Ultrasonography in Canine Reproduction

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Preamble

- Ultrasonography is the imaging method of choice in Canine Reproduction (Aries et al, 2022).
- Helps in assessment of the bitch's reproductive tract, allowing the diagnosis of urogenital disorder.
- Evaluation of the morphological changes of the uterus and ovaries throughout the estrous cycle.
- Provides early pregnancy detection.
- Ultrasound can greatly improve breeding management, especially when combined with other methods, such as vaginal cytology, vaginoscopy and hormonal assays.
- The ovarian endocrine function depends on its active angiogenesis mechanisms, characterized by endothelial cell proliferation.
- It is highly dependent on the bitch's cyclic activity, reflecting the blood supply adaptation required for adequate gonadal function.

Basics of Image Optimization

- ***Driving the Transducer:*** Hold the transducer and rotate it at 90 degrees by rolling the transducer between your fingers and thumb (TVP 2015).
- Do not grip the transducer tightly, and you do not push the transducer into the dog or cat's abdomen to produce good-quality images.
- There are 3 different types of transducer motions:
  - i) with distance motion, the transducer moves across a physical distance on the patient;
  - ii) with non distance angle motion, the transducer is angled in different directions but stays in the same position;
  - iii) by using non distance, rotational motion, the transducer is fixed in its position and rotated in a clockwise or counterclockwise direction
- ***Memorizing Echogenicities***: The relative echogenicities can be remembered using a a progressive increase in echogenicity for:
  - Fluid (anechoic or black)
  - Medulla (renal)
  - Cortex (renal)
  - Liver
  - Spleen
  - Prostate gland with benign prostatic hypertrophy
  - Peritonitis (the mesentery becomes hyperechoic or white and hyperattenuating).

Abdominal Ultrasonography

- Abdominal ultrasonography (AU) is a noninvasive technique that provides cross-sectional anatomy of the organs of the abdomen based on differences in acoustic impedance (TVP 2016).
- A systematic pattern for scanning the abdomen is an important aspect of any US examination.
- In approaching abdominal ultrasonography, the practitioner should identify the questions the scan needs to answer; however, a negative US scan does not rule out disease.
- For abdominal US, the dog or cat can be in dorsal or lateral recumbency; both scanning techniques are equally effective.
- This approach is just as applicable to scanning in lateral recumbency. The sonographer must learn to scan the patient in either position.
- The systematic approach:
    - Starts in the cranial abdomen (at the liver)
    - Proceeds in a clockwise fashion that extends around the outside of the abdomen
    - Comes back in a counterclockwise fashion to incorporate the gastrointestinal tract and middle abdomen

US Machine Control and Operation

- ***Ultrasound Machine Controls:*** There are 7 basic controls: i) On/off or power switch; ii) Probe adjustment; iii) Frequency adjustment; iv) Depth adjustment; v) Focal zone adjustment; vi) Gain adjustment (GA) + time gain compensation (TGC) or depth gain compensation (DGC); vii) Image contrast settings (ie, dynamic range or log compression).
- ***Operating the US machine:***
  - Patient Data: After turning on the US machine, enter the patient data.
  - Probe & Settings Selection: Choose the probe and preset for imaging the patient.
  - Patient Preparation: Clip the patient's hair. Alcohol can be applied to the skin prior to using the gel.
  - Areas for Evaluation: Specify a sequence of organs and areas for evaluation, to allows the sonographer to start and end at the same points for each study.
  - Depth & Focal Zone Control: The 2 most common controls adjusted during each study are depth and focal zone, which go hand in hand.
  - Transducer Position and Frequency: Hold the transducer perpendicular to the skin, over the area of interest according to the anatomy of the dog or cat; Use the highest frequency on the multi frequency transducer first.
  - Gain Adjustment: Use the GA and TGC) or DGC controls to adjust overall image brightness.
  - Dynamic Range Control: Or log compression or contrast—controls the overall grayscale of the image.

Doppler Ultrasonography

- Doppler ultrasonography (DU) is a technique based on the interaction of soundwaves with moving blood cells, resulting in a frequency shift of the received echoes.
- Combined with the two-dimensional mode (B-mode), the technique itself provides important information regarding vascular architecture, presence of blood flow and its direction, as well as hemodynamic properties of the examined vessel.
- Although DU can detect signals from small vessels, it cannot evaluate the microcirculation itself.
- DU is used to measure the blood flow through your blood vessels (Mayo Clinic 2024).
- It works by bouncing high-frequency sound waves off red blood cells that are circulating in the bloodstream. A regular ultrasound uses sound waves to produce images, but can't show blood flow.
- DU may help diagnose many conditions, including: Blood clots, poorly functioning valves in leg veins, heart valve defects and congenital heart disease, blocked arteries, called arterial occlusion, decreased blood circulation into your legs, bulging arteries, known as aneurysms, carotid artery stenosis.

Contrast-enhanced ultrasonography

- Contrast-enhanced ultrasonography (CEUS) is a novel technique in which a contrast agent, that mainly constitutes microbubbles, consisting of a gas core and a stabilized, highly reflective biological shell, is administered intravenously, allowing the detection of the microvasculature for both qualitative and quantitative assessment of tissue perfusion.
- Studies have been conducted for the assessment of placental perfusion in normal and abnormal canine pregnancy, uterine perfusion in bitches with cystic endometrial hyperplasia-pyometra complex, normal and abnormal canine testis, prostate and in mammary tumours.
- Studies concerning CEUS evaluation of the ovaries have been conducted in sheep and primates, demonstrating its applicability in evaluating vascular modification of the ovaries according to the cyclic activity.
- Unprecedented findings were recorded regarding perfusion parameters of the ovaries of bitches during the follicular phase of the estrous cycle.
- DU only demonstrated a slight significance, however, the interval between the timepoints of evaluation could potentially limit the detection of vascular modifications of the ovaries by this technique, as well as technical factors regarding the insonation angle.