



Ultrasonographic Imaging in Small Ruminant Reproduction

Introduction

First use of ultrasonography in small ruminants was described in 1983, for pregnancy diagnosis both in sheep and goats. Ultrasonographic evaluation of the male genital system in small ruminants was first reported in 1988; however, unlike in the bovine, application of ultrasounds in small ruminants was associated with the female and not extended to the male. Currently, around 25 years later, ultrasonography is no longer an elite technique for few selected breeders but a widely recognized and used key tool in reproductive management and research.

Irrespective of which scanning technique is applied, the result is shown on the screen of the console as an image in grey-scale, varying from white to black. The different echotextures of the evaluated tissues have specific denominations depending on tissue characteristics (echogenicity). Thus, tissues or substances such as urine, follicular fluid or other fluids that permit sound waves to penetrate them do not produce echoes. These tissues or substances are called **anechoic** or **anechogenic** and their images appear black on the screen. At the opposite end of the spectrum, tissues such as bone or the uterine cervix intensely reflect ultrasound waves, thereby producing an intense echo; they are called **hyperechoic** or **hyperechogenic** and their images appear white on the screen. Tissues, such as ovary or uterine stroma, that reflect intermediate proportions of ultrasound waves are called **echoic** or echogenic and their images appear in different shades of grey on the screen.

Techniques for imaging the reproductive tract:

The objective of the ultrasonographic evaluation will determine the scanning technique to be applied (transrectal or transabdominal). Transabdominal ultrasonography is easier to perform but a detailed study of the genital system requires the use of high-resolution probes used transrectally. Therefore, the transrectal technique is the method of choice for ultrasound examination of non-pregnant and early-pregnant females. Transabdominal ultrasonography can be used for diagnosing pregnancy from Day 25 to 30 of pregnancy onwards, and its use is obligatory from Day 60 as **7.5 MHz** transrectal probes do not have enough penetration to permit seeing the entire uterus.

Transrectal observations may be conducted with the female standing or restrained in dorsal recumbency either manually or in a cradle. Thereafter, the probe is placed into the rectum, orientating the transducer perpendicularly to the ventral abdominal wall. The urinary bladder is located first; it is easily visualized as an anechogenic structure (**Fig. 1**). The body of the uterus will be located dorsal to the bladder, and each uterine horn will be found on its respective side. The position of the uterus varies according to the amount of fluid in the bladder, size of the uterus and the age and number of parities of the female.

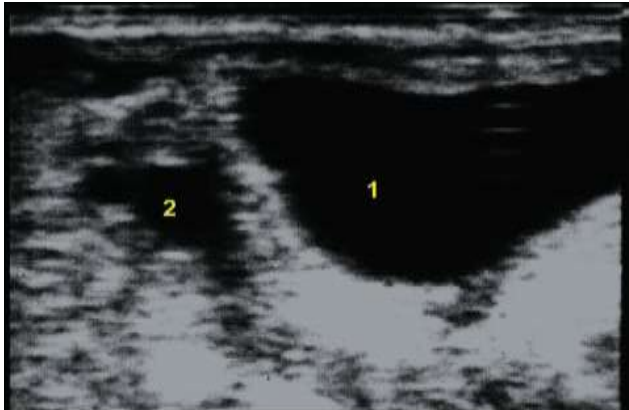


Fig. 1. Transrectal Ultrasonographic image of the urinary bladder (5 MHz probe ; depth 2.5 cm). The urinary bladder is the reference structure to locate the reproductive tract.
1: Urinary bladder; 2: Uterus.

Although **Transabdominal** ultrasonography is usually performed with the animal in a standing position, it can also be performed in a sitting position. The transducer should be placed in the right inguinal region of the female because the rumen displaces the pregnant uterus to the right. To eliminate the presence of air and promote contact between the transducer and skin, the wool or hair of the inguinal area may be clipped in some breeds and the probe may be abundantly covered with contact gel (**Fig.2**).

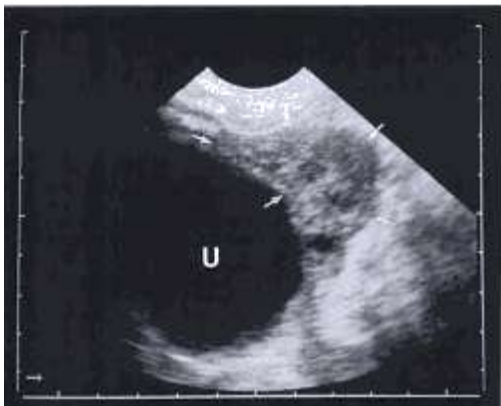


Fig.-2: Trans-abdominal Ultrasonic image of Urinary bladder (U) and non-pregnant uterus (arrows) of ewe .

