Diagnosis and Treatment of Intussusceptions in Dogs

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ABSTRACT: Intussusceptions occur primarily in dogs younger than 1 year of age and are most commonly found at the ileocecocolic junction. Intussusceptions may, however, occur at other locations within the gastrointestinal tract, including the gastroesophageal junction and pylorogastric region. Gastroesophageal and pylorogastric intussusceptions result in more acute, severe clinical signs than do intussusceptions within the small intestine. Radiographic studies, including contrast-enhanced and non–contrast-enhanced radiographs, and ultrasonograms are extremely helpful in making a diagnosis of intussusception. Immediate systemic stabilization of the patient, followed by surgical correction of the intussusception, is critical to a successful outcome. Enteroplication techniques used to prevent recurrence of intussusception are not without potential complications and should be performed in accordance with specific guidelines.

An intussusception is strictly defined as the taking up or receiving of one part within another, especially in reference to the invagination of one segment of intestine within another segment of intestine. The portion of the gastrointestinal (GI) tract that is displaced into the lumen of another segment of the GI tract is referred to as the intussusceptum, whereas the outer or receiving portion is referred to as the intussuscipiens. Intussusceptions usually occur in the direction of normal peristalsis (aborally); these are referred to as direct or normograde intussusceptions. Intussusceptions that occur against the direction of normal peristalsis are referred to as indirect or retrograde intussusceptions. Intussusceptions are named by citing the intussusceptum followed by the intussuscipiens. For example, an enterocolic intussusception is a normograde intussusception in which the small intestine (i.e., entero-) has invaginated into the large intestine (i.e., colic).

Intussusceptions in dogs have been identified in numerous locations within the GI tract. Many factors are reported to predispose dogs to intussusception...
formation. This article describes the proposed etiologies and mechanisms of intussusception formation and outlines appropriate diagnostic tests and therapeutic options for intussusceptions in dogs.

MECHANISMS OF INTESTINAL INTUSSUSCEPTION FORMATION

The formation of an intestinal intussusception is proposed to be the result of a lack of homogeneity of the bowel wall. This inhomogeneity may be caused by any abnormality within the bowel wall that alters local intestinal motility or pliability. As the intussusception is formed, longitudinal and circular contractions of the normal bowel wall adjacent to an area of local inhomogeneity cause displacement of that portion of the intestine and a “kink” or fold in the intestine is formed (Figure 2). The fold is then propagated circumferentially, and longitudinal muscle contraction completes the invagination. Once formed, intussusceptions progress by the same basic mechanism.

An intestinal intussusception may also form secondary to a mechanical linkage between nonadjacent segments of bowel. In this model of intussusception formation, longitudinal peristalsis generates a force on each end of the linkage between bowel segments (Figure 3). Contraction of circular muscle fibers within the bowel wall results in a small displacement and kink formation. As in the inhomogeneity model, the kink is then propagated and the bowel wall invaginates as longitudinal contraction continues. Many local factors such as mesenteric attachments and bowel-wall pliability play a role in the development of intussusception in an aboral or oral direction.

GASTROESOPHAGEAL INTUSSUSCEPTIONS

Etiology

Gastroesophageal intussusceptions (GEIs) are rare in dogs, with only 26 cases reported in the literature. A GEI is a retrograde invagination of the stomach into the esophagus without displacement of the gastroesophageal junction. The etiology of GEIs is not well understood. The presence of esophageal abnormalities, including megaesophagus, abnormal esophageal motility, and laxity of the esophageal hiatus, may predispose dogs to this type of intussusception. The active, retrograde motility initiated during vomiting may also play a role in invagination of the stomach into the esophagus.

