

GI SURGERY CASES

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LINEAR FOREIGN BODY

Clinical presentation: Linear foreign bodies (e.g., string, plastic bags, tinsel, tape deck tape, yarn, thread) occur in the dog and cat. The classic presentation is a patient four years of age or less with persistent vomiting, anorexia, and depression. These signs are common with many gastrointestinal disturbances and linear foreign body should be included in your differential diagnosis. Occasionally, patients are presented late in the course of the disease and may have a history of intermittent vomiting with anorexia, depression, and weight loss as the major presenting signs.

Diagnosis: A thorough physical examination should be performed with emphasis on oral examination and abdominal palpation. Oral examination often reveals the linear foreign body around the base of the tongue in cats. The foreign body itself may be seen or an area of inflammation may be present at the junction of the base of the tongue and frenulum. Abdominal palpation may reveal "bunched-up" small intestine due to the plication. When this finding is made, the clinician should be very gentle with further abdominal manipulations so as not to encourage bowel perforation.

Radiography: Definitive diagnosis is based on characteristic findings on survey and contrast radiography. Survey radiographs may reveal plicated bowel bunched up in one quadrant of the abdomen. Due to its plicated nature, air accumulation in the bowel lumen forms a characteristic "tapered enteric gas bubble". Three or more tapered gas bubbles are diagnostic for linear foreign body. Evidence of peritonitis (i.e., ground glass appearance), free gas in the abdominal cavity, ileus, or the presence of a needle are findings that may be present on survey radiographs.

Presurgical treatment: Surgery for the removal of linear foreign bodies should be accomplished as soon as possible. Pre-surgical preparation of patients diagnosed early and in good health include an intravenous catheter, maintenance fluids (22 ml/kg TID), replacement of fluid loss from vomiting and dehydration, and antibiotics prior to abdominal exploratory. When fluid losses have been replaced and shock therapy instituted the patient is anesthetized for abdominal exploratory.

Surgical treatment: After a xyphoid to pubis ceiliotomy, the plicated bowel is gently exteriorized from the abdominal cavity. In order for a linear foreign body to result in intestinal obstruction and clinical signs, it must be lodged somewhere in the proximal gastrointestinal tract. The surgeon's first task is to locate the area in which the foreign body is lodged and release it. If it is lodged under the tongue it should be cut at the time of exploratory laparotomy; if it is lodged in the stomach or pylorus, it is released via a gastrotomy; if it is lodged in the duodenum, it is removed via enterotomy.

Once the proximal end is released, the extent of the linear foreign body is evaluated, and 1-3 subsequent jejunal enterotomies may need to be performed to remove the remainder of the foreign body.

Care is taken to remove the linear foreign body in segments short enough that further cutting of the mesenteric border of the intestine does not occur during removal, yet long enough to perform a minimum number of enterotomies. All linear foreign bodies should be removed to the level of the ascending colon. Colotomies are **not** necessary, as once the linear foreign body is in the colon it can be passed with little danger of causing obstruction.

An alternate technique for removal of a linear foreign body is to identify and release the obstructed proximal aspect of the foreign body and attach the released end of the linear foreign body to the flanged end of a 12 - 18 French red rubber catheter/feeding tube. Pass the blunted end of the catheter into the gastrotomy or enterotomy and pass it aborally through the entire length of the intestinal tract and out through the anus. As the catheter is passed, it pulls the linear foreign body out of the GI tract and releases the bowel from its plication. This technique eliminates the need for multiple enterotomies to remove the foreign body. Difficulty can arise when attempting to pass the catheter through the small intestine. Care should be taken not to encourage further trauma to the mesenteric border while passing the catheter.

After the foreign body has been completely removed, a close examination of the mesenteric border is made for evidence of perforation. Any perforation should be debrided and sutured. If multiple perforations occur, a resection and anastomosis may be necessary.

