Clinical Skills Session

Medical ultrasound of the bovine abdomen

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Abstract

Ultrasonography of the bovine abdomen can provide details about the form and function of many areas of the gastrointestinal and hepatobiliary systems otherwise undetectable without exploratory laparotomy. This discussion will review the application of ultrasonography to the diagnosis of disorders of the abdominal viscera in cattle.

Key words: ultrasound, abdomen, diagnostics

Résumé

L'échographie de l'abdomen bovin peut fournir des détails concernant la forme et la fonction de plusieurs parties du système gastro-intestinal et hépatobiliaire qui ne seraient pas détectables à moins de faire une laparotomie exploratrice. Cette discussion va examiner l'application de l'échographie au diagnostic des troubles des viscères abdominaux du bovin.

General Considerations

The need for patient preparation for ultrasonography is dependent on the haircoat density and cleanliness of the patient. This can be a large drawback to the application of this diagnostic modality in terms of preparation time, but also in that the animal may be visually altered which could adversely affect its subsequent sale. However, some animals with short and light hair coats can be imaged reasonably well without clipping. Alcohol can be applied with a garden sprayer to save time during the procedure. Acoustic coupling gel may be needed for fine detail in some regions of the body, but is generally not required for abdominal ultrasound in the bovine.

Following physical examination, many diagnostic aids such as hematology, serum biochemistry, rumen fluid analysis, and abdominocentesis can be very useful in the evaluation of ruminants with gastrointestinal dysfunction. However, results of such examinations can take hours to days to receive, and rarely do they give confirmation of a specific clinical diagnosis. Ultrasonography can be used to evaluate the reticulum, abomasum, and portions of the intestines near the body surface and can provide clinicians with diagnostic information previously available only via exploratory laparotomy, and the information is available immediately.

Ultrasonographic examination of the bovine reticulum is easily accomplished with 3.5 to 5 MHz transducers. The luminal contents of the forestomachs are admixed with air, thus magnets and foreign bodies inside the reticulum cannot be visualized ultrasonographically. Scans are made in sagittal and transverse planes adjacent to the xiphoid cartilage. The normal relaxed reticulum appears as a crescent-shaped line adjacent to the diaphragm and cranioventral body wall. Reticular contraction is biphasic (or triphasic during cud chewing). A short initial contraction is followed by incomplete relaxation, and the second contraction usually takes the ventral reticulum out of the scanned image with a 3.5 MHz probe. The reticulum can be imaged in contact with the diaphragm, ventral abdominal wall, atrium ruminis, liver, and spleen to the cranial, ventral, caudal, right and left, respectively. Measurements of reticular contractions (frequency and amplitude) and subjective evaluation of the speed of contraction should be assessed.

Ultrasonography of the reticulum is very useful in the diagnosis of traumatic reticuloperitonitis (TRP) and associated sequelae. Ultrasonographic findings suggestive of TRP include change in the contour of the reticular wall, displacement of the reticulum by inflammatory debris, perireticular fluid cavitations, visible echogenic adhesions between the reticulum and surrounding structures, and reduced reticular contraction distance. The location of penetrating foreign body may not be visible, but ultrasound provides useful information regarding the site and extent of septic loculations and can supply valuable prognostic information regarding the degree of spread of the peritonitis.

Ultrasonography is also useful in the evaluation of animals with evidence of omasal transport failure. Such cases typically have markedly diminished evidence of rumen motility as assessed by auscultation, but reticular ultrasonography readily demonstrates hypermotility. Furthermore, causes such as perireticular abscessation due either to TRP or liver abscessation can be visualized to the right of the reticulum. Luminal foreign bodies (rope, twine, or placenta) and mucosal masses cannot be detected via this technique, however. The omasum is readily imaged in the mid to lower right 7th to 10th intercostal spaces and immediately ventral to the costal arch. The omasal wall is similar in appearance to the reticulum, but frequently a scalloped internal border can be identified which is unique to this organ. The rounded shape of the omasum can be elucidated while scanning over the region.

Ultrasonography can be helpful in the diagnosis of several disorders of the abomasum including displacements, impactions, ulceration and adhesions, lymphosarcoma, and ostertagiasis. The abomasum is imaged along the ventral abdominal wall beginning immediately behind the xiphoid cartilage. The abomasal wall is thinner and less distinct ultrasonographically than is the reticular wall. A characteristic feature of the abomasum is the base of the rugal folds which are evident as hypoechoic vermiform lines inside the wall. Imaging of abomasal contents is variable depending on the age of the animal, diet, and presence of gas or geologic material such as sand. In general, the luminal contents are well visualized in young suckling animals. The abomasal contents tend to be predominately hypoechoic with milk diets, although hyperechoic regions are commonly encountered and probably represent rennet clot formation. In adults the ingesta tends to be more echogenic and heterogeneous. Geologic sediment accumulation in the body of the abomasum can prevent luminal imaging and assessment of the dorsal border of the structure for assessment of its depth. The pylorus has a characteristic ultrasonographic appearance in cross section, but it may be difficult to visualize if under the costal arch. The pylorus should be located at the 10th to 12th costochondral junction in the non-gravid adult bovine. The position of the abomasum changes in late gestation, moving cranially and to the left, but returns to normal position by 2 weeks postpartum. Ultrasonographic detection of the abomasal borders significantly outside or deep to these margins supports a diagnosis of an abomasal outflow disorder such as type III or IV vagal indigestion or primary abomasal impaction.

