What Is Your Diagnosis?

In collaboration with the American College of Veterinary Radiology

Figure 1—Right lateral (A), left lateral (B), and ventrodorsal (C) radiographic images of the abdomen of a 15-year-old spayed female mixed-breed dog with a 2-day history of worsening anorexia, vomiting, and restlessness and a 2-year history of intermittent vomiting and weight loss.

History

A 15-year-old 13.4-kg spayed female mixed-breed dog was presented with a history of worsening vomiting, anorexia, and restlessness for 2 days. The owner reported that over the previous 2 years, the dog had had intermittent vomiting and decreased body weight from 22 kg to 13.4 kg. On physical examination, the dog was lethargic and had severe muscle wasting, 5% to 8% dehydration, 2/9 body condition score, tachypnea (78 breaths/min; reference range, 18 to 35 breaths/min), and tachycardia (150 beats/min;

reference range, 70 to 120 beats/min) with left apex systolic murmur (grade 2/6). The rectal temperature was within reference limits (39 °C; reference range, 37.2 to 39.2 °C). The oral mucous membranes were pink but dry. The capillary refill time was within reference limits.

Hematologic examination revealed polycythemia (67.8%; reference range, 37.3% to 61.7%) and leukocytosis (20,540 leukocytes/ μ L; reference range, 5,050 to 16,760 leukocytes/ μ L) characterized by neutrophilia without left shift. Serum biochemical examination revealed high activities of alanine aminotransferase (411 U/L; reference range, 10 to 125 U/L) and alkaline phosphatase (243 U/L; reference range, 23 to 212 U/L) and high concentrations of creatinine (3.6 mg/dL; reference range, 0.5 to 1.8 mg/dL) and BUN (105 mg/d; reference range, 7 to 27 mg/dL). The canine pancreatic lipase test (SNAP cPL Test; Idexx Laboratories) was positive. Abdominal radiographs were obtained (Figure 1).

Wen-Sheng Li ,DVM¹; Ruey-Shyuan Wu, DVM, MS¹; Pin-Chen Liu, DVM, PhD¹; Hsien-Chi Wang, DVM, PhD^{1,2}; Kuan-Sheng Chen, DVM, PhD^{1,2*}

¹Veterinary Medical Teaching Hospital, College of Veterinary Medicine, National Chung Hsing University, Taichung, Taiwan

²Department of Veterinary Medicine, College of Veterinary Medicine, National Chung Hsing University, Taichung, Taiwan

*Corresponding author: Dr. Chen (kschen@dragon.nchu.edu.tw)

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Formulate differential diagnoses, then continue reading.

Figure 2— Same radiographic images as in Figure 1. There is marked gastric distension and a gas-filled dilated esophagus (e). The fundus (black arrowheads) is gas filled in the right lateral image (A) but fluid filled in the left lateral image (B). The pylorus (white arrowheads) is filled with gas and fluid in the right lateral image (A) but is completely gas filled in the left lateral image (B). A large amount of gas-filled fundus and pylorus with normal anatomic position is evident in the ventrodorsal image (C). The spleen (asterisks) is displaced into the caudoventral aspect of the abdomen in a reverse C-shape position, and the splenic head (white arrow) is in the left caudal region of the abdomen. The caudoventral liver margins are rounded.

Diagnostic Imaging Findings and Interpretation

In the abdominal radiographic images (**Figure 2**), the stomach was markedly distended with a large amount of fluid and gas, and the fundus and pylorus were in the normal anatomic positions. The small intestine was displaced caudally, and the serosal detail in the caudal abdomen was mildly decreased. The spleen was caudoventrally displaced in an orientation resembling a reverse C-shape, but its size was within normal limits. The splenic head was located in the left caudal abdomen. The caudal esophagus was markedly dilated with gas, and the liver had rounded margins. These radiographic findings of the stomach were most compatible with 360° gastric dilatation-volvulus (GDV). Other differential diagnoses including gastric dilatation (GD) or chronic pyloric obstruction such as hypertrophic pyloric stenosis, pylorospasm, foreign body, inflammation, scarring, or neoplasia were unlikely. The malpositioned spleen was most likely caused by the gastric malpositioning instead of GD because of anatomic connections between the fundus and spleen. Splenic torsion was considered unlikely, given no splenomegaly. The most likely cause of the distended

esophagus was mechanical obstruction secondary to GDV, which hindered the egress of air from the esophagus to stomach. Other differential diagnoses included esophagitis or neuromuscular dysfunction. Differential diagnoses of the rounded hepatic margins included normal variation, inflammation, metabolic disorders, or neoplasia.

The vital signs of the patient were relatively stable, and it was alert and cooperative during physical and radiographic examinations; these observations were not typical for a case of GDV (eg, nonproductive retching, dyspnea, hypersalivation, prolonged capillary refill time, pale mucous membranes, and a weak pulse). To confirm GDV and rule out other differential diagnoses, a contrast-enhanced (Optiray 350, Liebel-Flarsheim Canada Inc) CT (Alexion 16, Toshiba) was performed with mild sedation (**Figure 3; Supplementary Videos SV1 and SV2**). The stomach was markedly distended with fluid, gas, and food, and the gastroduodenal junction had shifted from the right to the midline. The proximal duodenum coursed over the abdominal esophagus at the midline and then proceeded ventrally, and the descending duodenum coursed back to the right side. A mixed, soft tissue- and fat-attenuating whirl sign was observed, composed of a clockwise axial rotation of the abdominal

Figure 3—Postcontrast transverse (A), dorsal oblique multiplanar reconstruction (B), and dorsal (C) plane abdominal CT images in a soft tissue window (window width, 400 HU; window length 40 HU) of the dog described in Figure 1. The gastroduodenal junction (black arrows) is displaced toward the midline and the proximal duodenum (d) and leftward and dorsally between the abdominal portion of the esophagus (e) and fundus (black arrowheads). The fundus is in the left side of the abdomen, the pylorus (white arrowheads) is in the right side, and the spleen (asterisk) is displaced, with the splenic head (solid white arrow) shifted to the midline in the caudal aspect of the abdomen. A whirl sign, composed of the esophagus, vessels, and fat (open arrow), in the middle aspect of the abdomen is evident. d = Duodenum. e = Esophagus. gb = Gallbladder.

esophagus and surrounding vessels. The splenic head had been shifted from its normal position in the left cranial abdomen to the midline in the caudal abdomen; however, the size, margin, shape, and contrast enhancement were within normal limits. The final diagnosis was a clockwise 360° GDV, based on the CT results.

