Avian Coelomic Surgery

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Introduction

A basic understanding of general surgical principles should be understood prior to avian surgery. Although there are many anatomical and physiological differences between birds and mammals, surgical techniques are very similar. Due to small patient size and anatomical differences (avian air sacs for example), microsurgical instrumentation with magnification with focused light is often necessary for efficient bird surgery. Because of physiologic variations (compared to mammals, birds exchange oxygen on inspiration and expiration and can frequently go into cardiac arrest following relatively brief apnea), anesthetic techniques in avian species are very different and are discussed at another session during this conference.

Doolen listed several principles that hold very true to maximize avian surgical success.[1] First is to minimize hemorrhage. The second is to minimize tissue trauma. Third is to minimize anesthetic time. Fourth is to minimize anesthetic and metabolic complications. Last, provide post-surgical support and analgesia. These seem simple enough, but are very important to understand and practice during all avian surgical procedures.

If interested in avian surgery, actively pursue continuing education. One of the best continuing education courses is at one's own hospital in the form of necropsy patients. If permitted by the owners, perform as many necropsies as possible to gain experience and exposure to avian anatomy, tissue handling and microsurgical instrument use. Also attend continuing education courses conducted by the Association of Avian Veterinarians, American Association of Zoo Veterinarians, Mid-Atlantic States Association of Avian Veterinarians or other groups supporting avian medicine and surgery. Several texts listed in the 'Recommended Reading' section at the end of this paper give excellent descriptions of numerous avian surgeries. Publications such as the *Journal of Avian Medicine and Surgery* provide numerous well-referenced papers on surgical techniques, in addition to medical topics.

Also familiarize yourself with the numerous potential surgical 'tools'. These 'tools' include radiosurgery, microsurgical instruments, endoscopes, high powered microsurgical loops with light, operating microscopes, laser units and other items that have become commonplace with avian surgery. Consult with surgical instrument companies, colleagues and the continuing education resources listed above.

During the presentation, the author will discuss his most commonly used instruments and 'tool's used with avian surgeries. Although little information exists on suture material in birds, chromic catgut, polyglactin 910, polydioxanone (PDS), monofilament nylon and monofilament stainless steel have been evaluated in rock doves (*Columba livia*).[2] In a separate study of polygalactin-910, chromic catgut and polydioxanone used in cloacopexy surgery in pigeons, the authors concluded that inflammation and fibrosis were most prominent with polygalactin-910.[3] Because of the degree of inflammation and fibrosis, the authors felt that polygalactin-910 would be more appropriate for cloacopexy as a means

to promote adhesion formation at the surgical site.[3] From this information and the author's experience, PDS is slowly absorbed and causes minimal tissue reaction making it suitable for both internal and skin closure use.[2] For the purposes of this discussion, PDS will be used for all monofilament, absorbable sutures in bird surgeries.

The approaches and closure methods for the avian gastrointestinal tract have not be critically evaluated, controlled and reported in a scientific journal as most such surgeries are based on anecdotal experience.[4] While there is a belief that avian gastrointestinal tract surgery carries an 'unacceptably high incidence of post-operative complications', the author feels these procedures can be performed safely and effectively in many circumstances.[4]

