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ULTRASOUND FOR LIVESTOCK

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Introduction:

Ultrasound techniques are becoming increasingly important in animal reproduction, offering both a mean of diagnosis and a useful therapeutic tool. Accordingly, understanding the use of ultrasound technology is critical in contemporary animal sciences, since ultrasound examinations are now a routine component of diagnostic workups in reproduction. Ultrasound technology offers the assessment of pregnancy status and foetal viability early post breeding in order to identify animals that fail to conceive, improving reproductive efficiency; early identification of animals carrying twin foetuses, allowing for the implementation of differential management strategies to avoid the negative effects of twinning on general health of the mother animal and also at parturition; and the visualisation of ovarian and uterine pathologies not accurately detected via rectal palpation, allowing appropriate therapies to be implemented. In addition, determination of foetal sex in utero can be done by ultrasonography. The techniques used in studying patterns of follicular development involved the measurement, counting and histological evaluation of ovaries of animals killed at various stages during the oestrous cycle, or marking of follicles with ink, followed by serial laparoscopy. In contrast, the development of ultrasonic probes that can be used intrarectally to visualise ovaries has opened up new possibilities for examining the dynamics of follicular growth and regression and provided a means for repeated, direct, non-invasive monitoring and measuring of follicles within the ovary.

Application in animals:

Ultrasonography is the second most commonly used imaging format in veterinary practice. It uses ultrasonic sound waves in the frequency range of 1.5–15 megahertz (MHz) to create images of body structures based on the pattern of echoes reflected from the tissues and organs being imaged. An ultrashort pulse of sound is directed into the animal, after which the transducer switches to the receive mode. Echoes occur as the sound beam changes velocity while passing from a tissue of one density to one of another density, even

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when the change occurs at nearly microscopic levels. The greater the change in velocity, the greater the strength of the echo. A small percentage of these echoes are reflected back to the transducer, which then reconverts the energy of the echoes into electrical impulses recorded by the computer in the ultrasound machine. The strength of the echo, the time required for the echo to return after the pulse, and the direction the sound beam that was sent are all recorded. Using information from multiple echoes, the machine creates an image that represents the appearance of the tissues when cut in the same plane on an anatomic specimen.

Although ultrasound can be used to evaluate most soft tissues, including muscles, tendons, and ligaments, the heart and abdominal organs still constitute the majority of examinations performed in small animals. In scanning of the abdomen, the abdominal structures should be systematically evaluated. Each sonographer develops his or her own system of completely evaluating the abdomen. Systematic evaluation ensures that all structures are scanned.

Development of diagnostic ultrasound:

Ultrasound is defined as any sound frequency above the normal hearing range of the human ear; i.e. greater than 20,000 Hz. Sound waves in ultrasound devices are typically produced by vibrations of specialised crystals housed in an ultrasound transducer, with the vibrations of the crystals themselves produced by pulses of electric current. A proportion of the sound waves reflected back to the transducter is converted to electric current and displayed as an echo on the ultrasound viewing screen. The transducer, therefore, acts as both the sender and receiver of echoes. The echoes are evident on the viewing screen as varying shades of gray .Early applications of ultrasound as a diagnostic aid in medicine utilised Amplitude or A-mode ultrasound. Early applications using A-mode ultrasound included imaging the human abdomen to identify gallstones and foreign material. Imaging in obstetrics and in the eye. The first use of ultrasound as a diagnostic aid in veterinary medicine was for the detection of pregnancy in sheep. Nowadays, Brightness B- mode and Doppler are more commonly used than A-mode, and a variety of applications have emerged using these techniques. The introduction of computer systems to ultrasound machines has enabled the storage, processing and presenting of large amounts of data, allowing the production of static two-dimensional grey scale images and real-time imaging. This real-time B-mode imaging is currently the form of ultrasound most commonly used. Prior to real-time imaging, the examination of moving structures such as the heart required a technique now

known as Time Motion or M-mode ultrasound. As early as 1954, this form of imaging was used to assess the movement of heart valves and walls. However, neither B- nor M-mode is capable of assessing blood flow.

Recent advances in ultrasound:

Battery operated hand-carried ultrasound scanners are available .Although initially intended for use in small animals, this type of equipment is now increasingly being used in conservation projects for the reproductive management of farm, wild and captive endangered species including elephants and rhinoceros. All of these machines are capable of B and M-mode real-time imaging and many now also incorporate colour flow Doppler, increasing the scope of the examinations that can be performed.

All ultrasound machines allow individual images to be captured and displayed. Combining computer technology with medical ultrasound can help with displaying the data in a more appropriate fashion. With this, advanced post-processing functions have given the operator greater ability to optimise image quality, therefore allowing the production of vastly superior images and Doppler traces. For example, three-dimensional ultrasound has been used in horses to examine the reproductive tract.

Advantages of ultrasound in veterinary:

- It's noninvasive.
- It requires no medication or anesthesia.
- It's affordable.
- It can be repeated, such as with each new stage of a pregnancy.
- It allows us to view the internal organs with greater precision.
- The procedure typically doesn't distress pets.
- It can assist in surgical procedures and bioposes.

Disadvantages of ultrasound:

- Increased depth means a lower frequency is required for optimal imaging. As a consequence there is a lower resolution.
- Over time US machines have become more sophisticated, some of these machines use the returning second degree harmonic of the original frequency to produce an improved image.
- **Anisotropy**- Simply this means a structure is highly reflective to ultrasound. This occurs with nerves, tendons and needles. The US beam must be at or close to perpendicular to the structure for the beam to 'bounce' back to the probe for an image to be created. Manufacturers now have a specific program to enhance the needle image.
- Bone blocks US waves. As such imaging of the spine is increasingly difficult with increasing age.

- Training. Ultrasound techniques require improved anatomical knowledge and a formal educational program.

Conclusion:

In modern scanning systems, the sound beam is swept through the body many times per second, producing a dynamic, real-time image that changes as the transducer is moved across the body. This real-time image is easier to interpret and allows the examiner to scan continuously until a satisfactory image is obtained. The image may then be frozen and recorded in a digital format, which also allows for recording of short segments of the real-time scan. As for radiography and all other medical imaging systems, the accepted, legal format for digital ultrasound images is the DICOM III standard. The impact of real-time ultrasound on the study of animal reproduction has been dramatic, and development of portable ultrasound machines has given clinicians an added tool for diagnostic reproductive management. Ultrasound is commonly used to monitor uterine anatomy, involution and pathology. In addition, it has been used to detect pregnancy, study embryonic mortality, monitor foetal development, and determine foetal sex. Recent advances in ultrasound technology in both hardware and software have resulted in the production of superior images and the widespread use of ultrasound. The new information that has been generated through ultrasound has thrown light on therapeutic uses, thereby opening up new areas for research. Moreover, ultrasound-guided interventional techniques can be used for diagnostic or therapeutic purposes. This review, display the advances and applications of ultrasonography in domestic animal reproduction.