Evaluation of physiological conditions in pregnant females:

-Early pregnancy

Implemented transrectal ultrasonography for pregnancy diagnosis; thereafter adapted high-frequency probes .These techniques and equipment allow determination of pregnant status by visualization of embryonic vesicles as fluid-filled dilatations in the uterine lumen from Day 12 of gestation. Visualization of the conceptus (concept that includes the embryo or the foetus as well as the Extra-embryonic membranes) may be performed from Day 16 in goats and from Day 19 in sheep (**Fig. 3**). The accuracy at these early stages is, however, low. First, because of false negative diagnoses when the trophoblastic vesicle or the embryo are not detected; second, because of false positive diagnoses caused by intrauterine accumulation of fluids because of causes other than pregnancy or by confusion of embryonic vesicles with intestinal loops, blood vessels or pathological conditions.

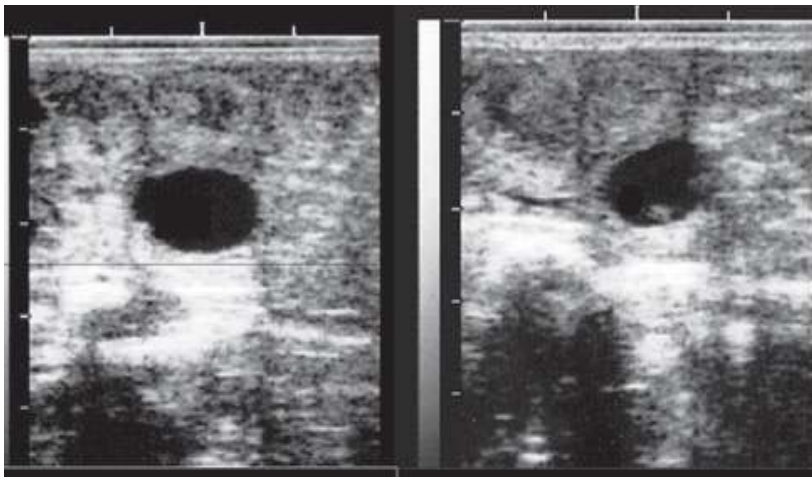


Fig.3:Transrectal U.S image during early stage of gestation based on visualization either of the embryonic vesicle (EV in left images) or of the conceptuses (arrows in right images)

-Midpregnancy

At 40 to 60 days, it is possible to see echoic fetuses surrounded by large amounts of hypoechoic fluid. Other structures of pregnancy, such as placentomes and the umbilical cord, also become readily visible,(**Fig-4**)