Signalment and Clinical Signs

Seventy-six percent of GEIs reported were in dogs younger than 3 months of age. The largest retrospective study of GEIs reported a higher incidence in males than females, but with the addition of recent case reports this trend is not supported. In the 16 cases in which gender was reported, 9 were male and 7 were female. Fifty-four percent of the 26 GEI cases reported occurred in German shepherds. GEIs may be acute in onset, resulting in severe respiratory compromise, or chronic in nature, with intermittent episodes of regurgitation and vomiting. The presence of the stomach and other abdominal organs within the caudal thoracic esophagus compressing the caudal lung lobes can produce respiratory distress in dogs with acute GEI. Respiratory compromise is made more severe by the presence of concurrent aspiration pneumonia. Dogs with intermittent or chronic, recurrent GEI present with chronic regurgitation or vomiting. The chronic form of GEI is thought to be secondary to a sliding intussusception.

Vomiting and regurgitation are the most common clinical signs associated with GEI and have been...
Figure 2—Inhomogeneity model of intussusception formation. (A) A focal area of inhomogeneity (I) is present within the wall of the bowel. (B) Longitudinal (F) and circular contraction of the bowel wall occurs adjacent to the area of inhomogeneity, creating a kink. (C) Continued longitudinal force causes complete invagination of the area of inhomogeneity. (D) The kink is propagated circumferentially, and longitudinal muscle contraction completes the formation of the intussusception.

Figure 3—Mechanical linkage model of intussusception formation. Lack of homogeneity of the bowel wall caused by an abnormality within the bowel wall alters intestinal motility or pliability. (A) Longitudinal peristalsis generates a force (F) on each end of the linkage between bowel segments. (B) Longitudinal and circular contractions of the normal bowel wall adjacent to the area of inhomogeneity (S) result in bowel wall displacement and kink formation. (C) As longitudinal muscle contraction continues, the kink is propagated and the intussusception is formed.
reported in 65% (17 of 26) of affected dogs, with hematemeses (n = 7) and dyspnea (n = 7) reported less frequently. Clinical signs may also include nonspecific signs of gastroenteritis or abdominal discomfort. GEIs are occasionally described as a type of hiatal hernia because of the associated laxity of the esophageal hiatus reported in several dogs diagnosed with GEI.

The majority of dogs (15 of 26) had evidence of esophageal disease, including megaesophagus, enlarged esophageal hiatus, and abnormal esophageal motility. The increased incidence of GEI in German shepherds may be secondary to the increased incidence of congenital megaesophagus and esophageal abnormalities within this breed.

Diagnosis

GEIs are diagnosed by identification of the invaginated stomach within the caudal esophagus. Plain thoracic radiographs may reveal a soft tissue mass within the esophagus and lack of a gastric gas bubble or pylorus within the cranial abdomen (Figure 4). Frequently, the esophagus is dilated. Aspiration pneumonia is often present and may be secondary to underlying esophageal disease or GEI. Contrast esophagography demonstrates a mass lesion within the caudal esophagus without failure of contrast media to enter the stomach. The risk of aspiration during contrast-enhanced diagnostic imaging should be considered significant in animals with vomiting and regurgitation and, therefore, should not be performed unless absolutely necessary for diagnosis.

Esophagoscopy has also been used to diagnose GEIs and this tool aids in differentiation of GEI from an esophageal foreign body. Typically, esophagoscopy reveals a soft tissue mass within the caudal esophagus. Rugal folds may also be identified within the
esophagus. In some cases, it may not be possible to pass the endoscope into the stomach.

**Treatment and Prevention**

Successful treatment of GEI has been reported in only 5 of 26 cases. Factors associated with successful treatment include early diagnosis; aggressive stabilization of the patient in shock with oxygen, intravenous fluids, and correction of electrolyte abnormalities; and accurate identification of concurrent diseases. Following stabilization, immediate surgical exploration, with replacement of the stomach and other involved organs to their normal anatomic location, is indicated. Rapid surgical reduction of the intussusception decreases the likelihood of vascular compromise of the invaginated organs and relieves respiratory compromise. A variety of permanent gastropexy techniques, including gastropexy of the right, left, or both sides of the stomach to anchor the stomach in a normal anatomic position, have been described to prevent recurrence of GEI. Treatment of concurrent aspiration pneumonia and esophageal abnormalities is necessary for a successful outcome. Recurrence of GEI has not been reported.

