Lecture title: Ultrasonography

Lecturer Affiliation: University of Mosul\ veterinary medicine

Summary:

Ultrasonography: is study of internal organs or blood vessel using high frequency sound waves, the actual test called ultrasound scan or sonogram.

- **Principle:**
- Ultrasound as sound waves of frequencies greater than audible to human ear i.e. greater than 20,000Hz. Frequencies between 1 to 10 MHz are mainly used for the purpose of diagnostic ultrasound.
- A sound waves travels in a pulse & when it is reflected it becomes an echo. The pulse-echo is used for ultrasound imaging
- A pulse generated by one or more piezoelectric crystals an ultrasound probe or transducer.
- Ultrasound probe crystal is shocked by single extremely short pulse of electricity to vibrate at a frequency determined by its thickness.
- Once echo are converted into electrical signals, these are processed & transformed into a visual display of the measure of the amplitude of the echo this is echo quantification.
- The transducer picks up the return echo & record any changes in the pitch or direction of the sound, the image is immediately visible on the screen.
- **Indications:**
  - Use in detecting abnormalities of heart, uterus, pancreas, urinary bladder, liver, stomach, kidney, eye & teeth.
  - Most commonly use in **obstetric** sonography to confirm intrauterine pregnancy , exclude ectopic pregnancy, fetal sex

determination, fetal viability, evaluate anomalies, Guided intrauterine fetal transfusion.

- In case of abdominal sonography check tumor, clotting status before intra-abdominal biopsy, gall stone, bile duct obstruction, speelnlomegaly.

- Sonography of urinary tract detect renal abnormalities, tumor, urinary calculi of urinary bladder, morphology of kidney.

❖ **Advantages of ultrasound:**

1. Ultrasound examinations are non-invasive i.e. they do not require the body to be opened up, or anything to be inserted into the body.
2. Ultrasound methods are relatively inexpensive, quick and convenient, compared to techniques such as X-rays. The equipment can be made portable, and the images can be stored electronically
3. No harmful effects have been detected: because it does not involve the use of ionizing radiation. Therefore it is safe for the veterinarian and animal.
4. Ultrasound is particularly suited to imaging soft tissues such as the eye, heart and other internal organs, and examining blood vessels.
5. It is rarely necessary to anesthesia of animals.

❖ **Disadvantages of ultrasound:**

1. Ultrasound is reflected very strongly on passing from tissue to gas, or vice versa. This means that ultrasound cannot be used for examinations of areas of the body containing gas, such as the lung and the digestive system.
2. Ultrasound also does not pass well through bone, so that the method is of limited use in diagnosing fractures.

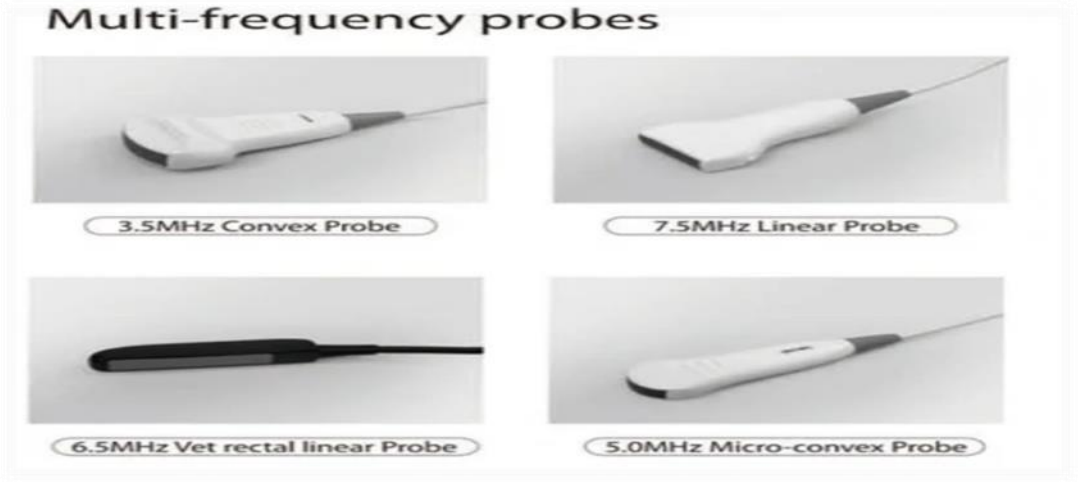
❖ **Probes:**

1. Linear probes:

Contain a large number of crystals (12 –256) along the longitudinal axis of the probe over a length of 5-15 cm. Linear scan probes generate a rectangular – shaped image of constant and sufficient width to cover the region being examined.

