SCANNING CATTLE

by Lana Kaiser, **DVM**

One of the wide variety of ultrasound machines available. This machine is portable, waterproof, battery operated and images can be viewed using goggles or a remote monitor. The probe is at the end of the cable at about 5 o'clock. The cable is hardwired into the ultrasound machine.

Medical ultrasound is an offshoot of sonar, used by the military to navigate under water. Basically, a sound wave is sent off to an object and the time it takes to echo back tells you how far away the object is. Ultrasound uses the same principles to look at structures in the body; human, bovine, canine, equine, you name it and it can be scanned!

Medical ultrasound, first introduced in the 1960's, is the second most common imaging technique used in human medicine today (after x-ray). One of the first human medical ultrasound machines took up an entire room, looked like a torture device and required a human patient be covered with a water bag.

Bovine reproductive ultrasound began gathering steam in the 1990's. Scanning dairy cows required a large, heavy machine covered in a clear plastic bag, placed in or on a cart with wheels and drug an electrical cord through the free-stalls. Not an ideal situation, but a bold beginning! Compared to dairy cattle, ultrasounding beef cattle was considered a relatively ideal situation, provided there was a chute, electricity and a place to put the expensive and delicate machine.

Today I can walk out into a field, tie a cow to a tree and determine if she is pregnant by ultrasound. My ultrasound machine is 7 lb., battery operated, water proof and I view images with goggles. I can collect images, download them to my computer and then send them via e-mail. Ultrasound has become mainstream and very tech savvy in large animal medicine.

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There are basically three parts to the ultrasound machine, the probe, the screen for viewing and the "black box" that takes the information from the probe and turns it into a picture you can see.

The probe, also called the transducer, is the most expensive part of the machine and is responsible for the quality of the image. It is made of over 100 piezoelectric crystals. The crystals emit sound waves that are either reflected back (echogenic) or transmitted through (nonechogenic) a tissue.

Each crystal is connected by cables to the both the pulsar (which creates the sound waves) and the receiver (black box). The pulsar causes the crystals to vibrate and emit sound waves, the crystals "listen" for the reflected sound waves, which are then sent to the receiver and converted to a real time image on the screen. You could think of the crystals like a cell phone, capable of sending and receiving. Real time images show what is happening. If the calf is doing the rumba, you will see it!

There are two types of probes, linear and sector. Linear probes have multiple crystals that fire downward and produce a rectangular image. This type of probe is most commonly used for bovine reproductive ultrasound. Sector probes have one rotating crystal and produce a pie-shaped image. Probes can be hardwired into the machine or interchangeable. Most portable machines have probes hardwired into the machine.

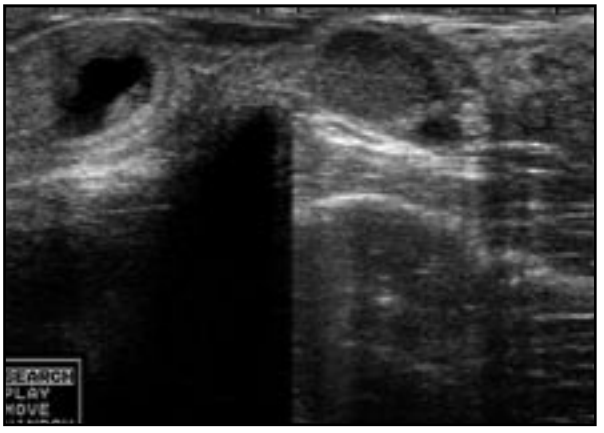
The ultrasound image can be viewed in a variety of different formats; the monitor can look like a TV screen or be a monocular goggle and almost anything between. There are wrist monitors, monitors looking like laptop computer screens as well as binocular goggles. The ultrasound machine itself can also vary. From the 7 lb. battery operated portable machine that sits on your hip, to the heavy, large screen machine that requires a cart and electricity and almost anything in between.

THE IMAGE

With a linear probe, the picture is a rectangle and represents a slice of whatever is being imaged. If you think of scanning a loaf of raisin bread, the linear probe picks up one slice and will show all the raisins in the slice, but nothing from the slice on either side. If you move the

Not everyone wants to ultrasound cattle in their backyard, but the portable battery operated machine makes it an option! Binocular goggles make for easy viewing. This 12-year-old Maine-Anjou cow is 28 days pregnant.

transducer left or right, it will image that specific slice. If your probe is on the top of the loaf, the top crust will be on the top of the picture, if your probe is on the bottom of the loaf, the bottom crust will be on the top of the picture.



