

# **The Acute Abdomen Mini Series**

## **Session Two: Intestinal Surgery – Tips and Tricks**

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Intestinal surgery – tips and tricks  
SURGERY OF THE GASTROINTESTINAL TRACT**

This webinar covers the surgical principles for surgery of the gastrointestinal tract; specific surgical techniques are then covered in detail and clinical considerations for specific conditions are then discussed.

## **THE STOMACH**

### **Indications for surgery**

The most common indication for gastric surgery is for removal of a foreign body. Other indications include neoplasia, gastric biopsy, gastric ulcers, gastric outflow obstruction and gastric dilatation and volvulus. Gastric dilatation and volvulus is covered in a separate session.

### *SURICAL TECHNIQUES*

#### **1. Gastrotomy**

A laparotomy is performed with an incision from the xiphisternum to midway between umbilicus and pubis. If it is not defined that only a gastrotomy is required then an incision is made for an exploratory laparotomy extending to the pubis. Balfour retractors will facilitate visualization of the stomach. If a foreign body is suspected, the entire gastrointestinal tract should be inspected thoroughly as there may be multiple foreign objects.

Stay sutures using 3 Metric PDS or equivalent are placed (full thickness) through the stomach to allow caudal retraction of the stomach. Moistened laparotomy swabs are used to isolate the stomach from the rest of the abdomen.

The incision is located in the centre of the body of the stomach, midway between the greater and lesser curvature. For some foreign bodies (e.g. linear foreign bodies) they may be lodged at the pylorus, therefore the incision is located more aboral in the pyloric antrum.

Once the location is decided, stay sutures are placed at either end of the proposed incision. A sharp number 11 blade is used to incise between the sutures. The stomach separates into 2 layers; the top layer is the serosa and muscularis and the bottom layer is the submucosa and mucosa. Once the incision is started, it can be continued with Metzenbaum scissors. More stay sutures can be placed on either side of the incision; having an assistant hold up the stay sutures or by using mosquito haemostats suspended outside of the abdomen will help reduce spillage of gastric contents into the abdomen.

The foreign object is grasped using large haemostats (e.g. Kelly haemostats) and discarded from the surgical site. If the object is attached to a linear foreign body, the string portion is cut which reduces the concertina effect on the rest of the intestines.

The stomach is sutured in 2 layers of a simple continuous appositional suture pattern using 2 Metric PDS in most dogs and 1.5 Metric PDS in cats or small dogs. A round-bodied needle is used to reduce tearing of the stomach wall; if not available a cutting needle can be used but extra care with tissue handling should be employed. Debakey forceps are used with care and manipulation of the gastric wall is minimized as the wall can be friable. If possible, grasping of the gastric wall with forceps is avoided.

The mucosa and submucosa are sutured together in the first layer; the submucosa is the strength holding layer. Sutures are placed 5mm from the edge of the incision and are approximately 2 to 3 mm apart. The top layer of the muscularis and serosa is sutured next similarly to the first layer.

The site is lavaged with sterile saline and any excess fluid is removed from the abdomen. The omentum can be placed over the gastrotomy site to aid healing and reduce chance of leakage. The surgeon's gloves are changed and any instruments contaminated with gastric contents are discarded (needle holders, Debakey forceps, scissors). Fresh instruments are used to close the abdomen.

#### *Prognosis*

The risk of dehiscence of a gastrotomy is 7 to 17% and the risk period corresponds to the lag phase of healing which occurs at 3 to 5 days after surgery. Leakage will lead to septic peritonitis (discussed below); because of the relatively low number of bacteria in the stomach ( $10^3$ ), it may be more difficult to diagnose than leakage of the lower gastrointestinal tract.

### **2. Gastric Biopsy**

A gastric biopsy is performed in a similar way to a gastrotomy including isolating the stomach and use of stay sutures. Once the stomach lumen has been entered, a 1cm<sup>3</sup> piece of stomach is created using the Metzenbaum scissors. Alternatively, a 6 to 8mm skin biopsy punch can be used to obtain a sample. Care must be taken to sample all layers of the stomach. The stomach is closed in 2 layers as described for gastrotomy.