2. Convex or curved probes:

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.



❖ The ultrasound image contains **three readings**

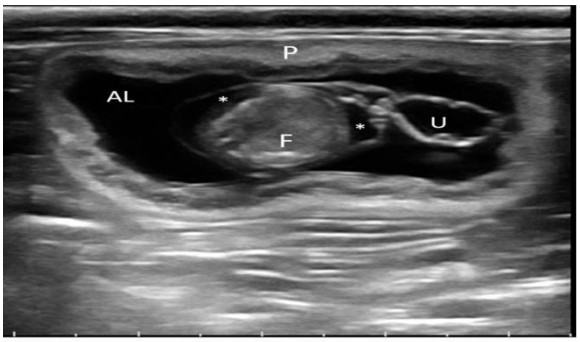
1. All fluids will appear in black (**non-echogenic**)
2. The second is white, and it is hard tissues such as bones and teeth (**hyper-echogenic**)
3. The third is a gray gradient color, and this represents soft tissue (**echogenic**)

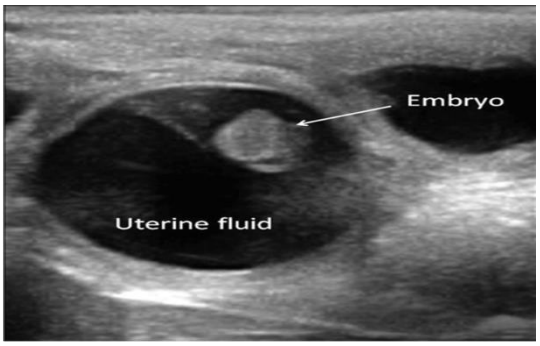
❖ Components of pregnancy in ruminants

1 - The fetal vesicle or **fetal sac** that contains fetal fluids and is black in color

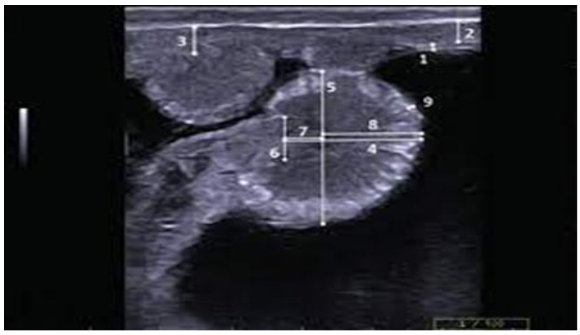
2 - The **embryonic mass**, which is represented by the fetus and takes on a white to gray color

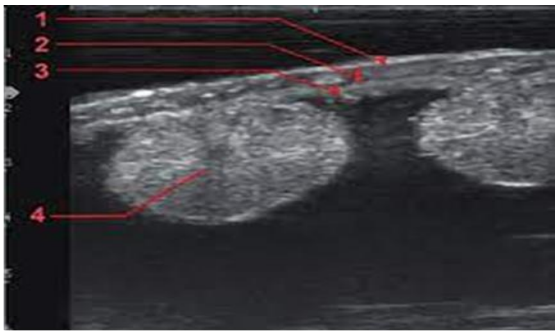
3 - The **placentoma** : it are small balls that take on a gray color





