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Objective—To compare complication and recurrence rates in dogs treated for intussusception that underwent enteroplication to rates in dogs treated for intussusception that did not undergo enteroplication.

Design—Retrospective study.

Animals—35 dogs with intestinal intussusception.

Procedure—Information on signalment, clinical signs, potential predisposing causes, surgical technique, opioid administration, use of enteroplication, postoperative complications, and whether the intussusception recurred was obtained from the medical records.

Results—Dogs ranged from 8 weeks to 10 years old. Opioids were administered in the perioperative period in 24 dogs. Enteroplication was performed in 16 dogs. Complications of enteroplication that required a second surgery were identified in 3 dogs. None of the 16 dogs that underwent enteroplication had a recurrence of intussusception, whereas 1 of the 19 dogs that did not undergo enteroplication had a recurrence. Rate of intussusception recurrence and likelihood that a second surgical procedure would be required were not significantly different between dogs that underwent enteroplication and dogs that did not.

Conclusions and Clinical Relevance—Results suggest that enteroplication may be associated with life-threatening complications in dogs, but the likelihood of a dog requiring a second surgical procedure following surgical correction of intussusception was not different between dogs that underwent enteroplication at the time of the initial surgery and dogs that did not. (J Am Vet Med Assoc 2001;219:1415–1418)

Intussusception is defined as invagination of a segment of the gastrointestinal tract into the lumen of an adjoining segment.¹ The intussusceptum is the invaginated segment of the alimentary tract, whereas the intussusciptens is the enveloping segment. Invagination may occur in an aboral (normograde) or oral (retrograde) direction, but is most commonly in the aboral direction.¹ Any portion of the alimentary tract may be involved, but intussusception at the ileocolic junction is most common in animals and people.¹² A variety of conditions are reported to predispose to intussusception, including intestinal parasitism, viral enteritis, foreign bodies, and masses, but in dogs, most intussusceptions are idiopathic.¹³ Treatment of intestinal intussusception in dogs and cats involves manual reduction or resection and anastomosis of the involved portion of the intestine.¹⁴ In previous reports²⁻⁵ involving a total of 88 dogs, 72 (82%) required resection and anastomosis because of an inability to manually reduce the intussusception or avascular necrosis of the involved intestine.

The most common complications following treatment of intussusception are recurrence, dehiscence of the intestinal anastomosis, ileus, intestinal obstruction, peritonitis, and short bowel syndrome.¹⁻⁵ The rate of recurrence in dogs with intussusception, regardless of the type of surgical intervention, is reported to be between 11 and 20%⁶⁻⁹; however, specific risk factors for recurrence of intussusception in dogs have not been identified. In dogs in which no surgical procedure was performed to prevent recurrence, intussusception recurred in 4 of 16 (25%) dogs that underwent manual reduction alone and in 14 of 72 (19%) dogs that underwent resection and anastomosis.⁷⁻⁹ In previous studies,²⁻⁵ 3 of 5 dogs with recurrence of an intussusception were <12 weeks old. However, the age of 14 other dogs with a recurrence was not reported, and most dogs that develop intussusceptions are <1 year old. Thus, definitive conclusions as to the relationship, if any, between recurrence of intussusception in dogs and age cannot be made. Perioperative administration of opioids, including morphine and butorphanol tartrate, has been reported to decrease the rate of occurrence of intussusception in dogs undergoing renal transplantation.¹⁰⁻¹¹ but what effect opioid administration has on preventing recurrence in clinical cases has not been evaluated.

Surgical procedures recommended for preventing recurrence of intussusception in dogs involve creating permanent adhesions between adjacent loops of small intestine, a process known as enteroplication.¹²⁻¹⁴ Enteroplication techniques used in dogs are based on surgical procedures developed in human medicine to prevent the development of obstructive adhesions following multiple abdominal surgeries.¹¹⁻¹⁴ Enteroplication of the small intestine has been reported to decrease the likelihood of recurrence of intussusception in dogs¹⁵⁻¹⁶; however, to our knowledge, studies evaluating the frequency of complications associated with enteroplication in dogs have not been published. Individual case reports of severe postoperative complications associated with enteroplication have been pub-
lished.19,20 The purpose of the study reported here was to compare complication and recurrence rates in dogs treated for intussusception that underwent enteroplication to rates in dogs treated for intussusception that did not undergo enteroplication.

