Anesthesia & Analgesia in Reptiles

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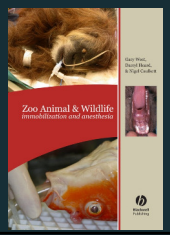
Resources

- 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

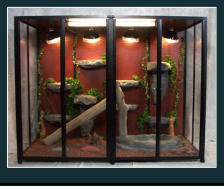
- Common as pets, in zoos and research settings
- Safe & effective anesthesia
- Minimize stress & discomfort
- Wide diversity of species

Overview

- Unique anatomy and physiology
- Anesthesia
  - Preanesthetic assessment
  - Premedication
  - Induction
  - Maintenance
  - Recovery
- Analgesia

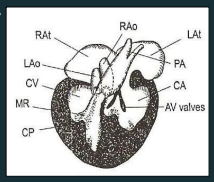
Thermoregulation

- 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

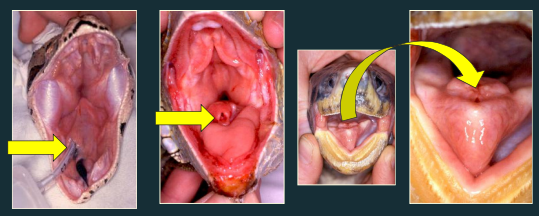
- Renal portal system
  - Administer parenteral drugs in the cranial half of the body

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.
J Zoo Wild Med. 1997; 28(4):386-93

Respiratory System

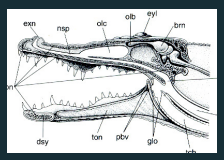
- Rostral glottis

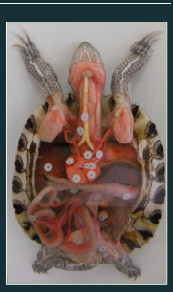


Endotracheal tubes

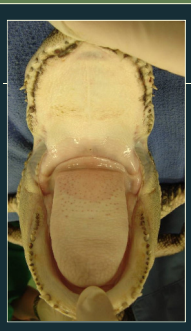
Respiratory Anatomy

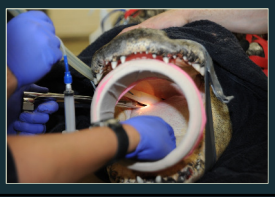
- Chelonia
  - Complete tracheal rings
- Epiglottic flap - crocodilians





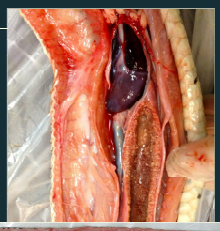
www.studyblue.com/notes/note/n/lab-exam-3-amphibians-and-reptilia-slack/869652

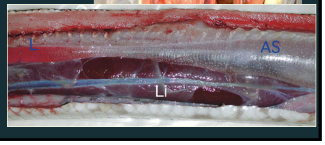




Lungs

- Lizards & chelonia
  - Paired, saclike
- Snakes
  - Functional right
  - Vestigial left
  - Air sac
- More fragile

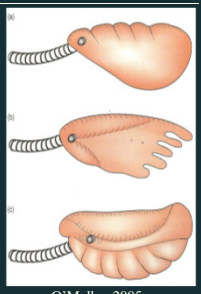




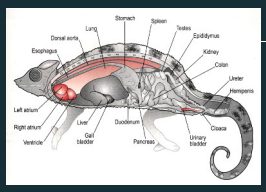
reptilechannel.com/kid-corner/beyond-beginners/snake-anatomy-respiratory.asp#.

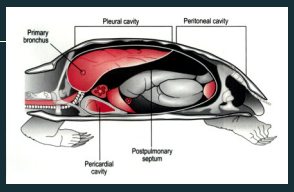
Lungs

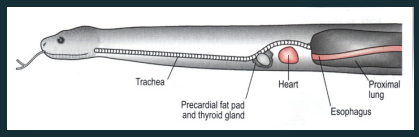
- Unicameral
  - Single chamber
- Paucicameral
  - Subchambers with single bronchus
- Multicameral
  - Multiple chambers with small airways



O'Malley 2005



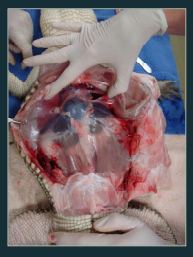




(O'Malley 2005)

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 PaO_2
- Mediated by changes in pH & $PaCO_2$
- Shunting / dive reflex
- Anaerobic metabolism
  - Metabolic acidemia

Physiologic Parameters

- Heart rate
- Respiratory rate
- Body temperature
- Blood pressure / SpO_2
- 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

