Ultrasonographic detection of ingested and perforating wooden foreign bodies in four dogs

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- Wooden foreign bodies are difficult to identify on survey radiographs, because they are often radiolucent. Focal soft-tissue swelling associated with an underlying periosteal response on the inner aspect of 1 of the left caudal ribs can assist the diagnosis.
- Ultrasonography may be helpful in identifying wooden foreign bodies in dogs. A wooden foreign body appears ultrasonographically as a linear, bright interface often associated with uniform acoustic shadowing.

A 3-year-old castrated male Labrador Retriever was examined by the referring veterinarian because of lethargy. The owner reported that the dog had eaten kabobs on sticks 6 weeks earlier. On physical examination, the dog was febrile (40°C [104°F]); signs of pain were evident during abdominal palpation. Radiographs of the abdomen were obtained, but no abnormalities were seen. Ampicillin (14 mg/kg [6.4 mg/lb], SC, once) and metoclopramide (0.3 mg/kg [0.14 mg/lb], SC, once) were administered, and the dog was discharged the following day. Amoxicillin (10 mg/kg [4.5 mg/lb], PO, q 12 h) was prescribed.

Four days later, the dog was reexamined because of a painful swelling of the left dorsal aspect of the trunk. Cytologic examination of a fine-needle aspirate from the swelling did not indicate a cause, and the dog was discharged with instructions for the owner to apply warm compresses and administer cephalexin (13.2 mg/kg [6 mg/lb], PO, q 8 h). Two days later, a 30 × 20-cm swelling involving the left aspect of the trunk was evident. No abnormalities were seen on a lateral radiographic projection of the abdomen. The mass was lanced, and a drain was placed. One week after drain removal, the swelling was smaller but still evident. Antimicrobial treatment was resumed for 2 weeks. The mass did not resolve, and the dog was referred to the Tufts University School of Veterinary Medicine.

On initial physical examination at the School of Veterinary Medicine, the dog was lethargic and had a 12 × 8-cm firm mass involving the left body wall adjacent to the 12th and 13th ribs. A CBC, serum biochemical panel, urinalysis, and abdominal radiography were performed. Results of the serum biochemical panel and urinalysis were unremarkable. Hematologic abnormalities included high WBC count and neutrophilia. On the ventrodorsal radiographic projection of the abdomen, there was an inhomogeneous soft-tissue opacity in the area of the swelling.

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Ultrasonographic evaluation of the mass revealed anechoic reticulation throughout thicker-than-normal, echogenic subcutaneous tissues. These changes were considered most likely a result of regional edema, seroma fluid, or granulation tissue. No discrete organized mass or fluid collection was evident. A long linear hyperechoic interface associated with uniform acoustic shadowing was seen in the gastric lumen (**Fig 1**). This linear structure appeared to cross the fundic wall, which appeared thicker than normal in this region. One end was located in the superficial connective tissue adjacent to the 12th and 13th ribs. There was no evidence of free peritoneal fluid or highly echogenic fat in the abdomen.

Ultrasonographic findings were considered indicative of perforation of the stomach wall by a linear foreign body. Exploratory celiotomy was performed, and the fundus and part of the body of the stomach were found to be adherent to the left body wall. Linear objects were palpable in the stomach. Gastrotomy was performed, and 2 wooden sticks were retrieved from the stomach. One was approximately 12 cm long; the other appeared broken and was approximately 8 cm long. One stick extended from the fundus of the stomach in the region of the left body wall and protruded in the pylorus. The other extended from the body wall to the antrum. The gastrotomy was closed in a routine fashion, and the portion of the stomach adherent to the body wall was resected and sutured with 2 mattress sutures. The abdomen was closed routinely, and the mass on the left side of the body wall was explored. No additional foreign bodies were found. Biopsy specimens were submitted for bacterial culture and histologic examination.