Criteria for Selection of Cases
Medical records of all dogs that underwent surgery at the University of Georgia or Purdue University between 1989 and 1999 for treatment of intussusception were reviewed. In all dogs, the diagnosis of intussusception had been made by means of ultrasonography or exploratory celiotomy. Dogs were included in the study only if they had been followed up for at least 3 months after surgery and if information on signalment, clinical signs, factors potentially predisposing to intussusception formation, opioids administered during the perioperative period, surgical technique (manual reduction, resection and anastomosis, enteroplication), and postoperative complications was available from the medical record.

Procedures
The enteroplication technique used in each case was determined from the surgery report. In all cases, an enteroplication technique consistent with that recommended in the veterinary literature14 had been used. Permanent serosal adhesions were created between adjacent loops of small intestine from the duodenocolic ligament to the ileocolic junction with absorbable or nonabsorbable suture material. Complications of enteroplication were defined as any complication directly associated with the enteroplication technique confirmed during a second exploratory celiotomy at the University of Georgia or Purdue University. Recurrence was defined as an intussusception confirmed during a second exploratory celiotomy at the University of Georgia or Purdue University. Follow-up information was obtained from the medical record when possible or by telephone contact with the referring veterinarian or owner.

Data analysis—A 2-sided Fisher exact test was used to compare the intussusception recurrence rate in dogs that underwent enteroplication with the rate in dogs that did not undergo enteroplication. A 2-sided Fisher exact test was also used to compare percentages of dogs requiring a second surgery because of recurrence or complications between dogs that underwent enteroplication and those that did not. A 2-sided Mann-Whitney U test was used to compare the median age of dogs in which enteroplication was performed with the median age of dogs in which enteroplication was not performed. For all analyses, values of \( P < 0.05 \) were considered significant.

Results
Thirty-five dogs with intestinal intussusception (18 treated at the University of Georgia and 17 treated at Purdue University) met the criteria for inclusion in the study. Dogs were between 8 weeks and 10 years old (mean, 18.2 months; median, 6 months), but most (25 [71%]) were ≤ 1 year old. There were 20 males (7 neutered) and 15 females (3 neutered). Breeds represented included German Shepherd Dog (n = 5), Labrador Retriever (4), Rottweiler (3), Golden Retriever (2), Basset Hound (2), and 12 other breeds represented by 1 dog each. There were 7 mixed-breed dogs.

Table 1—Potential predisposing causes and level of training of the attending surgeon for 35 dogs undergoing surgery because of intussusception

<table>
<thead>
<tr>
<th>Variable</th>
<th>Dogs undergoing enteroplication (n = 16)</th>
<th>Dogs not undergoing enteroplication (n = 19)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential predisposing causes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>None identified</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Previous surgery</td>
<td>5</td>
<td>4†</td>
</tr>
<tr>
<td>Parasites</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Viral</td>
<td>1†</td>
<td>0†</td>
</tr>
<tr>
<td>Foreign body</td>
<td>0</td>
<td>3†</td>
</tr>
<tr>
<td>Mass or cancer</td>
<td>1†</td>
<td>3†</td>
</tr>
<tr>
<td>Level of training of attending surgeon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faculty member</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Resident</td>
<td>4†</td>
<td>4†</td>
</tr>
<tr>
<td>Third-year</td>
<td>2</td>
<td>5†</td>
</tr>
<tr>
<td>Second-year</td>
<td>2</td>
<td>5†</td>
</tr>
</tbody>
</table>

*Two of the 4 also had parasitic infections (Giardia spp and Toxocara canis). Coronavirus infection confirmed by means of electron microscopy. dog also had Trichuris vulpis infection. †One of the 3 had a linear foreign body; and Giardia infection. *Mesenteric cyst. Leiomysarcoma, leiomyoma, and lymphoma. Two dogs developed complications. †One dog developed complications.

No predisposing cause could be identified in 14 dogs. Potential predisposing causes were identified in the remaining 21 dogs (Table 1). Three dogs had > 1 potential predisposing cause. Nine dogs had been anesthetized by the referring veterinarian within 30 days prior to the diagnosis of intussusception (mean time from surgery to diagnosis of intussusception, 13 days; range, 2 to 30 days). One dog had been castrated, and 8 had undergone exploratory celiotomy because of vomiting or diarrhea. Four of these dogs had had foreign bodies removed (3 underwent gastrotomy alone, and 1 underwent gastroscopy and enterotomy), 2 had undergone small intestine biopsy, and 2 had undergone exploration alone.