**Prognosis**

The prognosis for recovery from GEI is guarded to poor. A mortality rate of 95% was reported in a series of 22 cases described in 1984. However, recent case reports document successful treatment and long-term survival in dogs diagnosed promptly and treated aggressively. Management of esophageal abnormalities and aspiration pneumonia is also critical for long-term survival. Only one case report documents resolution of megaesophagus after correction of GEI.

**PYLOROGASTRIC INTUSSUSCEPTIONS**

**Etiology**

Pylorogastric intussusceptions (PGIs), also described as duodenogastric or gastrogastric intussusceptions, are retrograde intussusceptions that have rarely been reported in veterinary medicine. To date, only four cases of PGI in dogs have been reported. The infrequent occurrence of this type of intussusception in veterinary medicine precludes speculation on its etiology.

**Signalment and Clinical Signs**

The four reported cases of PGI were in adult, large-breed dogs. No obvious sex or breed predilection was noted. All dogs diagnosed with PGI have been reported for acute, severe vomiting. Marked dehydration, tachycardia, and abdominal pain were consistent physical examination findings.

**Diagnosis**

A diagnosis of PGI is difficult to confirm without an exploratory celiotomy. Electrolyte and biochemical abnormalities (i.e., azotemia, hypochloremia, hyponatremia, hypokalemia, isosthenuria) are consistent with acute gastric outflow obstruction and hypovolemia. Radiographic findings are consistent with a soft-tissue opacity mass in the gastric fundus but are not specific for PGI (Figure 5). Positive-contrast radiography and abdominal ultrasonography have not been proven to be beneficial in differentiating PGI from other causes of gastric outflow obstruction.

**Treatment and Prevention**

Successful treatment of PGI was reported in two of the four affected dogs. Fluid resuscitation with correction of electrolyte abnormalities is recommended prior to exploratory celiotomy. Intussusception
correction should be performed as soon as possible following normalization of cardiovascular parameters and electrolyte abnormalities. Evaluation of the vascular supply of the associated tissue is critical to avoid subsequent gastric necrosis or perforation. A gastrotomy is indicated to rule out the presence of a gastric foreign body or mass lesion predisposing to intussusception formation. If gastric or duodenal necrosis is present, resection and anastomosis may be required. At that time, the decision to perform a gastroduodenostomy or gastrojejunostomy is based on the extent of devitalized tissue.

In the two successfully treated cases of PGI, manual reduction of the intussusception was achieved without complication. Reduction of the intussusception in one of these successful cases was followed by a Y-U pyloroplasty to relieve the remaining outflow obstruction caused by profound pyloric edema. The Y-U pyloroplasty increases the diameter of the pyloric outflow tract by making a full-thickness, Y-shaped incision over the pylorus and advancing the stomach wall such that the incision is closed as a U-shaped incision. A duodenectomy was also performed in the reported animal to prevent recurrence of PGI. It is unknown whether a duodenectomy is necessary, as no recurrent case of PGI has been reported.

Prognosis
The prognosis for PGI is unknown due to the infrequent occurrence of this type of intussusception in veterinary medicine.

**INTESTINAL INTUSSUSCECTIONS**

**Etiology**
Intestinal intussusception is the most common form of intussusception seen in dogs. The most frequent site is the ileocecalcolic junction, but intussusception may occur at any area along the intestinal tract. Intestinal intussusceptions may be single or multiple and normograde or retrograde and frequently involve a large percentage of the intestine. Agonal intussusceptions are occasionally noted on postmortem examination and can be differentiated from antemortem intussusceptions by the lack of adhesion and inflammation of the involved intestine. Although the majority of intestinal intussusceptions reported in dogs are idiopathic in nature, many conditions reportedly predispose dogs to their formation, including intestinal parasitism, viral enteritis, intestinal foreign bodies, and intraluminal and extraluminal mass lesions.