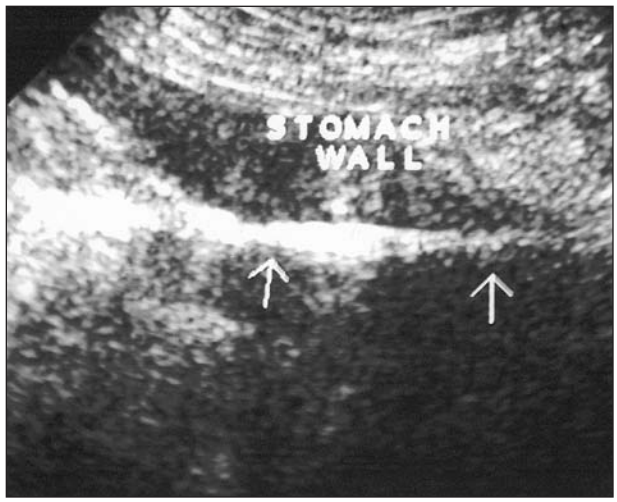

Figure 1—Ultrasonogram of the abdomen of a dog. A linear, bright interface (arrows) associated with uniform acoustic shadowing appears to cross the stomach wall and penetrate the adjacent subcutaneous tissues.

Granulomatous tissue was resected, an active drain was placed, and the incision was closed. Bacterial culture did not yield any growth. Histologically, necrosuppurative inflammation with fibrosis and granulation tissue was found in the tissue near the gastric perforation. The dog recovered without complications.

A 2.5-year-old Shetland Sheepdog was examined at the Tufts University School of Veterinary Medicine because of a painful mass located over the left caudal thoracic region. The swelling had developed 6 weeks previously when the dog had been taken care of by relatives for a weekend. The dog had been examined by a referring veterinarian and treated with amoxicillin-clavulanic acid (15 mg/kg [6.8 mg/lb], PO, q 12 h). The owner reported that the dog had a poor appetite, episodes of diarrhea, and signs of abdominal pain. Because of a lack of response to initial treatment, the dog was treated with cephalexin (20 mg/kg [9 mg/lb], PO, q 8 h), and abdominal radiographs were taken.

Evaluation of radiographs from the referring veterinarian revealed a proliferative bony reaction involving the left 11th rib (**Fig 2**). Cytologic examination of a fine-needle aspirate of the mass revealed a cellular infiltrate consistent with inflammation. Abdominal ultrasonography was performed. Soft tissues lateral to the caudal left ribs appeared swollen and contained anechoic striations. A linear echogenic tract extended from the gastric fundus laterally and caudally along the ventral aspect of the spleen to the body wall. At the body wall, the echogenic tract was in contact with a rib and extended into the subcutaneous space at the site of the external swelling. The rib had a surface defect. At the site where the tract was in close proximity to the ventral border of the spleen, the spleen appeared slightly deformed by discrete hyperechoic speckles associated with distal acoustic shadowing. The splenic changes were attributed to residual debris from a foreign body or dystrophic mineralization secondary to perforation from a migrating foreign body.

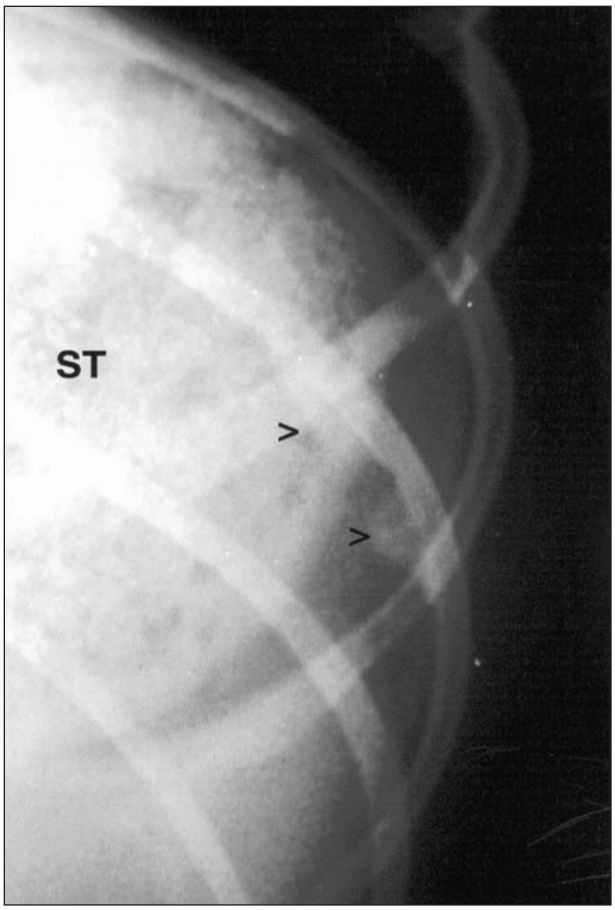

Figure 2—Ventrolateral radiographic projection of the left caudal ribs of a dog with a swelling involving the left caudal thoracic region. A well-defined periosteal response near a discrete bony defect is evident on the left 11th rib (arrowheads).

