

ANESTHESIA AND ANALGESIA IN REPTILES

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The study of anesthesia and analgesia in reptiles has significantly expanded and there is readily available information in the literature to help make sound clinical decisions for these patients. While reptiles are often thought of as stoic animals that do not show much behavioral changes, this is a misconception and anyone working with them should become familiar with knowing how to interpret pain and discomfort (Box 1). It is also important to remember that the analgesic effect provided by general anesthesia is short lived (up to the point of recovery) and analgesic protocols must be instituted in all cases when painful stimuli is unavoidable. We must think of anesthesia and analgesia as being two different components of one modality, both being essential for its success.

Analgesia

There are two main groups of analgesics commonly used in reptiles, NSAID's and opioids. Carprofen and meloxicam have both been used with good results over the years but meloxicam is currently more widely used. While butorphanol used to be the analgesic of choice, a series of studies revealed that opioids with mu agonist effects (morphine, hydromorphone) are more effective in reptiles. Currently hydromorphone has gained preference over morphine due to lower degree of side effects (respiratory depression) and improved recoveries from anesthesia. The use of tramadol may become more important as more research is available.

Box 1. Common signs of pain and discomfort in reptiles.

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| Change in normal behavior |
| Passive behavior in normally aggressive animals |
| Aggression in passive animal |
| Reluctance to move |
| Abnormal ambulation |
| Dull and closed eyes |
| Anorexia |
| Hunched posture |
| Elevated and extended head |
| Lameness |
| Decreased tendency to coil (snakes) |
| Aerophagia |
| Color changes (darker or paler) |

Anesthesia

There is no single all-purpose protocol for all reptile species. Selecting an anesthetic protocol should be based on presentation, findings of the physical exam, physiologic data (CBC, chemistry panel), procedure being performed, etc. The goal is to utilize a balanced approach that combines a variety of drugs in order to maximize the benefits of each drug while minimizing adverse effects in a balanced anesthesia approach. Historically ketamine (KT) by itself or in combination with other anesthetics like dexmedetomidine (DMED) has been the most widely used anesthetic in reptiles. While K and DMED can be excellent choices for reptile anesthesia,

there are a number of other drugs that can also be effectively used and which may in fact improve anesthetic events in reptiles. Diazepam and midazolam are two examples of anesthetics that can be combined with KT and DMED to provide a more balanced anesthesia. By including a benzodiazepine in the anesthetic plan, the doses of K and DMED can be decreased, which in turn reduces their potential for adverse effects. The author has found midazolam to be an excellent choice for tranquilization and sedation in chelonians and commonly uses it as part of the pre-medication or induction protocol in addition to KT and DMED. Isoflurane or sevoflurane should be used for maintenance of anesthesia only. While some advocate the use of inhalant anesthetics as sole agents for induction and maintenance of anesthesia, this practice does not provide consistent results or a balanced approach to anesthesia. The ability of reptiles to shunt blood from the right to the left side of the heart makes the use of inhalant anesthetics as the sole agents a poor choice. When right to left blood shunting occurs, there will be reduced uptake of gas anesthetics and the quality of the anesthesia will be diminished. This helps explain why in some cases a reptile that appeared to be fully anesthetized begins to move during surgery. If no other analgesic and anesthetic agents were utilized, the reptile may be showing signs of pain and awareness in the middle of a procedure. This has obvious implications for the welfare of our patients. For these reasons, inhalant anesthetics should be used as part of a balanced anesthesia plan in conjunction with an injectable drugs, especially when performing invasive procedures. Propofol is also an excellent choice for use in reptiles as it can be administered via direct venipuncture without the need for catheters. It can also be used as part of an anesthetic plan in combination with midazolam and an analgesic. Alfaxalone (Alfaxan[®], Jurox Inc., Kansas City, MO, USA) is a neuroactive steroid anesthetic that is now available in the USA and is reported to have very good efficacy in reptiles.

Monitoring

A key component of successful anesthesia and analgesia in reptiles is the ability to properly monitor the patient. Traditional monitoring equipment (pulse oximetry, capnography, ECG, etc.) often is not as accurate or reliable when used on reptiles, therefore trends are more relevant than individual readings or measurements. A reptile's heart can beat for long periods of time even after death so trends in heart rate are more important than the mere presence of heart rate alone. A trend towards bradycardia or tachycardia during anesthesia should prompt action to determine what may be causing those responses. A Doppler or ECG can be used to monitor heart rate and rhythm but the ECG settings have to be adjusted in order to obtain the best wave readings possible. One of the most important parameters to monitor in reptiles is body temperature. Core body temperature is best assessed with an esophageal probe placed at the level of the heart. Reptiles maintained at warm temperatures are more likely to properly metabolize and excrete drugs, and recover better from an anesthetic event. Maintaining a constant temperature through the pre-, peri-, and post-operative period is also more likely to produce faster recoveries. The author aims to maintain reptiles at 90-95°F during anesthetic procedures. It is critical to remember that respiratory stimulus in reptiles is primarily influenced by oxygen concentrations and not CO₂. Therefore reptiles should be weaned off 100% oxygen before the end of the procedure and transferred to room air in order to speed up recovery. Because reptiles are often weaned off from gas anesthetics before the end of surgery, it is even more important to ensure that proper analgesia has been provided.