Anesthesia & Analgesia in Reptiles

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Resources
- Clinical Anatomy and Physiology of Exotic Species
  - B. O’Malley
- Reptile Medicine and Surgery, Vol. 1&2
  - D. Mader
- Zoo and Wild Animal Medicine
  - M. Fowler and E. Miller
- Zoo Animal & Wildlife Immobilization and Anesthesia
  - G. West, D. Heard, N. Caulkett

Introduction
- Common as pets, in zoos and research settings
- Safe & effective anesthesia
- Minimize stress & discomfort
- Wide diversity of species
Overview
- Unique anatomy and physiology
- Anesthesia
  - Preanesthetic assessment
  - Premedication
  - Induction
  - Maintenance
  - Recovery
- Analgesia

Thermoregulation
- Poikilothermic
- Preferred Optimal Temperature Zone (POTZ)
  - Metabolic needs
  - Drug absorption, metabolism, excretion
- Hypothermia
  - Immunosuppression
- Hyperthermia
  - Vasodilation

Vascular System
- Three chambered heart
- Functional cardiovascular separation
- Shunting of blood from lungs

Hicks and Wang, 1996
Vascular System

- Renal portal system
  - Administer parenteral drugs in the cranial half of the body

The effect of the renal portal system on pharmacokinetic parameters in the red-eared slider (*Trachemys scripta elegans*)

Holz P, Barker IK, Burger JP, Crawshaw GJ, Conlon PD.

Respiratory System

- Rostral glottis

Endotracheal tubes
Respiratory Anatomy

- **Chelonia**
  - Complete tracheal rings

- **Epiglottic flap - crocodilians**

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**Lungs**

- **Lizards & chelonia**
  - Paired, saclike

- **Snakes**
  - Functional right
  - Vestigial left
  - Air sac

- **More fragile**
Lungs
- Unicameral
  - Single chamber
- Paucicameral
  - Subchambers with single bronchus
- Multicameral
  - Multiple chambers with small airways

Respiratory Physiology
- Episodic breathing and apnea
- Lack a functional diaphragm
  - Crocs - Diaphragmaticus
- Active pumping process – negative pressure
  - Intercostal muscles & limbs
Respiratory Physiology
- Temperature dependent
- Ventilation driven by PaO₂
- Mediated by changes in pH & PaCO₂
- Shunting / dive reflex
- Anaerobic metabolism
  - Metabolic acidemia

Physiologic Parameters
- Heart rate
- Respiratory rate
- Body temperature
- Blood pressure / SpO₂
- No “normals”
- Dependent on species, size, sex, environment

Preanesthetic Assessment
- Make every effort to evaluate patient prior to physical examination / anesthesia
- Have evolved to depend on their ability to hide illness to survive
- Not always possible with free ranging species
- Explain risk to owners / collaborators
Preanesthetic Assessment

- Reason for anesthesia

Physical Examination

- Body condition
- Trauma and injuries
- Disease
- Nutritional status
- Hydration
- Attitude

Preanesthetic Assessment

- Physical exam
- Reason for anesthesia
  - CBC, chemistry panel
Preanesthetic Assessment

- Physical exam
- Reason for anesthesia
  - CBC, chemistry panel
  - Imaging

Preanesthetic Assessment

- What can be done without anesthesia?
  - Safe for patient
    - Injury, myopathy, stress
  - Safe for you
    - Injury, stress

Fluid Therapy

- Hydration status
  - Skin turgor, CRT, PCV/TP
- Route of administration
  - Stable vs. debilitated patients
- Balanced electrolyte sol’n
  - Maint: 15-30 ml/kg/d
  - Surgery: 1 ml/kg/hr
Fasting
- Should be without food for 24-72 hours
- Longer in some species
- Dependent on size, diet, health

Drug Administration
- IV
- IM
Drug Administration
- IV
- IM
- IGe
- IO

Drug Administration
- IV
- IM
- IGe
- IO
- PO
- Inhaled

Premedication
- A2-adrenergic agonists – dexmedetomidine, medetomidine
  - Minimal sedation alone
  - Species effects variable (iguanas)
- Benzodiazepines – midazolam
  - Relaxation, slight sedation/use with ketamine

Dexmed 70-100 mcg/kg + Midazolam 1-2 mg/kg + Ketamine 1-5 mg/kg SC/IM
Premedication

- Opioids
  - Alone or in combination
  - Analgesia prior to painful procedures
  - Reversible
  - Differing receptor distribution among reptiles

- Butorphanol – κ agonist, µ antagonist
- Buprenorphine – µ partial agonist
- Morphine – µ full agonist

Medet 100 mcg/kg + Midazolam 2 mg/kg + Morphine 1 mg/kg SC/IM

Induction

- Isoflurane / Sevoflurane
- Mask / tube / chamber
Induction

- Apnea
- Vascular shunting
- Slow, stressful

Induction

- Propofol
  - Hypnotic
  - Binding of GABA receptor
  - Rapid effects, short recoveries
  - IV administration
    - Jugular, brachial plexus, tail
  - No analgesia
  - Respiratory depression & apnea
  - Best used to effect (5-15 mg/kg)

Induction

- Ketamine / Telazol Combinations
  - Safe, intramuscular
  - Good cardiac output
  - Some analgesia
  - Not reversible
  - Prolonged recovery
Maintenance
- Intubation
- Non-rebreathing circuit (<3 kg BW)
- Manual ventilation
  - 1-2 breaths/min

Maintenance
- Cranial to caudal
- Loss of palpebral reflex
- Loss of righting reflex
- +/- Maintain corneal reflex
- Sudden responsiveness

