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Clinical findings and outcomes of 153 dogs surgically treated for intestinal intussusceptions

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Abstract

Objective: To describe perioperative characteristics and outcomes of dogs surgically treated for intestinal intussusception.

Study design: Multi-institutional, retrospective study.

Animals: One hundred fifty-three client-owned dogs with intestinal intussusception.

Methods: Dogs were included when they had undergone surgical treatment of a confirmed intestinal intussusception. Medical records were reviewed for demographics and clinical data, including surgical complications (graded 1-4).

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Follow-up was obtained via telephone interview with owners and referring veterinarians.

Results: Dogs had a median age of 10 months (range, 2-156), and the most common location for intussusception was ileocolic (66/153 [43%]). Most cases had no identifiable cause (104/155 [67%]). Intestinal resection and anastomosis (IRA) was performed in 129 of 153 (84%) dogs; enteroplication was performed in 28 of 153 (18%) dogs, including 13 with and 15 without IRA. Intraoperative complications occurred in 10 of 153 (7%) dogs, all involving intestinal damage during attempted manual reduction. The median duration of follow-up after discharge was 334 days (interquartile range, 15-990; range, 1-3302). Postoperative complications occurred in 53 of 153 (35%) dogs, including 22 of 153 (14%) with severe (grade 3 or 4) events. Diarrhea, regurgitation, and septic peritonitis were the most common postoperative complications; intussusception recurred in four of 153 (3%) dogs, all within 72 hours postoperatively. Fourteen-day postoperative mortality rate was 6%.

Conclusion: Surgical treatment of intestinal intussusception was curative in most dogs, even when an underlying cause was not identified. Surgical complications were common, including a 14% risk of life-threatening short-term complications.

Clinical significance: Surgical treatment of intestinal intussusception offers an excellent prognosis, but the potential life-threatening complications should be considered.

1 | INTRODUCTION

Intestinal intussusception is a reported cause of bowel obstruction in dogs,[1] and, although spontaneous reduction has been reported, it most commonly requires surgical treatment in the form of manual reduction with or without intestinal resection and anastomosis (IRA).[1-5] The most common predisposing causes reported in the veterinary literature include idiopathic, intestinal parasitic infestation, bacterial or viral enteritis, alimentary foreign bodies (linear or not), nonspecific gastroenteritis, and neoplasia.[2-4,6]

Complications related to surgical treatment of intestinal intussusceptions have been reported and include recurrence, dehiscence of intestinal surgical incision resulting in septic peritonitis, obstruction at the site of bowel anastomosis, and short bowel syndrome.[2-4] Recurrence of intestinal intussusception has been reported in up to 27% of cases, and enteroplication (EP) has been hypothesized to decrease the risk of recurrence of intussusception; however, specific criteria for this prophylactic procedure are lacking.[1,2,4,6-9] Previous reports of smaller groups of dogs that underwent surgical treatment for intussusception described survival rates greater than 80%, with survival rate dependent on location, duration, completeness of obstruction, and predisposing cause.[1,3,9]

The objective of this study was to describe perioperative characteristics and outcomes of dogs surgically treated for intestinal intussusception.

2 | MATERIALS AND METHODS

2.1 | Study population

Medical records of dogs with intestinal intussusception presented to 11 veterinary academic and private referral centers between January 2004 and January 2019 were retrieved. Dogs were included when a diagnosis of intestinal intussusception was made at the time of surgery by or under supervision of a board-certified veterinary surgeon. Dogs were excluded when a nonintestinal intussusception (ie, an intussusception involving the stomach) was diagnosed or when an intussusception was diagnosed at physical examination, via diagnostic imaging, or at necropsy alone without surgical treatment. All surgical procedures

were performed by diplomates of the American College of Veterinary Surgeons or by surgical residents under their supervision.

