Performing Quality Anesthesia on Companion Avian Patients
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Birds are anesthetized daily for procedures including, but not limited to basic wing and nail trims, venipuncture, radiographs, fracture repair, wound management, soft tissue surgery, etc. Birds are not little dogs and cats and those who anesthetize them should be familiar with the normal anatomy and physiology of the specific species they are working with.

Avian anesthesia
A complete physical examination and at least minimal blood work including a PCV, TP, and blood glucose should be run when possible. Birds can stress easily during restraint and overall handling. Ideally, a pre-medication should be administered prior to any anesthetic induction. Until recently it was believed that birds primarily have kappa pain receptors in the brain. If this is true, full mu opioid drugs may not provide good pain relief for them. If the avian brain primarily has kappa pain receptors, butorphanol is likely the opioid drug of choice used as a pre-medication and an overall analgesic. Recent studies have shown that some avian species have more mu receptors in the brain and actually less kappa than once thought. Full mu opioids will likely provide better analgesia in these species. How do we know what drug will work best? We don’t know for most species, but the most current work suggests full mu opioids likely work better in the some hawks and falcons, while kappa agonists work better in psittacines. Opioids are usually given with midazolam IM into the pectoral muscles. Birds and reptiles have a renal portal system. It is believed that some drugs given caudal to the kidneys can potentially be shunted directly to them. If this happens, drugs may not be metabolized correctly.

Most general anesthesia is induced and maintained via an inhalant such as isoflurane or sevoflurane in oxygen. Mask induction is most commonly performed, but chamber or box induction can be used as well. Masks used for dogs and cats can be adapted for use in birds. In some cases, you will need to be inventive when dealing with patients with long or large beaks. Ideally the seal on the mask should be tight so the staff is not breathing anesthetic gases. I believe mask induction is safer compared to box induction because the patient can be monitored more closely. The anesthetist should ideally listen to the patient using either a stethoscope or Doppler from the time of induction until the patient is extubated. Isoflurane and sevoflurane are potent vasodilators and can have a dose dependent effect on hypotension. These inhalants act rapidly and are only minimally metabolized by the liver. Changes in anesthetic depth can be changed rapidly. As a reminder, in mammals, MAC or Minimal Alveolar Concentration is the concentration of anesthetic that produces anesthesia in 50% of patients that are given a noxious stimulus. MAC is influenced by anesthetic drug protocol, temperature, disease processes, species, stress, and age. Birds do not have an alveolar lung, therefore it is inappropriate to use the term “minimal alveolar concentration” in these species. Instead, we refer to MAC in birds as “minimum anesthetic concentration.” MAC in the avian patient is defined as the minimum anesthetic concentration required to keep the patient from purposeful movement to a noxious stimulus. In simple terms, MAC is the lowest percentage of inhalant anesthetic you can administer the patient without it moving in response to being stimulated. Isoflurane and sevoflurane do not provide analgesia therefore an analgesic drug must be used if performing a painful procedure.

Injectable drugs are not generally used due to the lack of studies performed in avian species and the difficulty of pre-placing an IV catheter. Once the bird has entered the appropriate plane of anesthesia, it should be intubated with an uncuffed endotracheal tube (ET tube) and either hand ventilated or placed on a ventilator and provided intermittent positive pressure ventilation (IPPV). The ET tube should be secured by tapping it to the lower beak or tapping it around the head (similar to what is done in dogs and cats). Most birds do not ventilate well under anesthesia so providing ventilation is a must. A non-cuffed endotracheal tube is used because birds have complete tracheal rings and lack elasticity in the trachea like dogs and cats. Using a cuffed ET tube can cause trauma and pressure necrosis to the trachea. This could eventually lead to the need for a tracheal resection or cause death.

The avian trachea is also sensitive to dry air forced through the endotracheal tube. Dry, forced air can cause irritation to the trachea leading to trans-tracheal membrane formation. Trans-tracheal membranes are not common and there is not a lot of information about them. Clinically, if they form, we see them develop about 5 to 10 days after intubation. Most cases are on small birds that were maintained on a pressure driven ventilator, but we have certainly seen them with large birds as well. These membranes are usually the kiss of death. Treatment often requires a tracheal resection and anastomosis. To help prevent trans-tracheal membranes we currently use ventilators with ultra low pressure settings or hand bag the smaller birds. Adding a Humid-vent® to the endotracheal tube can also help as this disposable device provides humidity to the respiratory tract while the patient is intubated.

As with dogs and cats, anesthetic depth can be monitored using toe pinch, jaw tone, and palpebral reflex. These are all good ways to help monitor the plane of anesthesia. Common monitoring includes HR, RR, venous refill time, MM color, ECG, Doppler with sphygmomanometer and blood pressure cuff, core body temperature, and ETCO₂. The temperature probe is placed either “rectally” into the coelom or into the esophagus.
ETCO₂ is attached to the endotracheal tube either using a mainstream or side stream technique. Capnography is a good tool to help assess ventilation in avian patients as this is an indirect measurement of arterial CO₂. ETCO₂ correlates well with PaCO₂ (direct arterial measurement of CO₂). In mammals, the measurement of ETCO₂ can read about 5 to 7mmHg lower than actual PaCO₂. In birds this opposite is true. The anatomy and physiology of the avian lung is quite different than that of mammals. Bird lungs create an efficient cross-current exchange system which produces a higher concentration of CO₂ in expired gas compared to the actual arteries. This means that the ETCO₂ reading on the capnogram will be higher than the actual PaCO₂. In birds, it is estimated that the ETCO₂ reading will be about 5mmHg higher than the PaCO₂ reading.