Maintenance
- Gas anesthesia
  - Isoflurane, sevoflurane
  - Mixed information on differences
  - Induction vs recovery data
  - Generally no appreciable difference in practice

Gas anesthesia
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Supportive Care

- Eye lubrication
- Heat source
  - Very important in small animals
  - Bair hugger, water blanket, Heat packs

Intermittent positive pressure ventilation

- Loss of motor activity decreases ventilation
- Maintain oxygenation
  - Tidal volume 10 ml/kg
  - 1-2 breaths/min
- “Sigh” breath
- 10 cm H₂O

Monitoring

- Challenging to assess depth at times
- Species differences with reflexes
  - Snakes – no palpebral/corneal reflexes

S. Chinnadurai
Monitoring
- Anesthetic Depth
  - Muscle tone
  - Righting reflex
  - Spontaneous respiration
  - Jaw tone
  - Response to stimuli
  - Palpebral & corneal reflexes

Monitoring equipment
- Doppler
- ECG
- Pulse oximeter
- Capnograph
- Blood pressure
- Temperature probes

Respiratory Monitoring
- Prone to apnea
- Shunting
- Pulse oximetry & capnography not validated
- Monitor trends
Recovery

- Ventilate with room air
  - Increased PaO₂ decreases ventilation
- Supplemental heat
- Stimulation
- Analgesia
- Patience

Recovery

- Monitor very closely until sternal, alert and responsive
- Prevent self trauma & intraspecific trauma
- Nutritional support
Analgesia

- Definition
- More difficult to assess
- How to assess pain
- Do they perceive pain
- Species specific recognition

Recognizing Pain

- Change appetite
- Aggression
- Self-mutilation
- Isolation
- Changes in behavior
- Examples of painful cases
  - Shell fractures, bites, burns, ocular, stomatitis

Analgesic Agents

- Opioids
  - Butorphanol
  - Buprenorphine
  - Morphine
- NSAIDs
  - Meloxicam
  - Ketoprofen
- Local anesthetics
Opioid Analgesia in Reptiles


**“Analgesic efficacy and respiratory effects of butorphanol and morphine in turtles”**

- Butorphanol showed minimal analgesic efficacy in turtles, respiratory depression with high dose (28 mg/kg)
- Morphine (1.5 mg/kg) provided analgesia but also caused respiratory depression

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Opioid Analgesia in Reptiles


- Butorphanol – high doses (20 mg/kg)
  - Analgesia in corn snakes at 8 hr
- Morphine – high doses (10 & 20 mg/kg)
  - Analgesia in bearded dragons at 8 hr

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Opioid Analgesia in Reptiles

- Tramadol 10-25 mg/kg PO/SC
  - Red Eared Sliders
  - Less respiratory depression than morphine
  - Thermal nociception
    - PO 6-96 hr
    - SC 12-48 hr
NSAIDs

- Not controlled
- Injectable and oral
- Lack of pharmacologic data & efficacy studies
- Likely significant species variation
- Use in well hydrated patients without renal compromise

<table>
<thead>
<tr>
<th>NSAIDs</th>
<th>Meloxicam 0.1 – 0.2 mg/kg</th>
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<tbody>
<tr>
<td></td>
<td>IM, IV, PO</td>
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<tr>
<td></td>
<td>q 24-48 hr</td>
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<td></td>
<td>PK for oral and IV in green iguanas</td>
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<td></td>
<td>Evidence of enterohepatic recycling</td>
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<td>Ketoprofen 2 mg/kg</td>
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Local Anesthesia

- Good adjunct for painful procedures
- Block nerve transmission peripherally
- Possible toxicity
**Local Anesthesia**

- Lidocaine (1%, dilute to 0.5%)
  - Rapid, short-acting
  - < 5 mg/kg
- Bupivacaine (0.25%, dilute to 0.125%)
  - Delayed, long-acting
  - < 2 mg/kg

**Local Anesthesia**

- Peripherally
- Intrathecally

**Sterilization of hybrid Galapagos tortoises (Geochelone nigra) for island restoration. Part 2: phallectomy of males under intrathecal anaesthesia with lidocaine**


*Veterinary Record* (2011) 168, 78

**Eastern Box Turtle with aural abscess**

- Morphine (1.5 mg/kg) 2 hr prior to procedure
- Include medetomidine 25-50 mcg/kg IM for relaxation if needed
- Local block with lidocaine
- Post-op meloxicam 0.2 mg/kg
EBD Shell Repair

- Consider minimally invasive techniques
- Stabilize patient
- Assess hydration, mentation, PCV
- Premed:
  - Morphine (1.5 mg/kg)
  - 2 hr before

EBD Shell Repair cont.

A. Med 25-50 mcg/kg + Ket 5 mg/kg
B. Or Propofol 3-6 mg/kg IV

- Intubate and ventilate
- Post op
  - Meloxicam 0.2 mg/kg
  - Or Ketoprofen 1-2 mg/kg
  - +/- Morphine

Green Iguana Gonadectomy

- Premed: Morphine 1 m/kg IM
- Induce: Propofol 7 mg/kg IV
- Post op: Meloxicam 0.2 mg/kg
- Local block: Bupivacaine
  - Cont. post-op analgesia
- SID/EOD Meloxicam 0.2 mg/kg IM
- +/- Morphine 1 mg/kg PRN
Conclusions

- Same principles of anesthesia & analgesia
- Assess risk, need & potential for pain
- Remember individual physiology and anatomy
- More research needed

Thank You