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# **Its Black And White Get More From Your Ultrasound Machine When You Examine The Mammary Glands And Teats**

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## **Introduction**

Now that many bovine practices are equipped with ultrasound for reproductive purposes, there is a desire to get a higher return on the investment by using the machine for other applications. Ultrasound is an excellent tool for diagnostic imaging in large animals because it is portable, easy to use in the field, produces results at the time of the examination, and can be used for most soft tissue and some orthopedic problems. The limitation of the use of ultrasound in bovine practice is the knowledge and comfort of the practitioner with the technology and the transducer available. Ultrasound transducers that are intended to be used for rectal examination of the reproductive system are ideal for examination of the mammary gland and teats.

## **Transducer selection and patient preparation**

Appropriate preparation of the site to be imaged will enhance the quality of the image. Clean off any loose hair and dirt. Wet the skin and hair with alcohol. An image can, in some cases, be obtained with just alcohol applied to the skin. Be sure that your probe will not be damaged by the use of alcohol. Ultrasound gel can be applied and rubbed in if there is no significant hair growth (i.e. teat) or if the hair has been clipped. Ultrasound gel acts as a coupling agent to prevent air from trapping between the transducer and skin. A 7.5 MHz transducer with a stand off pad is ideal for imaging the teats. A 5.0 MHz transducer provides an adequate image. A stand off pad can be purchased separately or can be made from a glove filled with ultrasound gel. Many transducers are sold with stand off pads that fit the head of the transducer and these are the easiest to use. 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.



## **Anatomy**

The gland is made up of alveoli and alveolar ducts. The alveoli are grouped into lobes and lobules. The collecting ducts open into the gland cistern or lactiferous sinus. The gland cistern is separated from the teat cistern by a fibrous annular ring. The wall of the teat cistern is composed of 5 layers: the outer stratified squamous epithelium, muscular layer with longitudinal and circular layers, connective tissue which contains the major blood supply, the submucosa and the inner mucosa. The streak canal is closed by a sphincter of smooth muscle and elastic tissue. The junction of the mucosa of the teat cistern and the stratified squamous epithelium of the streak canal is the rosette of Furstenburg.

### **Ultrasonographic Appearance of the Normal Bovine Mammary Gland**

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 hyperechoic. 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 4 layers visible on ultrasonographic examination. 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 innermost layer is hyperechoic and represents the submucosa and the mucosa. The muscular layer of the streak canal appears hyperechoic.



**Figure 1:** Ultrasonographic image of a teat in cross sectional (left) and longitudinal (right) planes. The lumen of the teat is anechoic (black). Note the blood vessels surrounding the lumen (arrows).

### **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 (membranous shelf) 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. In the case of a membranous shelf, once filled with saline the teat cistern may have normal anatomy and the proximal obstruction can be defined. Obstruction of the teat cistern may also be due to complete fibrosis. No anechoic milk will be visualized within the teat cistern instead it will be replaced with hypo to hyperechoic dense tissue. A teat cannula can not be passed in this case. 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.

If the streak canal is obstructed, the teat cistern will be filled with anechoic milk to the streak canal with normal anatomy. Fibrous clots may form in the lumen of the teat at the streak canal subsequent to trauma preventing milk flow.

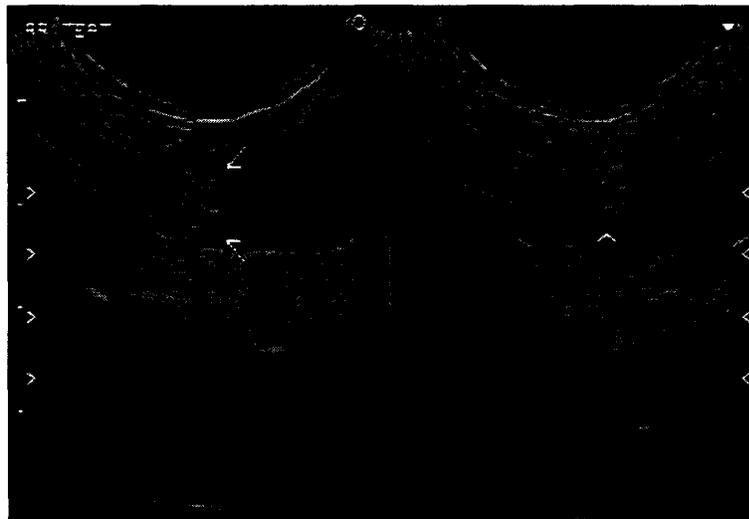


Figure 2: Ultrasonographic image of a teat in longitudinal (left) and cross sectional (right) planes. The lumen of the teat is anechoic (black). Note the obstruction at the streak canal (arrows).

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