

# Ultrasonographic appearance of lymphomatous infiltration of the abomasum in cows with lymphoma

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**Case Description**—4 adult Holstein dairy cows were examined for anorexia and decreased milk production.

**Clinical Findings**—Clinical signs included abdominal distension, normal to decreased ruminal motility, and decreased fecal output. Hypochloremia and high BUN concentration were also noted on serum biochemical analysis. Transabdominal ultrasonography revealed abnormal thickening of the abomasum with pyloric thickening and loss of the typical layered appearance of the pyloric wall. Results of cytologic examination of fine-needle aspirates of the abnormal portion of the abomasum were compatible with a diagnosis of lymphoma in 3 cows.

**Outcome**—The diagnosis of lymphoma involving the abomasum was confirmed by exploratory laparotomy, necropsy, or slaughterhouse reports. Two cows were euthanatized, 1 died 5 days after the diagnosis, and 1 was sent to the slaughterhouse, but the carcass was discarded because of generalized lymphoma.

**Clinical Relevance**—Transabdominal ultrasonography is a noninvasive portable test that can be useful for the diagnosis of lymphomatous infiltration of the pyloric portion of the abomasum, which may result in obstruction. This can be especially useful to avoid unnecessary treatments when no typical signs of enzootic lymphoma are present. Percutaneous fine-needle aspiration of the abnormally thickened abomasal wall should be performed. These procedures can enable diagnosis of this neoplasm, which has a relatively poor prognosis, thus avoiding the unnecessary costs incurred by exploratory laparotomy. (*J Am Vet Med Assoc* 2011;238:1044–1047)

A 6-year-old Holstein milking cow 5 months postpartum was examined for decreased milk production and anorexia. The cow had a normal heart rate (80 beats/min), respiratory rate (16 breaths/min) and temperature (38.7°C [101.7°F]). It had a papple-shaped abdominal contour and decreased ruminal contraction frequency (1 contraction/2 min). No ping or splashing sounds were detected on auscultation. Transrectal palpation revealed a small quantity of dark feces with fiber particles < 1 cm in diameter. Other clinical findings were within normal limits except for a slight enlargement of the left superficial cervical lymph node. A blood sample was taken on the first day for a CBC and serum biochemistry analysis. The most notable abnormalities were hypochloremia (64.5 mmol/L; reference range, 96.4 to 109.2 mmol/L), hyponatremia (111.0 mmol/L; reference range, 134.0 to 147.0 mmol/L), increased BUN concentration (58.9 mmol/L; reference range, 1.61 to 6.51 mmol/L), hyperfibrinogenemia (8 g/L; reference range, 3 to 5 g/L), leukocytosis ( $18.5 \times 10^3$  cells/ $\mu$ L; reference range,  $6.2 \times 10^3$  cells/ $\mu$ L to  $13.5 \times 10^3$  cells/ $\mu$ L), and lymphocytosis ( $10.73 \times 10^3$  cells/ $\mu$ L; reference range,  $4.00 \times 10^3$  cells/ $\mu$ L to  $10.00 \times 10^3$  cells/ $\mu$ L). The cow was then prepared for transabdominal ultrasonography to be performed with a 3.5-MHz convex probe<sup>a</sup> to as-

## ABBREVIATION

BLV Bovine leukosis virus

sess the abomasum and duodenum.<sup>1–3</sup> Briefly, the area extending caudally from the xiphoid process to the middle part of the flank was clipped. This area was extended ventrally to the ventral midline and dorsally to the level of the shoulder. Abomasal or duodenal obstruction was suspected on the basis of the abnormalities on the CBC and serum biochemical analysis.<sup>1–3</sup> The abomasum was recognized as a thin-walled viscus with heterogeneous content.<sup>1</sup> The abomasum was severely distended when compared with results of previous studies<sup>2,4</sup> in dairy cows, and its caudal margin was visible 20 cm caudal to the last rib. Abnormal findings were located in the pyloric region of the abomasum. The pyloric wall was hypoechoic to anechoic and circumferentially thickened (5.0 cm; Figure 1), when compared with previous published<sup>5</sup> values for pyloric wall thickness (1 cm) in adult cows. The typical layered appearance of the pyloric wall<sup>1,5</sup> was also not evident, with the thickened part appearing as a transmural bulky mass. Only small amounts of gastrointestinal content were observed passing through the abnormal area. Further diagnostic testing included ELISA<sup>b</sup> testing to confirm BLV infection. Additionally, percutaneous fine-needle (20-gauge) aspiration<sup>6</sup> of the abnormal pyloric wall revealed hemorrhagic content. Cytologic examination of this aspirate revealed many lymphoblasts, but blood

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contamination precluded a definitive diagnosis of lymphoma despite a high index of suspicion. Because of the prognosis and low value of the cow, no further investigations were performed. The owner was informed that the animal should not be slaughtered for human consumption. However, he decided to send the cow to the slaughterhouse, where its carcass was discarded because of the macroscopic diagnosis of generalized lymphoma.