### **3. Gastric resection**

This is unusual apart from in cases of gastric dilation and volvulus and is discussed in a separate webinar. Gastric resection may also be performed to remove an area of neoplasia or ulceration. See the reference in further reading for additional information on these less common conditions.

## **SPECIFIC SURGICAL CONDITIONS**

### *Gastric foreign bodies*

Depending on the size and type of the foreign body, surgery might not be necessary and the object may pass. In addition, some foreign objects are able to be removed endoscopically. With some foreign objects, the decision to perform surgery is controversial; surgical risk must be evaluated against the risk of leaving the object, which may lead to obstruction further down the gastrointestinal tract where risk of dehiscence of the enterotomy site is higher than the risk of gastrotomy dehiscence. Some objects such as needles or small fish hooks can actually pass spontaneously but serial radiographs should be performed to ensure the object is moving; if it remains in the same location on multiple images, it is likely embedded in the wall of the stomach/intestine and so removal is indicated. In addition, a needle and thread can act as a linear foreign body and so should be removed. A sharp object, such as a shard of glass, would not be wise to be removed endoscopically as it could lacerate the oesophagus during retrieval.

### *Presenting signs*

Animals typically present with vomiting and the owners may or may not have seen them eating the offending item. They may present with hypersalivation, lethargy and if they aspirate, they may present with signs related to aspiration pneumonia.

### *Diagnosis*

Orthogonal radiographs of the abdomen (lateral and ventrodorsal) may reveal a gas filled stomach; occasionally the foreign object is identified. Taking the other lateral view and evaluating the relative position of the fundus and pylorus can be useful. If the animal's condition is stable, repeating the radiographs a few hours later if the diagnosis is contentious can reveal movement of the object and aid diagnosis. Barium studies can help to outline the objects but should be performed with extreme care in vomiting patients and are rarely used.

Abdominal ultrasound is very useful as it can reveal areas of acoustic shadowing underneath the object. Endoscopy can be diagnostic and also therapeutic as the object can be retrieved without the need for surgery.

## THE SMALL INTESTINE

### **Indications for surgery**

Intestinal biopsy, enterotomy and enterectomy are the most common procedures performed in the small intestine. Enterotomy and enterectomy are generally performed in cases of foreign bodies, neoplasia and intussusception. Full thickness intestinal biopsies may be taken to investigate gastrointestinal signs. Dehiscence of the sutures can lead to the life threatening complication of septic peritonitis and so these risks need to be relayed to the owners.

### **Anatomy**

The small intestine consists of the duodenum, jejunum and ileum. The common bile duct enters the duodenum just distal to the pylorus at the major duodenal papilla. In dogs the common bile duct enters the duodenum at the major duodenal papilla adjacent to but not joined to the pancreatic duct. Dogs have an additional pancreatic duct, the accessory pancreatic duct which is located approximately 2cm aboral to the major duodenal papilla; it is the principle duct for pancreatic secretions in dogs. In cats, the common bile duct and pancreatic duct join before entering the major duodenal papilla. Only 20% of cats have an accessory pancreatic duct. These differences explain why cats frequently have concurrent biliary and pancreatic disease. Any disease in cats that affects the major duodenal papilla has the potential to affect the entire pancreatic secretions.

### **Decision making in intestinal surgery**

If there is any question as to the viability of the intestine e.g. after an enterotomy the intestine looks dark purple or black, an enterectomy should be performed. To test for viability of the intestines, you can look at the colour and if it is a light purple or red, it is likely to survive, whereas black or dark purple tissue should be removed. If there is haemorrhage from the cut surface or if when you prick it with a needle it bleeds or if there is active peristalsis, it will likely be fine to leave it behind. If you have any doubt, wait 10 to 15 minutes following relief of obstruction and reassess. If in doubt cut it out!

## *SURICAL TECHNIQUES*

### **1. Enterotomy**

This is performed generally for the removal of foreign bodies but can be performed if trying to cannulate the common bile duct or to remove a pedunculated mass (rare). The abdomen is packed off with moistened laparotomy swabs and the affected loop of intestine is lifted out of the abdomen. It is useful at this stage to have an assistant milk the intestinal contents away from the foreign body and to occlude the lumen gently with their fingers. If you are operating solo, use Doyen forceps on the first click of the ratchet only to occlude the lumen; if the surgery is prolonged, remove and replace the Doyens in a slightly different location every 5-10 minutes.