The fetal vesicle





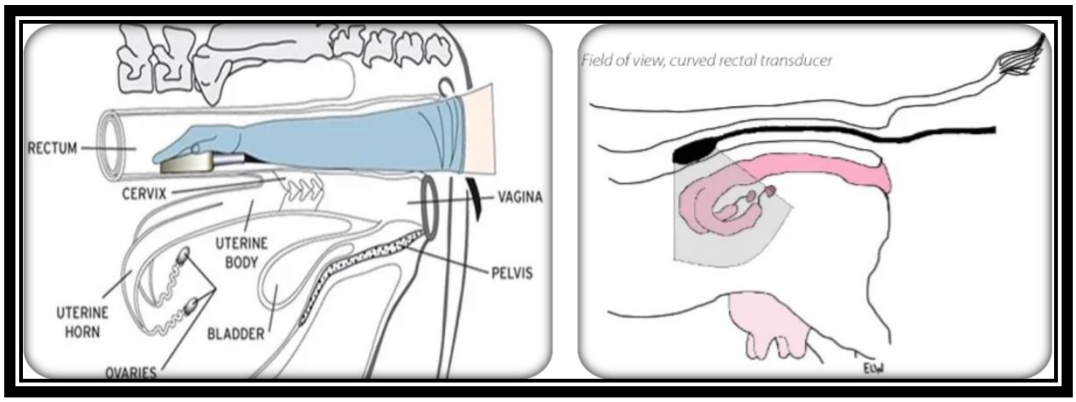
The placentoma

Note: there is a relationship between frequency and wavelength, and this relationship is inverse. The higher the frequency, the shorter the wavelength, and vice versa.

❖ Techniques of examination

➢ Transrectal ultrasound scanning in animals:

All faeces from the rectum should be evacuated prior to introduction of the transducer. It is often advantageous to carry out a preliminary exploration of the topography of the reproductive tract before commencing the ultrasonographic examination. The transducer face must be lubricated with a suitable coupling medium and is usually covered with a lubricated plastic sleeve before insertion in a cupped, lubricated hand through the anal opening in large animals. It is then progressed cranially along the rectal floor to overlie the reproductive tract. The transducer face must be pressed firmly against the rectal mucosa in order to effect ultrasound transmission through the rectal wall into the abdominal viscera. The probe is moved across the reproductive tract in a thorough and systemic manner.



❖ Transabdominal ultrasound scanning:

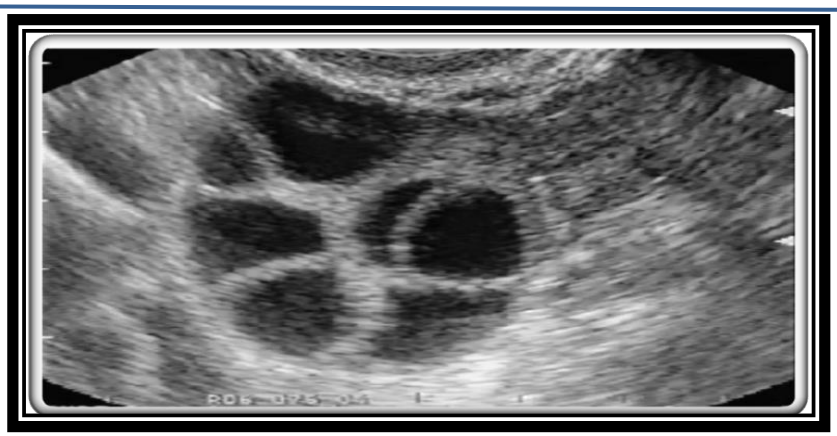
- A close contact is necessary between the ultrasound transducer and the animal's skin.
- Air does not allow the transmission of sound so it is important to clip the coat, to clean the skin, and to apply an acoustic gel which allows ultrasound transmission.
- Most animals are examined standing or laying on their side or back.

❖ Applications of ultrasound in ruminants reproduction

- Assessment of normal ovarian structures:

1. Follicles

• Antral follicles of various sizes appear as **non-echogenic** structures.

