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AVIAN GASTROINTESTINAL TRACT (GIT) SURGERY

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Experience required: Any aspiring avian surgeon, should first become a competent small animal surgeon. The sympathetic handling of soft tissues is mandatory in a successful avian surgeon. Avian surgery requires exactness in view of small body size and increased metabolic rate, as any such errors are magnified. Surgery on birds of less than 2kg requires micro surgical techniques and equipment as well as a significant degree of manual dexterity.

Equipment: see Scott Echolls this issue.

Microsurgery: It is vital that surgeons develop familiarization with magnification. Slight surgeons movements become very large when magnified and the surgeons natural ability to control such movements is reduced by magnification. Increased manual control is essential, which necessitates a sitting position with fore arm support. When planning avian surgery, other distractions and stresses such as time constraints should be removed. Fine muscle control will be impaired if you have under gone excessively strenuous exercise in the previous 24 hours. Do not increase or reduce caffeine intake. Access all risks and problems prior to surgery so that you are not phased by them as they occur. Never commence surgery unless you are wholly familiar with the anatomy. Use cadaver surgery to familiarize yourself with the anatomy and in order to become experienced at handling tissues and discovering what traction and trauma can be placed on delicate structures without causing lasting damage. Small infrequently used instruments are those most likely to have been misplaced. Ensure all the equipment that is required for a procedure is available and sterile prior to commencing the procedure. The operating table must be stable (against movement of people or machinery in the vicinity) and staff should be advised not to touch or knock the table during surgery as even slight patient movements result in significant surgical risks.

Radiosurgery: employs high frequency alternating current to generate energy. There are two electrodes the active electrode should remain cool.

Use of this equipment is invaluable, however training and care is required. Correct utilization of radiosurgery will not cause excessive tissue damage, and will facilitate

incision in the absence of significant haemorrhage, as well as accurate control of any bleeding points (using the bipolar forceps). The control of haemorrhage is invaluable, firstly to prevent significant blood loss, but also to permit continued uninterrupted visualization of the surgical field, thus reducing surgical time and permitting greater precision of surgery. The Surgitron (Ellman International Inc., Hewlett, NY) and other radio surgical units uses radio frequency current (as opposed to an electrical current), which is received at the indifferent plate, so that direct contact between the patient and the plate is not required. This removes any risk of heat generation at the contact point between patient and the indifferent plate, which might other wise lead to patient tissue necrosis. The two sides of the bipolar forceps constitute both electrodes (active and indifferent), so there is no need for the ground plate. Bipolar forceps are invaluable for controlling point haemorrhage, (even in the presence of a liquid blood filled field). Cautery with the monopolar head is ineffective if the surgical field is wet with blood. There is an adapter, which will allow intra-operative sterile switching from monopolar to bipolar; which is well worth the additional investment.

Correct use of radiosurgery is essential. 3.8 – 4.0 MHz is the optimum frequency for incisions. This frequency provides a precision focus of the energy in a minimal area. Excessive sparking or lateral heat should not occur, if it does the power setting is too high. If the power is too low, the electrode drags this in turn increases the lateral heat and tissue damage, which is undesirable. Any excessive tissue damage will impair post operative tissue healing. Fully filtered waveform is ideal as this minimizes lateral heat. The smallest possible electrode size is required, as this also minimizes the lateral heat production. The electrode should be in contact with the tissue for the minimum time possible, so as to minimise tissue damage. Once cut the operator should not return to the same tissue with a single wire within 7 seconds, or 15 seconds if it is a loop electrode. Fully rectified, fully filtered (90% cutting 10% coagulation) current should be used for cutting skin and biopsy collection. Fully rectified (50% cutting and 50% coagulation) current should be used for dissection with haemostasis, whilst partially rectified (10% cutting, 90% coagulation) current should be used for coagulation.

Surgical Lasers: Laser (light amplification by the stimulated emission of radiation) surgery is now more readily available and affordable. Tissues may be cut or ablated (vaporized) using contact (least co-lateral damage - typically 300-600u) or non-contact (when visualization is improved, although lateral damage tends to be slightly greater) modes. Using either technique, blood vessels of up to 2mm diameter may be incised in the absence of any haemorrhage. Laser surgery can be used endoscopically. There is no doubt that the application of surgical lasers will have a growing place in avian surgery during the next few years. The main advantages are the reduction of oedema, post operative swelling, lateral damage, reduced healing times, less post operative pain, whilst more extensive surgeries (e.g. orchidectomy) being able to be performed.