Routine abdominal exploration and gastrotomy were performed. A teriyaki stick approximately 10 cm long and a wooden coffee stirrer approximately 8 cm long were found in the stomach. A draining tract connected the stomach to the body wall in the area of the external mass. Some pinpoint fibrous scars, presumably a result of impalement by the teriyaki stick, were seen on the spleen. The abdomen was closed in a routine fashion. The left flank mass was surgically explored, and granulomatous tissue was removed. Bacterial culture of biopsy specimens did not yield any growth. Specimens were not submitted for histologic evaluation. The dog recovered without complications.

A 1-year-old Labrador Retriever mix was examined by the referring veterinarian because of lethargy, inappetence, and shaking. A diagnosis of gastroenteritis was made, and the dog was hospitalized for 3 days and treated with enrofloxacin (2.5 mg/kg [1.14 mg/lb], PO, q 12 h). The owner then noticed a swelling over the left flank. The dog was readmitted, and the area was lanced and a drain was placed. Doxycycline (4 mg/kg [1.8 mg/lb], PO, q 12 h) was administered at that time. Throughout this time, the dog had a persistently high WBC count.

The dog was referred to the Tufts University School of Veterinary Medicine because of lethargy and a flank swelling of 2 weeks' duration. A CBC, serum biochemical panel, and radiography were performed. Results of the serum biochemical panel were unremarkable. Hematologic abnormalities included a high WBC count and eosinophilia. Radiographs of the thorax were unremarkable. Biopsy specimens from the mass involving the left flank were submitted for bacterial culture and histologic examination. The histologic diagnosis was purulent necrotizing and fibrosing cellulitis. The dog was discharged, and the owner was instructed to administer amoxicillin-clavulanic acid (17.5 mg/kg [8 mg/lb], PO, q 12 h) pending results of bacterial culture. The bacterial culture did not yield any growth.

The dog was reexamined 11 days later, and the owner reported noticing a firm protrusion deforming the left flank area just caudal to the rib cage. Results of a CBC and serum biochemical panel were unchanged. On radiographs of the abdomen, there was a loss of abdominal detail near the spleen. Abdominal ultrasonography revealed a long (> 10 cm), linear, highly echogenic interface in the mid-portion of the abdominal cavity. This structure was associated with acoustic shadowing and outlined by a poorly echogenic tract (**Fig 3**) that was not connected to the gastrointestinal tract. Two discrete hypoechoic tracts were seen crossing the splenic parenchyma; these tracts were in close relationship to the most cranial aspect of the linear structure. The

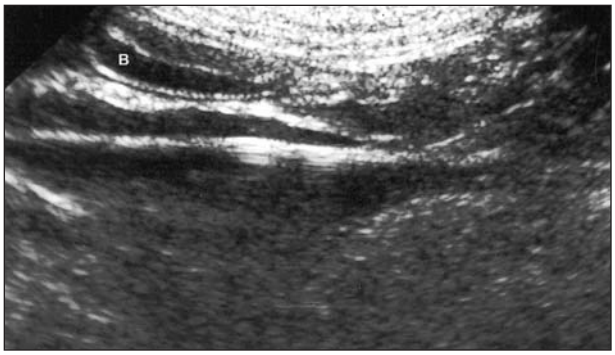

Figure 3—Ultrasonogram of the abdomen of a dog. A linear, highly echogenic interface associated with acoustic shadowing and outlined by a poorly echogenic tract is evident. B = Intestinal segment.

mesentery at that location appeared inhomogeneous, and a small amount of free peritoneal fluid was seen.

Routine abdominal exploration was performed. Adhesions of the omentum to the spleen were digitally broken down and ligated. A 15-cm wooden skewer embedded in the omentum was identified and removed. A fibrous tract of omentum was resected and submitted for bacterial culture and histologic examination. The dog recovered from surgery without complications. The diagnosis was granulation tissue associated with a foreign body; *Escherichia coli* was isolated from biopsy specimens.

