Monitoring Anesthetics in Exotic Animals

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Patient preparation

Pre-surgical patient preparation includes the gathering and organization of all monitoring equipment, heat sources, emergency drugs and other supplies prior to induction of anesthesia. Vascular support is recommended for all patients undergoing anesthesia, but especially for surgeries expected to last beyond 20 minutes, or for ill or unstable patients. Vascular access (IV/IO) is well described elsewhere.

Patient support

Standard mammalian fluid rates for uncomplicated surgical procedures are 10 ml/kg/hour, which has been used successfully in exotic mammals, and birds. Surgical fluid rates for reptiles are intuitively lower, and most published reports state 3-5 ml/kg/hr. However, it should be noted, guides for fluid support are mostly extrapolated from other traditional pet species. Fluids are delivered via an infusion pump, or by intermittent hand injection. For hypoalbuminemic patients, add hetastarch to crystalloid fluids at 0.8 ml/hour. Thermal support is critical. In studies in mammals and selected birds, reduction in core body temperature occurs within 20 minutes of induction of anesthesia; drops are associated with cardiovascular instability, poor recovery and decreased patient survival. Common methods of thermal support include warm water blankets, forced air heaters, electric heating pads and radiant heat. Some exotic companion mammals are especially susceptible to overheating, in particular the chinchilla; thus core body temperature should be monitored with a flexible temperature probe inserted carefully into the rectum.

All exotic anesthetic patients should ideally be intubated, which is commonly performed in birds, reptiles, exotic carnivores and rabbits. Intubation in birds and reptiles is particularly easy due to the rostral location of the glottis at the base of the tongue. Intubation of rabbits requires significant practice and can be accomplished by blind, endoscope guided and otoscope techniques; intubation of guinea pigs and smaller rodents is accomplished with the aid of the endoscope and is significantly more challenging. However, with practice, many exotic anesthetists are regularly intubating patients such as rabbits, guinea pigs, chinchillas, prairie dogs and even larger rats.

The largest disadvantage of intubation of the more challenging patients is time required for successful intubation. In small birds, reptile and mammals, there is an increased risk of mucus occlusion of very small endotracheal tubes. In the author's experience, risk of occlusion appears to increase with tube size below 2.5 mm. Some practitioners will not intubate birds smaller than 100 g for this reason. As reptiles typically do not spontaneously breath under anesthesia, intubation of even very small patients is required.

Anesthetic Emergencies

The goal of monitoring is to detect abnormalities in the early stage, prior to the need for intervention. In the author's experience, the first parameter to change in birds and exotic mammals is the respiratory rate and/or character, for example, slight decrease in rate or thoracic excursion. Since most reptiles do not spontaneously breath under anesthesia and are therefore continuously ventilated, detection of respiratory changes is impossible. As in other species, blood pressure in birds and exotic mammals often drops prior to the detection of other more severe abnormalities such as bradycardia. However, blood pressure measurement can be challenging in these species. (It should be noted that in the author's experience, blood pressure evaluation in reptiles is even more challenging and typically unrewarding). When blood pressure measurements begin to decrease, reduce general anesthesia slightly, and consider administration of bolus fluids. Decreases in respiratory rate and cardiac rate are addressed with ventilation, reduction of the amount of general anesthesia, and when prolonged or severe, administration of drugs such as doxapram, atropine and vasopressin. Consider reversal of injectable anesthetic agents such as medetomidine or dexmedetomidine. In severe cases, consider reversal of opioids.

Occlusion of the endotracheal tube often presents as an increase in respiratory effort. Mechanically ventilating may relieve an occlusion. If not, the patient is extubated and maintained on a facemask, as re-intubation is often too challenging once the surgical procedure has begun.

Restoration of Normovolemia

Optimal fluid therapy is critical for treatment of hypovolemia associated with anesthesia or blood loss. While little information exists on specific guidelines for treatment of hypovolemia in these species, information can be extrapolated from work from with other traditional pet species. The endpoint of fluid resuscitation is restoration of normal blood pressure and normalization of other parameters. The following strategy outlines treatment of hypovolemia in exotic companion mammals, and has been used with success in birds as well:

Reduce amount of general anesthesia. Administer rapid intravenous infusion of warmed isotonic crystalloids at 10-15 ml/kg, followed by colloids (Hetastarch, 6%, (B Braun Medical Inc., Irvine, CA) at 5 ml/kg over 5-10 minutes. Boluses of isotonic crystalloids (10-15 mg/kg) and colloids (5 ml/kg) are continued until systolic Doppler blood pressure reads above 90 mmHg.