A 2.5-year-old Holstein cow that was 6 months postpartum was examined 2 months into its current gestation because the owner had noticed decreased appetite and milk production over 2 days. On initial ex-

amination, the cow was slightly depressed and mildly dehydrated. Moderate bilateral ventral abdominal distension was visible. The cow had a rectal temperature of 38.8°C (101.8°F), heart rate of 68 beats/min, and respiratory rate of 15 breaths/min. The rumen was atonic. Transrectal palpation revealed a small quantity of dark feces. No other abnormalities were noted on physical examination. On CBC and serum biochemical analysis, abnormalities noted were hypochloremia (71.1 mmol/L), hyponatremia (129.9 mmol/L), increased BUN concentration (12.7 mmol/L), and hyperfibrinogenemia (7 g/L). Transabdominal ultrasonography<sup>a</sup> was then performed to assess the reticulum and abomasum.<sup>1,3</sup> Reticulum motility was within normal limits.<sup>3</sup> The position of the abomasum was displaced ventrally, with the majority of the organ observed on the left ventral part of the abdomen and the pyloric part of the abomasum medial to the right mammary vein. Multiple foci of abomasal wall thickening were observed in the fundic and pyloric regions. The maximal thickness of the abomasal wall was 5.3 cm. The echogenicity of the thickened wall was heterogeneous and mostly anechoic to echoic with transmural bulky appearance (Figure 2). No peritoneal effusion was observed. Fine-needle aspiration biopsy of the thickened foci of the abomasal wall was not attempted because the owner opted for a surgical approach to correct the abomasal displacement. A right standing exploratory laparotomy was performed and revealed multiple masses upon palpation of the abomasal wall and a left displaced abomasum. There were no other abnormal findings on abdominal exploration. Examination of a sample of the thickened wall of the abomasum obtained via fine-needle aspiration during surgery was compatible with a lymphomatous infiltration. A diffuse population of large lymphocytes with scant basophilic cytoplasm, large irregular nuclei, and a high mitotic index was observed. The displacement was corrected, and an omentopexy was performed; the cow received antimicrobials for 3 days after surgery

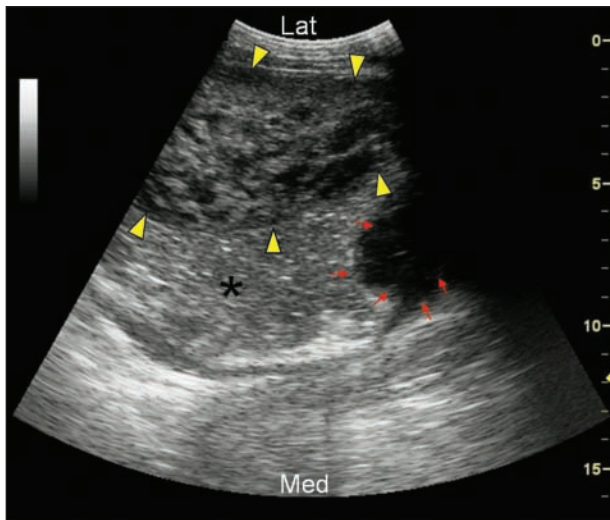


Figure 1—Ultrasonographic appearance of the pyloric portion of the abomasum of a 6-year-old Holstein cow which was irregularly thickened by lymphomatous tissue. The wall layering is lost. Two thickened areas can be seen with different echogenic patterns. The first area contains anechoic to hypoechoic material (yellow arrowheads), and the second area is mainly anechoic (red arrows). The abomasal content can also be seen (asterisk). Lat = Lateral. Med = Medial.

