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## ISSUES IN GASTROINTESTINAL DISORDERS

# Diagnosing Canine Abdominal Organ Torsions: Twisted in Every Way

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Conditions causing acute abdominal pain—and the associated sudden onset of anorexia, vomiting, and lethargy—are common reasons pets present to veterinary hospitals. The 4 main pathologic processes that cause abdominal pain are ischemia, inflammation, distention, and traction.<sup>1</sup> Although organ torsions are relatively uncommon, they are associated with all 4 of these processes. Affected organs rapidly become ischemic, which leads to local and/or system inflammation. Organ distention results from gas or fluid accumulation within the lumen (hollow viscera) or edema formation within the parenchyma (solid viscera). Given the proximity and/or attachments between abdominal viscera (e.g., gastrosplenic ligament), torsion of one organ usually causes traction of another.

If left untreated, organ torsions result in significant pain, organ dysfunction, hemodynamic compromise, and even death. Triaging and stabilizing patients presenting with an acute abdomen is absolutely imperative before pursuing imaging studies.<sup>1</sup> Most patients benefit from flow-by oxygen, fluid resuscitation, and

analgesic therapy. However, imaging should immediately follow hemodynamic stabilization, as prompt diagnosis and surgical correction are necessary for a positive outcome in all of the following conditions.

## GASTRIC DILATATION AND VOLVULUS

As the name implies, gastric dilatation and volvulus (GDV) refers to the twisting of a stomach that is distended with gas and/or fluid. Although risk factors and commonly affected breeds (e.g., large- or giant-breed, deep-chested dogs) have been investigated, GDV can occur in any breed of dog, at any age, and with a variable history.

### Imaging Findings

The radiographic appearance of GDV depends on the contents of the stomach, magnitude of distention, and degree of rotation.<sup>2</sup> Identifying the location of the abnormally positioned pylorus is key to diagnosing GDV and

#### TWISTED STOMACH

Abdominal pain, depression, anxious behavior, and distention are typical symptoms associated with gastric dilatation-volvulus.

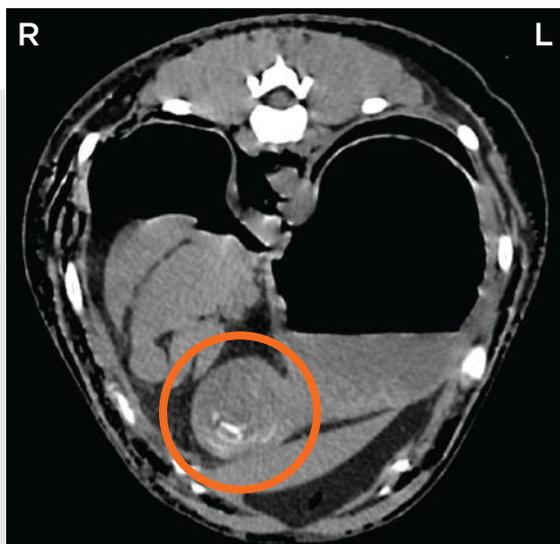
differentiating it from conditions that cause only gastric dilatation. In dogs, the normal pylorus is oriented ventrally and to the right of midline (**FIGURE 1**). Most commonly, the stomach rotates clockwise approximately 180°, with the pylorus malpositioned dorsally and to the left of midline (when looking at the dog in a caudal to cranial direction). The spleen often shifts abnormally to the right with the fundus of the stomach, owing to their connection via the gastrosplenic ligament.

If GDV is suspected, a right lateral projection of the cranial abdomen is usually all that is needed to confirm the diagnosis.<sup>2</sup> The key radiographic findings are compartmentalization and malpositioning of the pylorus craniodorsal to its normal location.<sup>2</sup> In normal dogs, a right lateral projection shows fluid filling the pylorus while gas fills the fundus and body (**FIGURE 2A**). In patients with GDV, gas fills the craniodorsally located pylorus. Both fluid and gas are seen in the body and fundus (**FIGURE 2B**). The stomach often takes on an appearance that has earned numerous colloquial nicknames, such as a “reverse C,” “boxing glove,” “double bubble,” “Popeye’s arm,” or “Smurf hat.” This appearance is pathognomonic and requires no further radiographic views or imaging studies. In the rare instances that a right lateral projection is equivocal, ventrodorsal and left lateral projections may be performed to better identify the

