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Radiograph provided by Professor Filippo Martini, Parma – Italy
Subtotal Colectomy for the Treatment of Obstipation Secondary to Pelvic Fracture Malunion in Cats

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Eleven cats in which subtotal colectomy with end-to-end jejunocolostomy was performed for the treatment of chronic obstipation secondary to pelvic fracture malunion were followed for at least 18 months. Seven cats had no recurrence of clinical signs and no long term complications. In two cats, constipation was less severe and occurred less frequently; however, medical treatment was still required. In one cat, watery diarrhea gradually changed to semi-formed feces of normal consistency by month 6; the cat was clinically normal at month 18. One cat had recurrence of constipation and was euthanatized after 2 years of medical treatment.

Pelvic fractures and sacroiliac luxation with medial displacement and callus formation can result in narrowing of the pelvic canal and secondary rectal impingement. Tenesmus and constipation are associated with partial rectal obstruction and secondary colonic distension. The prevalence of this complication in cats with pelvic trauma is unknown.

Medical treatment consists of oral administration of stool softeners and laxatives, and dietary changes. Enemas and manual evacuation of feces from the colon are procedures required in obstipated cats. Surgical techniques have been directed mainly at reestablishing an adequate pelvic diameter for easier passage of feces. Techniques include pelvic ostectomy with removal or redirection of bone. Specific techniques include symphyseal separation and distraction by use of an autogenous, corticocancellous graft harvested from the ilial wing, or resection of variable portions of the ilium, acetabulum, pubis, ischium, and bony callus.

Because the onset of clinical signs in cats with malunion of a pelvic fracture and secondary megacolon is insidious, it is often difficult to determine indications for surgery and select an appropriate surgical procedure. The rationale for performing subtotal colectomy is that removal of the ileocecal valve and dilated colon results in production of a soft, semi-formed stool that passes through a collapsed pelvic canal more easily. Technique and results of subtotal colectomy for the treatment of persistent idiopathic megacolon in cats have been reported. However, no clinical studies have been done to evaluate the effectiveness of pelvic reconstruction or subtotal colectomy in eliminating clinical signs associated with obstipation secondary to pelvic malunion. The main problem in cats after pelvic reconstruction or subtotal colectomy is potential recurrence of clinical signs.

The purpose of this study is to evaluate results of surgery and complications after subtotal colectomy in 11 cats with megacolon and chronic constipation secondary to pelvic malunion.

Materials and Methods

Subtotal colectomy (jejunocolostomy) was performed in 11 cats for the treatment of megacolon and chronic constipation secondary to medial collapse and malunion of pelvic fractures and sacroiliac luxations. The main indication for surgery was a refractory response to medical management and an increasing need for enemas and manual evacuation of feces from the colon. All cats were followed for a minimum of 18 months after surgery.

Each cat underwent a complete physical examination. Pelvic canal narrowing was assessed by rectal palpation. Complete blood counts and a test for feline leukemia virus (FeLV) were performed. Ventrodorsal and lateral pelvic and abdominal radiographs were made to evaluate the severity of pelvic canal collapse by displaced fracture frag-
The jejunum, ileum, and colon were exteriorized and isolated. The jejunum was enlarged cranially by digital manipulation. Atraumatic intestinal clamps were used to occlude the lumen of the jejunum. The anastomosis was sutured in a simple interlocking pattern with absorbable suture (polyglaftin 910 or polydioxanone). If a second layer was sutured, an inverting (e.g., Lembert) pattern was used. The mesenteric defect was closed and the abdomen was copiously lavaged with warm sterile saline solution. Omentum was placed around the anastomotic site, and the abdominal incision was closed with a 3-layer closure.

Lactated Ringer's solution was administered intravenously for 1 to 4 days, and broad-spectrum antibiotics were administered for 5 to 7 days. The cats were examined at the time of suture removal (week 2), and the character of stool and defecation problems were evaluated. Cats were again examined or owners were contacted by telephone a minimum of 12 months after surgery to assess longterm complications.

Long-term results of surgery were classified as excellent, no recurrence of constipation and no complications secondary to surgery; fair, clinical signs improved compared with preoperative condition, but medical treatment required for management; poor—condition unimproved, cats require medical management and frequent manual evacuation of feces from colon.