In summary, ETCO₂ in the avian patient overestimates actual PaCO₂ by about 5mmHg which is opposite of what is observed in mammals.

In veterinary medicine, the most common ECG used for monitoring under anesthesia is the 3-lead system. There are various color schemes used for each lead, but most commonly a white lead is used for the right wing web, a black lead is used for the left wing web, and a red lead is used for the left leg or foot. These leads can be placed on the animal using an ECG sticky pad either attached to the foot/wing web or chest/coelomic wall. Alligator clips can also be used, but the teeth should be flattened out when possible. Sometimes these techniques do not work or the patient’s skin is too delicate. If this is the case, needles can be pushed through the skin with the alligator clips attached to the needles. I generally find this to be the best option for most avian patients.

Blood pressure is most often taken using an indirect, non-invasive method with a Doppler probe and blood pressure cuff. The Doppler probe is most often secured over the medial metatarsal or cutaneous ulnar (basilic) arteries with the cuff placed proximal to the probe. The probe can be taped into place or two tongue depressors can be taped together to help hold the Doppler over the artery. The width of the cuff should measure about 40% of the circumference of the leg or wing (this is true for any species). There are a variety of very small blood pressure cuffs available on the market today. The most common sizes used for birds are #1 or #2 unless you are dealing with a large bird. One important thing to remember is that improper cuff size can give you erroneous results. If a cuff is too small (this does not happen that often with most exotic animal patients) or above the level of the heart, the blood pressure will be falsely decreased. On the other hand, if the cuff too large or below the level of the heart, the blood pressure readings will be falsely elevated. There are cases where the smallest blood pressure cuff is just too large for the leg. When this happens, I still try and monitor blood pressure knowing that I am mainly looking at trends rather than real numbers. I still feel this is worth doing because I have had cases where the systolic blood pressure readings were consistently around 100 mmHg and then suddenly dropped to 30 mmHg. This told me something changed. In one particular case I asked if there was any bleeding because the blood pressure had dropped drastically and the surgeon told me that the patient had just started to hemorrhage. A severe drop in blood pressure could also indicate the cuff moved or fell off, the patient is too deep, etc.

The Doppler method will only give you systolic blood pressure. To obtain the blood pressure, you must inflate the cuff using a sphygmomanometer. The cuff is inflated until the heart sounds can no longer be heard and then slowly deflated. The first heart sound you hear will correspond to a number on the sphygmomanometer. This number indicates the patient’s systolic blood pressure.

Keeping the patient warm while anesthetized is extremely important. The use of a heating pad, forced warm air blanket, heat lamps, etc. can be used. It is important to monitor the patient until it is awake and standing in the cage. Extubation should only take place once the patient’s eyes are open, moving the feet and wings, and has good jaw tone.

**Catheterization techniques**

As with dogs and cats, an intravenous catheter should be placed when possible. The jugular, medial metatarsal, or ulnar veins can be used for catheter placement. The most common sites are the medial metatarsal and ulnar veins. Depending on the size of the vessel, a 26 gauge to 20 gauge catheter can be used. The medial metatarsal catheter is taped into place in the same manner as a cephalic catheter in the dog or cat. The wing and jugular catheter will need to be sutured into place using a small butterfly piece of tape and a few simple interrupted sutures. If it is not possible to place an IV catheter, an intraosseous (IO) catheter should be placed. The IO catheter is generally placed in the ulna or tibiotarsal bone. In birds, the ulna is larger than the radius. IO catheters should never be placed into the humerus or femur. These bones are pneumatic and connect to the respiratory system. Administering fluids into a pneumatic bone can drown the patient. A spinal needle is used to help prevent a bone core from clogging the catheter. The size of the bone will determine the size of the catheter. Generally a 25 gauge to 20 gauge spinal needle is used. These catheters are easy to place but somewhat harder to maintain. Intraosseous catheter placement should be done using aseptic technique. The catheter is sutured in place using a butterfly piece of tape and protected with a bandage.

Fluid therapy should be started while under anesthesia as long as it is appropriate for the patient. The common anesthetic fluid rate for crystalloid fluids is 5mL to 10mL/kg/hour. Colloids can be used when necessary. The dose of whole blood or a synthetic colloid will vary based on the condition of the patient. In general, the rate is started between 2 and 5 ml/kg/hour and is adjusted as needed. Boluses can be given if needed. Because birds are small, a syringe pump should be used to accurately give fluids throughout the procedure.
If a catheter cannot be placed or if the procedure is very short (i.e. radiographs, venipuncture, bandage change, etc.) subcutaneous fluids should be considered. The most common site for subcutaneous fluids is the inguinal area. Others sites include the wing web or over the back. Fluid rates for birds generally range from 50 to 60ml/kg/day.