Oesophageal Surgery

There are few discussions on oesophageal surgical procedures. The most common discussions center on pharyngeal lacerations, crop burns (that extend up into the cervical esophagus), oesophageal foreign bodies and simple trauma. For the most part, the avian cervical esophagus is expansile and is easily closed in a simple interrupted or continuous inverting pattern. The overlying skin may be closed in a separate layer or with the oesophagus incorporated into the closure. One more common reason of esophageal surgery is to place an esophagostomy feeding tube. One report describes laceration of the upper third of the oesophagus in a male ostrich (*Struthio camelus*).[5] A 10 cm skin laceration resulted in underlying damage to the cervical oesophagus. The esophagus was closed in a simple continuous pattern using 3-O' polyglycolic acid. The skin was closed using nonabsorbable suture material in a simple interrupted pattern. The wound healed uneventfully and sutures were removed 10 days after surgery.[5] An oesophagotomy was successfully performed on a Canada goose (*Branta canadensis*) to remove an oesophageal impaction consisting of grass, legumes and fishing line.[6] The oesophageal incision was closed with 4-O' Vicryl in a simple interrupted pattern and then oversewn in a simple continuous pattern and the skin closed in a simple interrupted pattern. The authors noted that if an oesophageal foreign body is stuck and cannot be retrieved per os, it should be lubricated and pushed into the crop (if possible) for an ingluviotomy.[6]

Crop Biopsy and Repair

Crop biopsy may be indicated for determination of crop masses (most commonly papillomas), screening for proventricular dilatation disease (PDD) and any other suspected abnormalities where histopathologic evaluation is required. In two separate studies, crop biopsy was reported to be 68% and 76% sensitive in detecting PDD in psittacine birds.[7, 8] In the author's experience, crop biopsy is a relatively poor screening tool for PDD. Regardless, a normal crop biopsy does not rule out PDD. Incise the skin over the left side of the crop near the thoracic inlet. Bluntly separate the skin and crop until you can pull the crop partly out of the incision. If screening for PDD, remove a large 1-2 cm section of crop including large blood vessels. For other samples, remove the abnormal tissue or masses present. A two layer closure works best with crop incisions. The first layer is closed with an inverting suture and the author closes the skin and crop together as the second layer. The skin and crop should not be closed together as a single layer as this may increase the risk of dehiscence.[9] Monofilament absorbable suture is ideal.

The same approach is used to retrieve crop foreign bodies and to perform proventricular and ventricular endoscopy. One report noted using endoscopy and an endoscopic wire basket retrieval device to snare a ventricular foreign body (rubber tube) via an ingluviotomy in an African grey parrot (*Psittacus erithacus*).[10]

Crop repair is most often indicated following thermal burns in young. Following the thermal burn and prior to surgery, wait until the margins of the necrotic tissue are clearly visible (usually 4-7 days after

the incident). Remove all necrotic tissue and close as described above. The crop has an incredible ability to stretch and even large crop resections seem to be well tolerated by most young birds. Subsequent feedings will obviously need to be reduced depending on the post-operative size of the crop.

Celiotomy

The left lateral celiotomy provides good exposure to the female reproductive tract, left testes, proventriculus/ventriculus, spleen and left kidney and ureter.[11] Place the anesthetized patient in right lateral recumbency with the wings pulled dorsally, the right leg caudally and the left leg cranially. In some cases, the left leg is best pulled caudally, especially when a more cranial approach to the lateral abdomen is required. Tape the extremities in place with masking tape (or any other tape that is easily removed). Make a longitudinal incision from cranial to caudal in the left paralumbar area. The incision may extend from the cranial extent of the pubis to the uncinate process of the last rib. If needed, the incision can be further extended cranially by incising through the last rib(s) at the costocondral junction(s). Use radiosurgery, laser, sutures or simple hemostasis to control hemorrhage. Once through the skin, bluntly dissect through the lateral abdominal muscles (external oblique, internal oblique and transverses abdominus mm.) to expose the underlying ventriculus (cranial) and intestines (caudal). At this point the abdominal air sac is visible dorsally. Palpebral or similar retractors are very useful to better expose the underlying structures.

A ventral midline, transverse or combination celiotomy is used to expose the middle and/or both sides of the abdominal (coelomic) cavity gaining access to the liver, intestines, pancreas, cloaca and the oviduct (when enlarged). The incision is made on the ventral midline from just caudal to the sternum extending caudally to the interpubic space. The supraduodenal loop (ileum) lies relatively ventral along the midline of the caudal abdomen and can be easily transected if not careful. For this reason, the midline incision should be made as cranial as possible unless the caudal ventral abdomen must be explored as with some cloacal surgeries. After the skin incision is made, the linea alba is tented upward and carefully transected being careful not to damage underlying organs.

