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What Is Your Diagnosis?

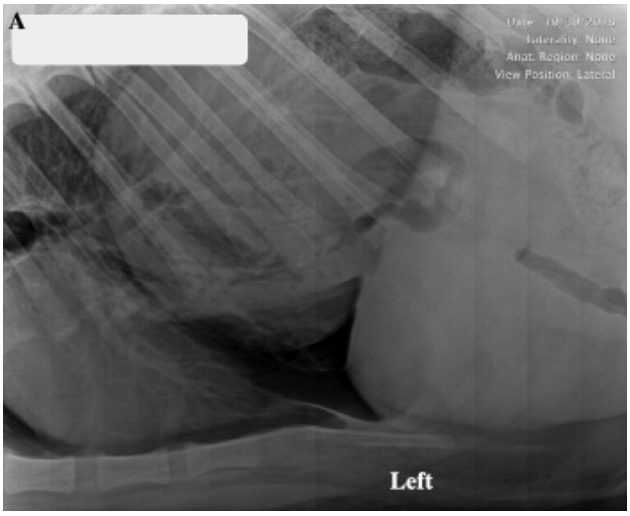

Figure 1—Left lateral (A) and ventrodorsal (B) thoracic radiographic images of a 2.5-year-old 136-kg sexually intact male white Bengal tiger (*Panthera tigris tigris)* hybrid that was referred because of a 1-month history of intermittent vomiting. Patient positioning is oblique in the ventrodorsal projection, and in both projections, portions of the thorax extend beyond the radiographic image margins because of the tiger's large size.

History

A 2.5-year-old 136-kg sexually intact male white Bengal tiger (*Panthera tigris tigris*) hybrid was referred because of a 1-month history of intermittent vomiting that did not respond to empirical treatment with omeprazole and sucralfate. The caretaker also reported that the tiger had had severe metabolic bone disease when it was obtained by a large felid rescue center 2 years earlier and that mild lameness had persisted, for which the tiger was receiving gabapentin (3 mg/kg, PO, q 12 h). The tiger was reported as otherwise healthy with normal activity and appetite levels. Results of a CBC and serum biochemical analyses performed by the referring veterinarian indicated moderate normocytic, hyperchromic, nonregenerative anemia with an Hct of 20.7% (reference range, 30.3% to 52.3%), high amylase activity (2,229 U/L; reference range, 500 U/L to 1,500 U/L), and mildly low lipase activity (96 U/L; reference range, 100 U/L to 1,400 U/L).[a]

The tiger was anesthetized with medetomidine (0.03 mg/kg), ketamine (3 mg/kg), and midazolam (0.1 mg/kg) administered IM with the use of a blow dart. On physical examination, the tiger's rectal temperature, heart rate, and respiratory rate were within reference limits for domestic cats during anesthesia. The tiger had signs of mild pyoderma on the ventral aspect of its abdomen and small skin ulcerations on its metatarsal pads bilaterally. The remaining findings from physical examination were unremarkable.

A CBC and serum biochemical analyses were performed, and results indicated moderate normocytic, normochromic, nonregenerative anemia with an Hct of 21%, and the remaining findings were unremarkable. Survey thoracic radiographic images **(Figure 1)** obtained by the referring veterinarian were reviewed.

Formulate differential diagnoses and treatment strategies from the history, clinical findings, and Figure 1—then turn the page →

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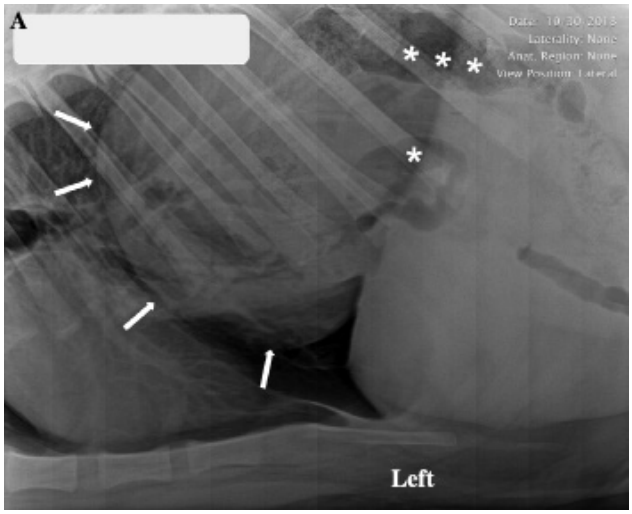