Preparation: The patient must be assessed in relation to energy and nutritional status, as well as circulatory fluid or blood deficit and any abnormalities corrected. Intra-operative and post-operative hypothermia, analgesia, sepsis and shock must be controlled. Pre surgical starvation should be limited only to sufficient time to enable crop emptying. Any longer period of starvation would be detrimental in view

of the risk of a negative energy balance. All birds over 100g are entubated to protect the airway from gastric reflux. Smaller birds are generally not entubated in view of the increased risk of blockage of small diameter tubes by respiratory secretions.

Skin Preparation: sufficient feathers are removed (never flight feathers) to enable adequate sterile access to the operative site. Adjacent feathers may then be retracted from the surgical field and held in place with proprietary office supplies adhesive tape. In the authors practice skin preparation is performed using an iodine based alcoholic tincture disinfectant. An aerosol surgical adhesive is applied to the skin, and a sterile transparent drape is applied. The minimization of the area of feather removal, whilst still enabling intra operative control of sepsis is beneficial in the control of intra or post operative hypothermia.

GIT TECHNIQUES

Beak and Jaw: conditions of the beak and jaw are beyond the scope of this paper and will not be covered here.

Tongue: due to the manner in which psittacines use their tongues and chew at solid, hard, abrasive and fragmentary objects, penetrations, lacerations and foreign bodies in the psittacine tongue do occur. Any recurrent or non-healing lesion of the tongue should be fully investigated with this in mind. Differential diagnosis includes *Cryptococcus neoformans* and mycobacterial infections. Other differentials for tongue pathology include candidiasis, trichomoniasis or bacterial granuloma. Non infectious differentials include hypovitaminosis A (cysts or abscesses), lymphoreticular neoplasia, cystadenoma and squamous cell carcinoma. Hypovitaminotis A leads to squamous metaplasia which commonly effects the salivary glands under the tongue, leading to sterile abscess formation. This is commonest in aged seed fed psittacines. Incision and curettage assists with healing and should be accompanied by weekly vitamin A injections and an improvement of the diet.

Oropharyngeal / choanal papilloma - see **cloacal papilloma**

Proximal oesophagus - may suffer fishing hook trauma (waterfowl). The exact position of fishing hooks may be ascertained by radiography using dermal radio-dense markers (e.g. hypodermic needles inserted in the skin) to pin point the exact location. Alternatively (especially if dealing with wildlife and cost is a factor) one may pass the loose end of any attached line through a rigid plastic catheter and then pass the catheter down oesophagus (over the line) to the position of the hook. This rigid plastic catheter may on occasions be used effectively to disgorge the hook and enable safe non-surgical removal. It is important to appreciate that many effected waterfowl have more than one hook present.

Once the hooks position is ascertained, care is taken to surgically explore the area and remove the hook. It is preferable to cut the shank of the hook, and pass the point and barb out in the direction of the point. If hooks are located in the thoracic oesophagus, which cannot be removed endoscopically, this author leaves them in situ and relies on the bird walling off the noxious object. Swans are individually identified and case follow up demonstrates a high survival rate. In view of the long

sternum in swans, such hooks are not accessible except by thoracotomy. In view of the trauma necessary, the high cost in a non fee-paying patient and the high survival rate without surgery, this author believes this action is justified.

Oesophageal stricture formation may occur after infections (trichomoniasis, capillariasis, candida infections), tube feeding trauma, thermal or caustic trauma, foreign body ingestion or iatrogenic surgical trauma. Where strictures occur, the eliciting cause must be determined and addressed. If necessary, a pharyngostomy tube (see later) may be placed during supportive and medical care. If a stricture remains this may be relieved by serial mechanical dilation, achieved by passing tubes or cannulae of increasing size periodically over a period of several weeks.[1]

