Ultrasonography (1)

Introduction :

In animal practice, ultrasonography has become an important component of small and large animal theriogenology since its introduction to practice in early eighties. The application of ultrasound as a tool in animal reproduction has lingering from its initial role in safe and early pregnancy diagnosis to its current use in the approach to clinical reproduction (obstetrics, infertility, urogenital disorders). As more practitioners become experienced in the application of ultrasound and as the cost of units becomes increasingly affordable, its use in the average large or small animal practice may become more common. One of the greatest advantages of ultrasonography is that it is easy to use, non-invasive and cheaper in comparison to other diagnostic tools.

Principles of Ultrasonography:

Ultrasonography is the technique where sound waves are passed through tissue interphases and their echoes from various tissues are received back and are displayed on a screen. The sound waves are generated by a piezoelectric crystal that has a unique property to convert electrical waves into sound waves and vice-versa. In reproductive management of animals, a-B- mode (brightness modality) scanners are generally used . B- Mode ultrasound displays an image of a cross-section of tissue. The intensity of echoes defines the brightness of the image in B- mode ultrasound. A **hyperechoic** tissue or organ appears bright and **anechoic** object appears dark in the ultrasound image. A **hypoechoic** tissue or organ appears in between grey and black color. Ultrasound images are best observed in a dark room where the human eye can visualize more shades of grey.

Ultrasound Units (Equipment) :

Ultrasound technology has advanced rapidly in the last twenty years, providing improved image quality as well as increased portability of equipment for field use. The ultrasound apparatus consists of a probe that is connected by a cable to a console. The console includes an electronic case, a command keyboard, and a monitor with an imaging screen.

Characteristics of probe and its resolutions:

The probe is the most fragile component of the ultrasound apparatus. In the Veterinary practice, we usually use the probes having a frequency of **3.5, 5.0** or **7.5 ,8.5** MHz.

Probe types

Probes are classified according to whether they provide a **linear** or **sector** scan of the tissue section with the ultrasound beam. There are two types of probes:

1-**Linear transducer(probe):** A linear probes contain a large number of crystals (128 – 256) aligned along the longitudinal axis of the probe over a length of 5 to 15 cm. The section is scanned electronically by sequential ignition of the crystals along the probe. Linear scan probes generate a rectangular - shaped image of constant and sufficient width

to cover the region being examined. The linear probe provides good resolution for tissues located close to the probe. In animal gynecology, linear probes are preferred for transrectal ultrasound examinations of the ovaries and uterus because their shape permits safer manipulation in the rectum. Most linear probes have grooves or indicators that facilitate manipulation in terms of properly orienting the probe.

2- **Sector probe (transducer):**

A larger zone can be viewed if the crystals are placed on a convex surface. This is the case with a convex or curved linear probe that generates an image which could be as large as the one produced by a linear probe at the surface, but which expands with the depth of the image. Sector probes produce a fan - shaped image that is very narrow at the surface and which expands with depth. This allows the veterinarian to view large structures located deep in the body and to produce images through narrow acoustic windows, such as between two ribs.

Frequency and power of resolution

The frequency represents the number of crystal oscillations per second (number of hertz, Hz) and depends on the crystal ' s characteristics (type and thickness of the matter). The frequencies used in medical imaging are between 2 and 10 megahertz (MHz), where 1 MHz is 1 million cycles per second, 50 times greater than the maximum frequency of audible sound by the human ear — hence the name ***ultrasound*** . The high **bandwidth** probes with a broad - spectrum frequency (from 4 to 8 MHz) emit different frequencies depending on the electrical impulse applied. These probes, like multi-frequency probes with crystals of different resonant frequencies, allow variations in frequency without having to change probes.

Table -1. Characteristics and indications of probes with different frequencies used in Theriogenology

3 MHz	5MHz	7.5MHz
Best field depth (0 – 20 cm)	Intermediate field depth (0 – 12 cm)	Reduced field depth (0 – 7 cm)
Lower resolution	Good resolution	Higher resolution
-Advanced gestation -Postpartum uterus	-Routine pregnancy diagnosis -Determining fetal sex	-Follicles and corpus luteum -Early pregnancy diagnosis -Determining fetal sex