2.2 | Data collection

Signalment, history, clinical signs, physical examination and diagnostic imaging findings, laboratory data, surgical findings, histologic and necropsy findings when applicable as well as outcome were retrieved from the medical records of the dogs included in this study. Information retrieved included surgery not directly associated with intussusception prior to presentation (yes or no), the type of surgery (nonabdominal, abdominal and intestinal) ≤1 month or > 1 month after initial surgery until presentation for intussusception, and duration of clinical signs prior to presentation. Physical examination findings included vital signs, presence of abdominal pain, palpable intussusception, intestinal mass effect, and/or distended bowels. Diagnostic imaging findings from abdominal radiographs, contrast studies, abdominal ultrasonography, and computed tomography were recorded.

Operative details included number, location and length of intussusception, associated gross lesions, surgical technique, and additional concurrent procedures. Categories of location of intussusception included duodenojejunal, jejunojejunal, jejunoileal, ileoileal, ileocolic, colocolic and jejunocolic. The surgical treatment methods were categorized as manual reduction only (MR), MR followed by ER (MR-EP), attempted MR followed by IRA (MR-IRA), and attempted MR followed by IRA and EP (MR-IRA-EP). Prophylactic colopexy was recorded when performed. Histologic evaluation of resected bowel, gastrointestinal biopsies, and any other macroscopically abnormal tissue discovered during surgery and necropsy was documented.

Surgical complications were defined as adverse events temporally associated with and attributed to surgical intervention, as described by Follette et al.[10] Intraoperative complications were defined as those that occurred between skin incision to closure, and postoperative complications were those that occurred after skin closure.[10] Postoperative complications that occurred up to 14 days after skin closure were considered short term, and complications that occurred after 14 days after skin closure were considered long term. Events were graded by a single investigator (M.A.G.) using standardized complication grading systems developed for reporting outcomes in human surgery, the CLASSIC (classification of intraoperative complications) scheme[11] for intraoperative events and the contracted Accordion Severity Classification for postoperative events.[12]

2.3 | Follow-up

Referring veterinarians were contacted by telephone or email at the time of data collection. When a dog had not recently visited the referring veterinarian, owners were contacted. Time from surgery to most recent follow-up was recorded. There were no minimal requirements regarding follow-up for inclusion in this study. However, only cases that had a minimum follow-up of 7 days were used for analysis of complications. Complications attributed by the owner or referring veterinarian to the dog's intussusception or its treatment were documented. When applicable, date and cause of death were recorded.

2.4 | Data analysis

Descriptive statistics were calculated for measured variables. Distribution of continuous variables was evaluated with a combined test of skewness and kurtosis. Complications were reported according to the highest grade experienced by the dog without separate counting of recurrent events.

3 | RESULTS

3.1 | Demographics

One hundred fifty-three dogs were identified from nine academic and two private practice hospitals. The median number of cases submitted per institution was 14 (range, 4-24). Median dog age was 10 months (interquartile range [IQR], 4-26; range, 2-156). There were 50 (32.7%) intact males, 36 (23.5%) intact females, 37 (24.2%) castrated males, and 30 (19.6%) spayed females. Commonly represented breeds included Labrador Retriever (n = 22 [14.4%]), mixed breed (n = 20 [13.1%]), German Shepherd dog (n = 14 [9.2%]), Golden Retriever (n = 9 [5.9%]), and German Short-Haired Pointer (n = 7 [4.6%]). Overall, 55 different pure breeds were represented. Median dog weight was 16.6 kg (IQR, 7.4-25, range, 0.8-60). Median duration of clinical signs attributed to intestinal disease was 4 days (IQR, 1-11). The most common clinical signs were vomiting (n = 133 [86.9%]), diarrhea (n = 111 [72.6%]), anorexia (n = 101 [66%]), lethargy (n = 97 [63.4%]), and hematochezia (n = 62 [40.5%]). Twenty-nine dogs had a previous surgical procedure performed within the 30 days of presentation, including 10 dogs that had undergone intestinal surgery, 15 dogs that had other abdominal procedures, and four dogs that had extra-abdominal surgeries. At physical examination, median body temperature was 38.6°C (IQR,

38.1-38.9), median pulse rate was 120 beats per minute (bpm; IQR, 100-148), and median respiratory rate was 30 bpm (IQR, 24-36). Half (75/150 [50%]) of the dogs had abdominal pain, and an intussusception was palpable in 49 of 151 (32.5%) dogs. Median values for common electrolyte, chemistry, and blood count values were within commonly held reference ranges, except total white blood cell count (median, 15.4×10^3 cells/μL; IQR, 11.8-23). One hundred fifty dogs had abdominal imaging including survey radiographs (n = 111), upper gastrointestinal barium study (n = 17), abdominal ultrasonography (n = 119), abdominal CT (n = 3), or a combination of imaging studies. Two of the dogs that did not have abdominal imaging recorded presented for an intussusception prolapsed through the anus from an ileocolic type of intussusception.

