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Introduction

In the past several years, there has been a significant increase in the number of avian patients presenting to small animal clinics and veterinary teaching hospitals. Many of these birds require surgery and many more will benefit from the use of chemical restraint to avoid undue stress during certain procedures.

Preanesthetic Considerations

Generally, anesthesia is indicated in fractious patients that require chemical restraint to lower the level of stress during a variety of diagnostic and therapeutic procedures. It is also indicated in the stable patient that requires surgical intervention. Contraindications would include severe anemia, renal disease, shock, ascites, respiratory distress, debilitating metabolic or infectious disease, and severe liver disease.[1]

The factors influencing the choice of anesthetic protocol in birds include the status of the cardiovascular system, the lungs, the kidneys, and the liver. The patient should be well hydrated and stable before being anesthetized. The hydration status may be estimated quickly and easily by clipping a toenail and collecting a capillary tube of blood for packed cell volume (PCV) and total plasma protein (TPP) determination. Hemoconcentration is present if the PCV is above 60% in most species of pet birds.[1] A TPP below 3 g/dl may suggest liver, kidney, or gastro-intestinal problems which should be investigated.[1] A PCV below 40% indicates anemia. If the PCV is below 25%, a transfusion may be indicated.[1] Prolonged bleeding at an intramuscular injection site or any bleeding when a feather is pulled may indicate a bleeding disorder. If this evidence is present, then the administration of vitamin K1 at 0.2 - 2.5 mg/kg may be indicated.[1]

The patient history and signalment can be helpful in deciding how best to evaluate the anesthetic risk. If the bird is very old, or has displayed abnormalities in the quantity of urates eliminated, then serum uric acid levels can be measured. Levels over 20 - 30 mg/dl could be the result of starvation or dehydration, but usually are due to renal disease.[2] This finding, combined with a low TPP may justify the measurement of liver enzymes. Aspartate aminotransferase (AST, SGOT) is most commonly elevated in caged birds with liver disease and levels above 230 IU/L are considered abnormal.[2] One of the more sensitive tests of liver function is a bile acid assay.[4] Lumeij suggests that a level between 20 and 60 um/dm-3 is normal.[5]

The crop should not contain any fluid when the bird is anesthetized, but due to the rapid metabolic rate and low body energy reserves in birds, it is desirable to fast them for only a short time to allow the crop to empty. If fasted too long, hypoglycemia may result.[1] Small birds should be fasted for one hour. The larger parrots may have food and water withheld up to four hours prior to being anesthetized.[1]

Injectable Agents

While inhalant agents are considered to be superior to injectable agents for safely anesthetizing the avian patient, there are times when an inhalation agent is impractical or not available. It may not be possible to do procedures in the mouth of a small bird with a mask in place or the trachea intubated. There may be a need for general anesthesia when the equipment for an inhalant agent is not available. In these cases, the agent of choice is ketamine alone or ketamine combined with another agent such as xylazine.[6]

Ketamine may be administered I.M. or I.V. at a dose of 10 - 30 mg/kg. Smaller species require slightly higher doses.[6] Start at the low end of the range and administer the agent to effect. The agent is partially excitatory in the CNS[7] which may account for the lack of muscle relaxation and

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frequent excitatory recoveries which have been characterized as violent and stormy. For this reason, it is often combined with xylazine. This provides muscle relaxation and enhances the level of analgesia.[6] Rapid induction and recovery are reported with I.V. administration of this combination.[6] It can also be given I.M., but the recoveries are sometimes prolonged.[6] Ketamine (100 mg/ml) is mixed at a 1:1 ratio by volume with xylazine (20 mg/ml), being sure to mix thoroughly. Generally, the dose is based on the ketamine dose with equal volume of xylazine added. This combination is considered to have a wide margin of safety, but the xylazine does provide a dose-related respiratory depressant effect and bradycardia, so it should be administered to effect - starting at the low end of the dose range.[7] The agents should take effect 3 - 5 minutes after I.M. administration, or 1 - 3 minutes after I.V.administration.[6] Monitoring of respiration and heart rate as well as response to pain may help to maintain the proper level of anesthesia, particularly when administered I.V.

Parenteral agents, as well as fluids or blood, may be administered via the ulnaris vein (wing vein) or the jugular vein. The right jugular is the larger of the two in most individuals.[8] The site of choice for intramuscular injections of anesthetic agents is the pectoral muscles. The injection should be made perpendicular to the surface and near the center of the muscle mass on either side, avoiding the lateral edge and the area immediately adjacent to the keel bone.[6]

Inhalation Agents

Several inhalant agents have been used to anesthetize birds, including ether, methoxyflurane, halothane, and isoflurane. Ether is unpredictable and very flammable, so its use in birds is not recommended.