A jejunocolostomy was performed. The cats were positioned in dorsal recumbency, and a median abdominal incision was made from the pubis to the umbilicus. The jejenum, ileum, and colon were exteriorized and isolated with moistened laparotomy sponges. Branches of the ileal, ileocolic, caudal mesenteric, middle and left colic, and cranial rectal arteries and veins were ligated and transected. Feces at the distal resection site were displaced cranially by digital manipulation. Atraumatic intestinal clamps were used to occlude the lumen of the jejunum and colon to prevent spillage during resection. The descending colon was transected 1.5 to 2.0 cm cranial to the pubis, where the cranial and caudal rectal arteries anastomose. The proximal resection site was at the ileojejunal junction or the distal jejunum. An end-to-end anastomosis of jejunal to colonic segments was performed. To manage the disparity in diameters, the diameter of the jejunum was enlarged by transecting it at an angle. If there was a large disparity, the antimesenteric portion of the colon was oversewn to form a lumen the same size as the jejunum. The anastomosis was sutured in a simple interrupted crushing or appositional pattern with 3-0 or 4-0 absorbable suture (polyglaftin 910 or polydioxanone). If a second layer was sutured, an inverting (e.g., Lembert) pattern was used. The mesenteric defect was closed and the abdomen was copiously lavaged with warm sterile saline solution. Omentum was placed around the anastomotic site, and the abdominal incision was closed with a 3-layer closure.

Long-term results of surgery were classified as excellent, no recurrence of constipation and no complications secondary to surgery; fair, clinical signs improved compared with preoperative condition, but medical treatment required for management; poor—condition unimproved, cats require medical management and frequent manual evacuation of feces from colon.

**TABLE 1.** Postoperative Complications and Long-term Results after Subtotal Colectomy in 11 Cats for the Treatment of Chronic Obstipation Secondary to Pelvic Malunion

<table>
<thead>
<tr>
<th>Cat No.</th>
<th>Age (yrs)</th>
<th>Duration of Signs (mos)</th>
<th>Long-term Complications</th>
<th>Long-term Results* (No. mos followed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>16</td>
<td>Watery diarrhea, resolved by 6 mos</td>
<td>Excellent (18)</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>12</td>
<td>Occasional inappropriate defecation behavior</td>
<td>Excellent (20)</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>12</td>
<td>Infrequent episodes of constipation; treated daily with lactulose</td>
<td>Excellent (20)</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>12</td>
<td>Two episodes of constipation requiring enemas; treated daily with lactulose</td>
<td>Excellent (20)</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>24</td>
<td></td>
<td>Excellent (26)</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
<td>24</td>
<td></td>
<td>Excellent (32)</td>
</tr>
<tr>
<td>7</td>
<td>1½</td>
<td>12</td>
<td></td>
<td>Excellent (24)</td>
</tr>
<tr>
<td>8</td>
<td>3½</td>
<td>30</td>
<td>Recurrent constipation; treated with multiple enemas and stool softeners</td>
<td>Excellent (33)</td>
</tr>
<tr>
<td>9</td>
<td>4</td>
<td>12</td>
<td></td>
<td>Poor (24)</td>
</tr>
<tr>
<td>10</td>
<td>5 mos</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>6</td>
<td>60</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Long-term results: excellent—no recurrence of constipation and no long-term complications occurring as a result of the procedure; fair—clinical signs improved compared with preoperative condition, but medical treatment required for management; poor—condition unimproved, cats require medical management and frequent manual evacuation of feces from colon.
laxity (e.g., perineal hernia). Pelvic osteotomy with removal of bone had been performed previously in cat 7, and pelvic osteotomy with symphyseal separation and distraction in cat 2. There were no consistent hematologic abnormalities. The test for FeLV was negative in all cats.

Fig. 1. Lateral abdominal radiograph of a 4-year-old domestic shorthair cat with chronic obstipation secondary to pelvic fracture malunion. There is distension of colon by feces.