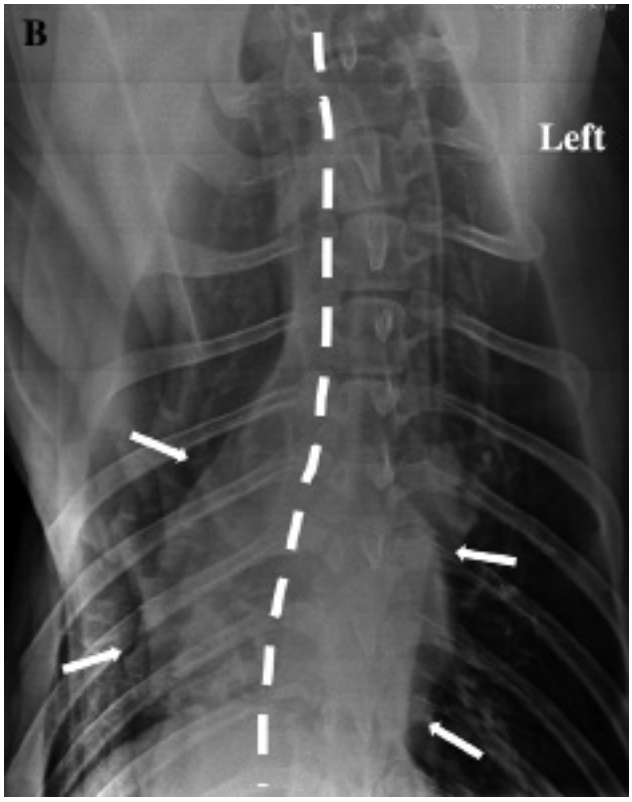

Figure 2—Same radiographic image as in Figure 1. There is a large, well-defined, smoothly marginated soft tissue structure (arrows) in the central to left caudodorsal aspect of the thorax. This soft tissue opaque mass has a gas-filled tubular structure (single asterisk) and a tubular structure containing heterogenous gas and soft tissue opaque material (triple asterisks), suggestive of feces in the colon. The mediastinum (dotted lines) and cardiac silhouette are shifted rightward, exacerbated by the obliquity of patient positioning, which also causes the soft tissue mass to be superimposed with structures in the right hemithorax. There is border effacement of the caudal aspect of the cardiac silhouette by the cranial aspect of the soft tissue mass.

Diagnostic Imaging Findings and Interpretation

Although the thoracic radiographic images provided did not show the entire thorax, findings evident included a large, smoothly marginated, well-defined, soft tissue structure in the central to left caudodorsal aspect of the thorax, and this structure was confluent with the abdomen **(Figure 2)**. On the ventrodorsal projection, the mediastinum was shifted rightward, and the caudal aspect of the cardiac silhouette was border effaced by the incompletely imaged mass. The abnormal soft tissue structure involved 2 tubular structures: one that contained only gas and that was presumed to have been the small intestine, and a second that contained heterogenous gas and soft tissue opaque material, suggestive of feces in the colon. Differential diagnoses for the soft tissue mass containing gastrointestinal structures were hiatal hernia, atypical congenital diaphragmatic hernia, or atypical diaphragmatic rupture.

To better define the lesion, CT was performed before and after IV administration of contrast medium (iohexol[b]; 300 mg I/mL; 0.74 mL/kg). On CT, the tiger's stomach, transverse colon, and spleen were displaced cranially into the left hemithorax and partly encapsulated by a thin soft tissue–attenuating and uniformly contrast-enhancing structure, consistent with a hernia sac composed of the phrenoesophageal ligament and peritoneum **(Figure 3)**. The caudal aspect of the esophagus was displaced ventrally and had a sigmoidal path as it crossed the diaphragm and entered the cardia of the stomach. The body of the stomach maintained its normal anatomic relationship to the transverse colon and head of the spleen. The cranial displacement of abdominal organs caused rightward displacement of the heart. These findings were consistent with a type 4 hiatal hernia.

