Avian Neonatal and Paediatric Surgery

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With the shift in emphasis on captive breeding programs throughout the world, neonatal and paediatric medicine have become an important part of avian practice. The hand-raising of chicks has presented the clinician with a number of surgical problems infrequently encountered in the past.

Although surgical intervention in neonates and juveniles is not required as frequently as in adult birds, a moderate number of surgical procedures is performed. Because little research on this subject has been done, the literature pertaining to it is sparse. Much of what is currently known, particularly relating to anaesthesia in neonates and juveniles, has been acquired through experience or is extrapolated from mammalian species.

There are distinct anatomical and physiological differences in the avian respiratory system as compared to mammals. The avian lung is smaller than its mammalian counterpart, is fixed within the thoracic cavity, and does not expand. The largest air capillaries of birds are less than one third the size of the smallest mammalian alveoli (Coles, 1985).

The two-cycle unidirectional air flow in the avian lung allows continuous absorption of anaesthetic gasses, even after cessation of anaesthesia as the result of stored gas in the posterior air sacs. Because of these and other variations in the avian respiratory system, and because of a lack of knowledge of physiological variations in the chick, the mechanisms of anaesthesia on the avian paediatric patient are uncertain.

Anaesthetic difficulties arise in paediatric avian patients because of their small size and the immaturity of several organ systems. The rate of oxygen consumption in neonates and young animals is two to three times greater than that of adults (Grandy and Dunlop, 1991). The respiratory rate of neonatal animals must therefore be two to three times greater than that of adults to meet the greater oxygen demand (Robinson *et al*., 1985). Therefore, it is necessary to maintain a high respiratory rate during anaesthesia to avoid excessive CO_2 build-up and hypoxaemia. This can be accomplished by keeping the paediatric avian patient under a lighter plane of anaesthesia than that used with adults.

Marley and Payne (1964), using halothane in fowl, showed that the $Paco_2$ gradually increased during prolonged anaesthesia of birds with a normal anaesthetic respiratory rate. Birds with depressed respirations showed a much more rapid increase in the $Paco_2$. All birds with a $Paco_2$ of 80 mm Hg died.

Neonates and very young birds appear to have a more rapid induction and recovery from inhalation anaesthesia than do adult birds. In young animals, there is an increased exchange of gasses in the lungs with high alveolar ventilation (Mortola, 1983). This might also be applicable to birds.

In the young animal, cardiac output is rate dependent because sympathetic innervation of the heart is immature (Grandy and Dunlop, 1991). Therefore, bradycardia can be a serious problem if not detected and reversed. This is particularly true of young birds that are anaesthetised for periods in excess of 10-15 minutes. Blood loss is of greater consequence in young avian patients because they are less able to compensate for haemorrhage. Smaller volumes of blood loss can result in tachycardia and hypotension.

Care must be taken when intubating the paediatric patient because the glottis and trachea are small and the cartilage is softer, more friable, and easily torn. If a cuffed endotracheal tube is used, the cuff should be inflated so that the balloon touches the tracheal wall with little to no pressure avoiding ischaemia of the tracheal wall or rupture of the tracheal rings. The bird has continuous tracheal rings and therefore there is no elasticity or expandability. Very little excessive pressure can create fatal necrosis of the trachea.

Featherless neonates have a much more difficult time maintaining body temperature during anaesthesia. Therefore prolonged anaesthesia should be avoided and an ambient temperature of 24°C to 28°C should be maintained.

Most surgical procedures are traumatic emergencies requiring immediate surgical intervention. An extensive presurgical workup as performed in adult birds (Altman, 1991) is not usually possible; however, if the paediatric patient has a history of pre-existing medical problems, a basic presurgical workup consisting of packed cell volume and blood glucose should be performed.

For baby birds, it is essential to maintain their glucose levels and body temperature. Body temperature should be monitored throughout the surgical procedure. Presurgical administration of 2.5% dextrose in half strength saline should be administered subcutaneously, intravenously or through the interosseous route (Lamberski and Gregory, 1991; Ritchie *et al*., 1991). If blood loss has been extensive or the packed cell volume is below 20%, hypotension and hypovolaemic shock can be avoided with a transfusion of whole blood.

Surgical preparation of the paediatric patient is similar to that of the adult bird; however, presurgical fasting can avoid reflux of crop material into the mouth with resultant aspiration and asphyxiation. By positioning chicks during anaesthesia so that the head is elevated or by removing food from the crop by gavage, aspiration can be avoided (Clubb *et al*., 1992). Preparation of the surgical site should be performed with a surgical scrub soap. If alcohol is used, it should be used sparingly, applying it only to the surgical site. Excessive use of alcohol will cause cooling and loss of patient body heat.

Anaesthetic monitoring is more difficult in the neonate and paediatric patient than in adult birds because of the increased difficulty in observing thoracic respiratory excursions; therefore very close observation is necessary to evaluate the level of anaesthesia. When draping the bird, it is essential to use clear plastic draping material to observe respiratory movement.