Air sac cannulation
Birds have a unique respiratory system that includes nine air sacs (four pairs and one singular air sac). These air sacs are beneficial to us as anesthetists because they provide us with an additional way to induce and maintain anesthesia. An air sac tube or cannula can be placed into the caudal thoracic or abdominal air sac. This allows for direct exchange of air through the air sac cannula, into the air sac. Air sac cannulas are generally placed in an emergency situation when a bird presents to the clinic for severe dyspnea. Proper placement of the air sac cannula can provide immediate relief for patients with upper airway obstruction caused by masses, foreign bodies, fungal plaques, etc.

Air sac cannulas are advantageous for surgical procedures of the head, neck, and trachea. A shortened endotracheal tube, rubber feeding tube, or intravenous catheter (very small birds only) can be used for air sac cannulation. The diameter and length of the tube will vary based upon the species you are working with. The bird should be placed in lateral recumbency, the feathers plucked, and the area aseptically prepared. An incision is made in the skin and mosquito forceps are used to bluntly dissect through the muscle wall and penetrate the air sac. Once the air sac is penetrated, the cannula is inserted into the air sac through the opened jaws of the forceps. If the cannula has been properly placed, air movement will be easily observed in the tube with each breath. A down feather can also be placed at the opening of the cannula. If it moves in and out with each breath, the cannula has been correctly placed. To properly secure the tube, a “butterfly” piece of tape is placed around the diameter of the cannula and sutured to the skin using a finger trap suture technique. If a cuffed endotracheal tube has been placed, the cuff can be slightly inflated to help hold the cannula in place. Ideally this procedure should be done under general anesthesia, but if a patient is literally dying, the cannula will need to be placed ASAP.

The bird will begin breathing immediately if the cannula has been placed properly. If the bird is anesthetized, the end of the cannula will need to be covered or the anesthetic breathing circuit moved to the cannula to prevent the patient from entering a light plane of anesthesia (due to the gas inhalant escaping from the cannula). The cannula will act as an endotracheal tube. You will be able to induce and maintain inhalant anesthesia as well as provide intermittent positive pressure ventilation as needed. When the cannula is not being used for anesthetic purposes, a piece of heap filter should be placed over the opening to prevent particles or debris from entering the air sacs.

Local anesthetic techniques
Many of the same local anesthetic techniques used with dogs and cats can be used with avian species as well. It is important to remember small patients can easily overdose from administration of local anesthetics. Always calculate the maximum dose prior to administration.

Local and regional anesthetic techniques are the only way to provide a complete blockade of peripheral nociceptive input therefore, they are the most effective way to prevent sensitization of the central nervous system and development of pathological pain. The onset and duration of local anesthetics will vary based on the drug chosen. However, the pre-operative use of local anesthetics will reduce inhalant anesthetic requirements and can often help patients have a smoother and less painful recovery. It is important to note that lidocaine has a quick onset, but a short duration of action while bupivacaine has a longer onset and longer duration of action.

Topical application
Topical anesthetics such as 2.5% lidocaine and 2.5% prilocaine (EMLA cream) can be applied to skin for minor procedures such as intravenous and arterial catheter placement. It is advisable to pluck the area of interest, spread on a thin layer of cream, and place an occlusive dressing over the area of application for at least 10 minutes.

Splash block
Local anesthetics can be administered into existing wounds or open surgical sites. This is usually accomplished by either soaking a gauze sponge with a local anesthetic or “splashing” the local anesthetic into the open wound.

Infiltration of local anesthetics
Infiltration of local anesthetics is commonly practiced in dog and cat medicine, but unfortunately not very often with exotic animals (but it should be used more often). Local anesthetics are commonly used to provide additional anesthesia and analgesia for procedures such as a minor laceration repair, skin biopsies, and removing small tumors lying just under the skin. Local anesthetics such as lidocaine and bupivacaine can be injected into the tissue, preferably around the nerve where you are trying to block pain sensation.

Infiltration of local anesthetics is generally quite easy and relatively quick. The area should be plucked and aseptically prepared prior to administering any drugs. Aseptic technique will help prevent accidental contamination of the tissues with skin bacteria when
the local anesthetic is injected. Generally, a small 25 to 27 gauge needle attached to a 1 mL or 3 mL syringe is used to prevent tissue damage and allow for more precise administration of the drug. The volume of drug to be administered will vary based on the area of interest and size of patient. If the patient is very small and the volume to be delivered is tiny, it may be necessary to dilute the local anesthetic prior to administration. Sodium chloride 0.9% is the most common fluid used for dilution.

Post-operative medications should be given for painful surgical or medical procedures. Again, butorphanol or hydromorphone are primarily used to provide various degrees of pain relief in avian patients. When possible, a non-steroidal anti-inflammatory (NSAID) is given to help with pain relief. Meloxicam is the most common NSAID used in birds. Pain medications should be repeated as needed to provide good pain control.