Applications of US in large animals reproduction

Real - time ultrasonography has become an essential diagnostic tool as well as a research tool in veterinary sciences because it provides information beyond transrectal palpation of the reproductive organs. As a diagnostic aid ultrasonography is well suited for bovine practice, particularly for the examination of female and male reproductive tracts. A 5.0 to 7.5 MHz linear rectal probe is the most commonly used and preferable to obtain good quality and detailed images of the different tissues of the reproductive organs.

Ultrasound technique and imaging:

The procedure of **US** examination of the uterus and ovaries is similar to that of a rectal palpation.

1-Ovarian evaluations: Ovaries must be routinely examined during all reproductive examinations. The bovine ovary is a structure that provides different ultrasonographic images depending upon the phase of its development. Correct interpretation of the nature of ovarian structures observed by ultrasonography is a complex issue because follicles and CLs are continuously growing or regressing. Among all the structures, ovarian follicles and corpus luteum are the most viewed structures.

1.1 -Follicles : Follicles are relatively easy to identify as they contain anechoic fluid inside them and appear as a black structure of various sizes in an ultrasound image. All **follicles** are not uniformly spherical. This is possibly a result of transducer pressure on large **follicles** or of pressure created by neighboring follicles. During the ultrasonographic evaluation of the ovaries, it is important to be able to distinguish a **follicle** from a blood vessel. A cross – sectional view of an ovarian blood vessel resembles the image of a spherical segment of a **follicle**. However, when moving the probe in the direction that will allow a longitudinal section rather than a cross section of the blood vessel, the initial spherical image will become elongated, contrary to the **follicle**, which becomes a smaller sphere and simply disappears from view when the probe is moved away. The accurate recognition of follicle with diameters of only a few millimeters depends mostly on the image quality generated and on the experience of operator.

1-2- Corpus luteum(CL): Corpus luteum is the structure that is formed after ovulation. It is a real challenge to identify corpus luteum via ultrasound because their morphological form changes continuously depending upon their stage of development. Corpora lutea are recognized by their size and shape as well as their characteristic echographic appearance. On the ultrasonographic image, the diestrous corpus luteum (CL) may appear to be imbedded in the ovary or may appear to protrude from the ovary. The diestrous CL has a granular echogenic structure, which intensifies during the luteal phase.

2- Uterus: Periestrus phase includes proestrus, estrus and the beginning of the metestrus. **During estrus**, the uterus is more heterogeneous in terms of echogenicity. During this period there is a high level of circulating estrogen, the uterus is more swollen, its tone increases and there is the presence of fluid inside the uterus. The ultrasound image looks much darker and the horn is less coiled in comparison to the diestrus. The presence of rosette-shaped mucus in the uterine lumen is very typical during this period. **During diestrus,** the uterus is quite

homogenous in terms of echogenicity.Due to the circulating level of progesterone bring the uterus back to a state of calm, preparing it for the implantation of an embryo it prepares itself for the implantation of the embryo. The uterus loses its tone, becomes thinner and normally loses the endometrial liquid.

-Ultrasonography for detection early pregnancy:

Pregnancy diagnosis is a very important application of ultrasonography. Early pregnancy diagnosis after insemination helps in better management of the pregnant animals and early submission of non-pregnant animals for subsequent breeding. Early ultrasound diagnosis of gestation reveals a uterine lumen containing a variable quantity of anechogenic fluid produced by the conceptus. Fluid accumulation and uterine distension depend largely on the stage of gestation and the age of the cow. It is sometimes difficult to locate the embryo in the slight quantity of amniotic and allantoic fluid before day 30 of gestation , because the young embryo is often lodged close to the uterine wall and may even be concealed by an endometrial fold . Careful examination in the zone of anechogenic fluid generally reveals the presence of the embryo close to the uterine folds. Starting on day 30 it is also possible to view the echogenic amniotic membrane that produces specular reflections due to its round shape.

Ultrasonography for diagnosis of female reproductive disorders:

1-Ovarian cyst: Cystic ovary in cattle is characterized by the abnormal presence of large anovulatory follicles which persist for a long period without the presence of corpus luteum and generally hampering the normal estrus cycle. The cysts are larger than 25 mm in diameter and persist for more than 10 days .**There Are Two Types of Ovarian Cyst**

a. Follicular cyst:

Ovarian follicular cysts in cattle are characterized by the persistence of large anovulatory structures for various periods of time in the absence of corpora lutea, with interruption of normal estrous cycles. They generally have a thin wall which is generally less than 3mm in diameter and the structure appear as anechoic and dark. The follicular cyst may be multiple and are present on one or both the ovaries. Oval or irregular shape with a uniform anechoic content and area of signal enhancement on the back surface.

b. Luteal cyst:

They have a thick wall greater than 3mm in diameter which appears grey with the central anechoic dark region. Incidence of cystic CLs ranges from 25.2% to 78.8% during diestrus and decreases during estrus.

Ultrasound of the Postpartum Abnormal Uterus:

The principal pathologic conditions of the uterus are infectious. Acute puerperal metritis, endometritis, pyometra are the most frequent infectious problems of the uterus. Other noninfectious pathologic conditions of the uterus that can be diagnosed with ultrasound are mucometra and hydrometra.

Endometritis: Endometritis is the inflammation of the endometrium, Fluid accumulations which are detectable inside the lumen of a non-pregnant uterus can be indicative for chronic endometritis. The amount of the fluids can vary considerably. Their echogenicity distinguishes the endometritis fluids from other uterine secretion as are seen during estrus or pregnancy. Anechoic fluids usually only occur under physiological conditions. The echogenicity of the fluid can develop to snow-storm like images and can become so severe that it appears nearly white.

Pyometra: Pyometra is characterized by a progressive accumulation of pus in the uterus and by the persistence of functional luteal tissue in the ovary. The typical pyometra sonogram shows the accumulation of a large quantity of a heterogeneous echogenic liquid and a thickened uterine wall. By balloting the uterus the suspended hyperechogenic particles will be sent into movement within the uterine liquid. Differentiation of pyometra from a normal pregnancy can sometimes be difficult, but there are a number of distinguishing points:

- The uterine wall is thicker than at pregnancy.
- The uterus has a more 'doughy' and less vibrant feel.
- It is not possible to 'slip' the allantochorion.
- In most cases of pyometra, no uterine caruncles can be palpated. However, when the infection occurred in a non-involuted uterus, involution of the caruncles is delayed and they may remain palpable for quite a long time.
- Transrectal ultrasonography will demonstrate the absence of a fetus and the presence of a 'speckled' echotexture of the uterine contents compared with the black anechoic appearance of normal fetal fluids.

Parameters	Ultrasound	Manual palpation
Pregnancy diagnosis at	**27day**	**34day**
Results	**immediate**	**Immediate**
Fetal age	**Accurate**	**Variable with skill**
Twin detection	**Accurate-95%**	**Inaccurate -50**
Fetal gender	**Yes-55-70day-**	**No**
Ovarian structures	**accurate**	**Variable with skill**
Uterine evaluation	**Accurate**	**Variable with skill**