Patients with multiple mesenteric perforations that cannot be sutured without severely compromising bowel viability should undergo massive bowel resection. Remember, you can successfully resect 60 - 70% of the small intestine and have a nutritionally acceptable animal. If the client is willing to treat their dog or cat with an acid blocking agent, this resection can be expanded to a 75 - 80% small intestinal resection.

The abdominal cavity is lavaged with copious quantities (e.g., 200-300 ml/kg) of sterile physiologic saline solution prior to closure. Placement of an enterostomy feeding tube should be considered in severely debilitated patients. Postoperative management (i.e., fluids, antibiotics, feeding) is as previously discussed.

Prognosis: Prognosis for patients with linear foreign body is directly related to the presence or absence of bowel perforation at the time of surgery. Patients without preoperative perforation have an 85% chance of survival while those with preoperative perforation have only a 50% chance of survival. This survival rate further reinforces the importance of early diagnosis and surgical treatment.

Massive bowel resection

A question often asked is; "How much small bowel can I resect and still have a nutritionally functional pet?"

Experimental surgical studies reveal that dogs with 75-80% of the small bowel removed usually die within 90 days of emaciation, cachexia, and massive diarrhea with undigested food in the stools when fed standard diets. However, dogs with 50-60% of the small bowel

removed will eventually undergo enough intestinal villous adaptation that a nutritionally sound pet can be expected.

Recently, it has been shown that dogs undergoing 75 - 80% small bowel resection (i.e., leaving 18 inches from the descending duodenum and 18 inches from the ileum in a 25 kg dog) will be nutritionally functional if given an H₂ receptor blocker or other acid blocking agent (i.e., cimetidine, ranitidine, famotadine, prilosec). This is probably due to the fact that massive small bowel resection results in gastric acid hypersecretion and lipid malabsorption. The cause of gastric acid secretion is unknown (possibly increased gastrin levels), but it results in a decreased pH of the small intestine. This acid intestinal environment inhibits lipase activity and the emulsification process. The use of H₂ receptor blockers improves patient response by decreasing acid production, increasing digestibility of lipids by 40%, and accelerating intestinal adaptation by increasing villous length, width, and numbers. It is recommended that patients with massive bowel resection (60% or greater) be placed on acid blocking agents.

INTUSSUSCEPTION

Intussusception is a sign not a disease. It most frequently occurs in young animals with a history of GI upset; generally secondary to parasitic infestation, parvovirus, etc. In older patients it may be associated with intestinal foreign body or GI neoplasia. Classic history is that of vomiting, diarrhea (with or without blood), and abdominal cramping or pain when lifted by the abdomen. Clinical signs are as with any gastrointestinal obstruction however, in puppies and kittens, the signs may "come and go". This is thought to be due to the effects of an intussusception that comes and goes (i.e., sliding intussusception). Physical examination generally reveals an easily movable, slightly painful, sausage-like abdominal mass.

Diagnosis is based on history, clinical signs, palpation of an abdominal mass, and pain on abdominal palpation. Radiographs may reveal an obstructive pattern. and _ A barium enema may outline the intussusception but is rarely necessary for the diagnosis. Be appreciative of the sliding intussusception that presents with periodic signs of an abdominal mass that seems to "come and go".

Treatment of intussusception in the dog and cat is generally surgical. Barium enemas rarely reduce the intussusception and maintain its reduction. Laparotomy generally reveals either an ileocecolic, jejunal, or rarely a colonic intussusception. A thorough abdominal exploratory for multiple intussusceptions, foreign bodies, or other causes of GI obstruction should be done in all cases.

When attempting to surgically reduce an intussusception, very gently **push** distally and pull proximally (don't pull hard).

Frequently, intussusceptions can be reduced without serosal tears. Once reduced, examination of the bowel for intestinal foreign bodies, masses, etc. is performed (remember, intussusception is a **sign** not a disease). If the intussusception is reducible but there is questionable viability, inject fluorescein dye and make viability assessments as previously described.

If no obvious abnormality exists to explain the presence of the intussusception, an enteroplication should be performed.

