The standard of today’s reptile practice calls on clinicians to use an ever-increasing array of diagnostic tools to gather information and obtain a credible diagnosis. Few, if any, pathognomonic signs exist, and most clinical syndromes are not understood well enough to be able to define standard therapeutic protocols for a set of clinical signs without objective diagnostic information. For example, in the relatively distant past, clinicians treating reptiles would routinely administer parenteral calcium to green iguanas (Iguana iguana) with the chief presenting sign of muscle tremors. Today we recognize that the risk of soft tissue mineralization and permanent damage to arteries, renal tubules, and other tissues almost always outweighs the potential short-term benefit, and that administering calcium without knowledge of the patient’s ionized calcium concentration is unwise. A problem-oriented diagnostic approach directed toward minimizing risk and maximizing therapeutic benefit is now the standard of reptile practice.

Similar to class Mammalia, class Reptilia includes a diverse group of species, each with a unique pharmacologic response to every chemotherapeutic agent. As a result, therapeutic safety and efficacy differ among species. Unlike mammals, conscious reptiles are ectothermic, so physiologic and biochemical processes are strongly influenced by body temperature. Reasonable assumptions about each individual species’ metabolism and immune response can therefore only be made under certain conditions. In most cases, the body temperature of a reptile patient must match that of the subjects in a given pharmacokinetic study for a treatment plan to be designed, although pharmacokinetics and pharmacodynamics do not necessarily differ at different temperatures. Species-specific pharmacokinetics, pharmacodynamics, therapeutic efficacy, and environmental requirements must be known before administration of any drug can be considered. This is not only to predict absorption, distribution, metabolism, excretion, and the therapeutic window but also to meet the environmental needs of a reptile so that an appropriate immune response and healing can occur. Published doses are available for many drugs, and these may have been selected empirically, may have been calculated with the use of allometric or other scaling technique, or may be from published pharmacokinetic research data under laboratory conditions in either healthy or affected animals. It is incumbent on the clinician to evaluate whether a published dose is likely to be safe and effective in a particular clinical case. Dosage, dosing interval, and administration route must be evaluated in light of the individual circumstances. Consult up-to-date, peer-reviewed literature to identify species and their environmental needs, optimal body temperature, and the pharmacokinetics and pharmacodynamics of the drug in the species at hand.
Managed thermoregulation, hydration, and nutrition are paramount for safe, effective drug therapy. Thermal options and gradients must be provided for conscious, active reptiles to behaviorally thermoregulate, and body temperature should be monitored during therapy. In cases of weakness and decreased activity, the patient’s thermoregulation should be actively managed as a part of the therapeutic plan. Dehydrated, anorexic reptiles may not absorb, distribute, metabolize, or eliminate chemotherapeutic agents in the same manner as the healthy animals tested under controlled conditions in pharmacologic research, so nursing care also must include management of fluids, electrolytes, and nutrition.

Administration and Dosing

Dosage and route of administration are determined by the chemical, pharmacokinetic, and pharmacodynamic properties of each agent in each species. Much work has been done to understand the mechanism of action, therapeutic window, absorption, distribution, metabolism, and excretion variables of many drugs in many species of reptiles, although many questions remain unanswered and informed, empirical dosing is still used in many cases. Veterinarians administer therapeutic agents to reptiles via oral, enteral via gavage, subcutaneous (SC), intramuscular (IM), intravenous (IV), intracoelomic, intratracheal, intrapulmonary, intraosseous, intraperitoneal, intrathecal, and intracardiac routes, as well as via nebulization. Parenteral administration has proven to be more reliable than the enteral route for many drugs in reptiles. Sufficient evidence exists to support administration of most parenteral drugs in the cranial half of the body when possible so that the first-pass effect for drugs that are eliminated via renal tubular excretion or hepatic metabolism is avoided. Venous blood from the caudal half of the body enters the caudal vena cava through either the renal portal system and peritubular capillaries or the hepatic portal system from the abdominal or mesenteric veins and through the hepatocellular parenchyma. Administration in the caudal half of the body is acceptable for a few specific drugs and may be considered for those drugs when the cranial half is not available. Dosage is adjusted to account for the renal or hepatic first-pass effects described in these reports. Intracoelomic administration of fluids or systemic drugs cannot be recommended. Absorption across coelomic membranes is difficult to assess in clinical patients and is not guaranteed, particularly in cases of abnormal blood proteins, coelomitis, or ascites. Accidental needle puncture or laceration of an organ and accidental deposition of the agent into the intestines, reproductive tract, or urinary bladder rather than the coelomic space have been observed and probably occur undetected in many cases; adverse effects of intracoelomic dosing have been reported. Some therapeutic challenges in reptiles can be overcome by novel approaches to drug administration, including osmotic pump, dermal patch, depot formulation, vascular access port, and topical administration.