A 4-year-old sexually intact male Lhasa Apso was examined by the referring veterinarian because of vomiting and listlessness. The dog had eaten part of a teriyaki stick 6 weeks previously. On physical examination, the dog was dehydrated, and the abdomen was tense on palpation. The remainder of the examination was unremarkable. The dog was treated with lactated Ringer's solution (250 mL, SC, once) and discharged. The owner was instructed to administer metronidazole (10 mg/kg, PO, q 12 h) and feed a bland diet. Two days later, enrofloxacin (2 mg/kg [0.9 mg/lb], PO, q 12 h for 10 days) was dispensed because the dog was not improving. Six days after the initial examination, the dog was returned to the referring veterinarian because of a mass involving the left body wall. The area was lanced, and the cavity was flushed with antimicrobial ointment and closed. No foreign objects were found. Surgery was again performed 2 weeks later, because the mass had increased in size. The necrotic tissue and a fistulous tract were débrided, but biopsy specimens were not submitted for bacterial culture or histologic evaluation. The dog was discharged, and the owner was instructed to administer enrofloxacin (2 mg/kg, PO, q 12 h). Two weeks later during suture removal, the incision site was swollen, and a purulent draining tract was present. The animal's appetite was decreased. Treatment with enrofloxacin was continued, and the dog was referred to the Tufts University School of Veterinary Medicine for further treatment.

On initial examination at the School of Veterinary Medicine, the dog was anorectic. Results of a physical examination were unremarkable except for a large (10 cm) hyperemic area involving the left flank that contained an open, draining incision with purulent, hemorrhagic discharge. Cytologic examination of an impression smear of the draining fluid revealed large numbers of RBCs and a few neutrophils. Results of a CBC and serum biochemical panel were unremarkable. Radiography of the area demonstrated a periosteal reaction involving the left 12th rib.

Ultrasonography revealed anechoic striations of the swollen soft tissues lateral to the left 12th rib. At the level of the draining tract, an echogenic tract associated with acoustic shadowing was seen in contact with the rib. The rib had an irregular contour. The tract appeared to extend to the region of the gastric fundus **(Fig 4)**. The gastric wall appeared thicker than normal (7 mm) in this region, and wall layering was reduced. A continuation of the linear tract was traced in the body of the stomach. There was no evidence of free air or fluid accumulating near the perforation site.

Abdominal exploration was performed. A linear foreign body palpable in the stomach had penetrated the left body wall where an adhesion had formed. Omental attachments of the spleen were also adherent to the body wall, preventing exteriorization of the spleen. The spleen itself was apparently unaffected. A gastrotomy was performed, and a teriyaki stick approximately 10 cm long was removed. The gastrotomy site and abdomen were closed routinely. The mass involving the left body wall was explored, and the area was flushed with saline (0.9% NaCl) solution. No foreign material was found, and the incision was closed. Following surgery, the dog was treated with cefazolin (20 mg/kg [9 mg/lb], IV, q 8 h). The dog was discharged, and cephalexin (20 mg/kg, PO, q 8 h) was prescribed.

Detection of migrating wooden foreign bodies represents a clinical challenge. Wood is typically radiolucent, so wooden foreign bodies generally cannot be seen on survey radiographs. In addition, they may be difficult to distinguish on positive-contrast fistulograms. Failure to locate and remove foreign bodies can lead to long-term secondary inflammatory reactions or infections, such as chronic fistulas, peritonitis, and local cellulitis. History and clinical signs are often nonspecific, although 2 dogs described in the present report had a history of ingesting foreign bodies. Evidence of a swelling, with or without fistula, anywhere along the body wall can be a useful suggestive sign of a migrating foreign body. All 4 dogs in the

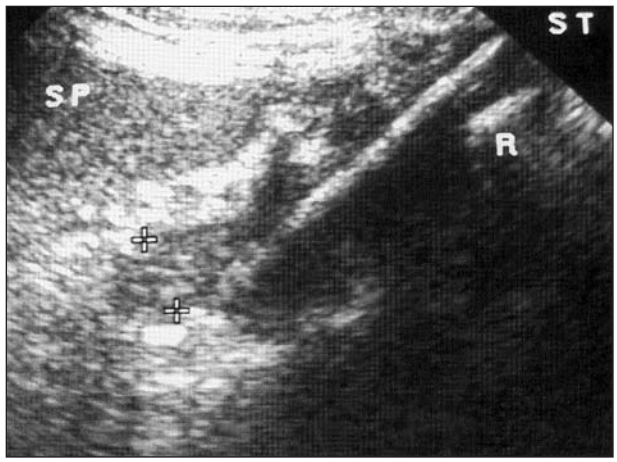

Figure 4—Ultrasonogram of the abdomen of a dog. A linear echogenic interface can be seen extending from the cranial aspect of the 12th rib (R) to the fundus of the stomach (wall between calipers). SP = Spleen. ST = Stomach.