Make an incision on the antimesenteric border of the intestine with a number 11 or 15 blade. If operating on the ileum, to avoid the antimesenteric blood vessel, make your incision adjacent to this vessel to avoid haemorrhage. The incision can be extended using Metzenbaum scissors. Use old haemostat forceps or Allis tissue forceps to grab the foreign object; try not to contaminate your gloves too much. It is useful when the lumen of the GI tract is entered to keep all contaminated instruments separate from instruments that will be used for closure, or use a separate kit to close.

Use monofilament absorbable suture such as Monocryl or PDS to close the intestine. Most of the time when you are performing an enterotomy, the intestine is abnormal; therefore, I use PDS because of its prolonged absorption times. Use fine sutures to avoid making large holes in the intestine; I would use 2 metric PDS for large dogs and 1.5 metric for cats to medium sized dogs. Be very atraumatic when handling intestines with instruments; do not grasp the edges with your forceps if possible; only Debakey forceps should be used. Place your sutures 2-3mm apart and at least 5mm from the edge of your incision. The strength-holding layer is the submucosa so it is important to **go full thickness** through the intestine.

You can either place simple interrupted or simple continuous sutures; I prefer simple interrupted sutures. Sutures should be snug, tighter than skin sutures but not so tight that they strangle the tissue. A useful tip to control everting mucosa and produce a neat appositional closure is to roll the first throw of the suture back towards the last tied suture; as you then tighten that throw roll the suture back into place perpendicular to the intestinal wound. This technique 'tucks in' the inverted mucosa and achieves a better appositional closure. After you have finished suturing, you can inject saline into the lumen of the intestine using an orange needle (25g) to test for leaks, indicating that another suture should be placed.

Lavage the surgical site/abdomen with warm saline, change gloves and instruments and omentalise the incision. To do this you can place the omentum over the sutures to provide extra security against small leaks. If there is no omentum available (it has been removed during a previous surgery or it is diseased) you can perform a serosal patch. This is where a free loop of intestine is sutured over the incision to allow the serosa to provide a source of mesenchymal cells to speed up healing and to provide a seal against leakage. To do this, two free loose loops of intestine are sutured together using 1.5 metric Monocryl and then sutured over the enterotomy site again using Monocryl in a simple interrupted pattern.

## **2. Enterectomy/resection and anastomosis**

This is performed if there is compromised viability of the intestine following foreign body obstruction, after a necrotic intussusception, to remove a tumor or to remove a site of perforation after, for example a linear foreign body or ulceration.

The abdomen is packed off with moistened laparotomy swabs and the affected loop of intestine is lifted out of the abdomen. It is useful at this stage to have an assistant milk the intestinal contents away from the area to be removed and to occlude the lumen gently with their fingers. If you operating solo, use doyen forceps on the first click of the ratchet only to occlude the lumen.

If the area to be removed is near the caudal duodenal flexure, it may be tethered by the duodenocolic ligament and avascular peritoneal reflection. This avascular ligament connects the duodenum to the colon and can be carefully transected using metzenbaum scissors. Please note that this area is very close to the root of the mesentery and branches of the portal vein so ensure you can see well where you are transecting. Having an assistant to hold the intestines out of the way can help. Otherwise, you can use a large moist swab to help to reflect the intestines.

The area to be removed is carefully considered and is based on the blood supply. It is important to remove all affected bowel so that you suture healthy bowel to itself. The site of removal is in a place where there is a mesenteric blood vessel supplying the end of the intestine left behind. Branches of the mesenteric vessels supplying the bowel to be removed are ligated and the mesentery is cut using metzenbaum scissors. The Doyens are placed at this stage and are at least 2cm away from the proposed site of transection. Another pair of Doyen or traumatic forceps is placed in the intestine to be removed. A fresh blade is used to sharply cut the intestine. There is often a bleeding vessel at the edge of the mesentery; use some fine haemostats to grab this vessel and ligate it with 1.5 or 2 metric Monocryl or Vicryl.