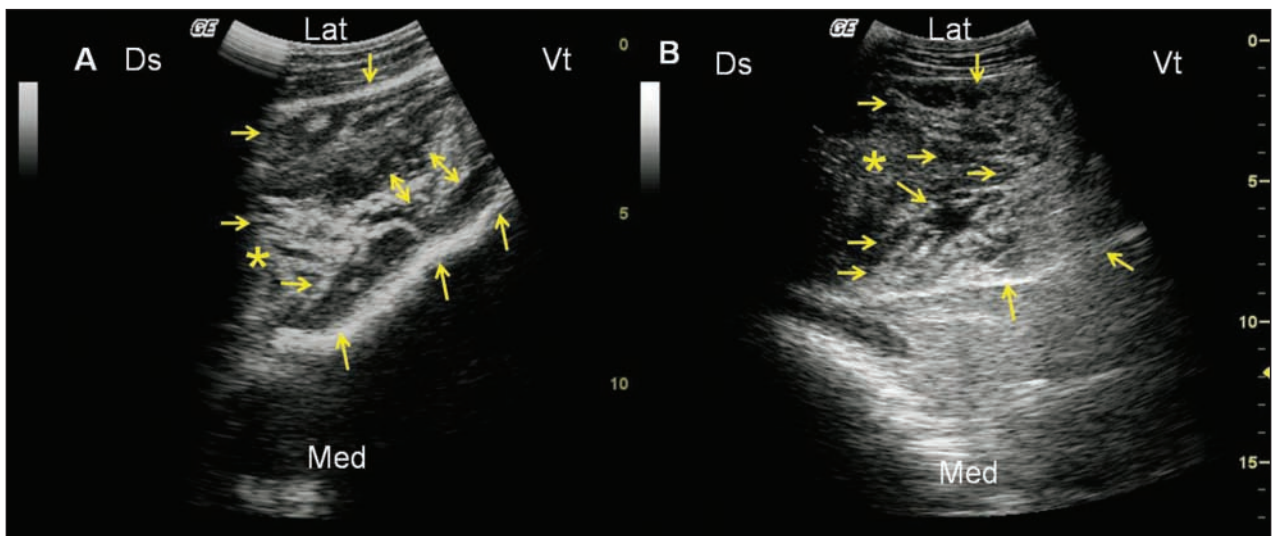


Figure 2—Ultrasonographic appearance of the pyloric region of the abomasum in 2 cows with abomasal lymphoma. Longitudinal views of the pyloric region of a 2.5-year-old Holstein cow (A) and a 5-year-old Holstein cow (B) are observed with heterogenous anechoic to echoic thickening of the abomasal wall (yellow arrows) because of lymphomatous infiltration. The echogenicity mimicks pseudolayering (A and B). Ds = Dorsal. Vt = Ventral. See Figure 1 for remainder of key.

(procaine penicillin, 22,000 IU/kg [10,000 IU/lb], IM, q 12 h). An ELISA<sup>b</sup> test for BLV was performed, and the result was positive. The cow died 5 days after surgery, and a necropsy was not performed.

A 5-year-old Holstein cow was referred to the Veterinary Teaching Hospital for acute anorexia and decreased milk production. The cow was 3 months pregnant, and according to the referring veterinarian, multiple firm masses of approximately 5 cm in diameter were palpable on transrectal examination. The cow had tested ELISA<sup>b</sup> negative for BLV 1 year prior to referral. On clinical examination, the cow was alert and had a rectal temperature of 38.1°C (100.6°F), heart rate of 140 beats/min, and respiratory rate of 24 breaths/min. Both jugular veins were distended. Ruminant contractions were within normal limits, and a ping was auscultated in the right paralumbar fossa. Transrectal examination revealed slightly diarrhetic feces, and multiple masses were palpated. These masses did not adhere to the uterus, left kidney, or other abdominal structures. No other abnormalities were noted upon physical examination. A CBC revealed leukocytosis ( $25.51 \times 10^3$  cells/ $\mu$ L), lymphocytosis ( $16.07 \times 10^3$  cells/ $\mu$ L), and monocytosis ( $1.79 \times 10^3$  cells/ $\mu$ L; reference interval,  $0.20 \times 10^3$  cells/ $\mu$ L to  $1.30 \times 10^3$  cells/ $\mu$ L). Blast cells were also present ( $0.26 \times 10^3$  cells/ $\mu$ L; reference interval, none), and several abnormal, enlarged lymphocytes were noticeable on the blood smear.

A serum biochemical analysis revealed hypochloremia (92.6 mmol/L) and increased BUN concentration (8.89 mmol/L). Increased aspartate aminotransferase (132 IU/L; reference interval, 30 to 104 IU/L) and creatine kinase activities (4,552 IU/L; reference interval, 0 to 310 IU/L) and increased  $\beta$ -hydroxybutyrate concentration (1,465  $\mu$ mol/L; reference interval, 324 to 1,296  $\mu$ mol/L) were also noted.