initial report were examined because of lethargy and a left flank swelling that was partially responsive to antimicrobial treatment. In a previous report,[1] a swelling was evident 14 days after ingestion of a radiopaque foreign body, whereas a swelling was evident 7 days after ingestion of sticks in 1 dog in the present report. We speculate that the length and rigidity of the wooden foreign bodies in these dogs prevented them from passing into the body or antrum of the stomach and caused them to perforate the wall of the fundus, resulting in a left-sided swelling.

Several reports[2-14] describe the use of ultrasonography to detect and localize radiolucent foreign bodies in soft tissues. Most of these reports[5-13] have involved foreign bodies in superficial and deep soft tissues, such as muscle, subcutaneous tissue, tendons, and ligaments, and only 1[4] involved an intra-abdominal radiolucent foreign body.

In a study[8] involving more than 200 human patients, it was reported that foreign bodies were missed during the initial examination 38% of the time. Ultrasonography has been reported to play an important role in the detection and removal of soft-tissue foreign bodies in people,[6-11,13,14] and the use of ultrasonography to detect radiolucent foreign bodies or assist surgeons in locating foreign bodies in animals has been also reported.[3-5]

The acoustic properties of wooden foreign bodies vary with their physical density. Wooden foreign bodies are most commonly described as hyperechoic; however, wooden fragments can become progressively less echogenic over time and may eventually be no longer distinguishable from the surrounding inflammation.[13] It has been postulated that wooden foreign bodies retained in the body for long periods absorb fluid, altering their imaging characteristics. Acoustic shadowing was evident in 3 of the 4 dogs in the present report but has been an inconsistent finding in several reports. Glass fragments and metallic foreign bodies have been reported to be associated with reverberation artifacts.[11,12]

In addition to detection of foreign bodies, ultrasonography is useful in assessing local changes, such as fluid collections, edema, seromas, hematomas, inflamed mesentery or omentum, thickening and perforation of the gastrointestinal tract, and free air. It is common to identify a poorly echogenic area around a foreign body.[9] This area most often represents inflammatory tissue or pus and should instigate a diligent search for a foreign body. In humans, ultrasonographic findings may falsely indicate a foreign body if the lesion has been drained recently, because fresh bleeding or small gas bubbles may accumulate at the site.[9] In chronic cases, granulomatous tissue may occasionally prevent accurate ultrasonographic detection of a foreign body.

Other imaging modalities used to evaluate chronic fistulas include survey radiography, fistulography, computed tomography, and magnetic resonance imaging.[6,8,12-16] Radiography is useful in detecting radiopaque foreign bodies but has been shown to be of little help in detecting radiolucent foreign bodies, such as wood, plastic, and glass. Two dogs in the present report had a localized periosteal response associated with 1 of the caudal left ribs, and such a reaction may be suggestive of a perforating foreign body.

Fistulography can be useful in outlining foreign bodies, but the usefulness of this technique depends on the size and shape of the foreign body and the amount and dilution of the contrast agent used. Some experimental studies[9,12,16] have been performed to compare the use of computed tomography, magnetic resonance imaging, and high-resolution ultrasonography for the detection of wooden splinters of various sizes. To better mimic in vivo conditions, some of the wooden splinters were soaked in water for 3 days or 5 months.[12] With computed tomography, splinters soaked for 3 days appeared less radiodense than muscle; in contrast, splinters soaked for 5 months were more radiodense than muscle. With magnetic resonance imaging, wooden splinters appeared as structures of low signal intensity on T1-weighted images. Soaked splinters had a moderate to high intensity signal on T2-weighted images. Results[12] suggested that ultrasonography and magnetic resonance imaging were more sensitive than computed tomography for detection of wooden foreign bodies embedded in muscle distant to bone. When the wooden splinters were located near the bone, the sensitivity of ultrasonography was relatively poor in comparison to computed tomography and magnetic resonance imaging.

In conclusion, ultrasonography can be a cost-effective method for detecting wooden foreign bodies in dogs. However, the technique has some limitations, in that small wooden splinters and splinters near shadowing structures, such as bone or gas, may be difficult to detect.

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