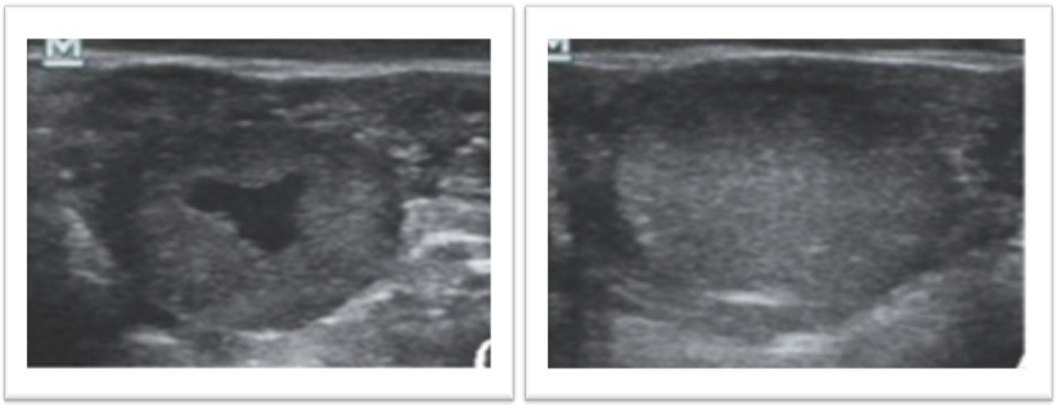


2. Ovulation

Determination of ovulation by ultrasound examination has been reported. ovulation was depicted by the absence of a preovulatory follicle that was present at a previous examination and subsequently confirmed by the development of corpus luteum at the same spot.

3. Corpora lutea

• A developing CL appears on the ultrasound image as a poorly defined, irregular, greyish-black structure with echogenic spots all within the ovary.



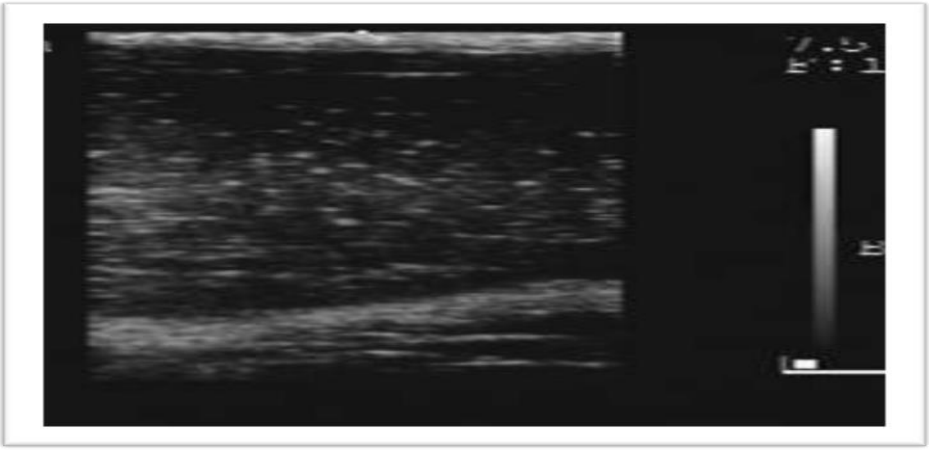
4. Ovarian tumor

A compact, highly echogenic image interrupted by **non-echogenic** blood vessels can observed in a cow with granulosa cell tumor.

Uterine abnormalities:

- Uterine abnormalities recognized during ultrasonography included:

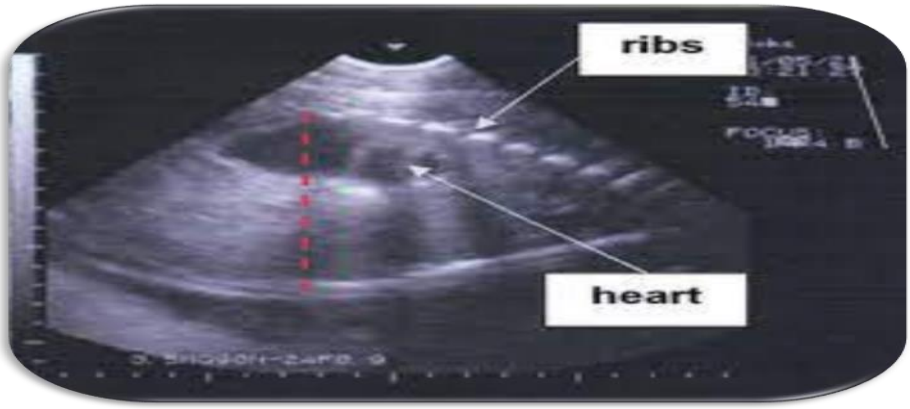
a. Endometritis
b. Pyometra
c. fetal maceration
d. fetal mummification.
e. tumor



