Drug Delivery and Safety Considerations

James G. Johnson III and Sathya K. Chinnadurai

Anesthetic drugs must be delivered at the appropriate dose and route of administration to produce the expected anesthetic effects. This is important for patient safety because anesthetic drugs function by depressing the central nervous and cardiovascular systems, which if improperly dosed or administered could cause potentially life-threatening effects. Several routes of administration and different drug delivery methods are available to safely and reliably anesthetize zoologic companion animal patients. Because of the nature of zoologic companion animal practice, anesthetic procedures pose risks that the anesthetist should understand to carefully plan procedures that are as safe and efficient as possible.

Fish Sedation and Anesthesia

Claire Vergneau-Grosset and Inga-Catalina Cruz Benedetti

Veterinarians often need to sedate or anesthetize fish to perform physical examinations or other diagnostic procedures. Sedation may also be required to transport fish. Painful procedures require complete anesthesia with appropriate antinociceptive agents. Regulations and withdrawal times apply to food animal species in many countries. Specific protocols are therefore warranted in commercial fish versus ornamentals. Tonic immobility of elasmobranchs and electric anesthesia should never be used to perform painful procedures. Anesthetic monitoring in fish remains challenging. This review summarizes ornamental fish anesthesia and discusses techniques used in the commercial fish industry and in field conditions.

Sedation and Anesthesia of Amphibians

Peter M. DiGeronimo and Julie A. Balko

Amphibians commonly are managed under human care for research, education, conservation, and companionship and frequently are in need of sedation, anesthesia, or end-of-life care involving euthanasia. Objective investigation of sedative and anesthetic protocols in these taxa still is in its infancy, but knowledge of current best practices is paramount to appropriate care. Tricaine methanesulfonate delivered via immersion (bath) is the most common anesthetic agent in amphibians, but several other effective techniques have been identified. This summary provides a comprehensive review of the current evidence-based literature regarding amphibian sedative, anesthetic, and euthanasia techniques.
Chelonian Sedation and Anesthesia 49
Stefania Scarabelli and Nicola Di Girolamo

Video content accompanies this article at http://www.vetexotic.theclinics.com.

Anesthetic management of chelonians represents a unique challenge; the order Chelonia includes numerous species that display diverse anatomic features, habitats, body sizes, temperaments, and metabolic rates. Owing to their peculiar characteristics, safe and effective sedation and anesthesia may be more complicated than in other animals. For example, gas inductions are not indicated, and intravenous catheterization requires practice. The pharmacology of anesthetic drugs is severely impacted by body/environmental temperature, site of administration, and organ function. This review will summarize the current knowledge in terms of anatomy, physiology, and drug metabolism in chelonians, before discussing practical aspects of anesthesia.

Sedation and Anesthesia of Lizards 73
Tatiana H. Ferreira and Christoph Mans

The field of lizard sedation, anesthesia, and locoregional anesthesia is advancing with new drug protocols being evaluated, and new locoregional techniques being developed and evaluated. Inducing and maintaining effective and safe chemical restraint in lizards can be challenging, particularly in systemically diseased individuals. Understanding the anatomic and physiologic adaptations of lizards, using reversible or partially reversible injectable protocols, and using locoregional anesthesia may increase the quality of chemical restraint, facilitate faster recoveries, and limit anesthesia-related morbidity and mortality.

Snake Sedation and Anesthesia 97
Daniel Almeida, Martin Kennedy, and Erin Wendt-Hornickle

Snakes can be more challenging to anesthetize compared with other animals because of anatomic and physiologic differences, a wide range of patient sizes, and variable responses to anesthetic agents. Snakes have preferred optimal temperature zones, which, along with physiologic characteristics, such as the ability to shunt blood toward or away from the lungs, can have an impact on anesthesia. Injectable agents, including benzodiazepines, α2-agonists, opioids, propofol, and alfaxalone, as well as inhalant anesthetics can be used to anesthetize snakes. Pain management must be incorporated to the anesthetic plan when performing procedures that are expected to produce nociception.

Psittacine Sedation and Anesthesia 113
Mikel Sabater González and Chiara Adami

Successful management of sedation/anesthesia of psittacine species relies on familiarity with their specific anatomy and physiology, and detailed knowledge of the recent advancements in applied pharmacology of the anesthetics and perianesthetic monitoring of cardiovascular and respiratory functions. Each sedation/anesthetic plan should be patient-specific,
developed based on preexisting conditions, size, species, age, and estimated risk. Other key factors to improve safety, quality of perioperative care, and client satisfaction are anticipation of complications, extension of close monitoring to the recovery phase, multimodal analgesic approach, stress prevention/reduction, and transparent communication with the owner.