For all 35 dogs, historical complaints and clinical abnormalities identified at the time of diagnosis of intussusception included vomiting (n = 33), diarrhea (24), anorexia (16), weight loss or failure to gain weight (16), lethargy (13), melena or hematochezia (11), rectal prolapse (2), tenesmus (1), and abdominal distention (1). An abdominal mass was palpated in 19 dogs. Duration of clinical signs ranged from 12 hours to 90 days (mean, 20 days).

Opioids were administered for preoperative sedation and postoperative analgesia in 34 of 35 dogs (Table 2). Opioids used for preoperative sedation were administered within 1 hour of induction of general anesthesia. Duration of administration of opioids after surgery ranged from 1-time administration to 36 hours.

The intussusception was enterocolic in 18 dogs, enteroenteric in 15, and colocolic in 1. In the remaining dog, intussusception was diagnosed on the basis of repeated palpation of an approximately 15-cm-long tubular mass in the dorsocranial aspect of the abdominal cavity and ultrasonographic evidence of a multilayer...
The intussusception was spontaneously reduced in 1 dog and manually reduced in 7 (5 with manual reduction alone and 2 with manual reduction and foreign body removal). In the remaining 27 dogs, the intussusception could not be reduced or the bowel appeared necrotic, and intestinal resection and anastomosis was performed.

Enteroplication was performed in 16 dogs. Enteroplication was performed after resection and anastomosis (n = 10), manual reduction (5), and spontaneous reduction (1). The decision to perform enteroplication was based on individual surgeon preference, with no specific criteria used to determine which dogs would undergo enteroplication. Median age of the dogs in which enteroplication was performed (6 months; range, 2 to 18 months) was significantly (P = 0.02) less than median age of dogs in which enteroplication was not performed (12 months; range, 2 to 20 months).

Follow-up time ranged from 3 to 96 months (mean, 27.5 months; median, 18 months). One dog was euthanatized 3 months after correction of the intussusception because of metastasis of an intestinal leiomyosarcoma. No complications associated with surgical treatment of the intussusception were reported for this dog. Four dogs required a second surgery because of complications associated with surgical treatment of the initial intussusception. These complications included recurrence of the intussusception in 1 dog, intestinal obstruction in 2 dogs, and intestinal strangulation in 1 dog. None of the remaining 30 dogs had any clinically important problems associated with the initial intussusception or with surgery to correct it; follow-up time for these dogs ranged from 8 to 96 months (mean, 29.3 months; median, 18 months).

None of the 16 dogs that underwent enteroplication had a recurrence, whereas 1 of the 19 dogs that did not undergo enteroplication had a recurrence. The single dog in which intussusception recurred was a 3-month-old female German Shepherd Dog that developed an enteroenteric intussusception approximately 48 hours after resection of an enterocolic intussusception. Treatment involved resection of approximately 25 cm of jejunum and enteroplication of the intestines from the duodenocolic ligament to the ileocolic junction. No other gastrointestinal tract problems were reported for this dog after the second surgery (follow-up time, 12 months).

Three dogs developed complications associated with enteroplication. In 2 dogs, intestinal obstruction developed because of plant material that was unable to pass through a bend in the enteroplicated small intestine. One of these dogs was examined 1 month after the initial surgery, and a 3-cm-long piece of wood and plant material was found to have penetrated the jejunum at a bend in the enteroplicated intestine. An intra-abdominal abscess had formed. The involved jejunum was resected, and 2 intestinal anastomoses were performed. In the second of these dogs, obstruction occurred 2.5 months after the initial surgery and was caused by impaction of plant material that was similarly unable to pass through a bend in the enteroplicated jejunum. An enterotomy was performed to remove the impacted foreign material, and an area of perforated jejunum was debrided and closed. Localized peritonitis in both dogs was treated with copious abdominal lavage and systemic antimicrobial treatment. In the third dog, a segment of small intestine became strangulated between enteroplication sutures in the jejunum approximately 5 months after the initial surgery. Strangulation and severe vascular compromise of the entrapped segment of small intestine was identified, and intestinal resection and anastomosis was performed. All 3 dogs that required a second surgery recovered, and none developed any other gastrointestinal tract problems (follow up times, 36, 7, and 15 months, respectively). No specific differences in enteroplication technique could be identified from the surgery reports for the 3 dogs that developed complications compared with the 13 dogs that underwent enteroplication but did not develop complications. Two faculty surgeons and a third-year resident performed the surgery on dogs that developed complications associated with enteroplication (Table 1).