The transabdominal ultrasonographic findings were compatible with a 4.5-cm-thick anechoic to echogenic transmural bulky mass in the pyloric region (Figure 2). The normal layering of the abomasum was not observed. Structures compatible with enlarged regional lymph nodes were evident and peritoneal effusion was also noted. An echocardiogram revealed mild pericardial effusion (1 to 2 cm of fluid in the pericardial space). Hypoechoic thickening of the right atrial wall was also observed, which was compatible with lymphoma with cardiac involvement.<sup>7</sup> An ultrasound-guided fine-needle aspiration of the abomasal thickening was performed with a 22-gauge, 1.5-inch needle. Cytologic analysis of the aspirate indicated a diagnosis of lymphoma. Abdominocentesis was also performed, and cytologic analysis of the fluid was also compatible with a diagnosis of lymphoma. Another serologic test for BLV was performed by use of ELISA,<sup>b</sup> and the result was positive. The owner decided not to euthanize the cow because of its high value, and supportive treatment was instituted. This included administration of propylene glycol (250 mL, q 12 h, PO for 3 days) for the treatment of acetoneuria and administration of ranitidine (0.1 mg/kg, q 8 h, IV for 3 days) for the treatment of suspected abomasal ulcers associated with abomasal infiltration. After a moderate improvement during hospitalization (increased appetite and heart rate within normal limits), and after 3 days of observation and treatment, the owner decided to take the

cow back into the herd and to stop any treatment. However, because of chronic wasting, the cow was euthanized 2 weeks later and no necropsy was performed.

A nonpregnant 9-year-old Holstein cow was referred to the Veterinary Teaching Hospital for acute anorexia and decreased milk production. The cow had been examined at the hospital 1 month previously for diarrhea. On clinical examination, the cow had signs of depression and was mildly dehydrated and had a rectal temperature of 37.5°C (99.5°F), heart rate of 120 beats/min, and respiratory rate of 12 breaths/min. The abdomen was distended with an apple shape. Ruminant contractions were decreased, and a ping was auscultated in the right paralumbar fossa. Transrectal examination revealed no feces and a distended rumen. No other abnormalities were noted on physical examination. On CBC and serum biochemical analysis, hypochloremia (80.3 mmol/L) and increased BUN concentration (13.42 mmol/L) were noted.

Ultrasonographic findings were compatible with transmural bulky thickening of the pyloric region. Despite the fact that normal layering was lost, pseudolayering was observed. Structures compatible with enlarged regional lymph nodes were also observed. An exploratory laparotomy was performed to allow fine-needle (22-gauge, 1.5-inch needle) aspiration of the masses in the pyloric wall and the enlarged mesenteric lymph nodes. The results of cytologic analysis of the samples obtained were compatible with a diagnosis of lymphoma. On the basis of these results and the guarded prognosis, the cow was euthanized. A necropsy was performed and confirmed the diagnosis, with histologic examination revealing lymphoma involving the abomasum, mesenteric lymph nodes, uterus, and heart.

## Discussion

In the present report, transabdominal ultrasonography readily enabled the identification of features highly indicative of lymphomatous infiltration of the pyloric portion of the abomasum in 4 dairy cows with nonspecific clinical signs. Subsequent testing confirmed the diagnosis in all patients. Although the incidence of gastrointestinal tumors is low in cattle,<sup>8</sup> lymphoma is the most common neoplastic disease in cattle in areas where BLV infection has not been eradicated.<sup>9</sup> Although the clinical signs of lymphoma may be obvious in typical patients examined with differing degrees of cachexia, polyadenomegaly, melena, congestive heart failure, and ataxia resulting from neurologic involvement, the diagnosis is more challenging when only internal organs are infiltrated by neoplastic tissue. The challenge for the clinician is the rapid establishment of an antemortem diagnosis while avoiding unnecessary treatments or expensive diagnostic procedures such as exploratory laparotomy. Transabdominal ultrasonography is a noninvasive tool that can aid in the diagnosis of abnormal infiltration of various gastrointestinal organs and can be used in both on-farm and hospital settings. The core needle biopsy or fine-needle aspiration of enlarged lymph nodes is useful when superficial lymphadenopathy is observed.<sup>6</sup> However, false-negative results can occur with reactional lymphadenopathy.<sup>6</sup> Clinically, the challenge occurs when no specific clinical signs are noted on physical examination or when lymphadenomegaly or organomeg-



