EMERGENCY CARE OF THE CRITICALLY ILL REPTILE

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Abstract: The veterinary care of reptiles has progressed a great deal over the past decade or so. Current practice has built upon the foundations laid down by pioneers such that the veterinary surgeon is now able to offer a comparable level of care for reptiles as has been available for the more domestic animals for many years. However, with increasing skill comes increasing expectations, and reptile clinicians are now being increasingly asked to deal with critically sick animals. This paper hopes to introduce the clinician to the important aspects of providing emergency care for reptiles, with emphasis placed upon medical stabilization and fluid therapy.

Key words: reptile, emergency, trauma, shock, hemorrhage, drowning, gastrointestinal obstruction, hypothermia, hyperthermia, pneumonia, fluid therapy

INTRODUCTION

Reptile emergencies do occur; the tortoise attacked by a dog, the iguana with hypocalcemic tetany, the septicemic python. The basic approach to emergency reptile medicine follows along similar lines to domestic animal medicine, however reptile medicine also throws up a number of other problems. Reptiles are ectothermic and have a metabolic rate comparable to \( \frac{1}{7} \) that of mammals. Their slower metabolism generally results in the slower clinical manifestations of disease. Therefore, the clinician will often be presented with a moribund reptile that was in apparently good health this day previously. Some of these cases are true medical emergencies but many represent the terminal presentation of a chronic illness.

History

In cases of true emergency, it may be essential to admit and commence treatment (e.g., oxygen therapy) prior to taking a complete history, but in such cases a history should be taken by a veterinary nurse or the veterinarian at the earliest convenience. The importance of a detailed history must never be overlooked and may actually help in determining whether the current situation is truly acute or merely the terminal stage of chronic disease. Historical details of interest include:

- temperature and thermal environment (power cuts, heater malfunction, electrocution, breeding program)
- lighting (sunlight, artificial (ultraviolet) UVB lights, how old, light-reptile distance, electrocution)
- hide-outs, substrate (wet, mouldy), furniture (fallen rocks or branches)
- recent changes in husbandry (last 6-12 mo)
other reptiles in direct contact with current patient (their health, clinical signs)

recent additions to collection (last 6-12 mo, quarantine)

appetite and food intake (reduced, increased, slow deterioration, complete anorexia, duration, food types, supplements)

water intake and humidity (observed drinking, increase or decrease, unknown)

changes in behavior (courtship, mating, egg laying/birth, tremors, depression, lethargy)

owners records (weights, snout-vent measurements, Jackson ratio, ecdysis, routine treatments, other medications.)

CLINICAL EXAMINATION

In cases of true emergency, it may be essential to admit and commence treatment prior to performing a complete examination. Nevertheless a thorough clinical exam is always indicated and should be performed as soon as possible. The examination should be systematic and cover all available systems. Traumatized areas including severe burns, fractures and wounds must be handled carefully to avoid further damage. During the examination:

- confirm species, sex and age

- obtain an accurate weight and length, and an appreciation of overall body condition (pelvic limb and tail coverage, poverty lines)

- obtain an appreciation of respiratory and cardiovascular function; head extended and open mouth breathing, glottal discharge, increased respiratory efforts at rest and when unrestrained, buccal mucous membrane color, demeanor (active or lethargic), auscultation or Doppler for heart rate and peripheral pulse rate

- obtain an appreciation of metabolic disturbances and hydration; tremors, seizures, moribund, urate tophi in mucous membranes of mouth, reduced skin elasticity, skin tenting, swollen limbs/jaw, pyramiding or saddle-like shell

- obtain an appreciation of the integument; abscessation, swellings and discharges, erythema and petechial hemorrhages, burns, lacerations and penetrating injuries

- obtain an appreciation of the gastrointestinal tract; buccal cavity, cloaca, coelomic palpation

- obtain an appreciation of the urogenital system; if possible palpate kidneys, coelomic cavity for bladder stones and eggs

- obtain an assessment of the musculoskeletal system; limbs, jaw, swellings, fractures, muscle loss, cachexia
TRAUMA

In cases of severe and continued bleeding hemostasis can be achieved by the application of local pressure bandages. Identified vessels may be permanently or temporarily ligated using nylon or vascular clips, or repaired under isoflurane or local anesthesia to maintain important vascular supplies. The application of calcium or adrenaline impregnated swabs and radiosurgery are also useful in the control of hemorrhage.