3.2 | Intraoperative findings and surgery

All dogs underwent exploratory laparotomy. A single intussusception was noted in 152 dogs at the following locations: ileocolic junction (ICJ) (n = 66 [43.1%]), jejunojejunal (n = 47 [30.7%]), jejunocolic (n = 21 [13.7%]), jejunoileal (n = 13 [8.5%]), ileoileal (n = 2 [1.3%]), colonocolic (n = 2 [1.3%]), and duodenojejunal (n = 1 [0.7%]). One dog had separate duodenojejunal and jejunocolic intussusceptions associated with a linear foreign body. In seven cases, the intussusception was doubly telescoped in the same location (ie, intussusception within an intussusception). Evidence of intestinal perforation unrelated to surgical manipulation was identified in 30 of 153 (19.6%) dogs. Intestinal surgical procedures were performed in all 153 dogs and included MR (n = 10 [6.5%]), MR-EP (n = 13 [8.5%]), MR followed by IRA (n = 114 [74.5%]) or typhlectomy (n = 1 [0.7%]), and MR-IRA-EP (n = 15 [9.8%]). Overall, 129 (84.3%) dogs had IRA, and 28 (18.4%) dogs had EP. Enteroplication was reported as complete in 10 dogs and partial in 18 dogs. An IRA was performed in 80 of 87 (92%) dogs with intussusceptions involving the ICJ and in 49 of 66 (74.2%) dogs with intussusceptions in other anatomic locations. Reasons for performing IRA were not consistently provided but included failure to manually reduce the intussusception, devitalized or perforated intestinal tissue, presumed neoplastic intestinal mass, and serosal damage associated with the intussusception during MR. Enteroplication was performed in 13 of 24 (54.2%) dogs that had MR alone and in 15 of 129 (11.2%) dogs that had IRA. Reasons for performing EP were not provided for any dog.

Surgery and anesthesia lasted a median time of 120 minutes (IQR, 90-150) and 180 minutes (IQR, 140-225), respectively. Forty-eight dogs underwent additional surgical procedures including incisional gastropexy (n = 14), ovariohysterectomy (n = 9), abdominal lymph node biopsy (n = 9), gastrotomy (n = 6), intestinal biopsy (n = 6), liver biopsy (n = 4), prescrotal castration (n = 4), enterotomy (n = 3), gastric biopsy (n = 2), and one each of omental biopsy, mesenteric mass removal, cystotomy, oral mass biopsy, jejunostomy tube placement, excision of omentum, and colopexy. At least one anesthetic adverse event was reported during the preoperative or intraoperative period in 115 (74.2%) dogs, including hypothermia (n = 105), hypotension (n = 63), cardiac arrhythmias (n = 13), regurgitation (n = 7), hypercapnea (n = 6), hypertension (n = 2), and hypoxemia (n = 1). Insufficient data were available to grade the duration, severity, or treatment of these adverse events. CLASSIC grade II intraoperative surgical complications occurred in seven dogs when MR of the intussusception resulted in tearing or splitting of the serosa. In one dog, the serosal injuries were closed with suture, and IRA was performed in six dogs. CLASSIC grade III intraoperative surgical complications occurred in three dogs when MR of the intussusception resulted in a full-thickness intestinal perforation. An IRA including the perforated site was performed in all three dogs. No other intraoperative surgical complications were reported. Peritoneal cultures were obtained in 20 dogs, including 14 with perforations; eight cultures from perforated dogs and one from a non-perforated dog were positive for bacterial growth. None of the three dogs with iatrogenic full-thickness perforations had cultures performed for bacteria. Samples were submitted for histopathology in 93 (60.8%) dogs. In 104 of 155 (67%) dogs, an underlying etiology was not identified, so these were classified as idiopathic. In the remaining dogs, causes attributed on the basis of history, fecal parasite testing, surgical findings, or histopathology included intestinal parasites (n = 15 [9.8%]), intestinal neoplasia (n = 12 [7.8%]), intestinal foreign material (n = 10 [6.5%]), chronic inflammatory intestinal disease (n = 5 [3.3%]), site of previous intestinal surgery (n = 2 [1.3%]), parvoviral enteritis (n = 2 [1.3%]), and campylobacter enteritis (n = 2 [1.3%]). Neoplasms included mast cell tumor (n = 2), leiomyoma (n = 2), lymphoma (n = 5), adenocarcinoma (n = 2), and spindle cell tumor (n = 1).