Raptor Sedation and Anesthesia
Michelle G. Hawkins and Gregg M. Griffenhagen

Sedation and/or anesthesia is routinely and successfully used in raptors for a wide variety of procedures from the routine such as physical examination, radiographs, or venipuncture, to the more complex, such as orthopedic surgeries. Understanding the anatomy and physiology of raptor patients who present for care, and being fully prepared before the start of any procedure can increase the success of anesthetic procedures. Recent advances in raptor sedation and anesthesia continue to improve the health and welfare of these avian patients.

Backyard Poultry and Waterfowl Sedation and Anesthesia
Christine Molter, André Escobar, and Carrie Schroeder

The popularity of backyard poultry (chickens, turkey, guinea fowl) and waterfowl (ducks and geese) is increasing in the United States, and these animals frequently present for veterinary care. Like other birds, these species have unique anatomy that should be clinically considered before anesthesia. A balanced approach to an injectable, inhalational, or combination anesthesia protocol must be taken to ensure a safe outcome for the patient and to achieve the procedural needs. A well-informed clinician may use both sedation and general anesthesia to care for backyard bird patients in practice.

Rabbit Sedation and Anesthesia
Sara Gardhouse and Andrea Sanchez

With the increasing frequency of rabbits as veterinary patients, the expectation for high-quality, intensive veterinary care, and resultantly an understanding of anesthesia has been increasing. Sedation and general anesthesia are commonly required for many routine and emergency procedures in rabbits, and this results in the need for a strong awareness of anesthetic principles, knowledge of limitations of anesthesia, and maintenance of high standards of anesthesia.

Sedation and Anesthesia in Rodents
Katarina Bennett and Kerrie Lewis

Sedation and anesthesia in rodent species are complex due to their wide species variation, small size, and metabolism. This review article covers recent advances in sedation and anesthesia as well as an updated drug formulary for sedation protocols. Setup, equipment, monitoring, maintenance, and recovery are reviewed as well as species-specific anatomy.
African pygmy hedgehogs and sugar gliders are common zoologic companion animals frequently presented to veterinarians for routine preventive care and illness. Given their small size, intravascular access, intubation, and monitoring can be challenging, and hypothermia is a common problem during chemical immobilization. Studied injectable sedation options are limited, but can provide an alternative to general anesthesia for minor procedures. Anesthetic induction and maintenance are most commonly performed with inhalant anesthetics, such as isoflurane or sevoflurane. Preparation of all necessary equipment and emergency drugs before chemical immobilization increases the chance of a successful procedure.

Ferret Sedation and Anesthesia

Providing safe anesthetic events in ferrets can be achieved if fundamental principles in anesthesia are followed. Each phase of the anesthetic, including preanesthetic, maintenance, and postanesthetic phase, have certain considerations. The anesthetic supervisor or veterinarian providing management should have a firm understanding of the species-specific anatomy, physiology, and common indications of general anesthesia along with perspective of their own experience with ferrets. Ensuring these guidelines are followed will facilitate safe administration of general anesthesia in this species.

Miniature Companion Pig Sedation and Anesthesia

With their increase in popularity in North America as pets, miniature companion pigs are in need of veterinary professionals familiar with sedation and anesthesia for the species. This article provides a review of the agents used for sedation, premedication, induction, and maintenance of anesthesia for miniature companion pigs. This review also covers species-specific anatomic and physiologic factors of miniature companion pigs with respect to administration of anesthetics, endotracheal intubation, anesthetic maintenance, and common complications so that the reader can make an informed anesthetic plan for the species.

Local and Regional Anesthesia in Zoological Companion Animal Practice

Local anesthetics provide analgesia and can be incorporated into multimodal anesthetic protocols. They work by blocking the voltage-dependent sodium ion channels along neurons that mediate nociception. Systemically, these drugs can be cardiotoxic in a dose-dependent manner. Lidocaine and bupivacaine are the most commonly used local anesthetics and their use has been reported in all classes of vertebrates.
Despite anecdotal reports to the contrary, zoologic companion animals are unlikely to be more susceptible to the cardiotoxic effects of local anesthetics than domestic small animals. Local anesthetics can be clinically useful for analgesia and anesthesia in zoologic companion animal practice.