Prolapses of gastrointestinal tract through penetrating coelomic wounds should be cleaned and replaced as long as the intestinal segment is viable and has no lacerations that will lead to the leakage of gut contents. The wound is then packed with sterile swabs soaked in dilute povidone-iodine solution or metronidazole solution (Torgyl, 5 mg/ml, Rhone Merieux) and bandaged using plastic film. In cases of intestinal laceration, the site should be packed with moist sterile swabs, maintaining the intestine outside the coelomic cavity and the whole area bandaged as before until surgery can be undertaken.

Cloacal, penile, colonic and bladder prolapses should be replaced if at all possible. If surgery is thought necessary the area can be bandaged using moist swabs and plastic film to prevent dehiscence until the operation can be safely undertaken.

Traumatized soft tissues including limbs, tail, flanks and shell should be treated in much the same way as for domestic animals. If medical stabilization is required before surgery then immobilizing the area, covering with sterile gauze and bandaging will prevent further damage and contamination. Burns are particularly prone to infection and the liberal use of topical silver sulfadiazine cream (Flamazine, 1%, Smith and Nephew) cream is recommended.

Bite wounds tend to be superficial lacerations but deep penetrating wounds should not be sutured, but treated as infected wounds.

DROWNING

Tortoises kept in garden enclosures seem particularly prone to drowning and may not be recovered from the pond for several hours. These animals are often presented in a moribund state. In very unresponsive cases (no deep pain response or corneal reflex) it is wise to obtain ECG evidence that the reptile is still alive before proceeding. Whatever the species, position and tape an endotracheal tube in place, and hold the animal head down. Pump the limbs of Chelonia, massage the thorax of lizards or lung field area of snakes to aid evacuation of water. This should encourage voiding of any fluid remaining within the lung fields. Inflate the lungs with either air or pure oxygen and give intravenous doxapram (Dopram-V, 20 mg/ml, Willows Francis) at 5-10 mg/kg i.v. to help stimulate respiration. Until spontaneous breathing returns (which may take minutes or hours) the reptile should be maintained on a respiratory monitor and given intermittent positive pressure ventilation 2-4 times every minute. Cases of drowning in freshwater seldom require fluid therapy unless severe cardiovascular or respiratory compromise continues. However, cases of drowning in marine water will often lead to rapid water loss from the lungs and dehydration. In these cases fluid therapy is recommended. The prophylactic use of broad spectrum antibiotics is advisable as secondary pneumonia is not uncommon.
HYPOTHERMIA AND HYPERTHERMIA

Severe hypothermia can result from heating failure or more commonly delayed national and international transportation. Slow sustained warming is essential as too rapid a rise in core temperature may cause further compromise. Gradual increase in environmental temperature to the species-specific POTZ (preferred optimum temperature zone) over 4-24 hr depending on degree of hypothermia is usually sufficient. In severe cases fluid therapy using warm fluids may also be beneficial.

Hyperthermia is less common than burns, however, constant exposure to temperatures above the POTZ and approaching the species-specific critical high temperature (often 35-45°C) will lead to heat stress. Open mouth breathing, increased respiratory effort and collapse are common signs. Immediate reduction of the environmental temperature to the lower end of the species specific POTZ is required. In severe cases, fluid therapy using cooler but not refrigerated fluids (20-30°C) may be beneficial.

INTESTINAL OBSTRUCTION AND CONSTIPATION

Gastrointestinal obstructions may be due to gravel, stones, bark, balls, rubber suction devices, elastic bands, abscesses, neoplasia, intussusception, ileus, renal enlargement, cloacitis, fecoliths and parasites. Characteristic signs include regurgitation, tenesmus and diarrhea, and less commonly blood in feces or vomitus. Coelomic palpation may reveal discernible masses within the gastrointestinal (or reproductive) tract.

In such cases electrolyte and fluid imbalances should be corrected. Fecal analysis may reveal parasites that should be treated. In cases of constipation, it is important to consider predisposing factors including renal disease, but until the reptile is stable and a thorough investigation can be undertaken, the use of oral laxatives or water enemas may be tried.

Once stable, radiography and endoscopy should be used to diagnose the problem and appropriate measures can then be taken where necessary.

PNEUMONIA

Reptiles lack a functional diaphragm and therefore have great difficulty in coughing. In cases of pneumonia, infectious exudates tend to accumulate reducing the functional area of lung. Once the functional pulmonary reserve has been exceeded the reptile will present with increased respiratory effort at rest, and a possible glottal discharge. Providing a high oxygen environment will help alleviate the signs. In severe cases with confirmed radiographic fluid lines, it is often helpful to insert a small catheter down the trachea into the lung fields and aspirate as much exudate as possible. The exudate should then be submitted for laboratory analysis. In moribund lizards sedation or isoflurane anesthesia is seldom necessary for lung exudate aspiration.
MEDICAL STABILIZATION

Assessment of Dehydration, Metabolic Disturbances, and Fluid Therapy

Hydration status can be assessed in much the same way as other animals, including reduction in skin elasticity, and dull and wrinkled skin. This must not be confused with normal ecdysis (skin shedding). Pre-treatment blood samples are very useful in evaluating hydration status and biochemical derangements in reptiles. Although there is relatively little published data on observed hematology and serum/plasma biochemistry values, serial blood samples offer the best assessment of hydration status and response to therapy.

