintenance
 - i. Isoflurane
 - ii. Sevoflurane

IX. Examples

- a. Example 1: Tranquilization to sedation
 - i. Sulcata for exam and venipuncture
 - ii. Option A: Midazolam, ketamine +/- dexmed. IM or IV
 - iii. Option B: Alfaxalone IM
- b. Example 2: Esophagostomy tube placement
 - i. Midazolam IV or IM for sedation
 - ii. Hydromorphone or morphine IM
 - iii. Meloxicam
 - iv. Local lidocaine block
- c. Example 3: Rads, gastroscopy +/- celioscopy of alligator snapping turtle
 - i. Premed/induction
 - 1. Hydromorphone 1mg/kg
 - 2. Ketamine 2-5 mg/kg
 - 3. Dexmedetomidine 0.25-0.5 mg/kg
 - 4. Midazolam 0.5-1 mg/kg
 - 5. IV injection
 - ii. Maintenance
 - 1. Isoflurane
- d. Example 4: Rads, gastroscopy +/- celioscopy of alligator snapping turtle
 - i. Premed/induction
 - 1. Hydromorphone 0.5 - 1mg/kg
 - 2. Propofol 10mg/kg or Alfaxalone 10-20 mg/kg
 - ii. Maintenance
 - 1. Isoflurane
- e. Example 5: green iguana coelomic surgery

- i. Premed/induction
 - 1. Hydromorphone 1mg/kg
 - 2. Ketamine 2-5 mg/kg
 - 3. Dexmedetomidine 0.25-0.5 mg/kg
 - 4. Midazolam 0.5-1 mg/kg
 - 5. IV injection
- ii. Maintenance
 - 1. Isoflurane

X. Injection sites

XI. Intubation

- a. Chelonians
- b. Snakes
- c. Lizards
- d. Crocodilians

XII. Patient Monitoring

- a. Same principles as other species
- b. Corneal reflex is good indicator of depth and death
- c. Heart rate
 - i. Doppler
 - ii. ECG
- d. Respiratory rate: often need IPPV
 - i. DO NOT EXCEED 15 – 20mmHg
 - ii. POP-OFF valve MUST REMAIN OPEN after breathing
 - iii. 2 – 4 breaths/min
- e. Temperature
 - i. KEY for successful anesthesia
 - ii. Aim for 32-35°C (90-95°F) during anesthesia

XIII. Cardiovascular Support

- a. IV Access
 - i. Jugular vein
 - ii. Ventral coccygeal vein
 - iii. Ventral abdominal vein
 - iv. Subcarapacial
- b. IO Access
 - i. Femur
 - ii. Tibia
 - iii. Carapace/plastron
 - iv. IO access can be used the same as IV but with slower volume of infusion
 - v. IO Catheter

XIV. Temperature support

- a. Forced air warmer

- b. Heat blankets
- c. Heat lamps
- d. Warm fluids
- e. Rice/bean bags
- f. Hypothermia
 - i. Heat loss
 - 1. Convection
 - a. Air exchange at body surface
 - 2. Radiation
 - a. Heat loss to surfaces and environment
 - 3. Conduction
 - a. Heat loss from contact (i.e. cold table)
 - 4. Evaporation
 - a. Heat loss from lungs, skin, exposed tissues
 - ii. Preventing Hypothermia
 - 1. Forced-air warmers
 - a. Can reduce convection, conduction, and radiation losses depending on the blanket type
 - 2. Heating pads
 - a. Reduce conduction losses
 - 3. Heat lamps
 - a. Reduce radiation losses
 - 4. Water bath
 - a. Reduce conduction, radiation losses
 - 5. Bean/rice stockings
 - a. Reduce radiation losses

- XV. Recovery
- a. Wean off gas before the end of procedure
 - b. Maintain O₂ at low flow rate
 - c. KEEP WARM!!!!!!!!!!!!!!
 - d. Breathing stimulus in reptiles: O₂

- XVI. Key to success
- 1. Keep patients warm
 - 2. Keep patients hydrated
 - 3. Use balanced anesthesia and analgesia
 - 4. Discontinue O₂ before end of surgery

- XVII. Not every patient needs drugs
- a. Radiography
 - b. Computed tomography

References mentioned in the presentation

Ferreira TH, Fink DM, Mans C. Evaluation of neuraxial administration of bupivacaine in bearded dragons (*Pogona vitticeps*). Vet Anaesth Analg. 2021;48(5):798-803. [doi: 10.1016/j.vaa.2021.06.012](https://doi.org/10.1016/j.vaa.2021.06.012). Epub 2021 Jul 2. PMID: 34326001.