aly is suspected on the basis of the results of transrectal examination, but the mass cannot be aspirated safely. In the present report, fine-needle aspiration was successfully used to percutaneously obtain tissue from the pylorus in 3 cows for diagnostic testing, after the identification of pyloric enlargement via transabdominal ultrasonography. The abnormalities on hematologic and serum biochemical analysis (eg, hypochloremia, hyperglycemia, and increased BUN concentration) in the cows of the present report were nonspecific findings consistent with upper gastrointestinal obstruction. Hyperfibrinogenemia was also noted in 2 cows; therefore, inflammatory diseases of the abomasum such as perforated ulcer must be differentiated from lymphoma by use of tests such as transabdominal ultrasonography, which will reveal abnormalities compatible with a diagnosis of traumatic reticuloperitonitis (eg, free fluid in the abdomen with multiple strands of fibrin).<sup>10</sup>

The typical ultrasonographic aspects of abomasal lymphoma in the cows of the present report were similar to ultrasonographic features that have been described in cats with lymphoma.<sup>11,12</sup> These consist of a loss of internal wall layering, transmural thickening, and reduced wall echogenicity.<sup>12</sup> Diseases affecting the abomasal wall are uncommon in cattle and mainly consist of abomasal ulceration and ostertagiosis, which typically cause discrete abomasal lesions. In a 1997 report,<sup>1</sup> neither condition was evident on abdominal ultrasonography; however, a study with high-frequency probes has not been performed. Abomasal infiltration by neoplastic cells causes a nodular thickening of the abomasal wall that can be noted in up to 80% of patients with lymphoma caused by BLV.<sup>13</sup> The clinical signs related to abomasal wall infiltration by neoplastic cells result from abomasal ulceration or stasis.<sup>9,13</sup> Noninvasive assessment of the abomasum is currently limited to transabdominal ultrasonography. Endoscopic examination of the abomasum cannot be performed in adult cattle because it is impossible to visualize the reticulo-omasal orifice and because of the permanent presence of food in the forestomach. Therefore, the ultrasonographic description of abomasal lesions is helpful to aid in the diagnosis of diseases involving infiltration of this region by abnormal tissue.

The other ancillary tests that can be used for the assessment of the abomasum are laparoscopy<sup>14,15</sup> and exploratory laparotomy.<sup>15</sup> A paracentesis can also be performed, but its diagnostic value is dependent on the quantity of fluid obtained and the presence of neoplastic cells in the abdominal cavity. In the present report, only 1 of the 4 cows had detectable peritoneal effusion, and results of cytologic analysis of this fluid were compatible with a diagnosis of lymphoma. No abdominal effusion was detectable by use of ultrasonography in the other 3 cows, and for this reason, abdominal paracentesis was not attempted. A definitive diagnosis of abomasal lymphoma requires visualization of neoplastic lymphocytes following fine-needle aspiration or biopsy of the abnormal portion of the abomasum. In the present report, the diagnosis was confirmed in 3 of 4 cows by use of fine-needle aspiration and Wright stain of cells, as previously reported for fine-needle aspiration of abnormal lymph nodes.<sup>6</sup> In 1 cow, the diagnosis could not be obtained via examination of the fine-needle aspirate because of blood contamination, but was confirmed postmortem.

Despite the poor prognosis for lymphoma in cattle, some palliative treatments have been attempted to maintain pregnancy or to give the owner time to conserve the genetic potential of the cow.<sup>16–18</sup> There are no specific antitumor drugs available for administration to food-producing animals. L-asparaginase is a bacterial enzyme that depletes circulating supplies of the amino acid asparagine by converting it into aspartic acid.<sup>19</sup> The use of L-asparaginase has been mentioned in 1 previous report<sup>17</sup> for maintaining a good quality of life in a cow and allowing the owner to save her pedigree.<sup>17</sup> This cow survived 57 days with 4 injections of L-asparaginase, and reportedly, the cow's appetite and general health improved rapidly after L-asparaginase injection.<sup>17</sup> However, this medication is not approved for use in cattle and should be reserved for nonproductive animals because of its unknown withdrawal time.

- a. LogiqBook, General Electric, Wauwatosa, Wis.
- b. BLV-ELISA kit Idexx, Idexx Laboratories, Westbrook, Me.

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