Ingluviotomy: commonly indicated for the retrieval of foreign bodies (which are not accessible per os) or for retrieval of proventricular or ventricular foreign bodies (using micro-magnets [glued in place within plastic tubes], lavage or endoscopy), for the placement of an ingluviotomy or proventriculotomy tube, or the collection of biopsies. Crop calculi or ingluvioliths may also form and require to be removed in this manner. A whole range of materials may be found, including rolled up hay, newspaper or other nest material, these may be hard and inert or may be susceptible to putrefaction leading to toxaemia. The bird is placed in dorsal or lateral recumbency; entubated, with the head elevated above the level of the crop. A probe is placed per os into the crop, to delineate the position of the organ. The skin is incised over the left lateral crop wall, close to the thoracic inlet. The crop wall is localised and isolated. An incision site is chosen to avoid large blood vessels and so as not to interfere with postoperative feeding tube placement. Stay sutures are placed in the crop and an incision 1/3 to 1/2 the length of the skin incision is made (as it will stretch to equal that of the skin). Crop closure is achieved with 4-0 to 6-0 synthetic absorbable material using a single or double continuous inversion pattern, followed by separate skin closure.

Treatment of crop burns: Hand reared birds, fed excessively hot or inadequately mixed food (which is too hot) may suffer crop burns. Birds may present with delayed crop emptying or a wet skin patch over the crop. Necrosis may also occur in adult birds following the consumption of caustic substances. Necrosis of the crop wall and skin leads to fistula formation. Surgical repair should be delayed (4/5 days), until viable tissues can be clearly differentiated from necrotic tissue. It is essential that nutritional support and prevention of secondary infections (bacterial or fungal) be maintained. Pharyngostomy or duodenostomy feeding may be necessary (see later). By the time a fistula has formed, the crop wall will be adhered to the skin. Following induction of anaesthesia and entubation, the skin is surgically separated from the crop wall. The crop wall is then closed, using a double inversion patter 4-0 to 6-0 synthetic absorbable material, followed by a separate skin closure

Crop or oesophageal lacerations: may occur following traumatic tube feeding or external trauma (e.g., talon punctures from a raptor). Tears are often not recognised at the time of trauma but instead later when a significant build up of fetid toxin producing food material has occurred subcutaneously. A significant active inflammatory reaction will be present. Surgical exploration, closure of the crop wound, drainage, (pharyngostomy tube placement if required), fluid therapy,

analgesia, anti-inflammatory and antibiotic therapy may be required, prior to surgical skin closure some days later.

Sour crop: Raptors suffering crop stasis rapidly become toxaemic because of putrefying meat in the crop. The crop contains no digestive juices or acid (which might prevent putrefaction) and any meat contained in it is maintained at a temperature approaching 41^{o}C. Although these birds may appear bright, they have a poor risk for extensive surgery or handling. In the authors experience the most effective treatment is, anaesthesia, administration of fluid therapy, the crop is opened, contents removed, then flushed per os with warm saline. If the bird is sufficiently strong the incision may be closed immediately, if weak it is left open and closed the following day. This is a quicker and a less stressful or risky procedure than removal of meat per os.

Crop biopsy: is the safest and least invasive ante-mortem diagnostic technique for psittacine proventricular dilation syndrome (PDS). This method has 68% sensitivity with a 100% specificity.[2] The collection site should be in the left lateral (non-dependent) area of the crop. The sensitivity is further maximised (up to 76%) by selecting a section of crop wall where a clearly visible blood vessel terminates and by harvesting a large full thickness biopsy (0.5-1.0cm x 0.5-1.0cm). Differential diagnoses for PDS include chronic heavy metal poisoning, enteric papillomatosis, foreign body ingestion, severe parasitic enteritis, mycobacteriosis, bacterial, megabacterial or fungal ventriculitis, ventricular foreign bodies, proventricular or ventricular neoplasia or papilloma.[3,4]

Crop repairs: pigeons are often presented with extensive crop injuries following wire strikes. Where the crop wall has been exposed to the air for some hours, it may be desiccated. Non vital tissues should be removed and a repair effected. Pigeons will tolerate extensive crop wall loss, so long as the wound can be closed using healthy tissues.