Paediatric Surgery

Ingluvotomy

Baby birds are presented with foreign bodies in their GI tract. Crop foreign bodies include bitten off feeding tubes, small toys, unhulled seed, and cage substrate such as sawdust, corncob and wood chips. Baby birds will ingest cage substrate or excessive volumes of food if inadequately fed. Most of these foreign bodies can be palpated or shown radiographically. It is possible to retrieve small foreign bodies through the mouth by manipulation of the foreign object rostrally up towards the cervical oesophagus and removing it with a grasping instrument. A water-soluble lubricant diluted with physiological saline can be introduced into the crop to minimise trauma to the crop and oesophageal wall (Joyner, 1992). When *per os* extraction of the foreign material is not possible, surgical incision into the crop may be made. Harrison (1986) suggests that surgical removal be done without anaesthesia in neonates because the procedure is simple and short.

An incision of adequate length should be made into the crop to facilitate removal of the foreign material. Attempts to remove large quantities of material or foreign bodies through a small incision will require more time and will traumatise the delicate tissues of the margins of the crop wall causing oedema and prolonged healing. Because an incision heals from side to side, adequate exposure is more important than the length of the incision. Closure with a double layer (skin and crop) is preferred using 3-5 0 vicryl** with a swaged-on atraumatic needle in a simple interrupted pattern. With older paediatric patients, Isoflurane® anaesthesia should be used.

Foreign bodies in the proventriculus can often be approached through the gizzard via a ventriculotomy incision. Proventriculotomy is more difficult beacuse the access to the proventriculus requires a left lateral approach. Crop, proventricular and ventricular foreign bodies should be removed as quickly as possible to avoid damage to the gastrointestinal mucosa.

Ventriculotomy

The approach to the ventriculus is accomplished via a standard transabdominal laparotomy incision. A skin incision is made several millimetres parallel and distal to the sternal border. This is a small skin incision on the midline just large enough to insert a haemostat or thumb forceps into the incision to elevate the skin, thereby tenting the skin off the surface of the abdominal musculature. Tenting the skin ensures that the underlying abdominal musculature and viscera will not be lacerated during electrosurgical transection of the skin.

Surgery in the juvenile bird, particularly the neonate, must be performed as rapidly as possible, closely following all of the tenets of haemostasis. Anaesthetic and surgical time should be minimised and restricted to 10 to 15 minutes. Total haemostasis decreases the risk of hypotension and shock. The most effective means of decreasing surgical time and maintaining haemostasis is through the use of radiosurgery.

The skin is incised from medial to lateral in one direction and repeated from medial to lateral on the opposite side. An incision is then made through the abdominal musculature in a similar manner to the skin incision. The ventriculus lies to the left of the midline and can be grasped with forceps. The thin muscular wall of the gizzard can be palpated and/or visualised by removing or reflecting the overlying ligament and fat that attaches the gizzard to the abdominal wall. Care should be taken to avoid tearing the blood vessels associated with this ligament. This thin muscular area can be visualised as an ellipse directed horizontally across the middle of the ventriculus. Muscle fibres run in a different direction than that of the rest of the gizzard and the colour is lighter than that of the heavily muscled area.

A horizontal incision through the thin musculature offers access to the ventriculus. A small gallbladder scoop or haemostat can be used to remove the ventricular foreign material. Closure is accomplished using 3-5 0 Vicryl with a swaged-on atraumatic needle and a simple interrupted suture pattern. The sutures should be placed close together to prevent leakage of ventricular material. Foreign bodies in the proventriculus can be grasped through the ventricular incision and removed.

Trauma and thermal burns of the crop

A common surgical problem seen in neonates and fledgling birds is trauma to the crop. One source of trauma is penetrating wounds resulting from the improper or careless gavage feeding of baby birds (Joyner, 1991). Even experienced breeders, through carelessness and rushing, have traumatised and lacerated the crop and oesophagus. This causes leakage into the subcutaneous tissues, forming abscessation with resulting toxaemia. Recognition and early surgical intervention are necessary.

Burns resulting from feeding hot formula are frequently seen (Joyner, 1991; Rosskopf *et al*., 1991). Microwaving food will often leave small central areas of the formula very hot, while other areas of the food will be cool to touch. When consumed, the hot areas will burn the crop and often the skin overlying the crop. Burns of the crop and overlying skin have also been seen resulting from overzealous attempts to dry this area with a hair dryer.

Burns will coagulate tissue and sclerose blood vessels, causing necrosis of the crop and overlying skin. Alteration and changes of appearance of the skin will not be evident for 3 to 5 days after the burn has occurred. Rosskopf *et al*. (1991) indicate that the appearance of necrosis can take as long as 7 to 14 days.

Burned skin will blanch and the texture will change. If the feather tracts in the area are involved, these feathers usually fall out. The devitalised tissue then becomes leathery and black. As the burned area becomes well demarcated, the necrotic patch will separate from the normal tissue and slough out. Food particles and fluid can leak from the crop to the outside.