Fig. 2. Ventrodorsal abdominal radiograph of a 4-year-old domestic shorthair cat with a unilateral pelvic fracture malunion with medial collapse and secondary rectal impingement. Secondary megacolon is present.

Fig. 3. Ventrodorsal abdominal radiograph of a 3½-year-old domestic shorthair cat with bilateral pelvic fracture malunion.

Moderate to severe megacolon was visible in plain abdominal radiographs (Fig. 1), and there were displaced unilateral or bilateral ilial, ischial, and pubic fractures (Figs. 2 and 3). All fractures were completely healed, with varying degrees of unilateral or bilateral medial pelvic collapse; however, the exact degree of pelvic collapse could not be determined.

Intraoperative technical difficulties were encountered in two cats. In cat 7, fibrous adhesions secondary to previous pelvic trauma and pelvic osteotomy prevented resection of the distal 3 cm of the colon. Because of the small size of cat 10, too much distal colon (3 cm) relative to the size of the cat was left.

All cats had diarrhea to soft, semi-formed feces immediately after surgery. Character of the feces changed to soft, formed stool during weeks 1 to 4 in 10 cats. Persistent, severe diarrhea causing tenesmus, perineal irritation, or weight loss was not a problem in any cat. However, cat 1 had watery diarrhea for 6 months, when the stool gradually changed to semi-formed consistency as a result of dietary management. Six cats were anorexic the first 1 to 4 days, but all cats were eating voluntarily by day 5.
Bacterial peritonitis, sepsis, and shock developed in cat 10 on day 14. Exploratory surgery was performed and a small leak was found at the jejunoileal anastomosis. The leak was repaired, a serosal patch was applied, and the abdomen was copiously lavaged. The cat recovered uneventfully. The leak was attributed to a large fecalith that formed in the colon after the first operation.

Eight cats had excellent long-term surgical results without constipation, diarrhea, or weight loss; stool softeners, laxatives, or enemas were not required (Table 1). Two cats (5 and 7) had fair surgical results. Constipation necessitated daily administration of a stool softener. Enemas were required for two episodes of constipation in cat 7 when the medication was discontinued. Cat 11 had poor surgical results and required daily administration of a laxative and stool softener. Enemas and manual evacuation of feces from the colon were required to treat repeated episodes of severe constipation. The cat was euthanatized at month 24 because of intractable constipation. Physical examination was not performed before euthanasia. Necropsy was not performed.

Discussion

The surgical management of cats with constipation caused by pelvic fracture malunion and rectal impingement has not been well described. One reason is that clinical signs associated with a collapsed pelvic canal are often insidious and intermittent, and, therefore, many affected cats are managed medically. However, when the clinical response becomes refractory, surgery is indicated.

Pelvic reconstruction increases the width of the pelvic canal to decrease or eliminate rectal impingement by displaced fracture fragments or callus. However, chronic colonic distension can cause intramural myoneural damage, resulting in irreversible colonic dysfunction. Pelvic reconstruction may then be ineffective, with affected cats requiring continued medical treatment. If the response is poor because of colonic dysfunction, subtotal colectomy may be indicated, as in cats 2 and 7. Other disadvantages of pelvic reconstruction include the substantial soft tissue dissection necessary, and for pelvic osteotomy, collection of a graft from a rib or the ilium. Osteotomies through the sacroiliac joints may also be required. Injury to the sciatic nerve, urethra, or rectum can occur with either procedure.

subtotal colectomy offers an alternative to pelvic reconstruction procedures when there is a high probability of irreversible colonic damage. Removal of the ileoceleal valve and dilated colon usually result in production of soft, semi-formed feces that can pass more easily through a narrow, collapsed pelvic canal. Absence of the ileoceleal valve, a loss of a major section of intestine responsible for water absorption, and decreased storage capacity are thought to be responsible for the production of softer stool.