The transverse and combination ventral celiotomy can be used to increase exposure to the abdominal cavity in birds. A transverse incision is made midway between the vent and sternum. If needed, a ventral midline incision is used in conjunction with the transverse incision to increase exposure. As discussed above, underlying structures should be carefully avoided when incising through the underlying abdominal wall.

Liver Biopsy

Liver biopsy is a fairly common procedure and is very useful in determining hepatic pathologic change. Liver biopsy is obviously indicated when hepatic disease is suspected, but is also useful in determining response to therapy. Ideally, a thrombocyte estimate and capillary clot time (normal is less than 5 minutes) should be performed prior to surgery.[12] With that stated, avian platelets can only be estimated as they tend to clump in birds.[13] If a coagulopathy is suspected, give vitamin K_1 (0.2-2.5 mg/kg IM) 24-48 hours pre-operatively.[13] If ascites is present, as much fluid as possible should be drained via coelomocentesis prior to surgery. A cranial ventral midline abdominal (just caudal to the sternum) approach works well for most hepatic biopsies.

Minimally invasive endoscopic and ultrasound-guided and blind percutaneous biopsies are also acceptable and are described elsewhere in the current avian literature.[12, 14, 15] One study showed that ultrasound guided liver biopsies resulted in 96.7% and 63.3% recovery of hepatic tissue in pigeons and quail (*Corturnix coturnix*) respectively.[13] While only a small amount of liver tissue was recovered using a tru-cut biopsy needle and biopsy aid in the study, the authors noted the sample size was

sufficient for histopathological evaluation. In the study, one of 19 quails died under anesthesia due to hemopericardium. While no pigeons died during the procedure, 6 of 15 necropsied pigeons (40%) had right liver lobe hematomas 1 week post surgery. The authors concluded that 'ultrasound guided liver biopsy without a biopsy aid is too risky considering the size of the avian liver.[13]

Incise through the midline skin and linea alba to gain access to the cranial abdomen and ventral hepatic peritoneal cavities. With hepatomegaly, the liver is readily visible and the right lobe is usually larger. With microhepatica, the liver is tucked under the sternum. Use cup-end biopsy forceps or curved hemostats to collect a small piece of liver. Typically the edge of the liver is biopsied using either instrument while the cup-end forceps are more appropriate for selecting specific lesions and with microhepatica. When biopsying the liver's edge, bleeding is often minimal and sutures are rarely required. If hemorrhage is persistent, use hemostats to clamp on the bleeding area until hemostasis is established. If possible, collect extra tissue for culture and electron microscopy. Close the muscle and skin layers as with other abdominal surgeries.

Although complications such as uncontrolled hemorrhage, perforation of intestines and other underlying organs and introduction of ascitic fluid into the air sacs are reported, these problems are fairly uncommon with the abdominal approach discussed above.[12] Even with severe liver disease, complications such as clinically evident coagulopathies are uncommon in the author's experience.

Selected laboratory values will likely change following a liver biopsy. In pigeons and quails undergoing ultrasound guided tru-cut liver biopsies, AST, CK, LDH, AP, TP and albumin were measured before and 1 week after surgery. In pigeons the AST and albumin both significantly increased post-surgically while only AST increased in the quails.[13] In a study of mixed wild raptors, 'liver and kidney' values increased within 5 days after liver biopsy.[16]

If both bile ducts are ligated (chickens), severe fibrosing cholehepatitis results within 28 days.[17] The typical lesions that result from extrahepatic bile duct ligation in poultry include cholestasis, fibrosis, proliferated biliary ductules and increased Ito (fat storing) cells within the liver.[18] While not jaundiced, chickens with both bile ducts ligated also developed intensely yellow stained droppings 6-7 days post-surgery.[17] Bile duct ligation results in atrophic and sclerotic testes 10 weeks post surgery in 1 year old chickens likely as a result of the hepatic fibrosis and obstructive cholestasis the procedure causes.[19]

In one study involving 8 Pekin ducks infected with duck hepatitis B virus that underwent serial surgical liver biopsies at 4 to 5 week intervals (34 surgical procedures total), there was only one perioperative death with no evidence of wound complications or intra-abdominal sepsis.[20] With a little experience, surgical liver biopsies can be easily and safely performed in birds.