**Signalment and Clinical Signs**
Seventy-five percent of dogs diagnosed with intestinal intussusceptions are younger than 1 year of age. Although an early study suggested that German shepherds may be predisposed to intestinal intussusception, subsequent retrospective studies have not identified a breed predisposition. A sex predisposition has not been identified in dogs diagnosed with intussusception.

The most common presenting clinical signs in dogs with intestinal intussusceptions are vomiting, diarrhea with hematochezia or melena, anorexia, and weight loss. Other reported clinical signs include dehydration, abdominal pain, tenesmus, and rectal prolapse. A palpable abdominal mass was present in 50% to 70% of dogs with intussusception, most frequently in the cranial abdomen. The clinical signs of intestinal intussusception may be acute or chronic in nature. The reported duration of signs from onset to presentation ranges from 1 to 90 days. The nature, severity, and duration of clinical signs are related to the location of the intussusception within the intestinal tract. The most severe clinical signs, including vomiting and electrolyte imbalance, are more likely to occur with intussusceptions that are in the proximal intestinal tract (i.e., enteroenteric). Other factors, such as the degree of intestinal obstruction, the amount of compromised intestine involved in the intussusception, and the presence and severity of peritonitis, may contribute to both the severity and duration of clinical signs prior to presentation.

**Diagnosis**
Physical examination in dogs with intestinal intussusceptions may reveal a palpable cranial abdominal mass. In some cases, the intussusceptum may protrude from the anus, in which case the intussusceptum must be differentiated from a rectal prolapse. This is accomplished by attempting to pass a blunt, lubricated probe between the rectal wall and the prolapsed tissue. In the case of a small-intestinal or colonic intussusception, the probe can be passed to a level cranial to the pubis; however, the probe cannot be advanced when a rectal prolapse is present.

Abdominal radiographs in dogs with intussusceptions commonly reveal fluid- or gas-distended bowels, consistent with mechanical intestinal obstruction. A soft-tissue opacity mass may be identified on survey radiographs, but a definitive diagnosis of intussusception is difficult without contrast radiography or ultrasonography. In some cases, there is sufficient gas accumulation within the affected bowel to outline the intussusceptum on plain radiographs. Contrast radiography using either an upper GI study or a
Figure 6—Lateral (A) and ventrodorsal (B) views of an enterocolic intussusception following an upper GI barium study. A large filling defect (small intestine intussusceptum) is seen in the ascending colon (intussuscipiens). A “ribbonlike” line of barium is seen within the filling defect and represents barium within the lumen of the intussusceptum segment. Lateral (C) and ventrodorsal (D) views of an enterocolic intussusception following a barium enema. A large “coiled-spring”–appearing filling defect is present within the transverse and descending colon. Barium is present within the lumen of the colon surrounding the intussusceptum.
barium enema may increase the likelihood of diagnosing intussusceptions (Figure 6). The most appropriate contrast radiographic study to perform depends on the type of intussusception suspected. Enterocolic, cecocolic, or colocolic intussusceptions are best identified with a barium enema, while intussusceptions in a more orad location (i.e., enteroenteric) are best identified by an upper GI study or ultrasound.

Factors influencing the success of positive contrast studies include location of the intussusception, completeness of the obstruction, and the presence of significant intestinal ileus.

Abdominal ultrasonography has also been shown to be a reliable diagnostic tool for diagnosis of intestinal intussusceptions in dogs. The characteristic ultrasonographic appearance of an intestinal intussusception is a series of concentric rings in the transverse plane, frequently described as a “target sign” or “bullseye lesion,” and multiple parallel lines in the longitudinal plane (Figure 7). These findings correlate with the different layers of intestinal wall of the intussusceptum and intussuscipiens present within the intussusception. Ultrasonography may also identify concurrent abdominal abnormalities, such as lymphadenopathy, liver or splenic lesions, or infiltrative GI lesions.