Treatment and Outcome

The tiger underwent exploratory laparotomy, and findings confirmed type 4 hiatal hernia with the stomach, small and large intestines, and spleen displaced cranially through the defect. After the abdominal organs were returned to their normal anatomic position, a diaphragmatic hiatal plication and reduction were performed with size-0 polypropylene suture[c] placed in a simple continuous pattern. A left-sided incisional gastropexy was then performed and included placement of 2-0 polydioxanone suture[d] in a simple continuous pattern. No other abnormalities were found during surgery, and the laparotomy incision was closed routinely. The tiger recovered without complication and at last follow-up 7 months after surgery had not had any further episodes of vomiting.

Comments

In domestic dogs and cats, the esophagus passes through the esophageal hiatus in the diaphragm, to enter the abdominal cavity.[1] The esophagus is connected to the hiatus by the phrenicoesophageal liga-

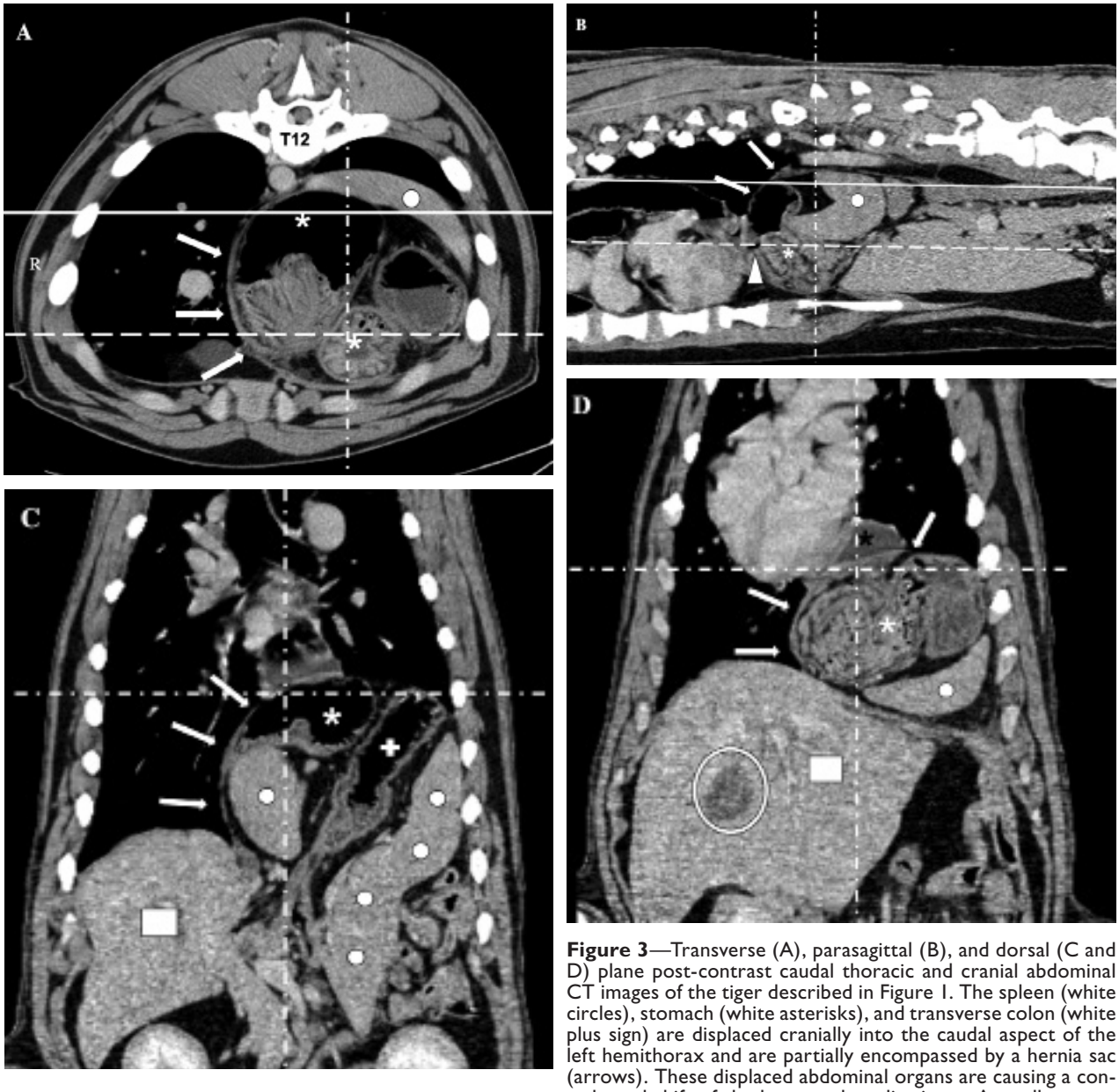

Figure 3—Transverse (A), parasagittal (B), and dorsal (C and D) plane post-contrast caudal thoracic and cranial abdominal CT images of the tiger described in Figure 1. The spleen (white circles), stomach (white asterisks), and transverse colon (white plus sign) are displaced cranially into the caudal aspect of the left hemithorax and are partially encompassed by a hernia sac (arrows). These displaced abdominal organs are causing a contralateral shift of the heart and mediastinum. A small amount of gas is evident at the gastroesophageal junction (arrowhead), and there is fluid in the lumen of the caudal aspect of the esophagus (black asterisk). No abnormalities are seen with the liver (white squares); the hypoattenuating area (encompassed by a circular outline) is considered a normal finding, consistent with the gallbladder. The images are presented in a soft tissue algorithm (window width, 300 HU; window level, 35 HU) with a 1.25-cm slice thickness. The lines across the images represent the planes of the other images, with the 2 dorsal planes distinguished by a solid line (represents the plane of C) and a dashed line (represents the plane of D). The tiger's right side is toward the left (A, C, and D) and its head is toward the left (B) or top (C and D). T12 = 12th thoracic vertebra.