Preoperative oral administration of antibiotics and multiple enemas to decrease intraluminal bacteria and evacuate the large colon and rectum was not done in these cats. A low incidence of postoperative infection was reported in cats undergoing subtotal colectomy without enteral antibiotics, and it was difficult to empty the colon and rectum effectively. Abdominal contamination by colonic bacteria can be minimized by colonic exteriorization and by packing off the abdominal cavity from the colon with moistened laparotomy sponges. Manual displacement of solid feces from the resection sites also decreases the chance of fecal contamination. Preoperative parenteral administration of gentamicin and ampicillin or gentamicin and cefazolin is recommended to counter postoperative infection with Gram-negative aerobic and anaerobic bacteria. Clinical studies evaluating the necessity of administering prophylactic antibiotics parenterally to cats undergoing jejunoilealostomy have not been performed.

Leakage or dehiscence of the suture line can lead to bacterial peritonitis, as in cat 10. Problems with the anastomosis or peritonitis were not reported after subtotal colectomy in two studies involving 42 cats. In an unpublished study, one of 45 cats treated for idiopathic megacolon by subtotal colectomy developed leakage of the suture line and died of generalized peritonitis. Although the prevalence of this complication is low, leakage of intestinal contents can result in severe peritonitis, sepsis, and shock. Cats should be monitored closely after surgery for signs of leakage and peritonitis.

It has been shown that the colon is not required for normal gastrointestinal function. Diarrhea associated with loss of the ileum, ileoceleal valve, and most of the colon is common immediately after subtotal colectomy, but the feces generally change to a soft, formed consistency within 1 to 2 months. Compensatory changes such as increased number of absorptive cells, cellular hypertrophy, and increased villus height resulting in increased absorptive surface area in the distal small intestine allow a more formed stool.

A low incidence of persistent, severe diarrhea resulting in weight loss, perineal dermatitis, and rectal straining has been reported after subtotal colectomy. Impaired digestion, malabsorption, bacterial overgrowth, and bile salt and fatty acid-mediated diarrhea associated with short bowel syndrome are reported. Removal of the ileoceleal valve may also be a contributing factor.

Discussion

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be indicated for cats with chronic, severe diarrhea. One cat in this study and one in another study eventually developed semi-formed stools several months after surgery. It is assumed that in both these cats, compensatory changes occurred in the remaining small bowel.

Recurrent constipation after subtotal colectomy is infrequently reported in cats treated for idiopathic megacolon. Similarly, a low incidence of constipation after surgery was seen in this study. The cause of recurrence of constipation is not known, but there appears to be variability of small intestinal adaptation and the resulting character of the stool. Owners should be warned of this risk and the possibility of continuation of medical management after subtotal colectomy.

Results of this study indicate that subtotal colectomy is an effective method of treating cats with megacolon secondary to pelvic fracture malunion. We currently recommend subtotal colectomy after 6 months of constipation associated with pelvic fracture malunion, or for cats developing refractory constipation after pelvic reconstruction. For cats with a history of recent pelvic trauma (<6 months) that have early problems associated with constipation, we recommend pelvic resection.

References

Abstract of Current Literature

ALTERED MOTILITY AND BACTERIAL FLORA AFTER FUNCTIONAL END-TO-END ANASTOMOSIS

The functional end-to-end technique with a gastrointestinal stapler is commonly used in humans, but the effects of this anatomically side-to-side anastomosis on motility are unknown. Fasting small intestinal myoelectric activity and culture results were compared in six dogs undergoing handsewn end-to-end and functional end-to-end anastomoses. Serosal electrodes were placed at 10 cm intervals, and the small intestine was divided 25 cm and 55 cm from the duodenocolic ligament. The functional end-to-end anastomosis was created with the GIA stapler (U.S Surgical Corporation, Norwalk, Conn) and closed with the TA-55 stapler (U.S. Surgical). The handsewn end-to-end anastomosis was performed with a two-layered technique. Order of each surgical technique was randomized. By weeks 12 to 20, 91% of the migrating myoelectric complexes crossed the end-to-end anastomoses versus 22% across the functional end-to-end anastomoses (p<.001). At year 2, only 56% of the migrating myoelectric complexes crossed the functional end-to-end anastomosis. Quantitative bacterial cultures suggested a trend toward bacterial overgrowth in the functional end-to-end anastomosis. These results demonstrate that the functional end-to-end anastomosis alters small intestinal motility to a greater degree than an end-to-end anastomosis, and may predispose to bacterial overgrowth.