General Surgical Principles

Robert B. Altman[1]

Presurgical Workup

Any animal or bird undergoing anesthesia and surgery should have a complete history taken, should be given a physical examination and as comprehensive a clinical pathological workup as is affordable. A complete blood count (CBC) and blood chemistry panel will give the broadest parameters; however, because of patient size or monetary constraints, it is often necessary to streamline the clinical chemistry to obtain the most pertinent information. Minimal data base should include a PCV, total solids and serum glucose.

A hematocrit (PCV) is valuable and simple to perform. A low PCV (below 20%)[1,2] indicates anemia. It is prudent to postpone the surgical procedure so that the anemia can be addressed and treated medically. If the surgery cannot be postponed, or blood loss is anticipated, a whole blood transfusion can be of value.

Stauber, et al[3] observed agglutination or hemolysis of RBC's in 66% of the subjects cross matched with heterologous blood. A study in which pigeon blood was transfused into selected raptors[4] reported a rapid destruction of the pigeon red cells. Stauber concludes that heterologous transfusions are of little value.

This author has found that transfusions in birds in which homologous blood was unavailable, heterologous transfusions were of benefit as long as cross-matching was done.

Birds with elevated PCV's (greater than 60%) should be supported with parenteral fluids before and during the surgical procedure.

Interosseous catheters are simple to insert and afford an excellent delivery system for fluids and blood.

Fluids can be administered subcutaneously prior to surgery; however, intravenous

[1] **2662 NW 41 Street, Boca Raton, Florida, 33434 U.S.A.**

(IV) or interosseous administration affords the best surgical support. Blood can be given intravenously as a slow drip or by bolus administration using micro delivery systems.

Birds have poor glycogen storage capacity and therefore with surgical stress can become hypoglycemic. Serum glucose levels below 200 mg/dl require glucose administration prior to and/or during surgery. A 2.5% glucose in half-strength saline solution or 5% dextrose in saline are suitable.

With uric acid levels above 30 mg/dl surgery should be postponed if possible. Elevated uric acid levels can be prerenal (dehydration) or can indicate kidney disease[1,2]

The bird's cardiopulmonary system and reserve can be assessed by radiography and/or assessing recovery time associated with stress. After stressing for two minutes, the bird should be replaced in its cage to assess its recovery time. If respirations return to near normal within three to five minutes, recovery time is considered normal. If recovery time is in excess of five minutes, cardiopulmonary compromise should be considered.

There is controversy as to the benefits of preanesthetic fasting. Because of poor hepatic glycogen storage, surgical stress following a 24 hour fast can cause blood glucose levels to drop precipitously. Therefore, fasting can significantly increase the potential for hypoglycemia. Regurgitation has been associated with non-fasted birds with resultant aspiration of refluxed crop material[2,5]. A five to eight hour fast has been suggested as a compromise; however, this author does not fast surgical patients unless surgery of the crop or gastrointestinal tract is contemplated and has not experienced aspiration. If the crop contains a large volume of food, aspiration of its contents and emptying is beneficial.

Surgical Prep

Feathers should be plucked from the surgical site offering adequate exposure to minimize incision contamination. Feathers should be plucked in groups of three to four and pulled gently in a direction parallel to and away from the follicle to avoid tearing the skin.

Primary flight and tail feathers should be removed individually securing the follicle base with the fingers to avoid tearing skin and traumatizing soft tissue. Since pain is experienced with primary flight and tail feather removal, anesthesia should be administered prior to removal.

The skin should be gently washed with chlorhexidine[1] (preferred to povidone iodine[2]) and prepped with alcohol. Use the alcohol sparingly to minimize cooling and heat loss and allow for complete evaporation before using radiosurgery. A sterile transparent drape[3] is the best means of maintaining sterility and monitoring anesthesia.

All birds undergoing a surgical procedure exceeding 10 minutes should be monitored for body temperature, heart rate and electrocardiographic changes. Body temperature and heart rate can fall precipitously during surgery. Unless measures are taken to alter these changes, the patient can succumb. Supplemental heat should be used throughout the surgery and during recovery.