Pancreatic Biopsy and Duodenal Aspiration

Pancreatic biopsy is indicated when pancreatic disease, such as pancreatitis and neoplasia, is suspected and accurate diagnosis is needed for individual case management. A cranial ventral midline approach is used similar as with liver biopsy. The dorsal and ventral pancreatic lobes rest between the ascending and descending duodenal loop. The duodenum is located to the right of midline and is often covered by a thin peritoneal membrane. Incise through the thin membrane and gently retract the duodenal loop. After examining the pancreas and duodenum for gross abnormalities, select the distal (free) end of the dorsal pancreatic lobe (unless another site is clearly abnormal). Using hemostats, clamp the pancreas just distal to its distal-most vessel coming off the duodenum. Remove the distal pancreatic fragment and submit for pathologic evaluation. Usually, a 3-8 mm section of pancreas is harvested. Remove the hemostats, but re-apply if bleeding occurs. Sutures to control hemostasis are rarely indicated. Close the abdomen in standard fashion.

Pancreatic duct ligation results in severe damage to the pancreas.[21] Most of the pancreas lies within the duodenal loop and has 1-3 draining ducts that enter the terminal duodenum in close proximity to the bile and hepatic ducts. The potential complications of bile duct ligation are listed above. Pancreatic duct ligation results in atrophic pancreatic acini and interstitial fibrosis in chicks (similar to what is noted with the same procedure in mammals). Pancreatic duct obstruction has been a proposed cause of stunting syndrome in chickens.[21]

A high grade pancreatic exocrine adenocarcinoma was removed from a 5 year old male cockatiel via celiotomy.[22] The report describes a 'large, firm, white multinodular pedunculated mass (2.5 cm in diameter) that originated between the distal portion of the pancreas and ascending loop of the duodenum'. The authors also reported they removed the distal tip of the pancreas adjacent to the mass at the same time. Neoplastic cells were surgically evident at the biopsy margins. Six weeks after surgery, the bird was doing well and Celecoxib (10 mg/kg PO SID) was administered for 3 months. One hundred forty-two days post-surgery the bird presented with dyspnea and died during diagnostic sample collection. The bird had diffuse metastatic pancreatic adenocarcinoma. Of note, the bird had acute diffuse renal tubular necrosis (possibly due to the Celecoxib.[22]

The birds and their pancreas seem to tolerate pancreatic surgery well. Following 99% pancreatectomy in chickens, the splenic pancreatic lobe undergoes a rapid enlargement (400% increase) over 16 days.[23] Partially depancreatomized chickens, with splenic lobe intact, also seem to maintain metabolic parameters remarkably well although a post-surgical transitory hyperglycemia may be noted. One conclusion drawn is that the avian splenic lobe appears to be 'extremely competent following removal of the major avian pancreatic lobes in adjusting to the demands placed on it for adequate nutrient absorption and distribution.'[23] Total pancreatectomy is fatal, but subtotal pancreatectomy (leaving the splenic lobe intact) results in transient 'diabetes' that resolves in 12 days in Peking ducks.[24]

Duodenal aspiration may be helpful in identifying occult parasitic (*Giardia spp* and other protozoa) and *Mycobacteria spp* infections and small intestinal bacterial overgrowth.[25] Via a ventral midline surgical approach, the duodenal loop is isolated (see above).[26] Using a 25 gauge or smaller needle, aspirate the duodenal contents for culture and cytology. Additionally, use another needle with the bevel side up to aspirate the mucosal surface of the duodenum. Oftentimes, occult mycobacterial organisms can be recovered cytologically by aspirating affected thickened duodenal mucosa. Closure is standard and the collected samples should be processed/evaluated as soon as possible.