Pharyngostomy, Oesophagostomy or Ingluviostomy tube placement: tube placement is required in situations where the mouth, proximal or distal oesophagus or crop needs to be by passed. Such conditions may include orthopaedic conditions of the beak and head or trauma, infection, neoplasia, severe parasitic infestations, or strictures affecting any part of the gastro intestinal tract between the mouth and the proventriculus or simply in a bird which is so weak that it is unable to feed itself.

The bird is anaesthetised, entubated and placed in lateral recumbency. A metal feeding tube is placed by mouth and tented up in an appropriate position in the cervical oesophagus (cranial to the crop). The skin is prepared and a small incision is made over the end of the feeding tube. An appropriately sized rubber or plastic feeding tube (which can be connected to a feeding syringe) is passed via the incision into the oesophagus, and advanced in a caudal direction. The tube is passed via the crop and distal (thoracic) oesophagus into the proventriculus. A skin suture is placed around the tube. Tape is placed either side of the feeding tube as it exits the skin incision and is sutured to the skin. The capped feeding end is then enclosed in a bandage wrap around the neck or attached to the birds back. Regular small meals (smaller than if feeding into the crop) are administered and care is taken to flush the

tube clean after each use. Such a tube may be left in place for several weeks if necessary.

Catheter duodenostomy: alternatively, nutritional support may be administered by needle catheter duodenostomy. The bird is anaesthetised, placed in dorsal recumbency. A 2-3cm incision is made in the ventral midline caudal to the sternum. The duodenal loop of the small intestine is recognised from the position of the pancreas. A 17-20 gauge-indwelling catheter is inserted through the body wall, via the duodenal wall and advanced into the descending small intestine and back up the ascending loop. The hub of the catheter should be directed caudally. Patency is ensured by passing a small volume of saline. One suture 5-0 polypropylene is placed between the duodenum and the abdominal wall at the site of catheter entrance, and the catheter is further attached to the skin on the outside of the body wall. The catheter is routed between the legs, up under one wing and attached to the base of the neck. On removal, the skin-catheter attachments are cut and the catheter is gently retracted. Closure is by natural healing.

Coeliotomy: The caudal thoracic and abdominal air sacs receive fresh air from the trachea. It is important to appreciate that coeliotomy is impossible without opening the posterior air sacs, this has a profound effect on both the effectiveness of inhalant anaesthesia and on intra operative heat loss. Once a coeliotomy incision is made, openings around the surgery site may be packed off, or plugged with abdominal organs. Alternatively, parenteral anaesthetic agents may be used. During any coeliotomy procedure, the birds head should be raised at 30-40^{o}, to prevent any surgical irrigation fluid from entering the lung field.

Left lateral coeliotomy: this is the most useful approach and is used for access to the gonads, left kidney, oviduct, proventriculus and ventriculus. The bird is placed in right lateral recumbency. The wings are reflected dorsally, whilst the left leg is restrained in a dorso-caudal direction. The skin web between the abdominal wall and the left leg is incised to facilitate further abduction of the left leg. A skin incision is created from the sixth rib to the level of the pubic bone on the left abdominal wall. The superficial medial femoral artery and vein will be visualised traversing dorsal to ventral across the lateral abdominal wall medial to the coxofemoral joint. These vessels should be cauterized with the bipolar forceps prior to transection. The musculature (external and internal abdominal oblique and transversus abdominis muscles) should be tented up away from the coeliomic contents and incised with sharp fine scissors whilst protecting the internal viscera. The incision is extended from pubis to the eight rib. The caudal 2-3 ribs (i.e. numbers 7 and 8) need to be transected. Bipolar forceps are placed around each rib, from the caudal aspect, such that the forceps close over the anterior border of the rib. The intercostal blood vessels are coagulated, prior to transecting the rib (with large scissors). A small retractor (e.g. Heiss) is then inserted between the cut rib ends to enable full visualization of the abdominal cavity.

The incision is closed using 4-0 to 6-0 absorbable synthetic material in a continuous or interrupted pattern in two layers. The intercostal muscles are opposed and no attempt is made to rejoin the transected ribs.

Proventriculotomy for access to proventriculus or ventriculus. Birds have an ability to mount an amazingly fast (compared to mammals) inflammatory response and are able to wall off noxious agents often rendering them harmless. In diving ducks and other species which have a highly muscular ventriculus and are prone to ingesting peculiar and often sharp foreign bodies, one often finds items such as segments of glass, wood and metal walled off within the coeliomic cavity. These objects have originated from the ventriculus.