Treatment and Outcome

The owner decided to euthanize the dog because of the poor prognosis. During necropsy, a clockwise 360° GDV and torsion of the abdominal esophagus were confirmed. The stomach was covered by the greater omentum and the spleen was displaced in the caudal abdomen. Macroscopic observation of the gastric wall and esophagus was unremarkable. The liver was mildly enlarged and had multifocal dark red spots. A histopathologic diagnosis of the liver was congestion.

Comments

GDV is a life-threatening condition that has been reported in dogs and its clinical signs may include abdominal distension, nonproductive retching, dyspnea, hypersalivation, prolonged capillary refill time, pale mucous membranes, and a weak pulse.^{1,2} However, the etiology and pathogenesis are still unclear.^{1,3} GDV is defined as the twisting of the stomach around its long axis and concomitant dilatation with food, fluid or gas in a clockwise or counterclockwise direction.¹ A typical GDV can be diagnosed radiographically, especially in the right lateral view. Radiographic features of a typical GDV include dorsal displacement of the gas-filled pylorus and compartmentalization of the stomach.⁴ The reported maximum clockwise rotation is 360°, and the maximum counterclockwise rotation is 90°. Cases of 360° GDV are rare compared to those of typical GDV.⁴ In this case, the radiographic features revealed a 360° GDV, but the typical clinical signs described above were absent.

Although CT can facilitate better anatomic evaluation, it is not necessary for diagnosing GDV because patients are usually unstable and require immediate surgery. Because the clinical signs of this patient were relatively stable and not characteristic of a typical GDV, CT was used to rule out other differential diagnoses and confirm the diagnosis of 360° GDV. The CT features of clockwise 360° GDV in this case included a medial displacement of the gastroduodenal junction, left dorsal displacement of the proximal duodenum between the esophagus and fundus, and torsion of the esophagus with a whirl sign. The whirl sign observed on CT indicates organ torsion or volvulus with relative blood vessels, which reveals the spiral path of the twisted tissue.^{5,6} Based on our literature review, these CT features have not been described previously in dogs with GDV.

It is challenging to differentiate 360° GDV from GD solely based on clinical signs and the position of pylorus and fundus radiographically.^{3,4} In a previous study, 16 (6.6%) out of 243 dogs confirmed with GDV were radiographically suspected with severe GD or 360° GDV, but only 6 (2.5%) dogs were diagnosed with 360° GDV based on the results of surgery or necropsy.⁴ The position of the fundus and pylorus appears normal radiographically in GD and 360° GDV.⁴ However, a markedly dilated esophagus and a malpositioned spleen may be indicative of GDV. In dogs with GDV, a volvulus is associated with occlusion that hinders the esophageal outflow and is secondary to the torsion of the distal esophagus.⁷ Thus, marked esophageal dilatation could support gastric malpositioning over GD. Furthermore, the inability to pass a stomach tube may also be indicative of a gastric malposition. The spleen is usually displaced with the greater curvature because it is attached to the gastric fundus by the gastrosplenic ligament. Malposition of the spleen, in combination with gastric dilatation of the pylorus without displacement or

compartmentalization, has recently been suggested as a radiographic sign of 360° GDV in dogs.² These radiographic findings are similar to that presented in this report. Although it is yet to be proven, evaluation of the spleen position may be beneficial in differentiating 360° GDV from GD.

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References

1. Broome CJ, Walsh VP. Gastric dilatation-volvulus in dogs. *N Z Vet J*. 2003;51(6):275–283. doi:10.1080/00480169.2003.36381.
2. Paravicini PV, Gates K, Kim J. Gastric dilatation organoaxial volvulus in a dog. *J Am Anim Hosp Assoc*. 2020;56(1):42–47. doi:10.5326/JAAHA-MS-6733.
3. Evans KM, Adams VJ. Mortality and morbidity due to gastric dilatation-volvulus syndrome in pedigree dogs in the UK. *J Small Anim Pract*. 2010;51(7):376–381. doi:10.1111/j.1748-5827.2010.00949.x.
4. Fischetti AJ, Saunders HM, Drobatz KJ. Pneumatosis in canine gastric dilatation-volvulus syndrome. *Vet Radiol Ultrasound*. 2004;45(3):205–209. doi:10.1111/j.1740-8261.2004.04034.x.
5. Ricciardi M, Campanella A, Martino R. Computed tomographic features of urinary bladder torsion in two dogs. *J Small Anim Pract*. 2018;59(3):188–195. doi:10.1111/jsap.12694.
6. Hughes JR, Johnson VS, Genain MA. CT characteristics of primary splenic torsion in eight dogs. *Vet Radiol Ultrasound*. 2020;61(3):261–268. doi:10.1111/vru.12844.
7. Muhlbauer MC, Kneller SK. Abdomen. In: Muhlbauer MC, Kneller SK, eds. *Radiography of the Dog and Cat: Guide to Making and Interpreting Radiographs*. John Wiley & Sons Inc; 2013:377–456.

Supplementary Materials

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