If there is excessive eversion of the mucosa, you could trim it using Metzenbaum scissors. If there is excessive luminal disparity, you can either cut the smaller lumen at a diagonal with the overhang at the mesenteric border, fish mouth or spatulate the mesenteric border of the smaller lumen, place your sutures wider apart on the larger lumen side or just leave a blind ending pouch on the dorsal surface.

To start suturing, place 2 or 3 sutures at the mesenteric side of the lumens. This is the most likely site of leakage due to poor suture placement, which is why it is important to place these sutures well before the closure begins to obscure the intestinal wall due to the mesenteric fat. Next, suture towards the mesenteric border in a simple interrupted or continuous pattern using 1.5 or 2 metric PDS suture.

As with enterotomy suturing, be very atraumatic when handling intestines with instruments; do not grasp the edges with your forceps if possible; only Debakey forceps should be used. Place your sutures 2-3mm apart and at least 5mm from the edge of your incision. The strength-holding layer is the submucosa so it is important to go full thickness through the intestine. Sutures should be snug, tighter than skin sutures but not so tight that they strangle the tissue. After you have finished suturing, you can inject saline into the lumen of the intestine using an orange needle (25g) to check for leaks.

When you are happy with your sutures, close the hole in the mesentery using fine Monocryl taking care not to damage the blood supply to the intestine left behind. After lavage and changing your gloves and kit, omentalise or serosal patch your suture line as described above.

### **3. Intestinal biopsies**

Preparation of the intestines is similar to that for an enterotomy. Full thickness biopsies are recommended. Biopsies are performed either using a skin biopsy punch or using a scalpel blade and Metzenbaum scissors.

The intestinal loop is elevated from the abdomen, which is packed off using moistened laparotomy swabs. To use a skin biopsy punch, the intestine is held by an assistant or using Doyen forceps. The punch is passed full thickness through the antimesenteric surface of the intestine, with care not to penetrate the far wall of the intestine. The sample is retrieved using Debakey forceps and the defect is closed as described for an enterotomy.

If a skin biopsy punch is not available, an incision can be made in the antimesenteric border using a number 11 scalpel blade. The hole is made larger using metzenbaum scissors. Care is taken to achieve a sample large enough for diagnostic purposes but not so large that closure is compromised. Rather than closing the intestine longitudinally, parallel to the mesentery, you can close transversely if the diameter of the lumen is compromised.

### **4. Enteroplication**

This is the creation of adhesions between adjacent segments of small intestines. It is commonly performed after intussusception surgery. After addressing the intussusception (see below), adjoining segments of intestine arranged in gentle bends are sutured side to side from the proximal jejunum to the ileum. Sutures are placed with 1.5 or 2 Metric monofilament absorbable suture through the submucosa. Enteroplication can be associated with relatively high morbidity including abdominal pain, vomiting, diarrhea, inappetence and constipation. In addition, complications include obstruction, strangulation, perforation and volvulus. The decision to perform enteroplication therefore, should not be taken lightly and each case should be considered carefully e.g. it is more appropriate to perform enteroplication in a young dog with viral enteritis which is difficult to treat the underlying cause rapidly compared to following an intestinal tumor removal in an adult dog where the tumor is removed.

## ***SPECIFIC SURGICAL CONDITIONS***

### ***1. Intestinal foreign bodies***

#### ***Presenting signs***

Animals typically present with vomiting, anorexia and depression. If the foreign body is occluding the bile duct, the animal may be icteric. The animal may present with abdominal pain and the mass may be palpable within the abdomen.

#### ***Diagnosis***

Orthogonal radiographs of the abdomen (lateral and ventrodorsal) may reveal gas filled loops of small intestine; occasionally the foreign object is identified. The main differential diagnosis for small intestinal obstruction is ileus secondary to a condition such as hemorrhagic gastroenteritis or parvo-virus and so careful attention as to the size of the intestinal loops is important. Comparing the maximum diameter of the small intestine to the height of the 5<sup>th</sup> lumbar vertebral body at its narrowest point is helpful: a ratio of small intestine:L5 of more than 1.6 is more suggestive of an obstruction.