On the left is a 28-day fetus, seen as a white structure protruding into the uterine lumen, between 4 and 6 o'clock. On the right is the corpus luteum on the ovary from the same side.

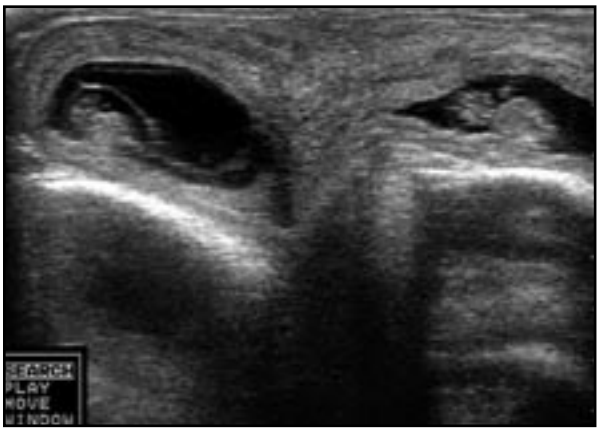
The ultrasound picture is a series of dots varying from black to white. When you first look at an ultrasound image, it looks a lot like black and white dots; but with experience and an understanding of the anatomy, it becomes crystal clear!

If something shows up black, it is called nonechoic, the sound waves pass through it. Clear fluid shows up black on ultrasound. Dense tissue, like bone, is hyperechoic (waves are echoed back to the probe) and show up white. Other tissues show up in varying shades of gray. Ultrasound pictures are a lot like Aunt Tilly, you know her because you have seen her before!

USES OF ULTRASOUND IN BEEF HERDS

Pregnancy diagnosis

One of the most common and important uses of ultrasound is determination of pregnancy. A fetus can be identified reliably at 28 days and finding the fetal heartbeat confirms the fetus is viable. Diagnosing a cow open at 28 days can allow you to re-breed her in a more timely fashion. Because early embryonic death is not uncommon in cattle, it is generally recommended these pregnancies be confirmed again after 60 days. Ultrasound has proven to be more useful than palpation in cases of early embryonic death. Cardinal signs of pregnancy can persist for up to 30 days after early embryonic death. These are the signs used to detect pregnancy by palpation. Thus, the cow may feel pregnant, but ultrasound will show the loss of heartbeat and debris in the fetal fluid. Early detection of this open cow can provide information to assist in management decisions.



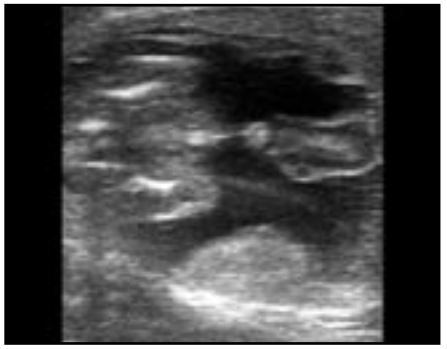
This scan shows a cross section of both uterine horns, with a 39-day fetus in each horn. You can see the membrane surrounding the fetus in the left horn and the head, body and one forelimb on the fetus in the right horn.

Fetal age

The age of the fetus can be determined from about 25 days to almost five months. Once the fetus falls over the brim of the pelvis, it becomes more difficult to view. Fetal age takes advantage of the fact that with time the fetus grows in a predictable way and fetal measurements can be made with ultrasound. Prior to day 50, a formula can give you the age (body length (head to butt), in millimeters + 18 = age in days). Most ultrasound screens have grid lines making it is easy to take measurements. After 50 days, fetal age is determined by measuring head or trunk diameter or head length and using the "cheat sheet." For example, a head diameter of 80 mm correlates with a fetus of 131 days of age. In addition, certain characteristics of the fetus occur in a known sequence, the forelimb buds (they become the front legs) show up before the hindlimb buds (back legs) by about