3.3 | Postoperative outcomes

Postoperative surgical complications were reported in 53 of 153 (34.6%) dogs (Table 1), including 13 dogs that experienced multiple complication events. The highest Accordion Severity Classification grade of postoperative complication experienced was grade 1 in 9 of 153 (5.9%) dogs, grade 2 in

TABLE 1 Frequency of complication by grade and surgical procedure in dogs with intussusception

Complications	MR, n = 10, n (%)	MR + EP, n = 9, n (%)	IRA, n = 105, n (%)[a]	IRA + EP, n = 12, n (%)
Grade 1—Mild complication[b]				
Seroma	0	0	1 (1)	0
Diarrhea	0	0	4 (4)	0
Incision inflammation and drainage	1 (10)	0	0	0
Hypokalemia	0	0	1 (1)	0
Rectal eversion	0	0	1 (1)	0
Pneumothorax	0	0	1 (1)	0
Grade 2—Moderate complication[c]				
Regurgitation	3 (30)	0	4 (4)	0
Diarrhea	0	0	20 (19)	1 (1)
Surgical site infection	0	0	3 (3)	0
Hemorrhagic gastroenteritis	0	0	0	1 (1)
Thrombocytopenia	0	0	1 (1)	0
Paw pad injury[d]	0	0	1 (1)	0
Grade 3—Severe complication[e]				
Septic peritonitis due to intestinal dehiscence	0	0	4 (4)	0
Recurrent intussusception	0	2 (22)	1 (1)	0
Intestinal obstruction due to adhesions	0	0	2 (2)	0
Colonic torsion	1 (10)	0	1 (1)	0
Colonic stricture	0	0	1 (1)	0
Cardiopulmonary arrest due to hypotension	0	0	1 (1)	0
Grade 4—Death[f]				
Septic peritonitis due to intestinal dehiscence	0	0	3 (3)	0
Septic peritonitis due to original intussusception	0	0	1 (1)	0
Septic peritonitis due to mesenteric abscess	0	0	1 (1)	0
Septic bile peritonitis due to iatrogenic injury	0	0	1 (1)	0
Recurrent intussusception	0	0	1 (1)	0
Cardiopulmonary arrest due to pneumonia	0	0	1 (1)	0
Mesenteric volvulus	0	1 (11)	0	0
Death at home due to unknown	0	0	1 (1)	0

Note: Grading scheme from the Accordion Severity Classification of Postoperative Complications: Contracted Classification. Dogs with <7 days follow-up and no reported complications were excluded from the analysis.

Abbreviations: EP, enteroplication; IRA, intestinal resection and anastomosis; MR, manual reduction alone.

[a]Includes one dog with typhlectomy.

[b]Requiring only minor procedures at cage side such as urinary catheter placement; complications treated with antiemetics, antipyretics, analgesics, diuretics, or electrolytes.

[c]Requiring pharmacologic support with drugs other than allowed for mild complications (eg, antibiotics). Includes blood transfusions and parenteral nutrition.

[d]Paw pads sloughed and managed as open wounds; injury presumed due to accidental paw strangulation with surgical positioning ties.

[e]Requiring reoperation or other surgical, endoscopic, or interventional radiologic procedures; complications resulting in failure of one or more organ systems.