Preferred reptile venepuncture sites:

- snakes
  - ventral tail vein
  - cardiocentesis
- lizards
  - ventral tail vein
- crocodilians
  - ventral tail vein
  - supravertebral vein
- chelonians
  - dorsal tail vein
  - right jugular
  - subcarapacial vein

The daily water requirements for reptiles have not been conclusively determined. Published literature suggests that reptiles may be rehydrated by providing fluids at a rate of 10-50 ml/kg/d, but 15-30 ml/kg/d appears more appropriate for the vast majority of species.\textsuperscript{5,6,7} Rehydration can take several days to a week or more and it is wise to rehydrate slowly.

Dehydration in reptiles may be characterized as isotonic, hypotonic or hypertonic.\textsuperscript{5} Hypotonic dehydration is most commonly associated with prolonged anorexia and hypertonic dehydration associated with water deprivation or an inability to drink. Isotonic dehydration can occur following hemorrhage, emesis, diarrhea and tissue damage. Water balance in reptiles differs from that of mammals as, per unit body weight, reptiles have a higher percentage of total body water (63.0-74.4%) and a higher percentage intracellular water (45.8-58.0%)\textsuperscript{9}. These values appear to be highest in freshwater species, lower in terrestrial reptiles and lowest in marine reptiles, with the concentration of isotonic saline in non-marine reptiles being 0.8%\textsuperscript{9}. This has led to the recommendation that standard 0.9% normal saline solutions be slightly diluted for use in reptiles to facilitate the intracellular diffusion of water. Four suggested fluid solutions for parenteral administration in reptiles are:

- two parts 2.5% dextrose in 0.45% sodium chloride and one part Ringer's or equivalent electrolyte solution
- one part 5% dextrose in 0.9% sodium chloride, one part lactated Ringer's and one part sterile water
- nine parts 0.9% sodium chloride and one part sterile water
- 0.18% sodium chloride and 4% glucose

All fluids given by any route must be warmed to the species-specific PBT (often 30-35°C) prior to administration.
Bathing, oral, subcutaneous and intracoelomic fluid administration must not be overlooked, however intravenous or intraosseous routes offer the best fluid therapeutic approach in emergency situations. Intravenous catheterization is not easy in reptiles and cut-down procedures are often required under local or isoflurane anesthesia. In large lizards, cephalic and abdominal vein catheterization has been employed, while the right jugular is most accessible in the Chelonia. In snakes, the right jugular can be catheterized using a cut-down technique. The incision site is located 12 abdominal scales cranial to the heart and two lateral scales to the right. A 2-3 cm incision reveals the jugular just medial to the ribs, which can then be catheterized with a 50-100 mm (2-4") 20-23 ga catheter. In larger snakes it is possible to place an intracardiac catheter. The heart is located and immobilized as described previously for blood sampling, and a 25-75 mm (1-3") 22-23 ga catheter is inserted just caudal to the heart apex and advanced cranially into the ventricle. In all cases of venous catheterization, the catheter must be securely sutured to the skin and bandaged in place. Fluid infusion is best controlled by a syringe driver. Most intravenous catheters can be left in place for up to 72 hr, or up to 36 hr in the case of intracardiac catheters.

Intraosseous infusion is an easier technique that is available for use in lizards, small crocodilians and chelonia. In lizards and small crocodilians a 19-38 mm (¾-1½") 20-25 ga spinal needle (or 16 mm (⅜") 25 ga hypodermic needle for very small species) is inserted into the proximal tibia. The limb is flexed and the tibial tuberosity located. The needle is inserted distally while holding the body of the tibia. Correct positioning can be verified by the aspiration of bone marrow, low resistance to flushing with heparinized saline, or radiography. Greater care must be exercised when dealing with osteodystrophic lizards as limb fractures are a potential complication. In chelonians, the intraosseous needle can be inserted into the distal tibia or the medullary cavity of the vertical shell that connects the carapace and plastron. Intraosseous needles are taped in position using zinc oxide tape, incorporating a loop of the extension line to reduce catheter tension. Syringe drivers are used to control the infusion rate. The author has used this intraosseous technique in reptiles as small as 75 g and considers it the parenteral route of choice.