Tissue Handling

Avian tissues have less tensile strength and are much more delicate than mammalian tissues, particularly in the neonate and pediatric patient. Therefore, proper handling and instrumentation are essential. The use of rat-toothed forceps increases the risk of tissue tearing and shredding. Blunt dissection and reflecting tissues should be accomplished with blunt instrumentation and sterile cotton tipped applicators.

In obese birds with fatty infiltration of the skin, the skin tears easily. It is essential to manipulate this tissue gently and, when suturing take large enough bites so that the sutures will not tear out. When handling muscles, particularly during orthopedic procedures, muscle fibers can split and tear with rough and excessive manipulation. Viscera requires gentle, steady handling, since these tissue have little tensile strength and tear easily. When ligating, excessive tension can cause tearing of tissue. The use of hemoclips[4] makes tissue ligation rapid and free of tension. Small and medium hemoclips are the most frequently used in avian surgery.

Suturing

Selecting appropriate suture material is based on the degree of contamination of the incision site, the inflammatory reaction caused by the suture material, tissue characteristics, tension created when tying the suture material, and the tying characteristics of the suture material. The most commonly used suture size is 3-0 to 5-0. For microsurgery, 10-0 is the suture size of choice. See Chart.

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1 **Nolvasan Scrub, Fort Dodge Laboratories Inc. Fort Dodge, Iowa**

2 **Betadine Solution, The Purdue Frederick Co. Norwalk, Conn.**

3 **Transparent Sterile Surgical Drape, Veterinary Specialty Products Inc, Boca Raton, Florida.**

4 **Hemoclip, Weck, Solvay Animal Health Inc, Mendota Heights, MN**

Suture patterns

For visceral organs, the crop and feet, an interrupted pattern should be used. For all other tissues, a continuous pattern should be used. A continuous pattern requires much less time to complete, but has greater potential for wound dehiscence.

Medical grade cyanoacrylate tissue adhesives [1]are biologically inert and cause very little tissue reaction. This material can effectively bond skin incisions, but should not be used on the feet since picking can result in incisional breakdown.

Suture Material Characteristics

Suture	Absorbs	No. of knot ties	Reaction	Mono-filament	Tying quality
polyglactin 910[a]	Yes	3	+	no	good
polydioxanone[b]	yes	4	-	yes	fair
catgut (medium chromic)	yes	3	+	yes	stiff
nylon	no	3	-	yes	good
stainless steel	no	2	-	yes	stiff

[a] Vicryl, Ethicon, (Summerville, New Jersey)
[b] PDS, Ethicon, (Summerville, New Jersey)

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[1]TissuGlu, Ellman Int'l Mfg. Hewlett, NY

3. Stauber E, Washizuka A, Wilson E, Wardrop J. Crossmatching reactions of blood from various avian species. Proc 3rd conference of the European Committee of the Assoc Avian Vet 1995;142-144.

4. Sandmeier P, Stauber E, Wardrop J., Washizuka A. Survival of pigeon red blood cells after transfusion into selected raptors. J Am Vet Med Assoc 1994; 204:427-429.

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Specific Surgical Techniques

Eye Enucleation

Enucleation of the avian eye is more difficult than the mammalian counterpart because of the size differential of the eye to the orbit, and because of the short optic nerve. If undue traction is placed on the optic nerve during the surgical procedure, it is possible to affect the contralateral optic nerve and cause blindness.

The lids should be sutured or clamped together and a circumferential incision through the skin only, avoiding the palpebral conjunctiva, is made 1-2 mm from the margin of the eyelids. When the medial canthus is approached, dissection is more difficult because of the ligamentous attachment of the medial canthus to the orbit. After the circumferential incision has been completed through the skin of the eyelid, blunt dissection separates the skin from the palpebral conjunctiva. Blunt dissection between the palpebral conjunctiva and the orbit separates all tissues from the boney orbit. It is not possible to dissect each ocular muscle. All soft tissues between the palpebral conjunctiva and the orbit should be dissected thereby separating the globe of the eye from the boney orbit. The palpebral conjunctiva remains attached at the limbus. By placing tension on the dissected eyelids and conjunctiva, the globe of the eye changes contour, often permitting access behind the eye. The optic nerve should be cut with a pair of curved scissors. This procedure is often done blindly because the optic nerve cannot be visualized unless the globe has been collapsed. Care should be taken not to place excessive tension on the optic nerve thereby causing damage to the contralateral nerve.