Proventriculotomy is most commonly indicated for the removal of foreign objects, which are not retrievable with rigid or flexible endoscopes. Proventricular biopsy is no longer recommended as the diagnostic method of choice where PDS is suspected, in view of the unacceptable risk (6/13) of post operative wound dehiscence with serious complications.[5] Although the technique has been described,[6] ventriculotomy is generally avoided, in view of the highly muscular walls (the physiological muscular activity can pull sutures out of the tissue), the inability to form an inversion closure as well the increased vascularity compared with the proventriculus. Ventricular foreign bodies can be accessed via the isthmus between the proventriculus and the ventriculus.

Access is gained via the left lateral coeliotomy approach; sufficient exposure is necessary to visualise the suspensory membranes and to avoid the proventricular vessels along its greater curvature. The ventriculus (gizzard) is identified as a muscular organ with a white tendinous lateral aspect. Blunt dissection is used to break down the ventricular suspensory attachments. Two (3-0) stay sutures are placed in the white tendinous part of the ventriculus, and sutured to structures outside of the abdomen, to maintain the ventriculus firmly in the abdominal opening. Dependent on the size of the patient it is advantageous to pack off the abdomen, behind the ventriculus, with saline soaked gauze swabs to minimise the effect of leakage. The triangular portion of liver, which covers the isthmus, is identified. Using a sterile cotton bud, the liver is elevated, revealing the optimum incision site into the isthmus (junction between the proventriculus and the ventriculus), to facilitate biopsy or access to the ventriculus for foreign body removal. An initial stab incision is made, which is extended with iris scissors. Suction should be available to remove enteric contents in a controlled manner. An endoscope may be passed into gut via the incision in both cranial and caudal directions to access that removal of all foreign objects has been achieved. The incision is closed in two continuous layers (opposed then inverted) using 4-0 to 8-0 synthetic absorbable monofilament material. After which the liver is tacked in place over the proventricular incision site. The body of the proventriculus has a poor ability to hold sutures and tears readily when sutured. Care should be taken to place sutures a sufficient distance from the wound edge so that they do not tear through, but not so far that one has to use undue pressure to close the wound, as this would also lead to tearing. Suture placement in normal gut surgery includes the submucosa in view of its greater collagen content.[7] However the avian proventriculus has minimal collagen,[8] so greater care is required. The placement of a collagen patch over a traditional ventricular closure, did not reduce the incidence of wound break down.[9] As birds have no mesentery, enterotomy carries a higher risk of post operative peritonitis. The liver may take the role of the mesentery in over lying the closed isthmal incision. The ventricular suspensory ligaments are not repaired. Closure is as stated above.

Care should be taken to minimise collateral damage during incision and repair of the isthmus. It has been demonstrated in turkeys,[10] that the entire neural network situated within the isthmus must remain intact for normal gastro duodenal motility to occur.

Proventricular Impaction: is common (especially in young inexperienced feeders) in a range of species. This can occur in psittacines of all ages,[4] typically where shredded newspaper or other fibre is ingested. In many cases, medical therapy and cessation of ingestion obviate the need for surgery. Neonate raptor chicks eating fur, feather, peat or wood shavings may also become impacted. Such chicks are presented very thin and weak with a distended abdomen containing an impacted proventriculus. These cases make poor surgical patients. However if sufficient nutritional and fluid support is administered (by crop tube), such that the chick resumes normal growth, within a few days the chick becomes big enough to 'cast' (normal physiological behaviour of raptors - regurgitate) the pellet (indigestible material), which it was previously too small to produce. Young ostriches will similarly eat indigestible fibre and other objects. In such cases a proventriculotomy should be performed. In the ostrich, the proventriculus lies in the mid-line caudal to the ventriculus. The bird is starved for 12 hours, by which time the proventriculus should be soft and small (unless impacted). Following induction of anaesthesia, the bird is entubated and placed in dorsal recumbency. The hard ventriculus is palpated and a ventral incision on the linea alba is created caudal to the position of the ventriculus, some 12cm caudal to the sternal crest. At this point the proventriculus is attached to the abdominal wall and will be opened simultaneously with the skin.[11] If necessary the skin is sutured temporarily to the serosal surface of the proventriculus (to minimise coeliomic contamination). The proventriculus is incised, cleaned out, then closed with long lasting absorbable suture material in a two-layer inversion pattern. A three layered closure is used in the body wall and skin.[12]

