

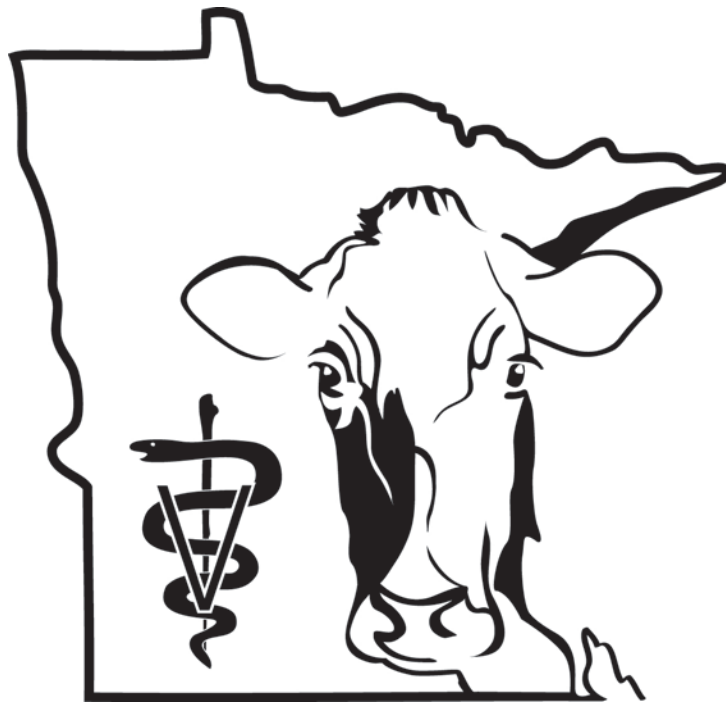
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Nonreproductive Uses of Diagnostic Ultrasound in the Bovine

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Ultrasonographic Appearance of the Normal Bovine Mammary Gland

Appropriate preparation of the mammary gland will enhance the quality of the image. If there is significant hair growth, the hair should be clipped and cleaned of loose hair and dirt. An image can, in some cases, be obtained with just alcohol applied to the skin. Most likely, ultrasound gel must be applied. A 7.5 MHz transducer with a stand off pad is ideal for imaging the teats. The mammary gland should be scanned with a 5.0-3.5 MHz transducer to give adequate penetration. All structures should be scanned in cross section and longitudinal planes.

The glandular parenchyma appears as a mixed trabecular pattern of anechoic (black) areas compartmentalized by hyperechoic (white) partitions. The anechoic areas represent milk within the gland. Small ducts in the matrix of the gland lead into larger lactiferous ducts that lead into the gland cistern. Blood vessels are seen within the mammary gland, but are difficult to differentiate from lactiferous ducts. The pattern formed by the lactiferous ducts and glandular parenchyma may vary among individuals. Non-lactating mammary glands appear as dense hyperechoic tissue with few visible blood vessels and lactiferous ducts. Periparturient cows will exhibit subcutaneous edema of the udder several days before and after freshening.

The gland cistern appears as a large anechoic area. The lining of the gland cistern appears as hyperechoic to hypoechoic folds. The annular ring can be detected as a hyperechoic band of tissue separating the gland cistern from the teat cistern. The teat cistern has an anechoic lumen surrounded by 5 layers. The most outer layer represents the skin air interface. The next inner layer is intermediate in echogenicity and represents the muscular layer. The 2 layers of longitudinal and circular muscle are difficult to differentiate on ultrasonography. The next most inner layer is thin and hypoechoic to anechoic and represents the blood vessels known as the plexus venosus papillaris and the circulus venosus papillae. The 2 innermost layers are hyperechoic and represent the submucosa and the mucosa. At the opening of the streak canal, folds of the inner layer extend into the lumen. Small anechoic areas are present within these folds representing milk. At the teat orifice, the anechoic areas can not be seen.

Mastitis

Acute purulent mastitis is denoted by marked udder enlargement with engorgement of the lactiferous ducts with fluid. If the cell content of the milk is high, the fluid in the ducts may appear hypoechoic as a result of the increased particulate matter. The demarcation between fluid within the lactiferous ducts and the glandular parenchyma may be diminished due to edema within the gland. A discrete abscess may be visualized anywhere within the glandular parenchyma. A thick hyperechoic fibrous wall may be present surrounding the abscess. Occasionally draining tracts can be followed to the abscess. Chronic diffuse mastitis results in an increase in fibrous tissue within the glandular parenchyma and a decrease in the lactiferous ducts, giving the gland an overall hyperechoic appearance.