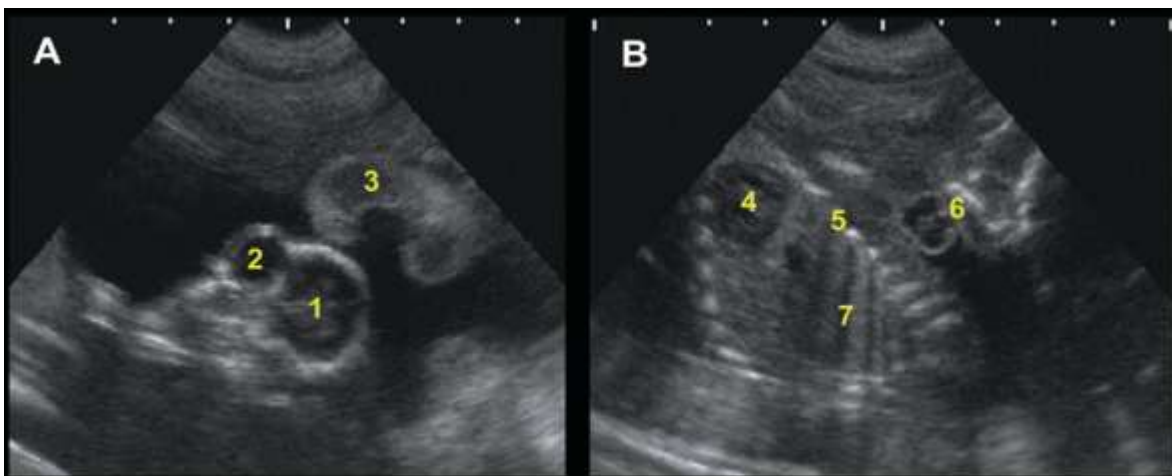


Figure-4. Ultrasound images of a 60 - day fetus (5 MHz sectorial probe; depth 8 cm). **A1:** Head appears as a hyperechoic, circular - shaped image; **A2:** Eye; **A3:** Placentome; **B4:** Heart and heart rate can be used as an indicator of fetal viability; **B5:** Ribs are easily observed due to their hyperechoic characteristics; **B6:** Umbilical cord; **B7:** Rumen filled with liquid indicating normal development of this portion of the digestive system.

During midpregnancy, transrectal ultrasonography becomes less accurate and must be replaced by the transabdominal or transcutaneous technique because the uterus descends into the abdominal cavity.



-Late pregnancy

After day **100** of pregnancy, it is difficult to determine the number of fetuses. Imaging of placentomes is still possible (**Figure-5**), but fetal body parts are only partially visible. Various approaches can be used for transabdominal diagnosis of pregnancy. The choice of technique and probe depends primarily on the stage of gestation and whether it is important to detect multiple fetuses. After day 60 (midpregnancy) transcutaneous ultrasonography using a **3.5 MHz** sectorial probe is best. The accuracy of diagnosis will depend on the range in gestational age at scanning, so it is important to know the dates of the beginning and the end of the mating period. The selection of technique depends on several factors, but a combination of speed and accuracy are important for pregnancy diagnosis in the field.

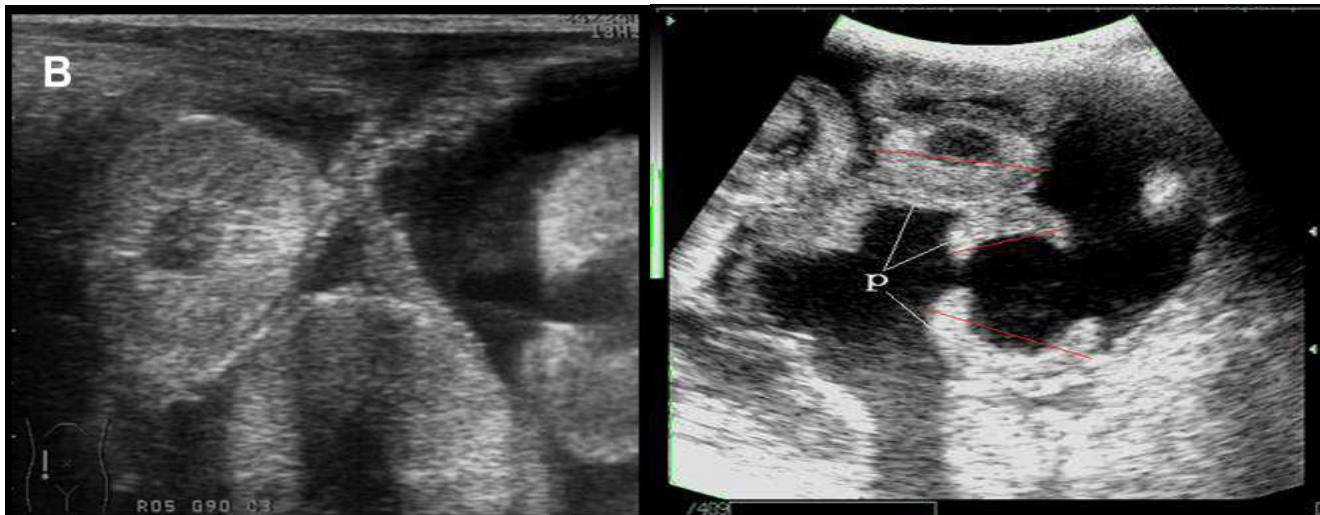


Figure-5. Late pregnancy (day 120) ultrasonographic image from a ewe (7.5 MHz linear probe; depth 9 cm-left image, and Sector probe 3.5MHz Right image). Due to the rapid development of the placenta in the second half of pregnancy the sonographic image is dominated by placentomes that, on cross section, are seen as **Cup - shaped**; on longitudinal sectional are appear as **O-shaped**, hyperechogenic structures.