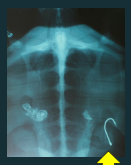
- Body condition
- Trauma and injuries
- Disease
- Nutritional status
- Hydration
- Attitude

Preanesthetic Assessment

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

Preanesthetic Assessment

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



Preanesthetic Assessment

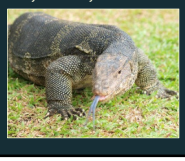
- What can be done without anesthesia?
  - Safe for patient
    - Injury, myopathy, stress
  - Safe for you
    - Injury, stress

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

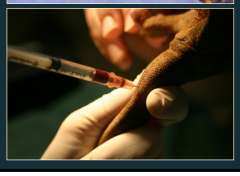
Fasting

- Should be without food for 24-72 hours
- Longer in some species
- Dependent on - size, diet, health

Drug Administration

- IV

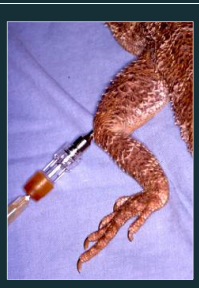




Drug Administration

- IV
- IM

Drug Administration

- IV
- IM
- ICe
- IO



Drug Administration

- IV
- IM
- ICe
- 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

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

Premedication

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

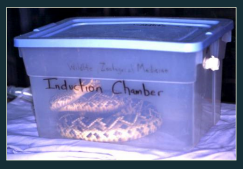
Medet 100 mcg/kg + Midazolam 2 mg/kg + Morphine 1 mg/kg SC/IM

Induction

- Isoflurane / Sevoflurane
- Mask / tube / chamber

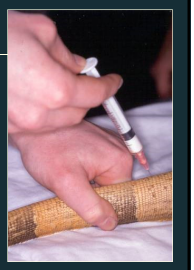
Induction

- Apnea
- Vascular shunting
- Slow, stressful



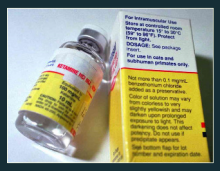
Induction

- 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

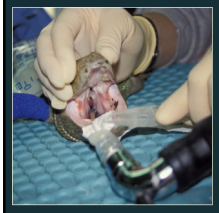
- Ketamine / Telazol Combinations
  - Safe, intramuscular
  - Good cardiac output
  - Some analgesia
  - Not reversible
  - Prolonged recovery



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
    - Hernandez-Divers, S.J. et al 2005 – Green iguanas
    - Bertelson, et al. 2005 – Dumeril's monitors
  - Generally no appreciable difference in practice

Supportive Care

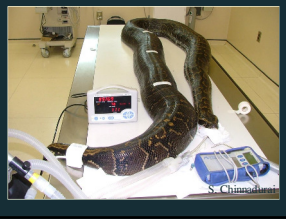
- Eye lubrication
- Heat source
  - Very important in small animals
  - Bair hugger, water blanket, Heat packs

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 H_2O

Monitoring

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



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

Evaluation of noninvasive oscillometric blood pressure monitoring in anesthetized boid snakes

Sathya K. Chinnadurai, DVM, MS; Amy Wrenn, DVM; Ryan S. DeVoe, DVM, MSpVM, DACZM, DABVP

J Am Vet Med Assoc 2009;234:625–630

Recovery

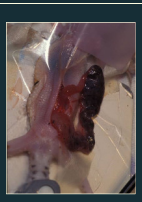
- Ventilate with room air
  - Increased PaO_2 decreases ventilation
- Supplemental heat
- Stimulation
- Analgesia
- Patience

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

- Opiods
  - Butorphanol
  - Buprenorphine
  - Morphine
- NSAIDs
  - Meloxicam
  - Ketoprofen
- Local anesthetics

Opiod Analgesia in Reptiles

- Sladky et al, 2007

"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

Opiod Analgesia in Reptiles

- Sladky et al, 2008
  - 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

Opiod 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

NSAIDs

- Melxoicam 0.1 – 0.2 mg/kg
  - IM, IV, PO
  - q 24-48 hr
  - PK for oral and IV in green iguanas
  - Evidence of enterohepatic recycling
- Ketoprofen 2 mg/kg
  - IM, SC
  - q 24-48 hr

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

S. Rivera, S. J. Divers, S. E. Knafo, P. Martinez, L. J. Cayot, W. Tapia-Aguilera, J. Flanagan, 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

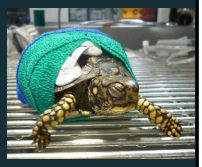
EBD Shell Repair

- 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