[f]Complications resulting in postoperative death.

22 of 153 (14.4%) dogs, grade 3 in 12 of 153 (7.8%) dogs, and grade 4 in 10 of 153 (6.5%) dogs. Five dogs died or were euthanized during the hospitalization period, and five dogs died or were euthanized 5, 6, 8, 10, and 29 days after hospital discharge. Overall, 144 of 153 (94.1%) dogs survived, and nine of 153 (5.9%) dogs died during the short-term (14-day)

postoperative period. The median duration of postoperative hospitalization for all dogs was 2 days (IQR, 2-3; range, 1-14). The median duration of follow-up after discharge was 334 days (IQR, 15-990; range, 1-3302). Reported postoperative complications occurred within 14 days of surgery in all dogs with the exceptions of one dog that had mesenteric volvulus 29 days postoperative, two dogs that developed mechanical intestinal obstructions attributed to adhesion formation 60 and 213 days postoperative, two dogs that developed colonic torsion 730 and 900 days postoperative, and one dog that had surgical revision of a colonic stricture 452 days postoperatively. Enteric wound dehiscence occurred in seven of 129 (5.4%) dogs that underwent IRA. Four dogs with dehiscence were successfully treated with reoperation including IRA, one dog was euthanized after reoperation including IRA with subsequent second dehiscence, and two dogs were euthanized without further treatment. Four dogs with undetermined etiologies for their intussusception developed recurrent intussusceptions 2 to 3 days postoperatively; two of these dogs had undergone MR with partial EP, and two dogs had undergone IRA with no EP. Three dogs were successfully treated with reoperation including IRA, and one dog was euthanized without further treatment. In the subgroup of 16 dogs with idiopathic intussusception treated without IRA, recurrent intussusception was diagnosed in two of 10 (20%) dogs treated with EP and in zero of six (0%) dogs treated without EP. In the subgroup of 88 dogs with idiopathic intussusception treated with IRA, recurrent intussusception was diagnosed in zero of 10 (0%) dogs treated with EP and in two of 78 (2.6%) dogs treated without EP. The only other grade 3 or 4 postoperative complication reported in a dog with EP was mesenteric volvulus at 29 days postoperatively.

4 | DISCUSSION

In this multi-institutional study, dogs affected by intestinal intussusception were primarily young and did not have an identifiable predisposing cause for developing intussusception. In line with previous studies,[1-4,7,13] the ICJ was the most common anatomic location for intussusceptions, and intussusceptions at this location had a particularly high (90%) rate of IRA. The most common intraoperative complication was tearing or perforation of the diseased intestine during attempted manual reduction of the intussusception. Postoperative complications were common, and although short-term survival was very high, 14% of dogs experienced severe or life-threatening postoperative complications. However, recurrence of intussusception was low (2.6%) in this cohort of dogs but occurred in dogs with and without EP. The rate of enteric wound dehiscence among dogs in this study that had IRA performed was 5%, which is in line with previous reports of IRA outcomes associated with other etiologies.[14-15]

Twenty-nine (19%) dogs had a surgical procedure performed within 30 days prior to presentation for intussusception. This finding is in line with previous reports of studies in which recent abdominal or extra-abdominal surgery was associated with intussusceptions.[1,4,7] During the postoperative period, segmental ileus is thought to lead to local bowel wall inhomogeneity potentially predisposing to intussusception.[2] Postoperative ileus results from neural, hormonal, inflammatory, and pharmacological pathways, but the inflammatory response located in the bowel wall is considered the primary cause because it leads to prolonged ileus.[16] The role of intestinal inflammation in postoperative ileus may explain why dogs that had undergone previous abdominal or intestinal surgery represented the majority of all dogs that underwent surgery within 30 days of presentation for intussusception in this study. Intussusception should be a differential diagnosis in dogs with signs of gastrointestinal disease that fail to improve with medical management after a surgical procedure. Furthermore, in two (1.3%) cases, an intussusception occurred at the site of previous intestinal surgery (IRA [n = 1], enterotomy [n = 1]). Therefore, except for postoperative ileus, the site of intestinal surgery itself may also be a risk factor for postoperative intussusception.