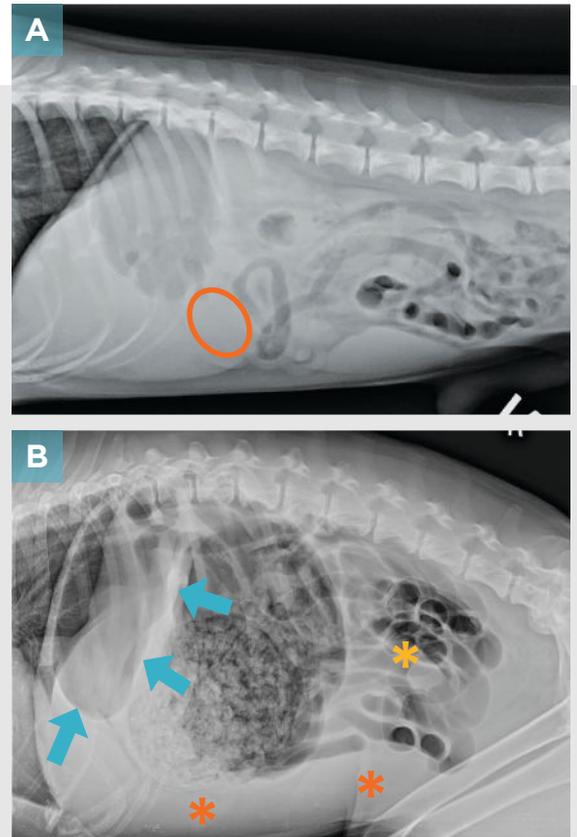
position of the pylorus. On ventrodorsal (or dorsoventral) projections, the pylorus will be located to the left of midline (**BOX 1**).

### Confounding Factors

A few tips should be kept in mind when considering a diagnosis of GDV. First, the degree of gastric distention is quite variable. Minimal gastric distention does not rule out GDV. Second, sometimes GDV is an incidental finding during thoracic radiography in animals that present with the client description of “excessive panting” or “respiratory distress.” The edge of the film on thoracic radiographs should always be examined for the presence of a malpositioned pylorus (**FIGURE 3**). Third, radiographs are a snapshot in time.



**FIGURE 1.** Transverse computed tomographic image of the stomach of a dog in sternal recumbency. The normal location of the pylorus (**orange circle**) in the abdomen is ventral and to the right of midline. The pylorus in this image contains fluid and bony fragments.



**FIGURE 2.** (A) Right lateral radiograph of a dog with a normal stomach. Note the ventrally located, fluid-filled pylorus (**orange circle**). (B) Right lateral radiograph of a dog with GDV. Note the craniodorsally located, compartmentalized, gas-filled pylorus (**blue arrows**). The mottled, soft tissue-opacity material within the body/fundus of the stomach is likely normal ingesta. This dog also has an enlarged and abnormally positioned spleen (**orange asterisks**) as well as caudally displaced small bowel that is diffusely dilated with a moderate volume of gas (**yellow asterisk**).

A few patients derotate once they are sedated and positioned for surgery. Failure to confirm GDV during surgery does not necessarily refute the pathognomonic diagnostic criteria seen on preoperative radiographs. Finally, GDV must be distinguished from functional and mechanical causes of gastric dilatation. Without volvulus, the pylorus will remain in its normal position. In cases of gastric dilatation without volvulus, a left lateral projection can be used to shift gas into the pylorus, helping to demonstrate its normal position. If a mechanical pyloric outflow obstruction is present, the gas may even provide negative contrast to visualize the causative lesion or foreign body.