Neoplasia of the proventriculus and ventriculus is uncommonly reported in psittacine birds. Carcinoma of the proventriculus occurs more commonly than adenocarcinoma of the ventriculus.[13] Clinical signs may include the passage of undigested seed and regurgitation. The gross appearance of proventricular adenocarcinoma is often not striking and only likely to be differentiated on histopathological examination.[13] By the time of diagnosis, such cases do not normally lend themselves to surgery (except for histological confirmation of diagnosis following biopsy).

Yolk sacculectomy: in neonate chicks (especially larger chicks e.g. ratites), the presence of an infected or unretracted yolk sac necessitates surgical removal. Chicks which eat early after hatching and those affected by reduced gut motility are believed to have a higher incidence of unretracted yolk sac.[14] Yolk sac infections are often associated with umbilical infections, enteritis or septicaemia. Clinical signs include anorexia, lethargy, constipation, diarrhoea, weight loss and abdominal distension. Non invasive diagnosis is readily achieved by ultrasonography. Signs are typically not detected early enough for medical therapy alone to be effective. Following induction of anaesthesia, the bird is placed in dorsal recumbency. A small incision is delicately created cranial to the umbilicus. This incision is extended around the umbilicus and the umbilical stump is excised. The yolk sac is exteriorized

and the duct ligated. Care is taken to avoid rupture or spillage of the yolk sac contents. The abdominal incision is closed in two layers.

Enterotomy: is an uncommon procedure usually resulting from trauma to the gastro intestinal tract, iatrogenic surgical damage, intussusceptions, torsion's, adhesions, enteroliths or areas of necrosis. The procedure carries a guarded to grave prognosis. If colon is prolapsed via the cloaca, an intussusception must be present. Such cases require an immediate mid line (with or without flap) coeliotomy, reduction of the intussusception, which may contain a length of devitalised gut. An enterectomy will be required to remove any devitalised gut. This condition has been seen by the author and effectively treated regularly in Red tail hawks (*Buteo jamaicensis*) suffering from protozoal enteritis. Intussusception has also been seen secondary to linear foreign bodies or following enteric infections.[15] If the bird is particularly shocked or weakened, then rather than resecting and re-joining the gut at one surgery, it may be prudent to create a stoma or a loop jejunostomy or colostomy, with re-attachment several days later.[15] Midline flap incisions give best access. Micro surgical instrumentation and techniques are mandatory. Blood vessel appositional clamps (e.g. Acland clamps) are invaluable to atraumatically achieve intra operative intestinal occlusion whilst simultaneously maintaining the tissue sections in apposition during suture placement. These vascular clamps, are designed to avoid tissue slippage, whilst maintaining low pressure to avoid tissue damage. The clamps may be used individually, or preferably attached to a bar or rectangle, so that both ends of the tissue are help close to each other. When passing needles through fine tissue, it is important that the needle is encouraged to follow its natural curvature, otherwise an excessive needle hole is created.

Anastomosis: of the intestine may be performed using an end to end technique using 6-0 to 10-0 material with a simple appositional method. If the gut is < 2mm in diameter then 6-8 simple interrupted sutures are used (similar to a blood vessel anastomosis). If the gut is >2mm in diameter a continuous pattern should be used. The advantages of a continuous pattern is that it reduces surgery time, yields improved apposition and so reduces risk of leakage, reduces tissue irritation and achieves improved endothelialisation.

Care should be taken not to over tighten a continuous pattern, as this would then cause a purse string and compromise food passage across the repair site.

Sutures are initially placed at 12pm and 6pm then sutures are placed in the caudal section of gut, before placing sutures in the anterior aspect. If the sections of gut being joined are of unequal size, or where end to end anastomosis is technically difficult for other reasons, a side to side or side to end technique may be used. If using a side to side the end sections may be closed with sutures or haemoclips. One section of gut is offered up to the side of the other and the back of the anastomosis is sutured, prior to the aperture being created and then the front being sutured. If necessary, the front repair sutures can be pre-placed.