Statistical analysis did not reveal a significant (P = 1.0) difference in the likelihood of recurrence of intussusception between dogs that underwent enteroplication at the first surgery and dogs that did not. Furthermore, the likelihood of undergoing a second surgery, either because of recurrence or complications, was not significantly (P = 0.3) different between dogs that underwent enteroplication and dogs that did not.

Discussion

Signalment and historical findings of dogs in the present study were similar to those for dogs in previous studies. Most dogs were < 1 year old, vomiting and diarrhea were the most consistent initial complaints, and intussusceptions were most commonly ileocolic. Potential predisposing causes were identified in 21 dogs, but it is not known whether the identified abnormalities were directly related with formation of the intussusception, even though each has been reported to be associated with intussusception in dogs.

The recurrence rate was 3% (1/35) for all dogs in this study and 5% (1/19) for dogs that did not undergo enteroplication. Recent retrospective studies have reported recurrence rates of 19% (4/21) and 15% (6/31) for dogs with intussusceptions surgically corrected at veterinary teaching hospitals. The reason for the lower rate of recurrence in the current study is not
known but may, in part, be attributable to the more common use of opioids for sedation and analgesia in veterinary medicine since the publication of these previous studies. Although the use of opioids in clinical veterinary practice to prevent intussusception or to prevent recurrence of intussusception has not been evaluated, the incidence of intussusception was decreased from 17 to 3% in dogs undergoing experimental renal transplantation when butorphanol was administered during the perioperative period. The decrease in incidence of intussusception was hypothesized to be the result of increased tone of the small intestine secondary to opioid administration. This increased tone, demonstrated by an increase in amplitude of the nonpropulsive rhythmic segmental contractions, is believed to reduce or prevent local bowel wall inhomogeneity and segmental ileus, therefore, decreasing the likelihood of intussusception.

Neither the present study nor the study by Levitt and Bauer found a significant difference in recurrence rate between dogs that underwent enteroplication and dogs that did not. However, when results of the 4 largest retrospective studies and the present study are combined, no dog that underwent enteroplication of the small intestine from the duodenocolic ligament to the ileocolic junction had a recurrence (0/30), whereas 17% (11/63) of dogs that did not undergo enteroplication developed a recurrence.

Enteroplication was performed in 16 of the 35 dogs in the present study. The decision to perform enteroplication was not obviously related to level of training of the attending surgeon, and the distribution of potential predisposing causes was similar between dogs that underwent enteroplication and those that did not. Enteroplication was generally not performed in dogs with intussusception secondary to neoplasia or a foreign body, and this may have accounted for the significant difference in age between dogs that underwent enteroplication and those that did not. Median age was not significantly different between groups if dogs with neoplasia were removed from the analysis.

Despite individual reports in the veterinary literature of clinically important complications in dogs undergoing enteroplication, the complication rate in dogs undergoing enteroplication had not been evaluated prior to the present study. Three of 16 (19%) dogs in the present study that underwent enteroplication experienced severe complications that required a second surgery. Two dogs had intestinal obstruction with plant material that, in the surgeon’s opinion, would have been able to pass through the intestine if the intestine had not been plicated. Strangulation, obstruction, and recurrence in dogs in which only a segment of small intestine was plicated have been reported in the present and previous studies. To reduce the incidence of complications, we recommend that the entire small intestine from the duodenocolic ligament to the ileocolic junction be plicated, that the bends in the intestine be gentle, and that the plication sutures be placed at intervals that will prevent entrapment and strangulation of other portions of the bowel.

Enteroplication was associated with serious complications in this study, and the recurrence rate even in dogs that did not undergo enteroplication was considerably less than in previous reports. However, relatively low numbers of cases were included in this and in previous studies of intussusception. Thus, a multicenter prospective clinical trial evaluating the perioperative use of opioids and the role of enteroplication in the surgical treatment of intussusception is necessary. Until the benefits and risks of enteroplication for preventing recurrence of intussusception have been fully evaluated, surgeons must subjectively weigh the perceived risk of recurrence against the risk of complications with enteroplication.

References


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