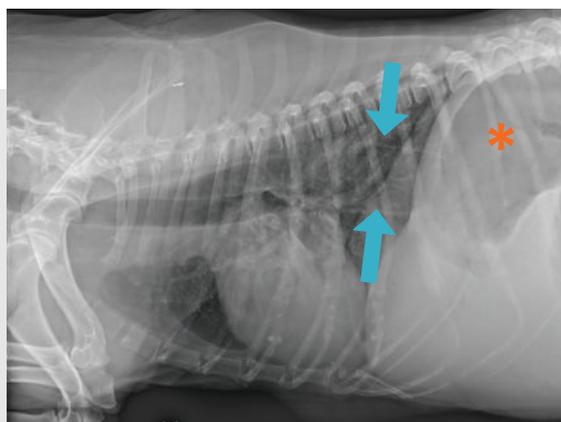
GDV is a relatively straightforward diagnosis as long as the pylorus remains malpositioned and visible. The hardest form of GDV to diagnose is a complete 360° rotation. In these cases, the pylorus and fundus deceptively return to their normal position, causing the stomach to look distended but not rotated (**FIGURE 4**). Since no radiographic finding is pathognomonic, physical examination findings and clinical intuition are essential to making the diagnosis.<sup>2</sup> During the initial triage examination, patients with a 360° GDV are more likely to be painful, in shock, and have abnormalities in blood lactate concentration. Failure to pass an orogastric tube is perhaps the most suspicious finding in a patient with 360° GDV. Ancillary radiographic findings that support GDV alone include esophageal dilation (**FIGURE 4**), a small caudal vena cava, microcardia, and an abnormally located spleen.<sup>2</sup>

Isolated splenic torsion is an uncommon condition that occurs when the spleen rotates around its vascular pedicle and ligamentous attachments.<sup>5</sup>

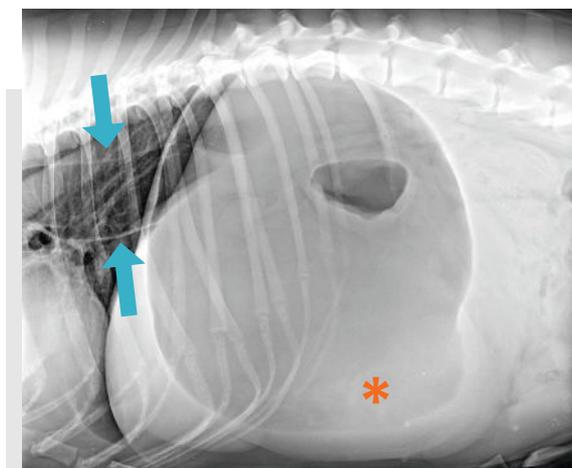
### SPLENIC TORSION

Isolated splenic torsion is an uncommon condition that occurs when the spleen rotates around its vascular pedicle and ligamentous attachments.<sup>5</sup> Rotation of the spleen's vascular supply causes complete (or near complete) venous occlusion and partial to complete arterial occlusion. Although an acute onset of clinical signs is presumably most common, a more chronic history is also reported and likely explained by the varying degree of vascular occlusion that can occur.<sup>5</sup> Once torsion occurs, venous congestion and ischemia lead to inflammation, infarction, and necrosis of the spleen. Although the splenic parenchyma usually remains sterile, secondary infection with gas-producing bacteria such as *Clostridium* spp has been reported.<sup>3</sup>

Splenic torsion may occur by itself or in conjunction with GDV. Similar to GDV, splenic torsion is reported



**FIGURE 3.** Right lateral radiograph of a 13-year-old basset hound with a history of vomiting and respiratory distress following a dental prophylaxis 3 days earlier. Note the craniodorsally located, compartmentalized, gas-filled pylorus (**orange asterisk**) on the edge of the projection caudally and the dilated intrathoracic esophagus (**blue arrows**).



**FIGURE 4.** Right lateral radiograph of a dog with a 360° GDV. The stomach is dilated with a large amount of gas and fluid. The pylorus (**orange asterisk**) is not easily identified, as it has returned to its normal ventral, fluid-filled location. Note the gas-dilated esophagus (**blue arrows**).

**BOX 1 Summary of Imaging Findings With Abdominal Organ Torsions**

**Gastric dilatation with volvulus**

- Craniodorsally located, compartmentalized pylorus (usually gas-dilated)
- Enlarged and abnormally located spleen
- Dilated esophagus
- Small caudal vena cava and microcardia

**Splenic torsion**

- Radiographic
  - Moderate to severe splenic enlargement, often mimicking a mass
  - Abnormally positioned spleen with a reverse C-shape
  - Absence of the splenic head
  - Air vasculogram<sup>3</sup>
- Ultrasonographic
  - Heterogeneous hypoechoic splenic parenchyma
  - Reduced or absent blood flow within the splenic parenchyma
  - Dilated splenic vein with reduced or absent blood flow
  - Hyperechoic hilar perivenous triangle<sup>4</sup>