Ventral Midline Coeliotomy: This approach gives poor visibility of the majority of the coeliom. It will facilitate surgery of the small intestine, pancreatic biopsy, liver biopsy or cloacopexy and is used in diffuse abdominal disease such as peritonitis, egg binding and cloacal prolapses. The bird is placed in dorsal recumbency, the

midline prepared and the legs abducted caudally. The skin of the abdominal wall is tented and an initial incision is made using scissors or the single wire radiosurgical electrode, (care is required to prevent iatrogenic visceral damage). The risk is minimised by creating the incision caudally over the cloaca, rather than over the small intestine. The incision is extended with fine scissors. This approach can be extended along the costal border cranially and to the pubis caudally to create a flap on one of both sides of the midline to increase access. This approach is particularly useful for access to the caudal uterus and cloaca.

Liver Biopsy: If AST levels are persistently over 330 iu/L or bile acid levels are in excess of 150um/L liver biopsy should be performed. Haemochromatosis, amyloidosis, chronic active hepatitis, hepatic lipidosis, toxin insult (e.g. alflotoxicosis), cirrhosis are the commonest anticipated findings. The liver will be identified beneath the sternum. The author favours a technique where two fine artery forceps are triangulated to isolate a wedge of liver tissue. The segment of liver is removed and the forceps removed a minute later. Alternatively, a monopolar loupe electrode may be used to harvest a biopsy. In such cases, the power is activated prior to making contact with the tissues.

Pancreatic biopsy: a number of pancreatic disease have been reported, [16,17, 18] but little research has been reported into the clinical significance of amylase and lipase levels.[19] Currently histopathology is the diagnostic tool of choice.[17] Clinical signs associated with avian pancreatitis include: anorexia, abdominal discomfort (colic), weight loss, polyuria, polydipsia, abdominal distension, polyphagia, or pale bulky faeces, although many cases are asymptomatic.

The bird is anaesthetised, entubated and placed in dorsal recumbency. A small (1-2cm) cranio caudal incision is made in the mid-abdominal region. Care is taken not to damage under lying viscera. The ascending and descending loops of the small intestine (in which is found the dorsal and ventral lobes of the pancreas), is readily located and exteriorized. If no lesions are readily apparent in other areas of the pancreas, the distal most aspect of the organ is harvested. The distal pancreatic lobe should be gently elevated prior to biopsy collection to ensure that the arterial supply to the distal portion is not damaged during collection. The incision is closed in a routine manner.

Cloacal conditions: cloacal conditions are common in pet birds, with varied aetiologies such as cloacitis (caused by papilloma, neoplasia, urolith, mycobacteriosis, parasitic, neoplasia, cloacal prolapse associated with oviductal or urethral obstruction, other oviductal disease or behavioural (hypersexuality and lack of dominance) abnormalities.[20,21,22,23,24,25,26]

Organs Prolapsed through the Cloaca: Apart from partial cloacal prolapses, prolapsed cloacal masses (papilloma, neoplasia or mycobacterial granuloma), total prolapses can occur, where the colonic, urethral and oviductal junctions (or phallus - in waterfowl) may be everted. Alternatively, the oviduct or colon may be prolapsed. Differentiation of the tissues involved is important and is achieved by assessing the size of the structures present.[25] If a colonic prolapse is present, inevitably there must be an intussusception (see above - enterotomy).

Cloacal papilloma: are particularly common in South American species e.g. macaws and Amazons. Many birds with cloacal or choanal papilloma go on to intestinal, pancreatic or biliary adenocarcinoma.[27,28] It has been suggested that cloacal papilloma may be caused by Herpes virus.[29,30] Cloacal, colonic or oviductal prolapses may resemble neoplasms, particularly if the prolapse tissue is necrotic. Histological examination of cloacal tissues is advised.