In recent years, isoflurane has come to be accepted as the agent of choice.[6] It provides good analgesia and adequate muscle relaxation. Isoflurane is the least soluble of the remaining three agents with a blood/gas partition coefficient of 1.4 compared to 2.3 for halothane and 12 for methoxyflurane.[9] This allows very rapid induction and recovery, as well as the capability of achieving very rapid changes in anesthetic level. Another major advantage of isoflurane is that it is a very stable agent, making it resistant to metabolic breakdown. This property affords a higher level of safety in those patients with compromised liver or kidney functions. While deep levels of isoflurane (3 MAC) have a depressant effect on the cardiovascular system, levels up to 2 MAC depress cardiac output and stroke volume minimally.[10] It is a vasodilator, but the resulting decrease in peripheral resistance lessens the work of the heart.[1,23] The mild hypotensive effect may be minimized by lowering the concentration or by providing surgical stimulation[6]. Isoflurane has a dose-related depressant effect on respiration.[12] This effect is rapidly minimized by a decrease in the anesthetic concentration. Harrison points out that with methoxyflurane or halothane, the time from apnea to cardiac arrest is nearly immediate. This time is significantly increased with isoflurane and resuscitation is usually successful because the heart is beating and it is only necessary to manually aid respiration and give pure oxygen for a short time until spontaneous ventilation resumes.[6] This respiratory depression most often occurs during surgical site preparation when there is no painful stimulus. Surgical stimulation will quickly reduce the degree of respiratory depression.[6]

A variable bypass, agent-specific vaporizer placed outside the circle is the most efficient way to deliver isoflurane. This may be a vaporizer which is calibrated for isoflurane or a halothane vaporizer may be used.[13] The vapor constant of halothane is very close to that of isoflurane and it is not necessary to recalibrate the vaporizer. Unlike halothane, isoflurane has no preservatives, so if a halothane vaporizer is to be used, it is necessary to clean the preservatives left by halothane out of the vaporizer. This can be accomplished by repeatedly flushing the unit with ether until the ether does not change color.

A valveless non-rebreathing circuit such as a Bain circuit is used to deliver the agent to the bird using an appropriately sized mask for induction.[6] A cat-sized mask may be modified by stretching a finger from a latex exam glove over the cone. The tip of the finger is cut off, leaving a small hole in the middle. A 35 ml. syringe case may be modified by cutting an opening in the small end and gluing an adapter on that will fit the Bain circuit. The bird may be maintained via the face mask, or it may be intubated. Commercially available endotracheal tubes may be used, but due to the very delicate nature of the tracheal lining and the rigidity of the tracheal rings, the use of an inflatable cuff is not recommended. Harrison suggests using red rubber feeding tubes.[6]

In the case of tracheal obstruction or

surgery of the face, a short piece of plastic tubing may be introduced directly into the abdominal air sac for anesthetic administration. A skin incision is made just behind the last rib in the dorsal paralumbar area, then the abdomen is entered bluntly with a curved mosquito hemostat. The tubing is inserted cranially to a point where condensation can be seen in the tube as the bird exhales. It is then sutured into place.[14] In the experience of the author, when a deep surgical level of anesthesia is reached the respirations cease. Pigeons and budgies have been maintained for one half hour with this unidirectional flow pattern and they recovered uneventfully and had no obvious untoward affects due to hypoxia. A light plane of anesthesia will not cause the respirations to cease. Up to 5% vaporizer settings may be used for induction, with 2 - 3 L/min oxygen flow. As soon as there is muscle relaxation, the vaporizer setting may be lowered to 2 - 3 percent with 0.5 - 1 L/min oxygen for maintenance. Some birds, like the blue and gold macaw, are more sensitive to the respiratory depressant effect and need to be maintained at a lower concentration.[6]

Monitoring

The CNS, the respiratory system, the cardiovascular system, and body temperature should be monitored during an anesthetic event. Generally, the status of the patient and the nature and duration of the procedure determine the sophistication of monitoring needed.

The status of the CNS, or level of anesthesia may be estimated based on the presence or absence of reflexes, degree of muscle relaxation, and response to painful stimuli.[6] The palpebral reflex is present at surgical levels with ketamine, but is gone with isoflurane. With either agent, pinching a toe while pulling on the leg will elicit a withdrawal response or other movement if the anesthetic level is too light. With isoflurane, the eyes are usually closed, but with ketamine the eyes are open. The corneas should be protected by the application of artificial tears on any anesthetized patient.