**Colonic torsion**

- Moderate to severe gaseous segmental dilation of the colon
- Cecum abnormally positioned dorsally and to the left of midline
- Descending colon abnormally positioned ventrally and to the right of midline
- Abrupt narrowing or disappearance of the descending colon

**Mesenteric volvulus**

- Moderate to severe gaseous or fluid dilation of the entire small bowel

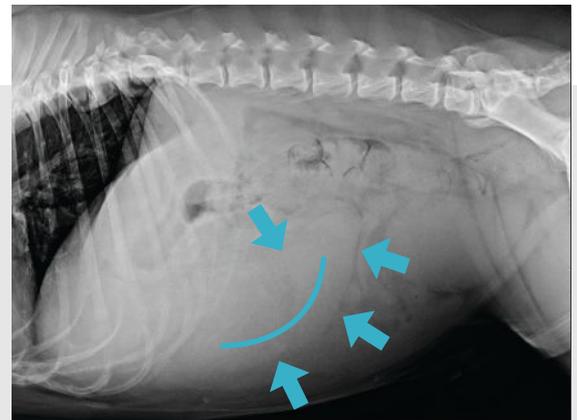
in Great Danes, German shepherds, English bulldogs, and other large- or giant-breed, deep-chested dogs. Although the exact etiology is not entirely understood, congenital or acquired laxity of the gastrosplenic and/or phrenicosplenic ligaments may play a role. Acquired laxity of these ligaments may be associated with previous surgeries, trauma, or GDV. Conflicting literature suggests a relationship between splenectomy and an increased risk for GDV, further illustrating the important anatomic relationship between the stomach and spleen via the gastrosplenic ligament.

**Imaging Findings**

Splenic torsion almost always results in severe enlargement of the spleen, which causes peripheral displacement of surrounding organs (**FIGURE 5**). Concurrent peritoneal effusion can obscure the spleen on radiographs, causing a mass effect in the middle to caudal abdomen. Given the ubiquitous and nonspecific nature of generalized splenomegaly or a mid-abdominal mass, these radiographs should be evaluated for more subtle signs that support the presence of a torsion. For example, malpositioning of the spleen secondary to torsion often results in a reverse C-shape on the lateral radiograph or the absence of the splenic head on the ventrodorsal projection.<sup>6</sup> If the spleen is infected, gas within the splenic parenchyma creates a characteristic “air vasculogram” or “emphysematous splenitis” that is almost pathognomonic for splenic torsion (**BOX 1**).<sup>3</sup>

**Confounding Factors**

Unfortunately, the definitive diagnosis of splenic torsion with radiographs alone is not always possible. If available, ultrasonography can rapidly differentiate splenic torsion from other, more common, splenic diseases. With torsion, the splenic parenchyma often becomes heterogeneously hypoechoic, taking on a mottled or lacy appearance (**FIGURE 6**).<sup>4</sup> Unfortunately, the splenic parenchyma can also remain ultrasonographically normal. Splenic veins are often dilated and will, along with the splenic parenchyma, demonstrate markedly reduced or absent blood flow



**FIGURE 5.** Right lateral radiograph of a dog with a splenic torsion. Note the markedly enlarged spleen with rounded margins and a “reverse C” shape (**blue line and arrows**). Concurrent peritoneal effusion due to hemorrhage and border effacement due to organ crowding are causing a moderate and diffuse decrease in serosal detail throughout the abdomen.