Treatment: many treatment modalities have been suggested ranging from repeated alternate day application of silver nitrate, inclusion of 2% capsicum in the diet, autogenous (high antigen loaded) vaccination,[31] cryo-surgery, radio surgery and yag laser therapy. Cloacotomy yields the best access and enables complete surgical removal of papilloma.[32] The bird is placed in dorsal recumbency, a ventral midline incision is made with scissors through the skin, vent sphincter muscle and cloacal mucosa. Hemorrhage is controlled with radio surgery bipolar forceps. Following surgery to remove the papilloma, the cloacal mucosa is closed using 4-0 synthetic absorbable material with a simple continuous pattern. The vent sphincter is apposed with 4-0 synthetic absorbable material in a horizontal mattress fashion and the skin is closed with simple continuous pattern using similar material.

Bladder mucosal stripping has been utilized extensively in mammals as a treatment for carcinoma.[33] Cloacal mucosal stripping has been reported in one Amazon. Although the bird tolerated several episodes of mucosal stripping, it did not prevent the papilloma from reforming.[34]

Vent strictures can occur following any extensive cloacal surgery and can be addressed with regular stretching using an aural speculum.

Cloacolith: these are firm, rough surfaced aggregations of urates. They are uncommon and the pathogenesis is unclear. This author has experienced them most frequently in carnivorous birds, especially in birds which have recently under gone extended nesting or brooding behaviour, such that they may not have voided faeces as frequently as normal. Birds present with repeated straining, often passing scant traces of blood. The condition is readily diagnosed on digital exploration of the cloaca. The bird is anaesthetised, the cloacolith may be fragmented with artery forceps, and removed piece meal. Analgesics and antibiosis should be administered.

Cloacopexy: cloacal prolapse is the common indication for a cloacopexy. Cloacal prolapse is commonest in hypersexual birds. Cockatoos are most commonly afflicted. Behavioural modification is important, in particular gaining dominance over the bird and reducing its psychological and nutritional drive towards sexual activity.

A cotton bud is advanced into the cloaca, and used to tent the cloaca within the abdomen, to confirm its position. An horizontal incision is made over the most anterior portion of the cloaca, being careful not to incise the thin walled cloaca. The fat pad which is present on the ventral aspect of the cloaca is removed. In severe cases, two sutures are placed, one around the 8th rib on each side, then each is passed through the full thickness of the cloaca on the same side, each suture is tightened, such that the cloacal wall is apposed to the rib. Two further sutures are placed through the cloacal wall and incorporated in the abdominal wall closure.

Although surgical procedures exist for the control of cloacal prolapses, reoccurrence is common, particularly if the behavioural abnormalities are not addressed.

Cloacoplasty: (reducing the diameter of the cloacal aperture) is also recommended where there is atony of the vent sphincter. The internal margin of the vent (lateral or dorsal section) is excised for up to 60% of the circumference (to provide a cut edge for healing). The edges are then sutured from side to side, to reduce the diameter of the cloacal aperture.

Abdominal Hernia: seen most commonly in obese female psittacines, especially cockatoos and budgerigars. They are often related to breeding, hormonal influences or other reasons for space occupying coeliomic masses. High energy diets lead to obesity and also serve as a drive to egg production (increasing liver size and follicular activity respectively). Prior to any consideration of surgery, the bird must be converted from a seed based diet, onto a more balanced (pelleted) or fresh food diet, and the weight reduced significantly. Avian abdominal hernia is dissimilar to mammalian hernia. There is no specific hernia ring, instead a thinning and gradual separation of muscle fibers. Surgery to pull the sides of the deficit together is not possible. It is recommended that the bird should under go salpingohysterectomy at the time of hernia repair. Following this a tuck may be taken in the abdominal musculature. The owner should be warned that this may not be effective, and additional surgery may yet be required. Additional surgery involves the surgical placement of a non-absorbable mesh material across the expanse of the present or potential deficit. Such surgery can only be contemplated once obesity has been corrected. An extensive bilateral flap ventral midline approach is used. Mesh is attached bilaterally to the pubis, to each 8th rib, as well as the sternum. These meshes are generally well tolerated although intense attention to sterility during surgery is mandatory. If surgery can be avoided by dietary change and weight loss this preferable. On occasions, herniation will occur secondary to abdominal lipoma, cystic structures, neoplasia or other space occupying masses.[35]

Post surgical Care

Post-surgical care greatly effects the outcome of the procedure. Prevention of self-trauma, a rapid recovery, sufficient analgesia, fluid, thermal and nutritional support as well as the minimization of stress are vital.

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