Ultrasonography is helpful in the evaluation of cattle suspected of having left displaced abomasum (LDA) with intermittent or equivocal pings. The left abdomen is scanned transversely from below the costal arch and proceeding dorsally into the last 3 to 4 intercostal spaces. Ventrally, the rumen is readily identified against the body wall. In a normal animal, the left longitudinal groove of the rumen will be visualized mid-abdomen. In cattle with an LDA, the rumen will be displaced medially by the abomasum. Ventrally, the LDA will have fluid ingesta of varying amounts. As the scan progresses dorsally, a gas-fluid interface can usually be identified. Further dorsal, the abomasal gas cap results in reverberation artifact which appears similar to imaging the pleural surface of the lung. Sometimes rugal folds can be identified in the abomasal wall or within the fluid compartment, giving conclusive evidence of an abomasal displacement. Ultrasonography can also be applied to the diagnosis of right displaced abomasum (RDA) or abomasal volvulus (AV) using analogous technique.

Ultrasonographic evidence of accumulated fluid and/or fibrin deposition centered around the abomasum, and distant to the reticulum, supports a diagnosis of perforating abomasal ulcer with concurrent peritonitis. Gross thickening of the abomasal wall can be visualized with abomasal lymphosarcoma. Abomasal edema can result in marked thickening of the abomasal rugae, which become more readily imaged and hypoechoic. The latter finding most frequently occurs with venous congestion (congestive heart failure) or hypoalbuminemia.

Percutaneous abomasocentesis is readily performed with ultrasound guidance and can be utilized to detect elevated abomasal pH in type II ostertagiasis wherein abomasal pH will be ~5 to 7. The pH of abomasal fluid collected via abomasocentesis in normal adult cattle is approximately 2 to 2.5. This is similar to abomasal pH values obtained via abomasal cannulae in pastured and grain-fed yearling steers (1.75 to 2.0).

Ultrasonography is of more limited value in the examination of the intestinal tract of ruminants due to inherent limitations of the technique. The scanning depth will be less than approximately 8 inches (20 cm) with a 3.5 MHz transducer or up to 12 inches (30 cm) with 2.5 MHz. Thus the size of the abdomen will preclude complete examination in larger animals. Also, the large intestine and cecum generally contain sufficient gas to prevent imaging beyond their surface. Despite these limitations, the small intestine normally has minimal gas accumulation, allowing for imaging over a large area of the mid to lower right abdomen.

The proximal duodenum can be visualized deep to the gall bladder in most cows. The descending duodenum can often be imaged in the mid-paralumbar region where it is enveloped in greater omentum. The jejunoileum is scanned in the last few intercostal spaces and over the right abdominal wall. In normal adult cattle, the jejunoileum is 0.8 to 1.6 inch (2 to 4 cm) in diameter, has a wall thickness of approximately 3 mm, and has periodic to constant motility. Ultrasonographic findings indicative of small intestinal obstruction include multiple enlarged segments, concurrent normal sized or small distal segments, and reduction or absence of spontaneous motility. More cranial intestinal obstructions tend to have fewer but larger dilated loops visible than more caudal obstructions. An intussusception may be visualized if located near the body wall, especially in young cattle or small ruminants where relatively more of the abdomen can be imaged. An intussusception is readily identified by the 'bulls-eye' or 'target' appearance in cross section, but tangential or longitudinal views may be encountered with a less obvious appearance.

Ultrasonography can also be useful in suspected cases of hemorrhagic bowel disease. Homogenous hyperechoic luminal contents consistent with blood clots may be seen. While the specific cause of an intestinal obstruction may not be determined ultrasonographically, it can provide valuable diagnostic information to supplement the clinical examination. Ultrasonography is especially useful in patients too small for rectal palpation.

Abdominal effusion is readily apparent with ultrasonography, as is its quantity and distribution. Evaluation of the echogenicity of the fluid and abdominal surfaces can give valuable insight as to its etiology. Examples of peritoneal disorders wherein ultrasonography has been diagnostically useful include uroabdomen, peritonitis, mesothelioma, omental bursitis, and hemoperitoneum. Cytological evaluation of abdominal effusion may be required to determine the etiologic basis of peritoneal effusions. Abdominocentesis is typically productive with ascites, but fluid can be difficult to obtain with localized lesions. Ultrasonography allows for targeted abdominocentesis with localized disorders.

Conclusion

A myriad of applications exist for the use of diagnostic ultrasonography in food animals. Accurate and timely use of this diagnostic modality requires a modest amount of training and practice, but its use allows for relatively rapid and non-invasive acquisition of clinically relevant data.