



Diagnostic Ultrasonography in Animal Reproduction

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Preamble

- Veterinary Reproduction covers the male and female reproductive anatomy, gametogenesis, fertilization, gestation, parturition, reproductive physiology and andrology.
- Various diagnostic techniques are applied for monitoring the stages of reproductive physiology and disorders in the male and female animals.
- Lab diagnostic techniques include Enzyme-linked Immunosorbent Assay (ELISA) for hormonal profiles (progesterone, estrogen, testosterone, FSH, LH, GnRH), spectrophotometry for detection and characterization of proteins, genetic testing, sequencing, proteomics and metabolomics (glucose, proteins and triglycerides), stress physiological biomarkers (cortisol, MDA malondialdehyde, SOD superoxide dismutase, GPx glutathione peroxidase and HSP heat shock protein).
- Heat detection vaginal probe for electrochemical sensors and cortisol assays for stress monitoring.
- Ovarian monitoring, heat detection and pregnancy diagnostic and ultrasonography

Ultrasonography, history

- The use of ultrasound in medicine began during and shortly after the 2nd World War in various centres around the world.
- The work of Dr.Karl Theodore Dussik in Austria in 1942 on transmission ultrasound investigation of the brain provides the first published work on medical ultrasonics.
- The work of Professor Ian Donald and his colleagues in Glasgow, in the mid 1950s, did much to facilitate the development of practical technology and applications (BMUS).
- Rapid technological advances in electronics and piezoelectric materials provided further improvements from bistable to grayscale images and from still images to real-time moving images.
- Doppler ultrasound progressed alongside the imaging technology but the fusing of the two technologies in Duplex scanning and subsequently the colour Doppler imaging investigated the circulation and blood supply to organs, tumours etc.

Definition and importance

Definition:

- A non-invasive diagnostic tool that uses high-frequency sound waves to create real-time images of internal organs.

Importance:

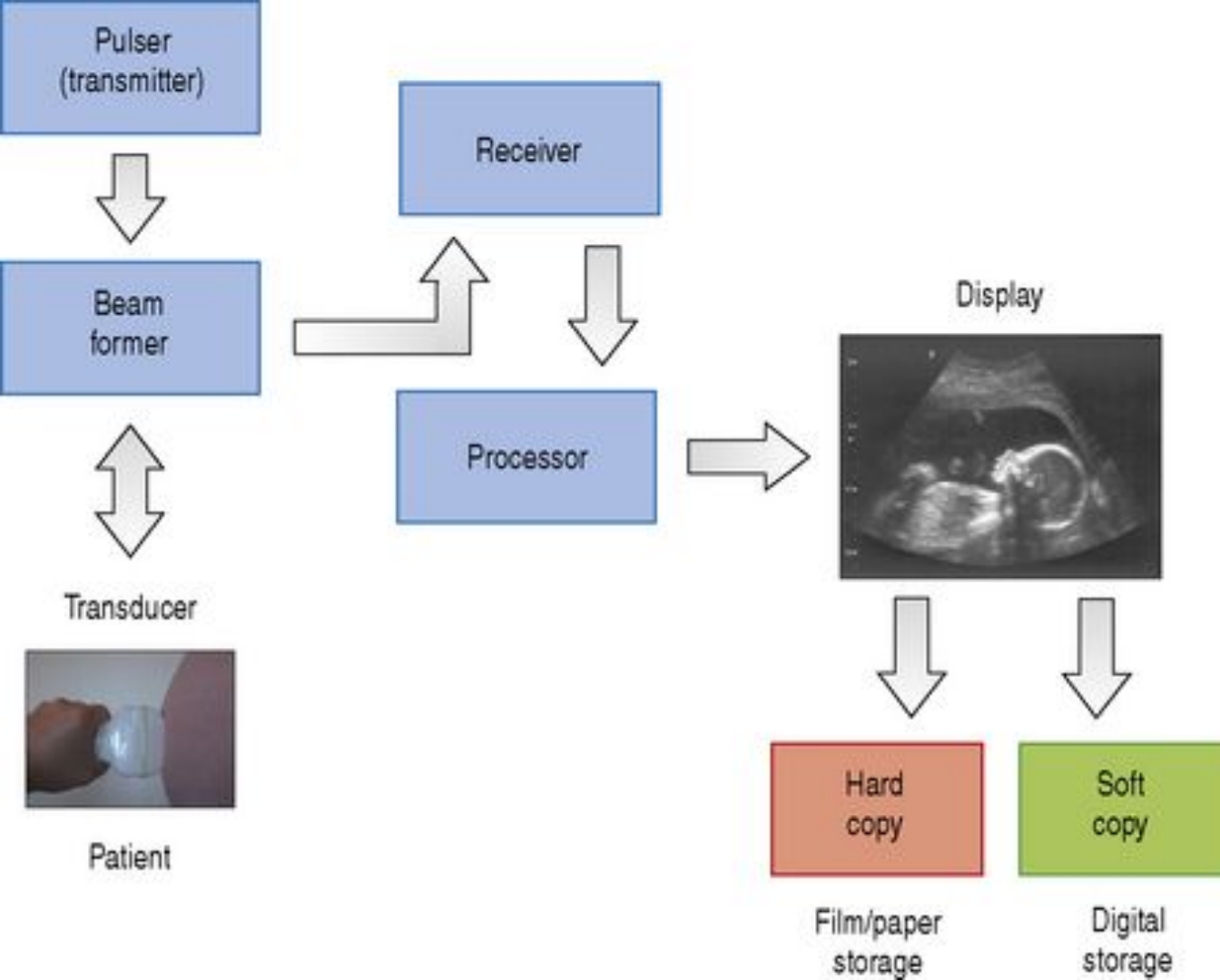
- Early pregnancy detection.
- Assessment of fetal development and health.
- Diagnosis of reproductive tract abnormalities (e.g., ovarian cysts, uterine infections).