If bleeding from the vessels accompanying the optic nerve occurs, neither ligation nor electrocoagulation should be attempted because of the potential of traumatizing the contralateral optic nerve. If the vessels can be isolated they should be carefully clamped with a hemostat. If this does not stop the bleeding, a piece of gelfoam can be packed into the orbit or the socket can be allowed to fill with blood after pressure has stopped or slowed down the bleeding. This prevents dry socket and does not permit the sutured lids to sink into the orbit resulting in an unsightly crater. The eyelids are then sutured using a simple interrupted pattern. If enough eyelid is retained, the procedure is cosmetic and not disfiguring. In some birds, because of the relative size differential of the eye and the orbit, it is not possible to dissect behind the globe. It is therefore necessary to collapse the eye by eviscerating the ocular content, affording adequate working space.

Another procedure, suggested by Karpinski, is evisceration of the ocular contents by removing the cornea and intraocular contents, and then suturing the conjunctiva over the globe with 5-0 absorbable sutures. The eyelid borders are trimmed close to their margins, and the lids are sutured closed. With this technique it is essential that any previous infection of the eye be eliminated or abscesses and fistulas can occur.

Transabdominal Laparotomy

A transabdominal approach offers the greatest intra-abdominal exposure of all laparotomy approaches. The bird is placed in ventrodorsal recumbency. Depending upon the size of the patient, a horizontal incision is made 3-10 mm caudal to the end of the sternum. The skin is grasped with forceps, lifted off the abdominal musculature and incised avoiding large blood vessels. The abdominal muscles and peritoneum are then grasped with forceps, "tented" and elevated off the abdominal viscera and incised. This prevents laceration of any of the abdominal viscera. The incision can be extended to achieve the desired exposure. Radiosurgery eliminates the need for ligation of blood vessels under 2 mm. in diameter.

The gizzard and pancreatic loop of the intestine are the most prominent organs visible after the abdomen has been entered. It is preferred to maintain as much air sac integrity as possible when exploring the abdomen. Closure should be in two layers using a simple continuous suture pattern. Polyglycolic suture material (3-0 to 5-0) will eliminate the need for suture removal.

A lateral approach described by Harrison requires the removal of one to two ribs and is performed in right lateral recumbency.

Ventriculotomy

Approach to the ventriculus is required for the removal of foreign bodies and in repair of penetrating wounds. After a laparotomy incision, the ventral border of the ventriculus is grasped. The ventriculus is elevated and rotated laterally so that the thin muscled area between the two poles of the ventriculus can be approached. A stab wound into this area will gain entrance into the ventriculus permitting exploration and removal of foreign material.

Access to the proventriculus through this incision is possible for the removal of foreign bodies.

Closure is made with 3-0 to 5-0 PDS with a simple interrupted pattern. Care must be taken to avoid the large branches of the celiac vessels and spillage of ventricular contents into the abdominal cavity.

Cloacapexy

A transabdominal laparotomy incision is made halfway between the caudal border of the sternum and the cloacal orifice. The lower abdomen is explored and the cloaca is identified. It is helpful and sometimes necessary to have an assistant place a finger or atraumatic probe into the cloacal orifice permitting easy identification of the cloaca. A stay suture of 3-0 to 5-0 PDS is placed through the muscular layer of the cloaca but not penetrating the mucosa and is carried around the pubic bone. A second

transfixing suture is placed similarly around the opposite pubic bone. Two more fixation sutures are placed through the muscular layer of the cloaca and through the abdominal wall cranial to the abdominal incision and the sutures are tied. Abdominal closure is made with an interrupted pattern of 3-0 to 5-0 PDS. The sutures pick up the margins of the abdominal wall and the muscular wall of the cloaca, incorporating the cloaca into the abdominal wall closure. The skin is closed with a 3-0 to 5-0 vicryl utilizing a continuous pattern.