Enteroplication: Technique. Enteroplication is performed by exteriorizing the small intestine from the proximal jejunum to the ileum. The bowel is placed in an accordion-like manner and sutured together to form permanent adhesions. The seromuscular/submucosal layer (do **not** penetrate into the lumen) of one loop of bowel is sutured to the seromuscular/submucosal layer of the adjoining bowel using simple interrupted sutures of 4-0 Vicryl, Dexon, PDS, or Maxon.

The plicated bowel is replaced into the abdominal cavity and closure is routine. The planned adhesions prevent bowel from re-intussuscepting. Plicated bowel remains adhered for at least two months postoperatively and no abnormal gastrointestinal signs or nutritional disturbances result. Recurrence is essentially eliminated.

If reduction of the intussusception results in seromuscular tears or if bowel viability is assessed as poor, serosal patching or resection and anastomosis should be considered. Serosal patch and anastomotic techniques have previously been described. Any of the appositional techniques may be successfully used. If resection and anastomosis is performed, the resected bowel should be examined carefully to determine a possible cause. If there is no evidence of a foreign body, mass, etc., the remainder of the bowel should be plicated as described above. Postoperative treatment for patients with intussusception is as previously described for any intestinal foreign body.

Ileocecolic and ileocolic valve resection

If bowel resection results in removal of the ileocecolic valve (cat) or the ileocecal and cecocolic valves (dog) malabsorption syndrome and chronic diarrhea may result. These valves function to control bacterial numbers in the small and large bowel. The small bowel has a relatively low bacterial count, and the large bowel a high bacterial count. If the valve is removed in an intestinal resection (i.e., ileocecolic intussusception), reflux of bacteria from the colon into the ileum may occur. Overgrowth of bacteria in the small intestine results in an increased deconjugation of bile acids and hydroxylation of dietary fatty acids as well as production of bacterial metabolites toxic to epithelial cells. The absorptive capacity of the epithelial cells is then decreased, resulting in malabsorption. The toxic effect on villi result in inflammation and edema causing fluid secretion into the lumen and further malabsorption resulting in chronic diarrhea. Treatment with intestinal antibiotics may help control the overgrown small bowel bacterial population. Given time, most dogs and cats recover to a normal GI function.

SURGICAL MANAGEMENT OF MEGACOLON IN CATS

Clinical presentation: Megacolon is a condition in which the ascending, transverse, and descending colon are chronically large in diameter and filled with inspissated stool. Patients generally present with a history of chronic constipation (i.e., weeks to years), tenesmus, and weight loss. Males are more commonly affected than females and the age ranges from one year to 12 years.

Etiology: The etiology of megacolon is either congenital, acquired, or idiopathic. The idiopathic form is the most common type seen in the cat.

Diagnosis: Diagnosis of idiopathic megacolon in cats is usually made on the basis of history, abdominal palpation, and radiography. Confirmation is based on exploratory laparotomy.

Treatment: The decision to operate is generally made on the basis of the constipation becoming progressively worse and responding only to multiple enemas and manual deobstipation. Exhaustive medical therapy is generally performed prior to surgical intervention.

Preoperative management: Preoperative bowel preparation, using antibiotics administered orally or multiple cleansing enemas is probably useless in cases of severe constipation or obstipation. A parenterally administered antimicrobial agent, with a spectrum of activity directed toward coliforms and anaerobes, is probably the most efficacious preoperative management.

Subtotal colectomy: Subtotal colectomy is the procedure of choice in cats with megacolon. This technique is performed regardless of how much of the colon appears diseased. The surgical objective is to remove all of the colon except what is necessary to reestablish bowel continuity. When the ileocecolic valve is removed (i.e., which is done if the cecum appears grossly abnormal), a 1.5 - 2 cm segment of descending colon just proximal to the pubis (i.e., colorectal junction) is saved to accommodate the ileo-colonic anastomosis. When the ileocecolic valve is retained, a 1 cm segment of ascending colon is preserved to accommodate the colonic anastomosis.