**Treatment and Prevention**

Before surgical intervention, the patient’s hemodynamic and electrolyte status must be stabilized. Definitive treatment of intestinal intussusception must include reduction of the intussusceptum from the intussuscipiens and reestablishment of a patent GI tract. In dogs, this requires exploratory celiotomy and either manual reduction of the intussusception or resection of the intussusception with anastomosis of the remaining intestine. Manual reduction of the intussusception should be attempted by gentle “milking” of the intussusceptum from within the intussuscipiens. This technique should employ more pressure on the intussuscipiens in an effort to reduce the intussusceptum by pushing it out rather than using traction on the intussusceptum. Care must be taken to avoid tearing the serosa. Serosal adhesions, vascular compromise, or the presence of intestinal perforation prohibited manual reduction and necessitated resection and anastomosis in approximately 81% of 123 reported cases of intussusception in dogs.

The recurrence rate of intestinal intussusception after surgical intervention in dogs reportedly ranges from 3% to 25%. Historically, recurrence was reported in 22% of 18 dogs having undergone manual reduction alone and in 17% of 88 dogs having undergone resection and anastomosis. Recurrence of the disease process in both dogs and humans usually occurs in an anatomic location other than the original site. Butorphanol tartrate has been reported to decrease the occurrence of intussusception formation in a canine model of renal transplantation. In this model, the incidence of intussusception following renal transplantation was decreased from 17% to 3% when butorphanol tartrate was administered during the perioperative period. It is hypothesized that opioid administration increases the tone of the small intestine and reduces or prevents local bowel wall inhomogeneity and segmental ileus and, therefore, decreases the likelihood of intussusception. Recently, an increase in the use of perioperative opioids in clinical veterinary medicine has been suggested to be associated with a
lower rate of recurrence of intestinal intussusceptions following initial correction of this condition.19

Enteroplication, defined as the formation of permanent serosal adhesions between adjacent loops of small intestine, has been advocated as a means to prevent recurrence of intussusception in dogs.16,17,30 Enteroplication was originally introduced in human abdominal surgery to prevent obstructive adhesions following multiple abdominal surgeries, but it has not been advocated for the prevention of recurrent intussusceptions. Although two previous retrospective studies report no significant difference in recurrence rates with or without enteroplication,18,19 results of the five largest retrospective studies involving 30 dogs indicated no dog that has undergone enteroplication of the entire small intestine has developed a recurrent intussusception. In contrast, 17% of 63 dogs that did not receive enteroplication developed recurrent intussusception.17–21

Until recently, there have been only isolated reports of significant complications associated with enteroplication in dogs.32 In a recent retrospective study, complications of enteroplication performed for the prevention of recurrent intestinal intussusception in dogs included intestinal obstruction with vegetative material and strangulation of enteroplicated loops of jejunum between enteroplication sutures.19 This study suggested that the likelihood of a dog requiring a second surgical procedure following surgical correction of intussusception is no different between dogs that undergo enteroplication at the time of the initial surgery and dogs that do not. In order to fully evaluate the role of enteroplication in the treatment of recurrent intestinal intussusception, a randomized, multi-institutional, prospective clinical study using a standardized enteroplication technique is needed. Until such a study is completed, the decision to perform enteroplication is at the discretion of the individual surgeon who must balance the potential benefit with the risk of complication. If enteroplication is performed, the technique used must create gentle loops in the intestines to minimize the possibility of foreign material becoming lodged at the bends during transit. Plication sutures, using nonabsorbable or absorbable suture material, should be placed at intervals that will prevent entrapment and strangulation of other portions of bowel (Figure 8). Sutures should incorporate the submucosal layer of both loops of bowel without penetrating the lumen. The entire small intestine from the duodenocolic ligament to the ileocolic junction must be plicated.33
The prognosis for dogs with intestinal intussusceptions depends on many factors. Rapid identification of the intussusception with correction of fluid and electrolyte disorders, followed by immediate surgical intervention, is critical to the long-term outcome. Although early reports suggested recovery rates ranging from 35% to 65%, recent studies in which dogs received aggressive fluid therapy and rapid surgical intervention suggest a survival rate greater than 80%. The location of the intussusception within the GI tract affects the disease process. Patients with intussusceptions of the proximal GI tract are more severely affected by electrolyte imbalances secondary to vomiting and loss of gastric secretions. The presence of generalized peritonitis, secondary to perforation of the bowel, also worsens the prognosis for this disease.