Obstruction of the Teat

Obstruction of the teat may occur as a congenital anomaly or secondary to a traumatic occurrence. The obstruction may occur anywhere from the teat orifice to the gland cistern. Ultrasound can be used to determine the location of the obstruction and its extent. If the teat is completely obstructed the teat will be filled with milk proximal to the obstruction. Distal to the obstruction the teat will appear collapsed and does not contain milk. To further delineate the thickness, structure and extent of the obstruction, saline can be infused retrograde into the teat canal. This technique will outline the obstruction and provide information to obtain a treatment plan and prognosis.

If the teat orifice is obstructed, the teat cistern will be filled with anechoic milk to the streak canal with normal anatomy. Trauma or chronic mastitis may form a web within the teat cistern causing teat obstruction. The teat cistern will be filled with anechoic milk but thin hypoechoic strands can be visualized emanating from the walls of the teat cistern. Obstruction of the teat cistern may also be due to complete fibrosis of the teat cistern. No anechoic milk will be visualized within the teat cistern instead it will be replaced with hypo to hyperechoic dense tissue. Occlusion above the teat cistern will leave the cistern collapsed and hypoechoic. Once filled with saline the teat cistern may have normal anatomy and the proximal obstruction can be defined. A mural teat abscess may appear as a discrete hypoechoic area containing flocculent material. The abscess may be intra or extraluminal and a draining tract may be visible.

ULTRASOUND OF THE BOVINE LIVER

Normal Sonographic Appearance of the Liver

A 5.0 MHz transducer is ideal for imaging the bovine liver. A 3.5-2.5 transducer may need to be employed if pathology is present. The liver is scanned in a dorsal to ventral direction in each intercostal space. The parenchyma of the liver is homogeneous and intermediate in echogenicity in comparison with the spleen (most echogenic) and kidney (least echogenic). Multiple large branching blood vessels are visible throughout the liver parenchyma. Bile ducts can not normally be visualized. The liver should have sharp well-defined borders that do not extend past the costochondral junction. The gallbladder will appear as a large anechoic viscus along the ventral border of the liver in the 9th-12th intercostal space. The gallbladder can vary considerably in size.

Fatty Infiltration of the Liver

Fatty infiltration of the liver results in hepatomegaly. Hepatomegaly is present when the ventral border of the liver extends past the costochondral junction and the borders are rounded, bulging and ill defined. In addition the liver parenchyma will be diffusely hyperechoic. Blood vessels are not as well differentiated from the parenchyma.

Hepatic Abscess

Hepatic abscess can be found anywhere in the liver parenchyma. The abscess appears as an area of anechoic fluid and hyperechoic debris enclosed by a hyperechoic capsule disrupting the liver parenchyma.

ULTRASOUND OF THE RETICULUM FOR TRAUMATIC RETICULOPERITONITIS

Normal Appearance of the Reticulum

A 7.5-5.0 MHz transducer is used to image the reticulum. The reticulum is visualized in the ventral aspect of the thorax in the sixth and seventh intercostal spaces. The reticulum is adjacent to the diaphragm that can be visualized as a hypoechoic structure with striations through it. The reticulum contains gas that appears as a bright hyperechoic line just dorsal to the body wall. Because the ultrasound beam can not penetrate the gas within the reticulum, organs dorsal to the reticulum can not be imaged. The reticulum should contract and move away from the body wall approximately once per minute. The reticulum usually has a biphasic contraction.

Abscesses Associated with Traumatic Reticuloperitonitis

The location of abscesses associated with reticuloperitonitis is variable depending on the area of penetration of the foreign body. Abscesses that do not contact the abdominal wall may not be seen with ultrasonography. Abscesses appear as encapsulated structures with heterogeneous material in the cavities. Gas pockets or gas fluid interfaces are often present due to anaerobic infection. Abscesses may appear septated or have fibrin tags floating within them. Wire foreign bodies appear as bright hyperechoic linear objects that cast a shadow. Peritonitis without abscessation results in anechoic to hypoechoic fluid that is often surrounded by hypoechoic plaques of fibrin. Adhesions of the reticulum to the diaphragm will prevent the reticulum from moving away from the body wall or may slow reticular contractions.

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