Proventriculotomy/Ventriculotomy

Proventriculotomy and ventriculotomy are reserved for the removal of foreign bodies not eliminated via conservative therapy or non-retrievable using endoscopy or other less invasive techniques. Most reported cases involve gastrointestinal impactions in ratites, but have also been described in kiwis (*Apteryx australis*), sarus cranes (*Grus antigone*) and umbrella cockatoos (*Cacatua alba*).[27, 28, 29] Ventricular foreign bodies and subsequent obstruction and perforation have been reported as an important cause of mortality in bustards.[30] This same approach is also used to obtain biopsies for suspected proventricular dilatation disease and cancer, address perforating ulcers and to explore the serosal surface of the proventriculus, isthmus and ventriculus. Prior to surgery, conservative therapy using bulking agents, fluid therapy and basic support should be attempted.

The ventriculus consists of two opposing muscle pairs: the cranial and caudal thin muscles and the lateral and medial thick muscles.[31] The isthmus is the short region between the proventriculus and the ventriculus. The myenteric nerves cover the entire surface of the thin ventricular muscles and isthmus. Studies in domestic fowl have shown that in order for proper gastroduodenal motility to occur, the myenteric plexus associated with the isthmus must remain intact. It is also suspected that initiation and regulation of the thick muscles also acts via the nerves covering the isthmus. Specifically, isthmus

denervation reduces the frequency of duodenal and muscular stomach contractions by 50% and abolishes glandular stomach contractions (in turkeys).[32] The nerves encircling the isthmus do not appear important in regulating thin muscle contractions.[31] These findings support the need for atraumatic and precise surgery when incising the isthmus as discussed below.

For adult birds undergoing proventriculotomy/ventriculotomy, fast the patient for at least 12 hours to help 'clean' the gastrointestinal tract. If possible, use handfeeding formula 1-2 days prior to surgery as these easily digestible foods tend to leave little residue in the ventriculus. (Also discontinue feeding formulas 6-12 hours prior to surgery.) Pre- and post-operative antibiotics should be considered as with other animals undergoing enterotomies.

A midline combined with transverse ventral or left lateral celiotomy may be used. If the ventriculus is displaced medially (as supported by contrast study radiographs), the ventral midline approach is more appropriate. Otherwise, the left lateral approach is more commonly used.

Once located, place stay sutures in the white tendinous portion of the ventriculus to help retract the organ(s) out of the coelomic cavity and improve exposure.[20] Due to its location, the proventriculus cannot be exteriorized but visualization is improved with ventriculus retraction. It is best to pack moist sponges around the retracted organs to help prevent coelomic contamination. Incise into the relatively avascular isthmus and extend the incision cranial into the proventriculus or caudal into the ventriculus as needed. At this point, both the proventriculus and ventriculus can be explored. Due to the massive mobile muscular tunic and high tensile strain on the tendinous centers, the ventriculus does not have a good site for incisional entry.[4] Additionally, an endoscope may be introduced to improve visualization and help retrieve foreign bodies when present. Irrigation and suction are often needed- be careful not to contaminate the coelomic cavity. Use fine monofilament, absorbable suture in a simple continuous pattern to close the wound. Oversew with a continuous inverting pattern. Meticulous closure is required to help prevent dehiscence.