Several techniques have been described for performing the colonic anastomosis. The author's technique of choice is an end-to-end anastomosis. A detailed description of this technique is available at www.videovet.org. The procedure is performed using a single layer simple continuous or simple interrupted appositional pattern with 3-0 or 4-0 synthetic absorbable or monofilament nonabsorbable suture. Because of lumen diameter differences between the ileum and colon, it is necessary to place several sutures in the larger diameter bowel in order to produce an even, watertight anastomosis.

After the anastomosis is completed, the peritoneal cavity is thoroughly lavaged with 200 - 300 ml/kg of warm, sterile physiologic saline solution prior to closure. In situations where the anastomosis is under any question, particularly with respect to color and blood supply (i.e., tissue viability), it is advisable to place a serosal or omental patch over the anastomotic area to help prevent leak, provide a source of blood supply, and help support the anastomosis.

Postoperative care: Immediately postoperatively patients should be supported with a balanced electrolyte solution intravenously until they are able to maintain their hydration status. Antimicrobial agents are continued for five to seven days in all cases. Patients are returned to their normal diet within 24 hours and are allowed water ad libitum.

Results: Long term results have been somewhat variable from case to case, but generally:

- 1) all patients maintain fecal continence post-operatively
- 2) after a 10-15% weight loss 2 - 3 weeks postoperatively, BW is regained within 3 - 7 weeks
- 3) watery to mucoid stools occur during the first 3 - 7 weeks followed by mucoid to semi-solid to formed stools by 3-6 months
- 4) frequency of stools is approximately six per day initially followed in 1-2 months by four per day, then at six months to 2-3 stools per day (range 1-4 stools per day)
- 5) owner satisfaction has been excellent in the majority of cases.

OPEN PERITONEAL DRAINAGE

Prior to abdominal closure, especially in cases with peritonitis secondary to intestinal perforation, the peritoneal cavity should be lavaged with copious quantities (200-300 ml/kg body weight) of sterile physiologic saline solution. The use of rubber drains for postoperative drainage and/or lavage of the peritoneal cavity is a controversial subject among surgeons. Several types of drains can be used, the most common include Penrose drains, single lumen fenestrated tubes, and double or triple lumen sump drains. Although these drains may be efficient for the first 12-24 hours, omentum quickly and effectively seals them off, precluding further drainage.

Jackson Pratt drains offer a more efficient means of post operative peritoneal drainage. These drains should be placed in the crania abdomen between the liver and diaphragm. Large dogs (>40 lbs) should have a second drain placed in the caudal abdomen. Drains should always be exited from the abdomen at a point distant from the midline abdominal incision. Abdominal wall closure is generally performed using absorbable or nonabsorbable monofilament suture material in a simple continuous pattern.

An alternative technique for treating patients with generalized suppurative peritonitis is termed open peritoneal drainage and intermittent lavage.

SEROSAL PATCH

A technique has been described for successfully treating hollow viscous organ perforation and leakage and for reinforcing areas of potential leakage. The technique involves suturing the surface of a loop of healthy bowel (generally jejunum) over the leaking or devitalized area to form a serosal patch.

In the small intestine, serosal patching is most helpful when debridement and closure of an intestinal defect would result in significant lumen compromise. Serosal patching is also indicated for support of an enterotomy or intestinal anastomosis that is of questionable viability. It is effective in preventing leakage even if the anastomosis breaks down as the patch seems to retain its integrity in the face of peritonitis or protein-calorie malnutrition.

Technique: When using a serosal patch to cover a defect, the defect is first debrided to healthy bleeding margins and irrigated. A loop of jejunum is brought into apposition with the defect and sutured using a simple continuous apposing pattern of 4-0 or 5-0 polypropylene (Prolene) suture. Sutures are placed 2-3 mm apart and about 3 mm from the edge of the defect; be sure sutures are in viable bowel wall. Polypropylene suture is used for its nonreactive properties as well as its continued tensile strength in the face of peritonitis, hypoproteinemia, and prolonged illness. Sutures are placed 360° around the defect making sure to suture submucosa of both structures with each bite. Advantages of serosal patch over omentum include: its strong subserosal layer, it withstands higher intralumen pressures, and it holds sutures well. It may also help to "support" the anastomosis during healing. When defects in the duodenum and colon are patched with a loop of jejunum, the serosal surface becomes lined with mucosa similar to the organ repaired.

