Reproductive Ultrasound

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Ultrasound is not a new technology and is commonly utilized in veterinary medicine for analysis of multiple body systems such as the reproductive system. In the past, ultrasound has been primarily utilized by Universities and specialty practices but now it is in the hands of the mixed animal practitioner. It is even in the hands of lay people in certain states that allow pregnancy diagnosis. (However, in Alabama lay people should not be diagnosing pregnancy). The fathers of reproductive ultrasound are Brad Stroud and O. J. Ginther. They have published books and videos on the art of reproductive ultrasound which are still utilized for training students in reproductive ultrasonography. There are a number of websites that provide training on bovine reproductive ultrasonograpy such as BCF Technology (http://www.bing.com/images/search?q=picture+of+ultrasound+probes&id=BC9B7808BC581FFB0F6DA8635F027A623D44B640&FORM=IQFRBA).

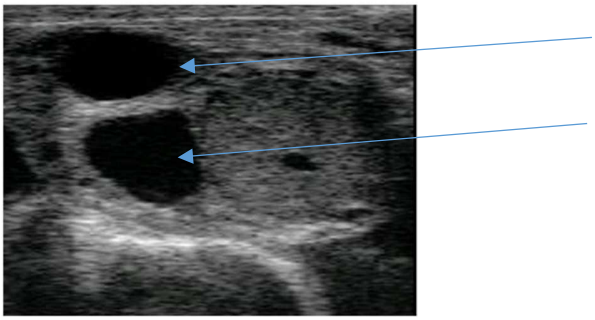
Equipment

Choosing the right ultrasound equipment is important because the primary use will determine what type of transducer will be the one selected. There are a number of different probe types such as linear, phased array, endocavitary, convex, biplanar, micro-convex, T-type linear, intra-rectal linear, transvaginal, as pictured below.

http://www.bing.com/images/search?q=picture+of+ultrasound+probes&id=BC9B7808BC581FFB0F6DA8635F027A623D44B640&FORM=IQFRBA). For reproductive ultrasound the intra-rectal, micro-convex, convex, and transvaginal probes are most often utilized. The transducer type will provide a unique view of the ultrasound image. The frequency of the probe is usually 5-7 MHz for transrectal and the 2.5-3.5MHz for transabdominal. Make sure that the animal is restrained sufficiently such as in a chute, stanchion or stocks prior to ultrasound. It may be necessary to sedate the animal depending on the procedure and the temperament of the animal. Some horses may need to be sedated for trans-rectal ultrasound or other ultrasound procedures. If cattle need to be sedated Acepromazine is often utilized at 1 mL per 1,000 lbs given

intravenously. Bos Indicus cattle are more sensitive so 0.5mL per 1,000 lbs is a better place to start and more can be given as necessary. Xylazine causes uterine contractions and is cardiovascularly depressive so it isn't often utilized in pregnant animals. There are currently extension arms available that can aid in the use of an intra-rectal probe which are often utilized in reproductive ultrasound of small ruminants, heifers and for detection of early pregnancies in cows. IBEX ® has developed an extension arm that is very flexible and easy to use (http://www.eimedical.com/new-ice-ibex-customizeable-extension).

When one is evaluating the image displayed on the monitor of the ultrasound it is important to know how tissue and fluid will appear on the image. The image characteristics are based on the density of the tissue and or fluid. The whiter or more echogenic the tissue the more dense it is, for example; bone is very white (http://www.bing.com/images/search?q=Echogenicity&Form=R5FD8). The more non-echogenic the tissue or fluid the darker it is for example clear fluid is black like what is seen in the follicles as below (arrows; http://www.agroscan.com/AGROSCAN16_WEB/UK/AGROSCAN_Gallery_IMAGO.awp)



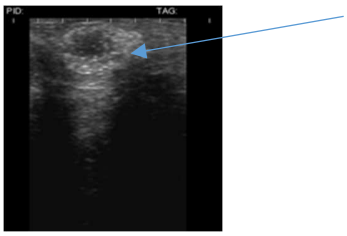
The monitor is often attached to the ultrasound probe in some fashion. However, wireless monitors are available and often times the monitor may take the form of goggles or even a mon-ocular eyepiece. Appropriate viewing of an ultrasound image is necessary to correctly interpret the image seen. In direct sunlight it is very difficult to clearly visualize the ultrasound monitor so googles or eye glass monitors work quite well under these conditions. It is nice to have an additional monitor for viewing while doing an ultrasound- guided procedure. A record of the ultrasound is important, especially when making serial assessments for comparisons, and will provide some amount of legal documentation.