Antibacterial Agents

Several antibiotics are currently used in reptile antibacterial therapy. Many pharmacokinetic studies have been published, so background information is available to assist in selection of dose and dosing interval for several drugs in a number of species and more research is necessary in the most common species presented to reptile veterinarians. A number of individual circumstances guide antibiotic selection in each case. Empirical antibiotic selection may be
necessary in critical cases and should be based on the prevalence of specific pathogens for the syndrome, antimicrobial spectrum of activity, distribution of the antimicrobial to the affected tissues, potential side effects, metabolic and excretory pathways, volume of the formulation necessary to deliver the necessary dose, dosing interval, and ease of administration. In many cases antibiotics can be withheld until culture and sensitivity results are available. Selection of antibiotics with a narrow spectrum of activity may help reduce the risk of therapy shifting the balance between enteropathic and commensal bacteria in the favor of the pathogens with the potential risk of infection. Multiple antimicrobials may be used to combat resistant strains of bacteria, and current guidelines for achieving synergy should be followed. Antibiotics often used in reptile medicine include amikacin, azithromycin, ceftazidime, ciprofloxacin, clarithromycin, danofloxacin, enrofloxacin, marbofloxacin, metronidazole, oxytetracycline, piperacillin, ticarcillin, trimethoprim/sulfamethoxazole, and tylosin. Most of these have been in use for decades and have been previously described. Information presented here is limited to agents with recent advances.

**Antifungal Agents**

Fungal infections are common enough in reptiles that antifungal therapy has become a routine part of clinical practice. Similar to antibiotics, antifungal agents are best selected in response to a specific etiologic diagnosis. Fungal culture should precede therapy, but antifungal sensitivity testing is not practical in most cases. Empiric selection of antifungal drugs may be necessary while awaiting culture results, which can take weeks. Selection should be based on the prevalence of a specific fungal organism for a disease syndrome, antifungal spectrum of activity, distribution of the antifungal drug to the diseased tissues, potential side effects, metabolic and excretory pathways, volume of the formulation required to deliver the necessary dose, dosing interval, and ease of administration. Multiple antifungal drugs may be used concomitantly to overcome the limitations of one drug alone or to expand the spectrum of activity. Topical agents are frequently combined with systemic agents for severe fungal dermatitis (e.g., *Chrysosporium anamorph* of *Nannizziopsis vriesii* [CANV]). A vaccine trial showed no difference between dermatologic lesions or septicemia between vaccinated and control bearded dragons experimentally infected with CANV. This review is limited to those agents in which new information is available.

**Antiparasitic Agents**

A number of antiparasitic agents are currently being used to treat endoparasites and ectoparasites in reptiles. Effective treatment addresses the life cycle and ecology of the parasite. For example, it is essential to know what tissues it affects, whether it is directly transmitted, has intermediate hosts, has free-living life stages, and whether it participates in the transmission of other infectious agents. Treatment may or may not include antiparasitic drug therapy. Commonly used antiparasitic drugs include albendazole, fenbendazole, fipronil, ivermectin, metronidazole, oxfendazole, paromomycin, permethrin, ponazuril, praziquantel, pyrantel pamoate, toltrazuril, and trimethoprim/sulfas. Promising newer products include combinations of imidacloprid/moxidectin and emodepside/praziquantel that are administered topically. This
review is limited to a few notable agents about which there are recently published data. Topical treatment with imidacloprid/moxidectin (Advantage multi/Advocate, Bayer, Shawnee Mission, Kan) and emodepside/praziquantel (Profender, Bayer HealthCare, Shawnee Mission, Kan) show promise for the treatment of internal parasites in reptiles and are reviewed above.

**Antiviral Agents**

Numerous viruses infect reptiles, and a causal relationship between disease and the viral pathogen has been established for a few; diagnostic tests are currently available for several of them. Nursing care is the mainstay of antiviral therapy for individuals, and immune-stimulators and antiviral drugs may be useful in some cases. Reptiles testing positive for a virus should be isolated from uninfected reptiles to prevent further transmission. Vaccine trials have shown promise for poxvirus in crocodilians but not herpesvirus in tortoises or paramyxovirus in snakes. A few antiviral drugs have been evaluated for reptiles and may help improve an individual patient’s clinical condition; however, in general, antiviral drugs are not expected to eliminate infection, and it is possible that a reptile could shed infective virus after treatment. Antiviral agents that have been evaluated in reptiles include acyclovir, ganciclovir, and valacyclovir.

**Analgesic and Anesthetic Agents**

Knowledge about reptile analgesia and analgesic agents has increased greatly in recent years. Some of the most important findings describe how to measure the effect of treatment (anti-nociception) and what opioid receptors are most important in reptiles. Analgesics commonly used in reptile medicine include butorphanol, buprenorphine, morphine, oxymorphone, tramadol, ketoprofen, and meloxicam. An excellent review of recent advances was recently published. A similarly thorough review of reptile anesthesia is also available. A number of reports have since been published describing the use of alfaxalone in reptiles. It is currently the preferred induction agent and should be used with together analgesic agents and followed by endotracheal intubation, positive pressure ventilation, and gas anesthesia.

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