Infusion rates for intravenous and intraosseous administration are similar. As a general guide 0.8-1.4 ml/kg/hr is suitable for rehydration purposes, but in cases of severe dehydration, shock or during surgery the author has used 5 ml/kg/hr for up to 3 hr without ill effect.

Hemorrhage

In cases of severe hemorrhage a packed cell volume (PCV) evaluation is warranted. If the PCV is below 0.05 L/L then a single whole blood transfusion may be indicated. Blood should only be collected from healthy reptiles preferably of the same species and from the same collection to avoid cross-colony infection. However, the author has taken blood from Hermann’s tortoises (Testudo hermanni) for transfusion into a leopard tortoise (Geochelone pardalis), and has taken blood from a green iguana (Iguana iguana) for transfusion into a common tegu (Tupinambis teguixin) without obvious ill-effects. Cross matching does not appear necessary, at least for a one-off transfusion. The donor reptile can provide 7 ml/kg blood which can be collected into a heparinized syringe for immediate administration to the recipient. Alternatively, blood may be collected into citrate-phosphate-dextrose and administered later. Catheterization of the right jugular of donor and recipient tortoises facilitates blood collection and transfusion. In lizards, collection and transfusion via the ventral tail vein appears to work well. In snakes a jugular catheter or cardiac catheter should be utilized. Blood has also been administered via an intraosseous catheter in iguanas. Reptiles are able to cope with much greater blood loss than mammals, and so blood transfusion is only required in dire circumstances when the animal is very depressed following acute and severe hemorrhage. Usually, the administration of intravenous or intraosseous fluids is acceptable. Colloids are less frequently used in reptiles because much of the water loss is from the intracellular space rather than plasma, but in cases of acute hemorrhage their use is commendable.
Laboratory Investigation (See Table 1)

Basic biochemistries can be run on many in-house practice laboratories (e.g., VetTest 8001) with a reasonable degree of accuracy. Uric acid must always be undertaken as a level of over 1000 \( \mu \text{mol/L} \) in an anorexic reptile tends to indicate severe azotemia (pre-renal, renal or post-renal). Above 1487 \( \mu \text{mol/L} \), uric acid may start to precipitate out and cause gout. However, post-prandial elevations of uric acid can occur normally in many species, particularly snakes, and so short-term elevations of uric acid may not carry such a poor prognosis. Consistently high or rising uric acid levels above 1500 \( \mu \text{mol/L} \), despite intensive fluid therapy, tend to carry the worst prognosis. Urea and creatinine are poor indicators of dehydration and renal disease and are not considered clinically useful. PCV and total protein are useful for assessing dehydration and are relatively inexpensive permitting serial assessments at a viable cost. The inclusion of glucose in parenteral fluids may be important in supporting cachexic reptiles and should certainly be used in cases of severe hypoglycemia. Another metabolic disorder, severe hypocalcemic tetany, will benefit from the inclusion of calcium in the infusion fluid. However, it is important to consider concurrent control of any pre-existing hyperphosphotemia (diuresis, phosphate binders) to avoid soft tissue mineralization. Electrolyte imbalances will usually resolve as renal perfusion and function is restored, however if carefully monitored the correction of acid-base and electrolyte imbalances may be attempted in a similar manner to mammals.

A complete blood count takes time and may well be beyond the capabilities of a practice laboratory, especially outside normal office hours. Nevertheless, a hematocrit tube can provide a PCV, semi-quantitative estimate of total white blood cell (WBC) count and an idea of plasma color and character. In a full hematocrit tube, the first 1% of the buffy coat represents approximately 10 \( \times 10^9/\text{L} \) and every additional 1% adds a further 5 \( \times 10^9/\text{L} \). This is obviously not very inaccurate but will provide an idea of whether a reptile has a WBC of 5 \( \times 10^6/\text{L} \) or 50 \( \times 10^6/\text{L} \). In addition, a fresh blood smear stained with DiffQuik will also permit the rapid assessment of a white blood cell differential, with particular reference to heterophils, azurophils and lymphocytes along with any leukocyte toxic changes.

Any discharges, fluids or superficial tissues can be sampled for impression smear cytology using Diff Quik stains. It is important to submit blood, tissues and aspirates for culture and sensitivity before commencing broad spectrum antimicrobial therapy. Enrofloxacin and ceftazidime are safe, broad antibiotics that are commonly employed. In cases of suspected septicemia, i.v. or i.o. ceftazidime and amikacin may be employed but beware of the nephrotoxic effects of aminoglycosides.