The most common locations for intussusceptions in this study were the ICJ (43.1%) and jejunojejunal (30.7%), which is similar to previous studies.[1-3,6-7] Furthermore, 21 (13.7%) cases had a jejunocolic intussusception resulting from telescoping of intestine initiated at the ICJ. According to the lack of homogeneity theory, a sudden change in diameter of the bowel (eg, ileocolic or gastroesophageal junction) can lead to inhomogeneity of the bowel wall that can alter motility and may predispose to intussusception.[2-3] On the basis of this theory, the ICJ is anatomically predisposed to intussusception, and this may explain why this location is overrepresented in the cohort of dogs reported in this study (87 cases [56.8%]) and in previous reports.[1-4,7,13]

Several surgical treatments were performed on the dogs of this study. The most common surgical technique performed to treat intestinal intussusception in this case series was MR-IRA, which was associated with a 1.6% (2/129) recurrence rate. Intestinal resection and anastomosis was frequently combined with MR; however, MR has been reported to be unsuccessful in completely reducing the intussusception in up to 81% of cases.[2] In this study, completeness of MR was not consistently reported, although surgical reports noted that MR was

not possible in many cases or resulted in moderate to severe intestinal damage in several others. Even when intestinal viability is clearly compromised and it is clear that IRA will be required, MR is helpful to identify the extent of the lesion and to appropriately identify and preserve important vascular supply during IRA, particularly in more anatomically complicated regions such as the ICJ. Because of the risk that any attempted MR could result in perforation and gross spillage of intestinal contents, surgeons should take all usual precautions intended to reduce contamination when attempting MR, such as packing the area with clean laparotomy sponges even when intestinal compromise is not immediately apparent.

The intussusceptum portion of an intussusception is prone to vascular compromise that in time can lead to ischemic necrosis and intestinal perforation.[1,3,17] However, intestinal perforation has rarely been reported in canine intussusception because the ensheathing intussuscipiens generally retains its vitality.[3] Evidence of intestinal perforation unrelated to surgical manipulation was identified in 30 of 153 (19.6%) dogs and occurred in three dogs after digital manipulation in the present study, which is considerably higher than what has been described in previous reports.[1] The median (4 days) and mean (12.9 days) duration of clinical signs prior to presentation in the dogs in the present study were similar to those in previous studies,[1,4,18] providing evidence that duration of clinical signs may not be a reliable predictive factor for intestinal viability in dogs.

An underlying etiology was not identified in 68% of cases, and the intussusception was considered idiopathic, which is in line with previous studies on canine intussusception.[3-4,7] Several factors may have led to an overestimation of idiopathic intussusception in this study. These include a lack of standardized fecal testing and histopathological evaluation of resected intestine, which is a limitation of this retrospective study. Although 60.8% of dogs in the present study did have resected tissue submitted for histologic evaluation, additional gastrointestinal biopsies were seldom collected. In one study, researchers found that the likelihood of obtaining a histologic diagnosis increases when the intussusception is submitted with additional gastrointestinal biopsies (46.9% without additional gastrointestinal biopsies compared to 85% with additional gastrointestinal biopsies); however, when neoplasia was the underlying cause, submission of resected tissue containing the intussusception alone was sufficient for a diagnosis.[13]

Major postoperative complications in this study included intestinal dehiscence, septic peritonitis, recurrence of intussusception, mesenteric volvulus, and adhesion formation leading to intestinal obstruction, which are similar to complications mentioned in previous reports.[1-2,4] Intestinal dehiscence occurred in 5.4% (7/129) of dogs that had IRA performed in the current study. This rate is lower than that in a recent study of dehiscence of enterectomy sites in dogs in which dehiscence was diagnosed in 11.4% (21.1% of dogs with preoperative septic peritonitis [PSP] and 6.6% without PSP) of cases.[14] In the current study, 10 (6.5%) dogs had a grade 3 or 4 postoperative complication requiring reoperation or leading to death or euthanasia, and this should be discussed when counseling owners regarding the potential complications associated with surgical treatment of intestinal intussusception. We did not investigate specific risk factors for severe surgical complications because of data limitations inherent to the study design and size. It is reasonable to assume that previously reported risk factors for intestinal dehiscence, such as preoperative septic peritonitis,[14-15,19] would also be of concern in this case population, and dog owners should be appropriately counseled just as for any intestinal procedure.