If mild to moderate intestinal dilation on radiographs is the only radiographic sign, further diagnostic tests such as GI contrast studies or ultrasound is warranted. Ultrasound is non-invasive and can allow identification of perforation. Administration of oral barium may identify an obstruction but can frequently lead to delay in surgical exploration and is contraindicated if perforation is suspected.

#### *Treatment*

Enterotomy or enterectomy as described above is indicated.

### *2. Linear foreign body*

Examples of common linear foreign bodies include thread, tights, string, socks and carpet. Usually, the foreign body becomes anchored around the tongue base or the pylorus and so careful oral examination is recommended in any case with a foreign body. If left untreated, as peristaltic waves carries the linear object down the digestive tract, the intestines becomes taught and eventually may perforate. They are more common in cats than dogs.

#### *Presenting signs*

Animals typically present with vomiting, anorexia and depression. As the obstruction is usually partial, the clinical signs are often mild and so diagnosis is delayed.

#### *Diagnosis*

This may be made on clinical examination with careful attention to abdominal palpation and examination underneath the tongue. Orthogonal abdominal radiographs may show plication of the intestines and unusual, often tear dropped shapes of gas within the lumen of the intestines rather than the normal tube like shapes. Ultrasound can help with diagnosis if there is any doubt from the radiographs.

#### *Treatment*

Although some cats are able to be managed conservatively once the foreign body is removed as long as they are stable and have no evidence of perforation, prompt surgical management is needed in almost all patients. At laparotomy, the plicated part of the intestines is isolated and a small enterotomy is performed midway along the plications. The foreign body is normally lodged in the wall of the intestines and is grabbed with some haemostats. The portion of foreign body under the tongue is cut, or if the foreign body is lodged at the pylorus, a gastrotomy is performed and the foreign object is cut and any remaining material in the stomach is removed. Gentle traction on the foreign body may allow its removal from a single enterotomy site; multiple enterotomies are often needed. A perforation of the intestine may only be visible after removal; in these cases enterectomies are performed.

### *3. Intestinal neoplasia*

Animals with intestinal neoplasia may present similarly to cases with foreign bodies. The most commonly diagnosed tumors in dogs include adenocarcinoma, lymphoma, leiomyoma or leiomyosarcoma (aka gastrointestinal stromal cell tumors or GISTS). These tend to be local, often annular lesions that can cause intestinal obstruction. Lymphoma can present as a solitary mass but is often more diffuse or associated with multi-centric disease. Removal of discrete lesions via an enterectomy with a margin of several centimeters of normal intestine is warranted. For diffuse disease, a biopsy is recommended.

#### *Prognosis*

If local resection of an adenocarcinoma is performed early in the disease process, the prognosis is reasonable. If there is gross metastasis at the time of surgery, the prognosis is poor. Leiomyomas and leiomyosarcomas have an excellent prognosis after surgery. Gastrointestinal lymphoma responds poorly to chemotherapy and so carries a poor prognosis.

#### 4. Intussusception

This is the invagination of one part of the intestinal tract (intussusceptum) into another part (intussusciens). It typically occurs in young animals and may be secondary to enteritis caused by parasites, viruses, linear foreign bodies or neoplasia in older animals.

##### *Presenting signs*

Animals typically present with vomiting, anorexia and depression. Bloody diarrhoea and tenesmus can also occur. Occasionally, part of the intussusception can protrude from the anus and can be confused with a rectal prolapse; in a prolapsed intussusception a probe can be passed easily between the anus sphincter and the intussusception.

##### *Diagnosis*

A cylindrical mass may be palpable in the cranial to mid abdomen. On orthogonal abdominal radiographs, a mass effect or dilated loops of intestine may be noted. On ultrasound, a series of concentric rings (Mexican hat sign) may be noted on transverse images, longitudinally there is a series of parallel lines.

##### *Treatment*

At laparotomy the entire GI tract is examined as multiple intussusceptions can occur. If the intestine appears viable, manual reduction is performed. Gentle squeezing of the intestine caudally to milk out the intestine is generally preferable to pulling to avoid tearing the walls. If reduction is impossible, there is perforation, necrosis or neoplasia, an enterectomy is performed. After correction, enteroplication can be performed. Occasionally, the intussusception may spontaneously reduce between diagnosis and surgery, enteroplication is recommended in these cases as recurrence is high.