Pyometra

Pregnancy diagnosis

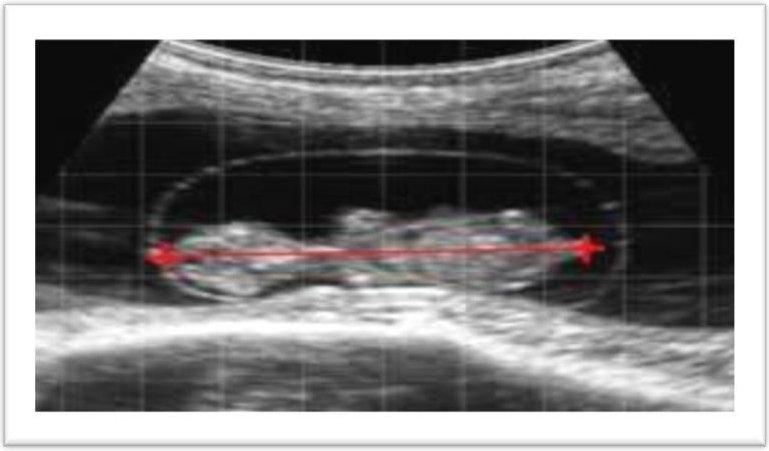
- Pregnancy diagnosis in cattle can be achieved by ultrasonography. In this the foetus appears as an echogenic structure inside a non-echogenic structure.
- they observed irregularly shaped non-echogenic structures in the lumen of the uterus from day 28 post-insemination.



Determination of fetal age

Measurements of fetus and uterus can be used for determination of fetal age such as:

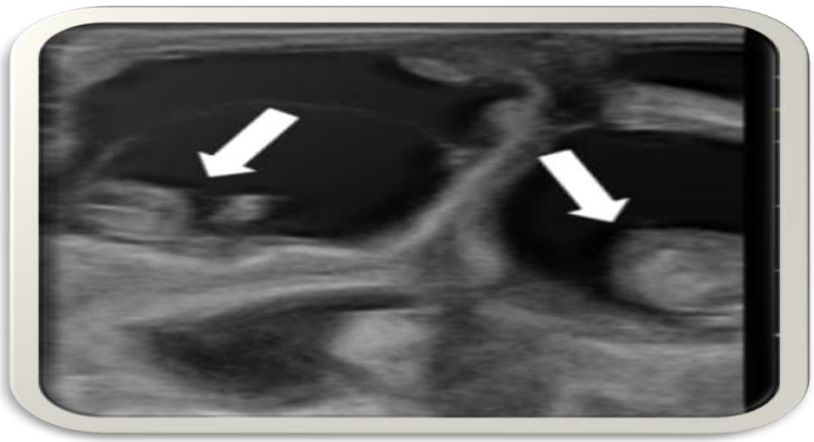
i. crown rump length
ii. placentoma length and height
iii. trunk and heart width
iv. intercostal distance
v. umbilical cord width
vi. eyeball
vii. skull



Crown-Rump Length: Calf X =2.5 (CRL+21),, Lamb X = 2.1 (CRL +17)

- **Determination of foetal number and viability** (identification of twins)

The ability to identify multiple foetuses with real-time ultrasonography is a clear advantage over other techniques. foetal number in goats was shown as detectable at day 40 post-mating; the best time was day 60 after mating. Determination of foetal number would allow producers to separate animals carrying singles, twins or triplets for differential management. ultrasound. Cows carrying twin foetuses can be accurately identified using transrectal ultrasonography by 40–55 days post artificial insemination. Determination of foetal viability is a clear advantage of ultrasound over other methods of pregnancy diagnosis. The heart contractility can be seen between the ribs during examination.



Foetal sex determination by ultrasonography

The gender of foetuses can be detected by visualisation of the location of the genital tubercle or the scrotum and mammary glands.The most appropriate time of ultrasonographic sex determination is 55–60 days of gestation and the technique can be accurate even under farm conditions.