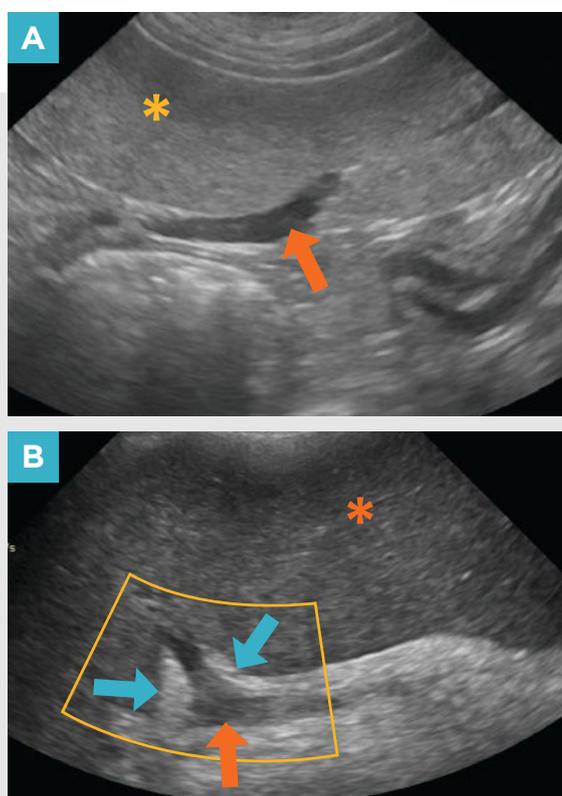
with color Doppler interrogation. Finally, a hilar hyperechoic perivenous triangle has been strongly associated with splenic torsion (**FIGURE 6**). In one study,<sup>4</sup> dogs with splenic torsion developed hyperechoic tissue in the shape of a triangle that surrounded the vascular pedicle. This tissue was often isoechoic to the mesentery and gave the appearance that the mesentery was entering the splenic hilum.

Although typically not available to the general practitioner, computed tomography with contrast easily identifies splenic torsion in cases that are unclear on radiographs.

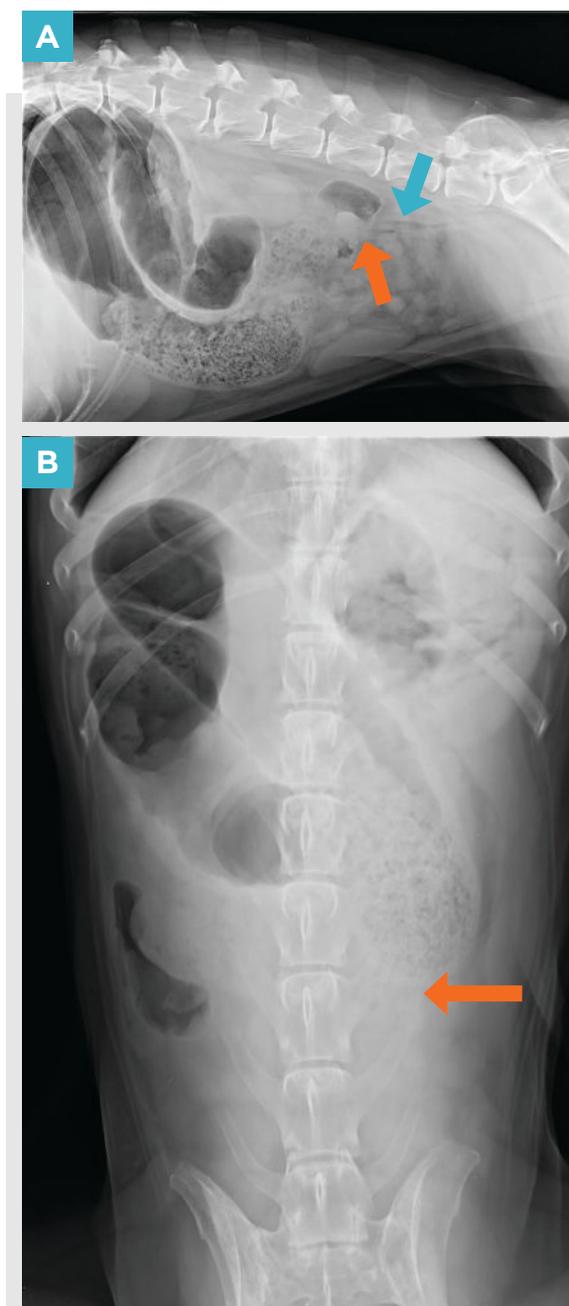
## COLONIC TORSION

Throughout the literature, the terms *torsion* and *volvulus* are both used to describe pathologic twisting of

the colon. Both result in mechanical obstruction and ischemia. However, the term *torsion* is specifically defined as twisting of any loop of bowel around its long axis whereas *volvulus* is the twisting of bowel around its mesenteric axis.<sup>7</sup> Although adherence to these



**FIGURE 6.** (A) Sagittal ultrasound image of the hilum of the normal canine spleen. Note the splenic parenchyma is hyperechoic and homogeneous in echogenicity and echotexture (**yellow asterisk**). The normal splenic vein is denoted by the orange arrow. (B) Sagittal ultrasound image of a dog with a splenic torsion. Note that the splenic parenchyma is hypoechoic and heterogeneous in echogenicity and echotexture (**orange asterisk**). A hyperechoic hilar perivenous triangle (**blue arrows**) is seen, and the splenic vein (**orange arrow**) does not demonstrate blood flow on color Doppler interrogation (**yellow box**).