The ventriculus may also be approached via the caudoventral sac.[20] The ventriculus has two blind sacs (craniodorsal and caudoventral) covered with relatively thin muscles. Incise through the muscle fibers to enter the ventricular lumen. Again, use meticulous closure. This tissue does not invert, so use interrupted sutures placed close together. In a study of Coturnix quail undergoing caudoventral sac ventriculotomy, ventricular mucosal healing was not complete until 21 days post-surgery.[4]

While collagen patches have been suggested in mammals to help intestinal wounds heal, they may be detrimental to birds. Porcine submucosal collagen patches placed over the serosal surface of the ventricular suture line in Cortunix quail that underwent ventriculotomy resulted in a statistically significant increase in gross or microscopic perforations.[4] The authors of the study suggested that the collagen patch generated a lymphocytic xenograft rejection response.[4]

In one study of proventriculotomies performed in ostriches, 6 of 18 died immediately post-operatively and 4 of the 12 surviving birds died within 30 days of the procedure.[28] The authors noted that many of the birds were debilitated prior to surgery and recommended an esophagotomy be performed in all young or debilitated birds at the same time as surgery to provide post-operative nutrition as many birds are anorectic for several days after surgery. The authors also made note that no adverse sequelae were noted from the esophatomy.[28] In a separate report involving phytobezoars in 3 Micronesian kingfishers (*Halcyon cinnamomina*), the authors noted that one 1 bird died during ventriculotomy via a ventral midline approach.[33] The other two birds were treated medically. When medical therapy failed to resolve the phytobezoar in one, ventricular endoscopy was unsuccessful and the bird died during preparation for ventriculotomy. Although the success rate was poor in this group, the authors recommended brief medical management followed by surgical extraction in non-resolving cases.[33]

Lower Intestinal Surgery

Lower intestinal surgery is rarely reported in avian medicine. Both metallic and non-metallic intestinal foreign bodies are described in multiple bird species.[34] Non-metallic lower gastrointestinal foreign bodies are rarely described in avian medicine and are most frequently linear, occasionally form a nidus or enterolith and diagnosed based on palpation or necropsy. Radiographs, with or without barium or iodine (especially if gastrointestinal perforation is suspected) and ultrasound may also aid in diagnosis. One case report describes a 14 month female Eclectus parrot (*Eclectus roratus*) with a mineralized intestinal foreign body. The foreign body and proximal part of the duodenum were removed and the bird recovered uneventfully. The details of the actual surgery were not included other than the foreign body was brittle upon removal and had a central fiber like structure.[34] One paper briefly notes that an ostrich died of complications associated with small intestinal resection and anastomosis performed because of a perforating intestinal foreign body. The same ostrich underwent a proventriculotomy 2 months previously.[28]

Intestinal resection, repair and anastomosis are delicate procedures in birds. Use microsurgical instruments to remove necrotic or damaged bowel and spare healthy tissue and the surrounding vascular supply. Use 6-O' to 10-O' absorbable monofilament suture on ¼ circle atraumatic needles for intestinal anastomosis and enterotomy closures.[9] Six to eight simple interrupted sutures are often necessary for end to end anastomosis. Enterotomy closures should be performed so as to limit intestinal stricture.

Duodenal feeding tubes may be needed to bypass a diseased proventriculus, ventriculus or other upper intestinal area. Via a midline or transverse celiotomy, an indwelling jugular catheter no less than ⅓ the small intestine diameter is placed through the left coelomic wall and into the descending duodenal loop.[9] Advance the catheter through the descending and ascending duodenal loop and remove the catheter's needle. Use 5-O' monofilament suture to attach the duodenum to the coelomic body wall and provide a tight seal. Test the catheter patency and duodenostomy seal by injecting sterile saline and then (routinely) close the body wall. Secure the external portion of the catheter using monofilament suture. Coil the external catheter and secure it to the bird's leg and wing. Divide the liquid diet into small frequent feedings. Flush the catheter with warm isotonic fluids before and after each use to prevent catheter obstruction. Closely monitor the incision site and patient for signs of coelomitis, leakage and catheter damage. When done, cut the sutures and pull the catheter leaving the incision to heal by second intention.[9]

Cecal surgery has been described but only under experimental conditions. In many avian species, ureteral urine flows aborad (via peristalsis) into the colon and ceca where water absorption occurs. At least in chickens, when the ceca are ligated total water excretion is increased.[35] Cecostomized chickens show increased water intake and reduced transit time of digesta in the ceca.[36] Current studies show the importance of avian ceca in water balance and should be considered if this organ is surgically manipulated.