MESENTERIC VOLVULUS

Mesenteric volvulus is an uncommon but often fatal disorder in dogs; it is rarely diagnosed in cats. Clinical presentation is a young to middle age, male, medium sized to large breed dog (German Shepherd Dogs appear to be most commonly affected), presenting with an acutely

distended and painful abdomen, hematochezia, +/- vomiting, and rapid onset of shock. The abdomen is moderately distended and tympanic. Abdominal distention occurs rapidly; generally less than 6 hours. Presumptive diagnosis is based on history, clinical presentation, physical examination, and radiographs. Abdominal radiographs reveal distended loops of small intestine suggesting obstruction or adynamic ileus. The stomach is generally not distended with air. Differential diagnosis includes GDV, intestinal obstruction, parvovirus, garbage gut, and generalized adynamic ileus. Treatment is emergency surgery. A xyphoid to pubis midline abdominal exploratory is performed. Adequate exposure is necessary to visualize and evaluate the volvulus for appropriate derotation. As in any strangulation obstruction, endotoxin is released to the systemic circulation when the vascular occlusion is relieved. Pretreatment with shock dose of polyionic isotonic fluids, glucose, broad spectrum antibiotics, and corticosteroids or flunixin meglumine are recommended. As these patients are also experiencing reperfusion injury, specific drug therapy shown to improve patient outcome should be considered (at this time no drug has been shown clinically effective in treating dogs with reperfusion injury).

GASTROINTESTINAL NEOPLASIA

The overall incidence of gastrointestinal tract neoplasia in animals is low (16% of canine neoplasms and 28% of feline neoplasms originate in the alimentary tract). Clinical signs associated with the presence of small intestinal neoplasia vary with the location of the tumor in the bowel (i.e., high or low), the degree of obstruction (i.e., partial or complete), and the rate of growth of the tumor causing the obstruction. Intermittent vomiting and diarrhea, hyporexia to anorexia, depression, and cachexia are commonly seen with slow growing mural neoplasms that cause chronic partial obstruction. An abdominal mass may be palpable on physical examination. A presumptive diagnosis can generally be made by characteristic findings on an upper gastrointestinal contrast study (i.e., barium). Definitive diagnosis requires abdominal exploration and intestinal biopsy (generally excisional biopsy).

Leiomyosarcoma in dogs

Leiomyosarcoma is a slow-growing, malignant tumor of smooth muscle origin. It is the second most common intestinal tumor in dogs. Dogs with leiomyosarcoma of the small intestine have no breed or sex predilection and present at a median age of 10 years (range, 8 - 15 years). Clinical signs include vomiting, lethargy, anorexia, and diarrhea. Occasionally, patients present with weight loss and distended abdomen. Radiology reveals an abdominal mass in 60% of cases. Jejunum is the most common site in the small intestine and duodenum is second. If surgical resection and anastomosis is feasible, median survival can be expected to be 1.1 year (range, 7 months to 5.3 years). Prognosis in dogs treated surgically for leiomyosarcoma of the small intestine is favorable to excellent.

Intestinal adenocarcinoma in the cat.

This tumor most often affects older male Siamese cats (11 years old is the mean). Presentation is often nonspecific and includes weight loss, depression, intermittent vomiting and diarrhea, and hyporexia to anorexia. Clinical signs may last from a few days to several months. Tumors are most commonly found in the jejunum, ileum, and ileocecal colic region (i.e., rarely colonic). Diagnosis is often made by performing an upper GI barium series. At laparotomy, they appear as pale annular strictures affecting 1-5 cm segments of the intestine. They are firm on palpation and may be associated with a pre- and post-stenotic dilatation of the intestinal tract. Treatment includes wide excision of the tumor. Since most recurrences are at the previous anastomotic site, it is recommended that 7-10 cm of

grossly normal intestine be included on each end of the resection. Remember, 60 to 70% of the small intestine can safely be resected in the dog and cat. A routine intestinal anastomosis as previously described is performed. Resection or incisional biopsy of a regional mesenteric lymph node should be performed and submitted with the intestine for histopathologic evaluation and tumor staging. It is important that the pathologist read the "margins" of the intestinal resection as well as the tumor and regional lymph node. This may help determine the appropriate prognosis. Postsurgical survival time varies from 5-28 months. Survival times may increase if wider resections are accomplished at laparotomy.