When utilizing the ultrasound to evaluate the reproductive tract of a cow, horse of small ruminant or the genitalia of the bull, stallion or male small ruminant have a system. For example

in the cow, start at the cervix and turn the probe perpendicular to the cervix and then slide down the cervix and then each horn, left horn, left ovary and then right horn and right ovary. If a bull start at the scrotal neck and then to the head of the epididymis, body of the epididymis, testicle and then the tail of the epididymis.

Pathology

Ultrasound of the reproductive tract can aid in the palpation findings immensely. Pathologic changes can be visualized with an ultrasound that might not be palpable for example; ovarian follicular dysplasia where dystrophic mineralization (arrow) can be seen on ultrasound of the ovary but not by palpation. Cystic ovaries cannot be diagnosed by palpation if they are follicular or luteal by it can be diagnosed via ultrasound. Pathology is much easier to determine based on ultrasound than just palpation whether it is lymphosarcoma of the uterus of luteal cysts of the uterus or a pyometra.



Other pathologic structures which can be seen are: Ovarian Neoplasia; Granulosa Theca Cell Tumor, cystadenocarcinomas, teratoma, metastatic – lymphosarcoma, leiomyoma, endometritis – echogenic fluid in the uterine lumen, pyometra – fluid in the uterine horn with corpus luteum (CL). A mummified of macerated fetus can be detected via ultrasound. Pregnancy examination can occur with 90% accuracy on day 22 and day 25 with 100% accuracy with ultrasound which is significantly improved over a 32 to 35 day pregnancy diagnosis by rectal palpation alone. The ovarian structures can be palpated but not in as great detail as seen on ultrasound can let you know where the animal is in her cycle whether she is metestrus, diestrus, proestrus, or estrus. This allows you to manipulate the cycle such as giving prostaglandin to short cycle her if she has a corpus luteum that will respond to the prostaglandin. Ultrasound of the testes and epididymis and vesicular glands is also beneficial to determine pathology.

Embryo Transfer

Additionally, ultrasound can help in embryo transfer programs to visualize and should be used to identify what side the CL is on in order to transfer the embryo to the same side of the CL. Placement of the embryo is critical in that the embryo should be placed ipsilateral to the CL and two-thirds of the way down the horn. A study was performed by Steel and Adams 1995 and they showed that when transferring grade 2 embryos that they pregnancy rates where better when placed in the upper 1/3 which had a pregnancy rate of 69.9% and the middle 1/3 wasn't much lower with a pregnancy rate of 68.8%. In comparison to the lower portion of the uterine tract

rates where significantly lower with placing the embryo at the lower 1/3 resulting in a pregnancy rate of 59.8% and much worse when placement was at the external bifurcation at 29.6% external bifurcation. However, when grade 1 embryos were evaluated under the same conditions there was not a dramatic difference. Special thawing of embryos might be necessary but if embryos are in yellow straws that is indicative of direct transfer which does not require the embryo to be in decreasing dishes of glycerol by usually just air thaw of 15 seconds and a water bath of 97.5 to 98 degree water bath.

Fetal Aging

Ultrasound can give an upper hand in accurate fetal aging. The fetal aging chart below in Table 1 by Poock & Wilson et al.,2011 Stroud & Collton gives various measurements of fetus at different stages.

Table 1. (Adapted from Drs. Jill Colloton and Brad Stroud) (SE Poock and DJ Wilson, Proceedings of Applied Reproductive Strategies in Beef Cattle 2011)