**FUTURE PROSPECTS**

Current research into the pathophysiology of intussusception formation may lead to a better understanding of both primary and recurrent intussusceptions. A model of intussusception formation has been developed in mice by the intraperitoneal injection of lipopolysaccharide. This model has been used to evaluate the role of inflammatory mediators such as prostaglandins, nitric oxide, and tumor necrosis factor in the formation of intussusceptions. Elucidation of the roles of these mediators and other agents (e.g., opioids) in the formation of intussusceptions may lead to the ability to prevent the recurrence of intussusceptions in dogs by pharmacologic intervention.

**REFERENCES**

1. GEIs
   a. occur most frequently in older, female dogs.
   b. may be present in dogs with either acute or chronic histories of regurgitation/vomiting.
   c. do not occur in association with esophageal motility abnormalities.
   d. are not surgical emergencies when associated with respiratory difficulty.

2. Treatment of GEIs requires
   a. aggressive patient stabilization, including oxygen supplementation.
   b. identification of concurrent disease processes, especially aspiration pneumonia.
   c. immediate surgical reduction of the intussusception.
   d. permanent attachment of the stomach to the abdominal wall to prevent recurrence.
   e. all of the above

3. PGIs
   a. are more common in dogs younger than 1 year of age.
   b. may be present in dogs with a chronic history of anorexia and weight loss.
   c. are more common in German shepherds than in other dogs.
   d. may be associated with dietary indiscretion and acute, severe vomiting.

4. Diagnosis of PGI
   a. is made exclusively by abdominal ultrasonography.
   b. may be made preoperatively with a variety of tests, including plain abdominal radiography, contrast radiography, ultrasonography, and gastroduodenoscopy.
   c. has only been successfully made during exploratory celiotomy.
   d. is necessary before surgical treatment of the process.

5. The majority of canine intestinal intussusceptions
   a. occur in dogs older than 5 years of age.
   b. have an identifiable cause for intussusception formation.
   c. are identified in German shepherds.
   d. demonstrate no identifiable breed or sex predilection.
6. The duration of clinical signs in dogs afflicted with intestinal intussusceptions
   a. is consistent for all dogs, regardless of the location of the intussusception within the intestinal tract.
   b. is always predictive of the ability to manually reduce the intussusception at surgery.
   c. directly corresponds to the prognosis for recovery.
   d. is extremely variable, ranging from 1 to 90 days in the veterinary literature.

7. Diagnosis of intestinal intussusceptions
   a. requires advanced imaging tests such as computed tomography or magnetic resonance imaging.
   b. may not be successful unless contrast radiography is incorporated.
   c. may be suspected based on signalment, history, physical examination, and plain abdominal radiography.
   d. may be made with a barium enema, which may also be incorporated in the successful treatment of a majority of the intussusceptions in dogs.

8. Manual reduction of an intussusception
   a. is never successful in dogs.
   b. should be attempted with forceful extraction of the intussusceptum from the intussuscipiens.
   c. is frequently unsuccessful in dogs because of severe vascular compromise and serosal adhesions of the affected intestines.
   d. should not be attempted in dogs older than 6 months of age.

9. Recurrence of intussusception
   a. most frequently occurs at the same location of the intestinal tract.
   b. is more common after manual reduction versus intestinal resection and anastomosis.
   c. is seen most commonly in dogs older than 5 years of age.
   d. is apparently prevented by performing the appropriate method of enteroplication of the small intestine.

10. Enteroplication of the small intestine for the prevention of recurrent intussusception
    a. has been associated with severe complications in dogs.
    b. should incorporate only the affected segment of the small intestine in the area of the original intussusception.
    c. is a technique developed in veterinary surgery in the 1950s.
    d. should be performed in every dog with intestinal intussusception.