A 7-year old female umbrella cockatoo (*Cacatua alba*) was evaluated after an incisional cloacopexy that incorporated the pubis.[37] The bird had a chronic history of cloacal prolapse. Six days post-cloacopexy, the bird's coelomic cavity was explored because of a recent history of anorexia, regurgitation, elevated creatine kinase, hyperuricemia and decreased intracoelomic detail on screening radiographs. Midline celiotomy revealed yellow serous fluid throughout the coelom, a 2-3 cm section of colon trapped between the cloaca and body wall and adhesions between the colon and cloacopexy site. Adhesions were removed revealing a 2mm colonic and cloacal tear which were repaired with 4-O'PDS in a simple interrupted inverting pattern. Cloacopexy sutures were removed to further free the entrapped colon. The bird passed feces the next die but died 3-days post-surgery. Upon necropsy, an adhesion incorporating the cloaca, colon and body wall at the level of the caudal margin of the keel

blocking the passage of fecal material was found. The gastrointestinal tract was distended with greenish fluid proximal to the adhesion. The authors noted that this and another bird (sulphur-crested cockatoo- *Cacatua galerita*) had a segment of large intestine trapped in the potential space between the cloacopexy sites and ventral body wall ultimately leading to the death of both.[37]

Ventplasty

Ventplasty is reserved for chronic cloacal prolapse. The cause of the cloacal prolapse should be determined and resolved if possible. Oftentimes, birds have prolapsed their cloaca so long that all cloacal muscles and supporting structures are permanently stretched and non-functional. The goal of ventplasty is to reduce the vent size such that cloacal prolapse does not recur. It should be understood that ventplasty will likely fail if the underlying cause of the prolapse is not resolved and the bird continues to strain post-operatively.

The extent of the dilated vent will determine how much tissue must be resected. For mild to moderate distension, usually one section of the vent is resected. For more severe distension, two areas of vent resection may be required. The basic incision is the same, but one versus two resections is based on surgeon preference in relation to the animal's needs. Pre- and post-operative antibiotics should be considered and based on culture and sensitivity results of a cloacal swab or cloacal tissue culture.

Prior to making the incision(s), estimate how much tissue needs to be resected in order to make a normal vent diameter. Triangular incisions work best with the 'base' of the triangle on the leading edge of the vent and the 'point' away from the vent. A single incision work best over the cranial ventral side of the vent while two opposing incisions can be performed at the right and left lateral sides.

Once the resection site(s) is(are) determined, excise the desired triangular area(s) taking epidermis and dermis. Save excised tissue in formalin if needed. If the sphincter and transverse cloacal muscles are visible (usually they are so stretched that they are unrecognizable), spare these muscles. The dermis can usually be bluntly resected from the underlying muscular and submucosal tissue layers. When apposed, the new epidermal edges should form the desired vent diameter. If needed, more epidermal/dermal tissue is removed.

With the appropriate 'new' vent margins, close the surgery site. First close the submucosa with the dermis. Place simple interrupted absorbable sutures medial (which represents the new vent wall) to lateral for all tissue layers. Next, close the dermis in the same fashion. Finally, the overlying epidermis is closed. The end result should be one suture line extending cranially (single vent resection) or one suture line extending laterally on the left and right sides of the vent (double vent resection). The new vent diameter should be just large enough to allow passage of droppings. Use lubricated cotton tipped applicators to test the patency of the vent. Sutures are absorbable but can be removed in 2 weeks if needed.

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