ment, which prevents axial displacement of the abdominal portion of the esophagus into the thorax.[1] The gastroesophageal junction is the anatomic region where the esophagus transitions into the stomach and is located just caudal to the level of the diaphragm.[1] Hiatal hernias are characterized by the protrusion of abdominal organs through the esophageal hiatus and are divided into 4 types. The tiger of the present report had type 4 hiatal hernia (in which the gastroesophageal junction, larger parts of the stomach, and other abdominal organs herniate through the hiatus),[1,2] suggested radiographically by evidence of 2 tubular structures similar to small intestine and colon associated with the abnormal mass identified in the thoracic cavity. Findings on CT and laparotomy confirmed type 4 hiatal hernia. The pathophysiologic process of hiatal hernia development is complex and can involve multiple factors, including displacement of the lower esophageal sphincter, anatomic changes to the esophageal hiatus and phrenicoesophageal ligament, alteration of the insertion angle of the esophagus into the stomach, motility disorders of the

esophagus, and diseases with respiratory, neurologic, or neuromuscular effects.[1,2]

To our knowledge, there have been 6 reports of hiatal hernias in exotic felids, specifically lynx (*Lynx lynx*), cougar (*Puma concolor*), lion (*Panthera leo*), leopard (*Panthera pardus*), and Bengal tiger.[3–5] The previously reported affected Bengal tiger also had a type 4 hiatal hernia; however, it occurred following an anesthetic event and was thought to be related to the animal's hypothyroidism.[5]

Clinical signs associated with hiatal hernias are related to gastroesophageal reflux caused by the displacement of the lower esophageal sphincter into the thorax and include regurgitation, dysphagia, vomiting, and ptyalism.[6] Respiratory signs, including dyspnea and exercise intolerance, can occur when there is increased intrathoracic pressure secondary to the hernia.

Diagnostic imaging evidence of hiatal hernias with displacement of abdominal organs into the thoracic cavity can be detected on radiography and CT, as was the case for the tiger of the present report. Additionally, definitive diagnosis can also be aided by performing positive-contrast imaging and endoscopy to identify evidence of gastroesophageal reflux and abnormally low esophageal motility.[7] For the tiger of the present report, we clearly saw on CT that the tiger's stomach, transverse colon, and spleen were displaced cranially into the left hemithorax and partly encapsulated by a thin soft tissue–attenuating and uniformly contrast-enhancing structure, consistent with a hernia sac composed of the phrenoesophageal ligament and peritoneum. Thus, we did not perform further diagnostic imaging but proceeded with laparotomy and surgical repair.

Acknowledgments

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Footnotes

a. Idexx Laboratories Corp, Westbrook, Me.
b. Omnipaque, GE Healthcare, Chicago, Ill.
c. Prolene, Ethicon Inc, Sommerville, NJ.
d. PDS, Ethicon Inc, Sommerville, NJ.

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