Days	Primary structure	Size	Secondary	Size	Tertiary structure	Size
< 30	Crown to rump	0.9 cm	-----	---	-----	---
35	Crown to rump	1 cm	-----	---	-----	---
40	Crown to rump	2 cm	-----	---	-----	---
45	Crown to rump	3 cm	-----	---	-----	---
50	Crown to rump	4 cm	Head diameter	0.7 cm	-----	---
55	Crown to rump	5 cm	Head diameter	1.1 cm	-----	---
60	Head Length	2.5 cm	Head diameter	1.5 cm	-----	---
70	Head Length	3 cm	Head diameter	2 cm	-----	---
75	Head Length	3.5 cm	Head diameter	2.3 cm	trunk diameter	2.5 cm
80	Head Length	4 cm	Head diameter	2.5 cm	trunk diameter	3 cm
85	Head Length	4.5 cm	Head diameter	2.8 cm	trunk diameter	3.5 cm
90	Head Length	5 cm	Head diameter	3.1 cm	trunk diameter	4 cm
95	Head Length	5.5 cm	Head diameter	3.5 cm	trunk diameter	4.5 cm
100	Head Length	6 cm	Head diameter	4 cm	trunk diameter	5 cm
105	Head Length	7 cm	Head diameter	4.5 cm	trunk diameter	6 cm
110	Head Length	8 cm	Head diameter	5 cm	trunk diameter	7 cm

Fetal Sexing

Ultrasound is also good for assessing fetal sex from day 55 to 115. It is really best to do fetal sexing on days 65 to 85 because a large pendulous tract can be very problematic to ultrasound. The evidence of genital tubercle (bilobed structure) under the tail and no evidence of one behind the umbilicus and no trilobed scrotum equals a female and often hyperechoic teats at 80 days. The secondary structures are the scrotum – tri-lobed, frontal and cross-sectional views and the teats; hyperechoic, frontal and cranial- caudal cross-sectional view. However, do not diagnose sex on these alone. There are three views; *Frontal – common and easiest; Cross-sectional –*

*usually presented; Lateral – rarely seen.*variations of all 3 obviously occur. The frontal view one can identify the head, thorax, abdomen, & inguinal area and should focus on umbilical attachment. The male GT is immediately caudal to umbilicus and if it is a female the GT is under the tail. In the frontal view there is lack of GT behind umbilicus for Female. The problems include: superimposed tail over the female GT so you have to angle the transducer to the left or right to oblique resulting in separate viewing of tail and GT. The Lateral View is hard to achieve and not as common but can easily distinguish (*60-100 day GT; 90 day – entire penis).* Cross-sectional View -Start at cranium and move distal and view beating heart. Assess fetal viability – ALWAYS!!! Or in other words sex don't matter on a dead fetus! Then ***v***iew umbilical attachment and the males GT is directly caudal. Then view the perineal area – tail and female GT may be hard to differentiate, move slow and oblique to separate. Do not diagnose sex on just the absence of the opposite sex GT, The male GT at particular angles may not be seen well so a misdiagnosis can occur. A female can be misdiagnosed as a male when the tail goes between the hind legs approaching the umbilicus looking like a male GT.

Fetal Viability

A fetal heartbeat and fetal movement should be detected with a baseline heart rate of 70-100/bpm which will accelerate by 25 to 40/bpm within 30 seconds of vigorous fetal movement. Embryonic and fetal mortality is diagnosed when the heartbeat is absent, the allantochorion will be free floating and there will be no fetal movement. The fetus is expelled about 2-5 weeks after death of an embryo and then the abortion will be detectable. Diameter of the fetal aorta and maximum depth of fetal fluids are also measures of fetal viability

Fetal Anomalies

There are a number of fetal abnormalities such as; omphalocele which is an abdominal wall defect in which the abdominal contents may protrude into the umbilical cord, out of the body wall. Other anomalies include; fetal ascites in which there is abnormal accumulation of fluid in the abdomen and compromised twin pregnancies. Excessive retroplacental fluid accumulations such as hydrallantois and hydramnios, placental separations, placentitis and compromised twins which predispose to hydrops conditions and dystocia.

Placental Abnormalities

The combined uteroplacental thickness (CUPT) can be measured and should not be more than a m**aximum of 1.15 +/- 0.24 cm** in the fetal horn transcutaneous & transrectally. So, the rule of thumb for each month is 1mm plus 1mm so – for 5 months it should not be greater than 6mm; no greater than 12mm at 330 days. In order measure transcutanously use a 2.5 to 5 MHz sector or curvilinear probes with a depth setting of 27.5 to 30 cm for sector probes on the ventral *abdomen.*

Summary

Ultrasound of the bovine and equine reproductive tract is a non-invasive diagnostic tool providing information to the producer from pregnancy diagnosis cysts to segmental aplasia to fetal sexing.