**FIGURE 7.** (A) Right lateral and (B) ventrodorsal radiographs of a dog with a colonic torsion. Note the segmental gaseous dilation of the colon with focal narrowing of the caudal aspect of the descending colon (**orange arrows**). Gas opaque linear striations are seen within the lumen of the descending colon immediately distal to the focal narrowing (**blue arrow**).

Mesenteric volvulus is the rare and often fatal twisting of the small bowel around the root of the mesentery, causing complete occlusion of the cranial mesenteric artery.<sup>10,11</sup>

definitions is not consistent in the veterinary literature, torsion is likely the more common variant in the colon since radiographic findings often support a twisting of the descending colon around its long axis.

As seen with GDV and splenic torsion, large- and giant-breed dogs appear predisposed, with extra consideration given to German shepherds, Great Danes, and Labrador retrievers.<sup>7,8</sup> Many dogs that develop colonic torsion do so along with or following an episode of GDV. A smaller percentage of dogs also develop colonic entrapment around the gastropexy site. It is worth noting that, although patients with colonic torsion often present for vomiting, as occurs with other causes of acute abdomen, many do not present with abdominal pain.<sup>7</sup>

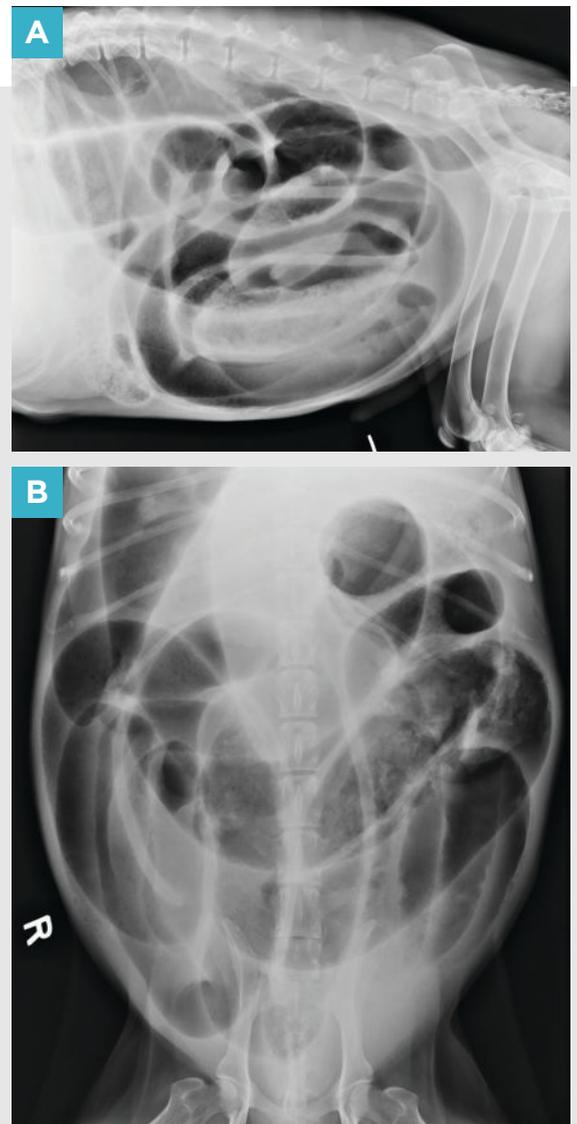
### Imaging Findings

In normal dogs, the cecum is usually located at the level of or ventral to the descending colon on lateral projections. On the ventrodorsal projection, the cecum is normally located to the right of midline in the mid-abdomen to cranial abdomen, whereas the descending colon is located to the left of midline. A normal colonic diameter in dogs usually does not exceed the length of the L7 vertebral body.<sup>9</sup> The radiographic findings of colonic torsion have been best investigated and described in a recent retrospective case series of 14 dogs.<sup>7</sup> In this case series, all dogs presented with gaseous segmental dilation of the colon (**FIGURE 7**) and abnormal displacement of the descending colon ventrally and to the right of midline. In the 79% of dogs in which the cecum was identified, it was also abnormally displaced, most often found dorsally and to the left of midline. Almost 79% of dogs demonstrated focal narrowing of the descending colon. Alternatively, abrupt disappearance of the descending colon has been