Intestinal adenocarcinoma in the dog presents in a similar fashion as in the cat. Surgical therapy is similar, as is prognosis. This tumor is relatively rare in the dog as compared to the cat.

DIFFUSE GASTROINTESTINAL DISORDERS

Abdominal exploration with representative gastrointestinal biopsies is a valuable adjunct in diagnosing diffuse gastrointestinal disorders (i.e., lymphangectasia, idiopathic inflammatory bowel disease, lymphosarcoma, lymphocytic-plasmatic gastroenteritis, eosinophilic enteritis). The preoperative condition of the patient should not preclude the use of gastric and intestinal biopsies as a diagnostic tool. Even severely hypoproteinemic patients will prioritize what protein they have to the healing of wounds. Delayed wound healing should be anticipated and appropriate measures taken to ensure wound tensile strength until healing is complete. A ventral midline celiotomy that allows complete abdominal exploration is performed. After examination of viscera the proper sequence of organ biopsies follows the general rule that clean procedures should be done first (i.e., lymph node, liver, duodenal aspirate) and potentially contaminating procedures done last (i.e., gastric, duodenal, jejunal, ileal). The recommended sequence of samples and biopsies are listed below:

1) Liver, spleen, etc. as needed, 2) Mesenteric lymph node, 3) Duodenal aspirate, 4) Stomach bx, 5) Duodenal bx, 6) Jejunal bx, 7) Ileal bx.

When taking gastric and intestinal biopsies for diffuse gastrointestinal disorders a **full thickness** biopsy is necessary for adequate histopathologic evaluation. Gastric biopsy is performed in the ventral body of the stomach. A 1 - 2 cm incision is made and a full thickness biopsy specimen is taken. Care is taken not to traumatize the specimen with excessive tissue handling during biopsy. Closure is routine.

When taking an intestinal biopsy, the easiest way to guarantee you will get an adequate size, full thickness piece of intestine is to use a 4mm brand new skin punch biopsy instrument. The skin punch is placed on the antimesenteric border of the proposed segment of intestine and 'drilled' through all layers of intestine until the biopsy punch can be felt to enter the lumen of the intestine. The skin punch is removed and the biopsy retrieved from the shaft of the skin punch biopsy. This technique is particularly useful for ileal biopsy as it is easy to biopsy between the mesenteric and antimesenteric vessels. Transverse closure of the biopsy site is recommended to eliminate the possibility of lumen compromise. Suture technique is as described above for enterotomy closure.

An alternate technique required the use of a scalpel. A small longitudinal or transverse enterotomy is made (i.e., 5 - 10 mm long) with a #11 Bard-Parker scalpel blade (see video on intestinal biopsy www.videovet.org). One end of the enterotomy is grasped with atraumatic

forceps. Metzenbaum scissors are used to cut a 2 - 3 mm wide full thickness biopsy. The mucosa tends to evert when the enterotomy is made (especially with diseases that infiltrate mucosa), so be sure to include serosa, muscularis, submucosa, and mucosa in the biopsy.

Closure of all tissues (i.e., stomach, intestine, linea alba, subcutaneous tissues, skin) should be accomplished with suture material with predictable absorption characteristics and that will retain a significant part of its original tensile strength 2-4 weeks postoperatively (e.g., nylon, polypropylene, Novafil, PDS, Maxon). As with all intestinal surgery patients the surgeon provides careful postoperative evaluation for possible signs of intestinal breakdown.