An alternative to initial treatment with crystalloids is the use of 7.2-7.5% hypertonic saline at 3 ml/kg as a slow bolus. Hypertonic saline quickly draws fluids from other compartments into the intravascular space. The effect is maintained with follow up administration of crystalloids as discussed above.

Respiratory Arrest

Respiratory arrest requires establishment of an airway, if not already in place. Guidelines for endotracheal intubation are included above. When direct intubation of an arresting mammal is not possible, the patient should be ventilated with a tight fitting mask over the mouth and nose. This technique will allow a reasonable degree of ventilatory support, but may also cause accumulation of air in the stomach. Another option is emergency tracheal intubation via tracheotomy, using a standard approach to the ventral trachea. The tracheal incision should not encompass more than 50% of tracheal diameter. Tube size depends on patient size, and may include smaller endotracheal tube, IV catheters and red rubber catheters. During resuscitation, another team member should begin establishing vascular access, if not already available.

Cardiac arrest

Immediate basic life support principles should be initiated, including airway support as discussed above. Chest compressions are recommended for exotic companion mammals; however effectiveness is unknown in birds and reptiles. In mammals, begin chest compressions at 100-120 times per minute by placing both hands on each side of the chest at the widest portion. The duration of compression should take up half of the total compression-release cycle. Another staff member should attempt intraosseous or intravenous access at this time if not already in place.

Epinephrine and vasopressin can be administered intravenously, intraosseously or via an endotracheal tube (double dosage). Anecdotal reports of success are reported, but true efficacy is unknown, especially for birds and reptiles.

Hemmorhage

Treatment for acute severe blood loss includes blood transfusion or the use of colloids with oxygen carrying ability such as Oxyglobin. With the exception of the ferret, exotic patients are known to have or should be assumed to have distinct blood types. However, the likelihood of transfusion reaction after a single transfusion is unlikely. The risk of reaction must be weighed against the risk of withholding transfusion. It should be noted the author has transfused a single sun conure with blood from 3 separate donors on 3 separate occasions without apparent ill effect.

Sources of blood donors include the ill pet's housemates, or pet stores. The author keeps a list of owners willing to provide blood donors in exchange for clinic credit. Blood is collected from healthy donors under sedation if necessary with 1 ml acid citrate dextrose (ACD) per 10 ml blood, maximum 10% of blood volume based on calculated body weight. Blood is administered via IV or IO catheter.

An example of blood transfusion following hemorrhage is outlined below:

- -Place an IV catheter or IO catheter of the recipient if not already established.

-Place a catheter cap or injection port, and secure the catheter with tape

-Sedate or anesthetize the donor. (Ferrets, birds and many reptiles will often tolerate blood collection with manual restraint alone. Note isoflurane and sevoflurane have been shown to cause PCV depression in the ferret)

-Collect blood from the donor (7-10% of body weight) via the largest available and safely accessed vein into one or several 1-3 ml syringes prepared with sodium citrate 1cc/10 ml blood.

-Administer whole blood via the IO catheter manually over 3-5 minutes, or with a small precision infusion pump.

Table 4. Summary of anesthetic monitoring techniques used in exotic patients.

Parameter	**Method**	**Comments**
Respiratory (rate and depth)	Direct visualization Respiratory monitor	 Newer models modified for small patients
Cardiac (rate and rhythm)	Stethoscope Ultrasonic Doppler Electrocardiogram	 Allows hands-free monitoring Requires rapid recording speed
Blood pressure (indirect, systolic)	Sphygmomanometer and pediatric cuff with ultrasonic doppler	Requires practice; more difficult in smaller patients
Mucus membrane color	Direct visualization; use the vent in birds and reptiles	Indirect measurement of peripheral tissue perfusion
Capillary refill time	Digital compression of mucus membranes	Indirect measurement of peripheral tissue perfusion
Temperature	Flexible temperature probe Infrared thermometry	Place carefully into rectum Early studies in mammals promising, good correlation with other methods
Oxygen saturation	Pulse oximeter	Estimates % arterial oxygen saturation of hemoglobin Reports on usefulness variable
End-tidal carbon dioxide (ETCO2)	Side stream capnograph	Measures CO2 in exhaled gas (estimates arterial PaCO2) May be unreliable in smaller animals