The respiratory system may be monitored by observing the rate and depth of respiration. In larger birds, like cockatoos and macaws, the rate should not fall below 25 - 35 breaths per minute (bpm). The rate in smaller birds should not fall below 35 - 50 bpm.[6] With ketamine, there is minimal respiratory depression until a dose of 30 - 90 mg/kg is given.[6] With isoflurane, much individual variation exists and the best way to fine tune the concentration for maintenance may be to try to balance between a negative response to pain and maximum respiratory rate. The rate of respiration may be monitored by simply observing the motion of the keel or a small feather may be taped over a nare when using injectable agents. When using inhalant agents, the rate may be monitored with an electronic thermistor device mounted in line with the endotracheal tube. This device gives an audible signal whenever air moves over it, indicating the ventilatory rate. In addition, the ventilatory volume may also be monitored by listening for changes in the duration of the audible beep produced by the unit. The ventilatory volume may be monitored by observing the depth of respiration. Before the bird is handled, an estimation of its normal depth of respiration can be made. During the anesthetic event, it may be possible to observe whether the patient is ventilating at significantly lower volumes by comparing the amount of sternal movement with that amount observed before the bird was anesthetized. Rapid, low volume respiration may be an indication for the application of intermittent positive pressure ventilation.

The cardiovascular system may be evaluated in a number of ways. The rate should not drop below 120 beats per minute in most birds.[6] With ketamine, the rate is increased, but when using ketamine with xylazine, the rate may range from slightly elevated to slightly decreased, depending on the response of the individual patient to the xylazine. With isoflurane, the rate is depressed in a dose-related manner. The rate may be determined by palpation of a peripheral pulse over the brachial artery in the wing, it may be auscultated, or it may be monitored by electrocardiography. Since isoflurane is a vasodilator, it is necessary to monitor mucus membrane color and capillary refill time. This may be observed in the mouth or the gently everted cloacal mucosa. The cutaneous ulnar vein may be observed to go from plump to flat if the blood pressure drops significantly.[15]

Hypothermia should be avoided by providing thermal support in the form of a circulating hot water blanket or hot water bottles. Most birds have a resting body temperature of approximately 40.5°C.[16] The patient should have a preanesthetic temperature taken to establish an individual baseline for that patient. The temperature may be conveniently monitored with an electronic thermometer with a flexible probe in the cloaca,

but a standard rectal thermometer works fine as long as the vent area is not obscured by surgical drapes as it may be in abdominal surgery.

Complications

Regurgitation and aspiration can be a major complication if the patient has not been fasted or is suffering from crop impaction or stasis. If the patient is otherwise stable and the material in the crop is fluid, the crop may be emptied by esophageal tube. In all cases involving the patient with a full crop, it is necessary to occlude the esophagus with cotton while placing the endotracheal tube. This may also be done to protect the airway in a bird which is too small to use an endotracheal tube.[1]

Respiratory arrest may occur with agents that have a respiratory depressant effect. This generally includes all of the inhalant agents. With isoflurane, there is usually enough time to revive respiration before cardiac arrest occurs.[6] First, turn the anesthetic concentration to 0% and flush the agent from the system with oxygen. Then gently depress the caudal aspect of the sternum at the rate of 30 per minute. If spontaneous respiration does not occur in approximately three to five minutes, 5-10 mg/kg of Doxapram may be given I.M. or I.V. to stimulate respiration.[17]

Cardiac arrest is usually terminal in birds, but resuscitation may be attempted by giving an intracardiac injection of norepinephrine. Direct cardiac massage has been performed successfully by Harrison using a saline-soaked swab inserted through the thoracic air sac.[6]

Recovery

The recovery area should be warm and the light should be dim. Patients recovering from isoflurane are usually perching and ready to eat within an hour. Patients recovering from ketamine may experience some seizure-like activity, so it may be necessary to wrap a towel around them during recovery to prevent them from injury.[6] Some practitioners recover small birds in a paper bag, but a more suitable environment may be a small aquarium which has been padded and is heated.

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SCAAV Nursery

The student chapter of the Association of Avian Veterinarians has maintained a nursery for the last three years where students have had the opportunity to help hand raise many species of psittacine birds. These include lovebirds, cockatiels, ringneck and moustache parakeets, as well as the larger amazon parrots, cockatoos, and macaws. Over the last year, approximately 45 birds have been raised by chapter members. This has helped to provide funding for wetlabs and for speakers. There is a rapidly growing number of people who are discovering the advantages of keeping domesticated parrots as pets and the SCAAV offers a means for students to get valuable exposure to the husbandry and medical care of these exotic birds.

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