Advantages:

- Non-invasive and safe technique for pregnancy diagnosis for both the mother and fetus.
- Real-time evaluation of reproductive organs, like fetal development and folliculogenesis.
- Providing solutions in embryo transfer technologies in OVum Pick Up (OPU).

Reproductive Ultrasonography

- Ultrasonography has been used in animal reproduction for diagnosing pregnancy diagnosis, ovarian functions and uterine disorders.
- Folliculogenesis may be monitored through ultrasonography including detection and measuring the antral and developing follicles, ovulation and development of corpus luteum.
- Advanced ultrasound techniques including Doppler, contrast-enhanced ultrasonography, elastography, and 3D/4D ultrasonography were developed to improve the diagnostic sensitivity of two-dimensional (b-mode) ultrasound, not as standalone exams.
- Ovarian Scanning for Identifying follicles, corpus luteum (CL), and ovarian cysts.
- Monitoring follicular waves in different species (e.g., cows, mares).
- Uterine Scanning for evaluating uterine horns for fluid or infection.
- Postpartum uterine involution (normal or abnormal).



Ultrasonography;
components of the
System.

Courtesy: Radiology
Key,
[Instrumentation and
Control](#)

Components of the Ultrasound System

- **The Pulser:** Produces the electric voltage that drives the transducer. The greater the applied voltage, the stronger the ultrasound pulse and the higher the pulse intensity.
- **The Beam Former:** It controls the shape and direction of the ultrasound beam. This enables the operator to have indirect control of depth, focus, sector width and zoom.
- **The Receiver:** Applies amplification to the returning echoes to make them stronger and to enable them to be visualized.
- **Transducer:** Made from piezoelectric materials to convert electrical energy into ultrasound energy and vice versa. Act as a transmitter and receiver of ultrasound. Able to produce beams which can be directed in various ways, controlled by the ultrasound machine to improve image quality.
- **The processor:** Can be divided into two individual parts, a signal processor – converts echo voltages to video signals and an image processor – formats the many scan line data into image form.
- **Display:** The image can either be displayed on a traditional cathode ray tube which is used in conventional televisions or be presented on a computer monitor or a flat panel screen.

Equipment Overview

- **Transducer (probe)** – emits and receives sound waves.
- **Control panel** – allows adjustment of parameters (e.g., gain, depth).
- **Display screen** – shows real-time images.
- Types of Probes:
 - **Linear probes** (rectal scanning, large animals).
 - **Convex/curved probes** (abdominal scanning, small animals).
- **Frequency range:** Higher frequencies for clearer images but shallower penetration (ideal for small animals), lower frequencies for deep structures in large animals.
- Preparing the Machine: i) Adjusting settings (gain, depth); ii) Applying coupling gel.

Ultrasonography in Female Reproduction

- **Early pregnancy detection:** i) Day 25-30 in cows, mares-; ii) Embryo/fetus visualization; ii) Heartbeat detection.
- **Fetal development monitoring:** i) Growth rate, number of fetuses (small ruminants); Ddetecting abnormalities like fetal mummification or fetal death.
- **Estrous Cycle Monitoring:** i) Identifying the optimal time for breeding or artificial insemination; ii) visualization of CL, GF, antral and developing follicles
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- **Preparing Machine:** i) Adjusting settings (gain, depth); ii) Applying coupling gel.

Ultrasonography in Male Reproduction

- **Testicular Scanning:** Evaluating testicular parenchyma, size, and abnormalities (e.g., tumors, cysts).
- **Accessory Glands (Prostate, Seminal Vesicles):** Detecting enlargement, inflammation (e.g., prostatitis in dogs).
- **Breeding Soundness Examination:** Assessing reproductive potential by examining semen production structures.
- **Testicular volume (TV)** is tightly associated with both sperm and hormonal parameters. Ultrasound (US) offers a greater accuracy in TV measurement than Prader orchidometer (PO).
- **US-derived TV** might play an independent role in specific clinical conditions (i.e. large hydrocele, inguinal testis, enlarged epididymis).
- **Scrotal US** may detect signs of testicular dysgenesis, often related to an impaired spermatogenesis and to a higher risk of malignancy, or testicular lesions suggestive of malignancy.