Hospitalization

Once the acute emergency is over and the animal is on continuous fluid therapy it is vital that the reptile is maintained in a suitable thermal environment, at the species-specific POTZ (often 25-35°C). All metabolic and physiological processes are dependent upon environmental temperature and all your hard work will be undone if the animal is left overnight in a cold kennel with a hot water bottle! Oxygen therapy can continue in the hospital vivarium and monitoring using peripheral pulse oximetry is useful.

Nutritional support is usually secondary to rehydration, but if in cases of severe starvation complete parenteral nutrition can be attempted. The oral route is preferred although the intravenous administration of lipid emulsions may be feasible. The author prefers Critical Care Formula (VetArk) as an initial oral electrolyte and maltodextrin, protein and amino acid mixture. This can be superseded by Hills a/d for carnivores and insectivores or commercial human baby foods (vegetable
and fruit varieties lacking dairy products) for herbivores. More recently, the use of Pretty Pets complete herbivorous reptile diets (tortoise and iguana) have been utilized with apparent success by simply adding warm water and mixing into a thick slurry. It must be stressed that such exclusive diets should only be used on a short term basis and that once the reptile has started to improve, efforts must be made to provide a more varied, natural diet. Most reptiles will be very weak and therefore food material should be placed directly into the stomach using feeding needles or stomach tubes. The head should be kept elevated for a prolonged period using foam or sand bags to avoid regurgitation.

Once stabilized further investigation (radiography, ultrasonography, endoscopy etc.) and surgery can proceed.

LITERATURE CITED

TABLE 1

Observed Serum Biochemistry Ranges Used to Assess Dehydration and Biochemical Imbalances in Selected Reptiles

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Green Iguana</th>
<th>Gila Monster</th>
<th>Tortoise (Testudo spp)</th>
<th>Box Tortoise</th>
<th>Boa Constrictor</th>
<th>Rat Snake</th>
<th>Caiman</th>
</tr>
</thead>
<tbody>
<tr>
<td>TP (g/L)</td>
<td>50-78</td>
<td>60-85</td>
<td>50-75</td>
<td>40-50</td>
<td>46-80</td>
<td>40-70</td>
<td>50-65</td>
</tr>
<tr>
<td>Urea (µmol/L)</td>
<td>0.0-0.7</td>
<td>na</td>
<td>0.25-6.70</td>
<td>na</td>
<td>0.1-1.67</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>Creatinine (µmol/L)</td>
<td>42-80</td>
<td>na</td>
<td>20-150</td>
<td>na</td>
<td>0.26-26.5</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>Uric Acid (µmol/L)</td>
<td>70-140</td>
<td>100-1000</td>
<td>75-200</td>
<td>100-200</td>
<td>75-250</td>
<td>75-250</td>
<td>175</td>
</tr>
<tr>
<td>Glucose (µmol/L)</td>
<td>9.4-16.0</td>
<td>2.5-6.0</td>
<td>2.6-5.2</td>
<td>2.0</td>
<td>0.6-4.0</td>
<td>na</td>
<td>4.1-6.3</td>
</tr>
<tr>
<td>Calcium (µmol/L)</td>
<td>2.2-3.5</td>
<td>2.2-3.5</td>
<td>2.7-3.6</td>
<td>2.5-3.5</td>
<td>2.5-5.5</td>
<td>2.5-6.3</td>
<td>2.3-3.8</td>
</tr>
<tr>
<td>Phosphorus (µmol/L)</td>
<td>1.5-3.0</td>
<td>1.4-2.9</td>
<td>0.8-1.5</td>
<td>0.9-1.7</td>
<td>0.8-1.6</td>
<td>2.1-3.1</td>
<td>1.3-2.9</td>
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<tr>
<td>Sodium (µmol/L)</td>
<td>140-183</td>
<td>150-190</td>
<td>120-158</td>
<td>130-149</td>
<td>130-152</td>
<td>130-160</td>
<td>139-150</td>
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<tr>
<td>Chloride (µmol/L)</td>
<td>102-125</td>
<td>114-130</td>
<td>98-128</td>
<td>104-108</td>
<td>104-124</td>
<td>125-147</td>
<td>109-132</td>
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<td>Potassium (µmol/L)</td>
<td>1.3-5.2</td>
<td>4.1</td>
<td>4.0-7.0</td>
<td>4.6-4.7</td>
<td>3.0-5.7</td>
<td>4.1-5.2</td>
<td>3.8-7.9</td>
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Adapted from references 3 and 4 and from the author's unpublished observations.