The underlying cause needs to be addressed and the animal should be treated for parasites.

#### 5. Septic peritonitis

The most common cause of septic peritonitis is leakage from intestinal surgery and is discussed below; other differentials include perforation of the GI tract as a result of trauma, neoplasia or ulcers, perforating wounds, migrating foreign bodies and leakage of infected urine or bile. Dehiscence of enterotomy or enterectomy sites is reported as 7 to 16% with risk factors being the presence of pre-operative peritonitis, hypoalbuminaemia, intestinal foreign bodies and delayed enteral feeding. Dehiscence usually occurs 3-5 days after surgery which corresponds to the lag phase of wound healing; it can occur earlier in some cases or later if there is leakage from the large intestine.

##### *Clinical signs*

Clinical signs may be acute and related to hypovolaemic or septic shock (tachycardia, altered pulse quality, pyrexia, hypotension). Vomiting, depression, anorexia and abdominal pain can also be noted. Animals may present collapsed or may have very mild clinical signs depending on how early you examine the animal. Cats can be more challenging to diagnose and are sometimes hypothermic as a result of severe hypotension.

##### *Diagnosis*

Ultrasound examination is performed. Abdominocentesis of free abdominal fluid can allow further diagnostic tests in particular cytology and identification of intracellular bacteria is diagnostic. There is a neutrophilia in an abdomen in an animal post-operatively without septic peritonitis so care to check for the intracellular bacteria is crucial. Measurement of peritoneal glucose and lactate has also been associated with diagnosis.

##### *Treatment*

Prompt, aggressive management is indicated in these patients where a prognosis of 50% has been reported. Broad spectrum antibiotics such as co-amoxiclav or cefuroxime are administered intravenously and fluid therapy using crystalloids is important for cardiovascular support. Animals with septic peritonitis generally require high doses of fluids; 5-10ml/kg boluses are administered over 15 minutes until pulse quality and heart rate return to normal.



Prompt surgical re-exploration is required whereby the site of dehiscence is removed if possible; if the location of the rupture does not allow removal of the segment of the GI tract e.g. duodenum adjacent to common bile duct, debridement and suturing of the intestine is performed. Omentalisation or serosal patching is performed as described above. A sample of abdominal fluid is submitted for culture and sensitivity. The abdomen is thoroughly lavaged and all fluid is removed from the abdomen.

Placement of an abdominal drain or performing open abdominal drainage can help to remove contamination and the large volumes of fluid produced post-operatively. A closed drainage system (Jackson Pratt) drain is preferable; Penrose drains or open systems are contraindicated because of the risk of ascending infections. Open abdominal drainage involves leaving part of the abdominal wall partially open by placing the PDS sutures in the rectus muscle very loosely and leaving the subcutaneous tissue and skin open. The abdomen should be wrapped in sterile dressings and protected by multiple absorbent layers as there is a large volume of fluid frequently produced. Placement of a water-impermeable drape will help prevent strike through. Bandage changes should be performed in theatre aseptically to avoid hospital acquired infections, preferably with the animal anaesthetized. Hypoalbuminaemia is common so these animals should be monitored closely. When the volume of fluid reduces, the animal is taken back to theatre and the wound is closed. Animals managed with open drainage are labour intensive and require a lot of supportive care and monitoring.

### THE LARGE INTESTINE

As a general rule, unless there is a focal mass lesion or a megacolon, making an incision into the colon should be avoided because of the increased likelihood of incisional breakdown. If a foreign body has travelled to the colon it will almost always be able to pass through the rectum. It can be milked to the rectum and removed via the anus if there is any doubt if it will pass. If biopsies of the colon are being considered, generally it is preferable to obtain endoscopic biopsies.

### **Further Reading**

Baines S. Small intestinal surgery 1. Principles. In Practice 2000;22:502-517.

Baines S. Small intestinal surgery 2. Techniques. In Practice 2000;22:574-592.

Halfacree Z. Surgical diseases of the stomach in small animals, In Practice 2010;32:138-149.