described.<sup>8</sup> Although usually not necessary for a definitive diagnosis, in the 4 dogs in which a barium enema was performed, longitudinal striations in a helical pattern were seen at the region of focal narrowing.<sup>7</sup> The small bowel is usually normal or only mildly and diffusely dilated with gas or fluid (**BOX 1**).

### Confounding Factors

Similar to dogs with GDV, colonic torsion may be dynamic and resolve before emergency celiotomy, creating the false impression of negative findings on exploration. In the aforementioned case series,<sup>7</sup> colonic



**FIGURE 8.** (A) Right lateral and (B) ventrodorsal caudal abdominal radiographs of a dog with mesenteric volvulus. Note the diffuse, severe gaseous dilation of all visible segments of the small bowel.

torsion was confirmed at the time of surgery in only 65% of dogs. However, the remaining 35% of dogs had grossly diffuse changes to the colon and mesentery that were strongly supportive of ischemia associated with colonic torsion.

## MESENTERIC VOLVULUS AND SMALL INTESTINAL TORSION

Mesenteric volvulus is the rare and often fatal twisting of the small bowel around the root of the mesentery, causing complete occlusion of the cranial mesenteric artery.<sup>10,11</sup> The exact cause is unknown but may share similar predisposing factors as seen in GDV. A recent study<sup>11</sup> of military working dogs established the following risk factors: breed (e.g., German shepherd), increased age, a history of gastrointestinal disease, or a history of gastropexy or other abdominal surgeries.

The link between gastropexy and mesenteric volvulus is unclear, and caution is advised when interpreting this finding. At this time, the benefit of gastropexy in preventing GDV likely outweighs the risk of mesenteric volvulus, which is considered rare. In another case series,<sup>12</sup> mesenteric torsion was reported in 21 out of 199 dogs with exocrine pancreatic insufficiency. It is unclear whether this association represents a breed predisposition or an etiologic relationship between the 2 diseases. Most patients with mesenteric volvulus present peracutely with no previously reported gastrointestinal signs or diseases.

### Imaging Findings

Similar to other gastrointestinal torsions, the radiographic features of mesenteric volvulus include moderate to severe dilation of most of the small bowel with gas and fluid (**FIGURE 8**).<sup>10</sup> Peritoneal effusion is variable, and concurrent torsion of other organs (e.g., GDV) is possible. In the early stages of the condition, radiographic findings can mimic those of functional ileus if the bowel dilation is only moderate. However, patients with mesenteric volvulus always present more painful and hemodynamically unstable, and they rapidly deteriorate clinically. If necessary, repeating abdominal radiographs in as little as 1 to 2 hours will likely demonstrate marked progression of the small bowel diameter (**BOX 1**).

### Confounding Factors

Torsion of a focal region of small bowel is possible but

also rare. Given the small portion of gut affected, these patients are usually more stable and have an overall better prognosis. Radiographic findings, which include segmental dilation of the affected bowel with gas or fluid, are similar to those of small intestinal mechanical obstruction. More significant dilation can create bowel with a stacked appearance due to crowding that causes hairpin turns. Differentiating this condition from small intestinal mechanical obstruction is impossible. Fortunately, immediate surgical intervention is indicated for both conditions. **TVP**

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### Marc Seitz

After graduating from Mississippi State University, Dr. Seitz spent 8 years in private practice as both a general practitioner and emergency clinician. His passion for teaching brought him back to MSU as an assistant clinical professor of emergency medicine. He is currently working toward a second specialty in diagnostic imaging. Outside of veterinary medicine, Dr. Seitz lives with his amazing wife, spirited daughter, and geriatric Labrador, and enjoys running and cycling.