Penetrating wounds of the crop and skin require immediate repair. The margins of the laceration should be debrided and the skin separated from the surface of the crop for a two-layer closure. The skin normally is closely attached to the crop. Part of the attachment is to two sheets of striated muscle that form a sling-like support structure for the crop diverticulum (McLelland, 1991). The crop should be sutured with 3-5 0 Vicryl, on an atraumatic swaged-on needle using a simple interrupted pattern. The sutures should be close enough to avoid leakage of fluid. The skin is then closed with a simple continuous pattern using 3-5 0 Vicryl. Any food material trapped in the subcutaneous space should be removed prior to closure.

For thermal burns, immediate attempts at repair should be avoided. Because sclerosing blood vessels will cause devitalisation of tissue, it is necessary to wait until the burned area is well demarcated. If the necrotic tissue is removed and debrided before the extent of devitalisation is known, the suture line will break down, requiring further reconstructive surgery.

As long as there is no food leakage to the outside, it is safe to wait for the tissue to start to slough.

When the full extent of tissue devitalisation is known, the necrotic tissue should be excised, leaving a few millimetres of healthy tissue attached to the necrotic patch. If the skin has adhered to the crop, attempts should be made to separate these tissues for a two-layer closure as described above.

In some instances, attempts to separate adhered skin and crop can create too large a defect. If this situation occurs, a single layer repair should be attempted. As in the double layer repair described above, the skin and crop should be dissected away from the necrotic tissue leaving 1 to 2 millimetres of healthy tissue. In closing, utilise wide bites to prevent the sutures from pulling through. Closure is accomplished with a simple interrupted suture pattern using 3-5 0 Vicryl on an atraumatic swaged-on needle.

With severe burns sclerosing large areas of tissue, the volume capacity of the crop can be markedly decreased, requiring small but frequent feedings until normal volume capacity returns. Postoperative care dictates feeding frequent, small food volumes for the first 72 to 86 hours.

Other surgeries

Chicks raised in the nest by parents may have injuries to the extremities resulting in or requiring amputation. Chicks that fledge in flight cages develop injuries to the sternum, wing tips and coccygeal area that can require surgical repair (Joyner, 1991). Neonatal and paediatric surgery can be as safe and successful as in the adult bird by the use of Isoflurane® anaesthesia, careful anaesthetic monitoring, rapid surgical technique, limiting surgical time to 15 minutes and maintaining total haemostasis.

References

Altman RB (1991). General Principles of Avian Surgery, in Johnston, D (ed): Exotic Animal Medicine in Practice, Compendium Collection Vol 1, Trenton, NJ, Veterinary Learning Systems, pp 101-107.

Clubb S, Wolf S and Phillips A (1992). Psittacine Pediatric Medicine, in: Psittacine Aviculture, Perspectives, Techniques and Research. Loxahatchee FL. Schubott, Clubb and Clubb Aviculture and Breeding Research Center, 1992.

Coles BH (1985). Avian Medicine and Surgery, Blackwell Scientific Publications, London, pp 102-108.

Grandy JL, Dunlop CI (1991). Anesthesia of Pups and Kittens. *Journal of the American Veterinary Medical Association*, **198**, 7: 1244-1249.

Harrison GJ (1986). Selected surgical procedures, in Harrison, GJ and Harrison, LR (eds): Clinical avian medicine and surgery, Philadelphia, PA. WB Saunders, pp 577-586.

Joyner KL (1991). Pediatric therapeutics. *Proceedings of the Association of Avian Veterinarians*, pp 188-198.

Lamberski N and Gregory D (1991). The efficacy of intraosseious catheters in birds. *Proceedings of the Association of Avian Veterinarians*, Chicago, IL, pp 17-19.

Marley E and Payne JP (1964). Halothane anaesthesia in the fowl, in Graham-Jones, O (ed): Small animal anaesthesia: Proceedings of a British Small Animal Veterinary Association/U.F.A.W. symposium. Oxford, England, Pergamon. p 127.

McLelland J (1991). A color atlas of avian anatomy, WB Saunders Company, Philadelphia, PA, p 50.

Mortola JP (1983). Some functional mechanical implications of the structural design of the respiratory system in newborn mammals. *American Reviews Respiratory Disease*, **128**: s69-s72.

Ritchie BW, Otto CM, Latimer KS, and Crowe DT Jr (1991). A technique of intraosseous cannulation for intravenous therapy in birds, in Exotic Animal Medicine in Practice, Compendium Collection, Vol 2. Trenton NJ, Veterinary Learning Systems, pp 14-17.

Robinson SL, Richardson CA, Willis MM and Gregory GA (1985). Halothane anesthesia reduces pulmonary function in the newborn lamb. *Anesthesiology*, **62**: 578-581.

Rosskopf WJ, Woerpel RW, Albright M, Shindo MK and Kibota-Sharp D (1991). Pet avian emergency care. *Proceedings of the Association of Avian Veterinarians*, Chicago, IL, p 349.