Ferreira TH, Mans C. Evaluation of neuraxial anesthesia in bearded dragons (*Pogona vitticeps*). Vet Anaesth Analg. 2019;46(1):126-134. [doi: 10.1016/j.vaa.2018.09.001](https://doi.org/10.1016/j.vaa.2018.09.001). Epub 2018 Sep 19. PMID: 30344028.

Fink DM, Ferreira TH, Mans C. Neuraxial administration of morphine combined with lidocaine induces regional antinociception in inland bearded dragons (*Pogona vitticeps*). Am J Vet Res. 2021;83(3):212-217. [doi: 10.2460/ajvr.21.08.0104](https://doi.org/10.2460/ajvr.21.08.0104). PMID: 34968185.

Mans, C. Clinical technique: intrathecal drug administration in turtles and tortoises. J Exotic Pet Med. 2014;23 (1):67-70. [doi: org/10.1053/j.jepm.2013.11.011](https://doi.org/10.1053/j.jepm.2013.11.011).

Mans C, Lahner LL, Baker BB, Johnson SM, Sladky KK. Antinociceptive efficacy of buprenorphine and hydromorphone in red-eared slider turtles (*Trachemys scripta elegans*). J Zoo Wildl Med. 2012;43(3):662-5. [doi: 10.1638/2011-0260R.1](https://doi.org/10.1638/2011-0260R.1). PMID: 23082538.

Mans C, Steagall PVM, Lahner LL, Johnson SM, Sladky KK. Efficacy of intrathecal lidocaine, bupivacaine, and morphine for spinal anesthesia and analgesia in red-eared slider turtles (*Trachemys scripta elegans*). Proc Annu Conf American Association of Zoo Veterinarians. 2011. P. 135. Available at https://www.researchgate.net/profile/Christoph-Mans/publication/292020716_Efficacy_of_intrathecal_lidocaine_bupivacaine_and_morphine_for_spinal_anesthesia_and_analgesia_in_red-eared_slider_turtles_Trachemys_scripta_elegans/links/56ad2d5708aeaa696f2cadb8/Efficacy-of-intrathecal-lidocaine-bupivacaine-and-morphine-for-spinal-anesthesia-and-analgesia-in-red-eared-slider-turtles-Trachemys-scripta-elegans.pdf.

Perry SM, Nevarez JG. Pain and Its Control in Reptiles. Vet Clin North Am Exot Anim Pract. 2018 Jan;21(1):1-16. [doi: 10.1016/j.cvex.2017.08.001](https://doi.org/10.1016/j.cvex.2017.08.001). PMID: 29146025.

Schumacher J, Yelen T. Anesthesia and analgesia. In: Mader D (ed): Reptile Medicine and Surgery, 2nd ed. 2012; St. Louis, MO: Saunders Elsevier. Pp 442-452.

Sladky KK. Treatment of pain in reptiles. Vet Clin North Am Exot Anim Pract. 2023;26(1):43-64. [doi: 10.1016/j.cvex.2022.07.004](https://doi.org/10.1016/j.cvex.2022.07.004). PMID: 36402488.

Sladky KS, Mans C. Clinical anesthesia in reptiles. J Exotic Pet Med. 2012;21:17-31. [doi: 10.1053/j.jepm.2011.11.013](https://doi.org/10.1053/j.jepm.2011.11.013).

Ting AKY, Tay VSY, Chng HT, Xie S. A critical review on the pharmacodynamics and pharmacokinetics of non-steroidal anti-inflammatory drugs and opioid drugs used in reptiles. Vet Anim Sci. 2022;17:100267. [doi: 10.1016/j.vas.2022.100267](https://doi.org/10.1016/j.vas.2022.100267). PMID: 36043206; PMCID: PMC9420515.