Previous reports have described recurrence rates from 3% to 27%.[1-4,7-9,20] The overall recurrence rate was 2.6% in the present study. Enteroplication is a prophylactic surgical procedure intended to prevent recurrence of intussusception, but results are contradictory in the veterinary literature.[1,4,8] According to two reports of previous retrospective studies, EP did not influence recurrence rates.[1,4] In total, 28 dogs had EP performed in the present study. Enteroplication was performed more commonly in dogs that had successful MR without the apparent requirement for IRA. This tendency could result from the influence of previous reports that concluded that dogs treated with MR alone were at higher risk of recurrence compared to when IRA was performed.[1-2,4,7-8] However, these prior studies had methodologic limitations that precluded a clear understanding of causation and best clinical recommendations. Enteroplication remains a controversial surgical procedure and has been associated with complications such as intestinal obstruction, septic peritonitis, intussusception recurrence, ileus, and strangulation of bowel loops.[1,4,20-21] However, in the current study, except for two dogs with recurrent intussusceptions, no dog treated with EP developed septic peritonitis or other grade 3 or 4 complications. The indication for performing EP was not recorded, and this is a limitation of the present study. In addition, a bias resides in surgeon preference and experience as well as common practices specific to an institution. Furthermore, EP technique was not standardized (partial vs complete or intrinsic differences in technique such as suture spacing, number of sutures used, and acuteness of folds) and was performed in only a small number of dogs. On the basis of these findings, limited conclusions can be formed regarding efficacy of EP. A large number of dogs underwent MR-IRA, which was associated with a low recurrence rate.

Median follow-up time was only 334 days, which may have resulted in the underestimation of recurrence rates in the dogs of this study.

Recurrent intussusception occurred in only 2.6% (4/153) of dogs and always occurred within 72 hours of surgery. Two dogs had undergone MR and partial EP, and two dogs had undergone MR-IRA only for surgical treatment of intussusception. It is interesting to note that both recurrences in the MR-EP group had partial EP. Although partial EP (18/28) was performed nearly twice as often as complete EP (10/28), one could speculate that partial EP is not effective in preventing intussusception recurrence. The low incidence of recurrence of intussusception precluded statistical evaluation of any associations.

Comparison of results between studies is difficult because of a lack of definitions and criteria used to report and categorize soft tissue and oncologic surgical complications in veterinary medicine.[10] In an attempt to standardize complications and facilitate comparison with future studies, the CLASSIC and the contracted Accordion Severity Classification scales were used in this study. These scales include all potential adverse events regardless of the severity, and our approach to comprehensive complication reporting could have resulted in our study identifying and reporting more events compared with previous studies. Overall, survival outcomes were excellent; however, owners should be notified about risks of serious complications, and clinicians should be proactive about surveillance in the postoperative period.

Major limitations of this study are due mainly to its retrospective nature. Because of its retrospective nature, systematic error including selection bias at the study and treatment group levels as well as measurement errors are possible. Complications data depended on events being entered in medical records or recalled by owners and, therefore, low-grade or late events could be underestimated. In addition, the long time frame involved in this retrospective study rendered follow-up challenging. The multi-institutional aspect allows for more variability in surgical technique, especially in EP technique, as illustrated by the distribution of partial and complete EP, and it allowed for the largest number of dogs undergoing surgical treatment of intussusception to be reported.

Surgical treatment of intestinal intussusception was curative in most dogs, even when an underlying cause was not identified. Surgical complications were common, including a 14% risk of life-threatening short-term complications. Recurrence rates were low, and surgical treatment carried an excellent prognosis. Additional studies are required to compare recurrence rates among different surgical interventions and prophylactic procedures.

CONFLICT OF INTEREST

The authors declare no financial or personal relationships that could inappropriately interfere or bias the results of this study.

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