Bovine Reproductive Ultrasound

1. **Pregnancy - can be detected after 28 days**
2. **Age of fetus - AI vs. bull bred**
3. **Fetal viability - identify fetal heart beat**
4. **Twins**
5. **Triplets**
6. **Fetal sexing - after 55 days; ideal considered 70-90 days**
7. **Fetal abnormalities - 2 heads; shistasoma reflexus**
8. **Uterine infections and tumors**
9. **Ovarian cysts and tumors**
10. **Number of follicles after superovulation**

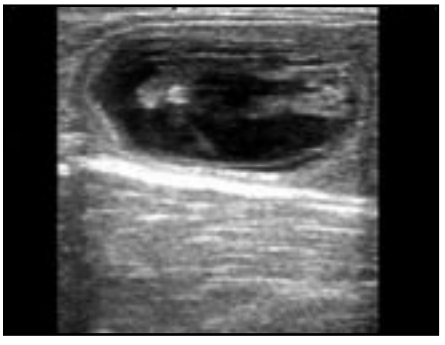


The thick umbilical cord is located at 3 o'clock, right behind where the cord attaches to the abdominal wall is the male GT, *a bright white structure.*

two days (29 vs. 31 days). You will not see split hooves or fetal movement until after day 40 and you will not see the ribs until after day 50.

These characteristics are useful because sometimes all you see on ultrasound is a fast moving foot or a view of the chest. Knowing when things occur will help age a fetus that is not perfectly positioned and relaxing!

Determining the age of the fetus can help you identify an embryo or an AI conception from a bull bred pregnancy and can be a useful management or marketing tool.



This is a back end view of a fetus, with the legs on the right and the tail on the left. Below *the tail is a bright, white structure, the female* GT.

Fetal sex

Determining the sex of the fetus depends upon finding the genital tubercle (GT) and identifying its location. The genital tubercle is a structure with two lobes that is very dense (hyperechoic, shows up white). It becomes the penis in the male and clitoris in the female. The male GT is located on the belly right behind the umbilical cord and the female GT is located beneath the tail. Determining the sex of the fetus requires a few things, the right age, the right view, a cooperative cow and a cooperative fetus. The GT is evident after day 55 and the ideal time to sex the fetus is generally considered between days 60 and 80, although different ultrasonographers have different age preferences. Experienced scanners can determine the sex of the fetus with high accuracy. For example, a man I know ordered 100 bred heifers to be carrying heifer calves and to calve within a week. Ninety-nine heifers were born and all but one calf was born within the specified week window. Not bad! Knowing the sex of the fetus can also be a useful marketing tool.

FETAL ABNORMALITIES

When scanning a fetus, one will occasionally encounter what looks like an abnormal fetus. Obvious abnormalities, two heads or schistosomus reflexus (abnormal curvature of the spine into a C shape and internal organs outside the body), can be accurately diagnosed prenatally. On other occasions, the fetus may appear "not quite right" but no specific abnormality identified. While it would be useful to be able to identify calves with tibial hemimelia (TH) prenatally, the various bone and joint abnormalities, as well as fetal movement and the inability to view the entire skeleton make it unlikely ultrasound can be used to diagnose TH. Similarly, the time course of the development of pulmonary hypoplasia with anasarca (PHA) is unknown and variable, making diagnosis of PHA by ultrasound prenatally unlikely.

Uterus

Ultrasound can be used to evaluate the uterus. The uterus looks different throughout the estrus cycle. During heat or pregnancy, the uterine fluid is clear and shows up as black, with metritis, the fluid shows up as flocculent with white specs in the fluid. Uterine abscess and pyometra can also be identified.

Ovaries

Ultrasound is used extensively in dairy cattle to evaluate ovaries. One of the coolest things to do is evaluate the ovaries of a superovulated cow prior to artificial insemination. You would not want to use expensive or rare semen on a cow with only one follicle, but you might want to on a cow with 15 follicles. While there is no guarantee, a cow with 15 follicles could give you 15 grade one embryos, a cow with only one follicle could only give you one. Ultrasound can also be used to identify ovarian cysts, follicles and CL's (corpora lutea). In a pregnant cow, finding 2 CL's would suggest you should look for twins!

Ultrasound can be a very useful tool for the beef producer. Identifying open cows early and knowing if the fetus is an embryo or AI versus bull bred or the cow is carrying twins. This information can be used in marketing and management. Knowledge is power, you can obtain more knowledge with ultrasound than with palpation and it is cost effective.

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