

REPRODUCTIVE ULTRASONOGRAPHY: CAMELID



BASICS

OVERVIEW

- No reproductive examination is complete without ultrasonography.
- Ultrasonography is the most important imaging modality for breeding management and any infertility work up in the male and female.
- In the male, ultrasonography is primarily used for precise testicular measurement and evaluation of testicular tissue and epididymis.
- In the female, ultrasonography provides the clinician with a precise determination and monitoring of ovarian activity, identification of type of size of ovarian structures and visualization and characterization of lesions. In addition, ultrasonography allows for an early pregnancy diagnosis, and evaluation of the health and wellbeing of the fetus and placenta.
- Ultrasound machines with Color Doppler have become affordable and portable and add a new dimension to diagnosis by evaluating blood flow to the reproductive organs and fetus.

INCIDENCE/PREVALENCE

- Common procedure. It is considered the standard of care for reproductive medicine in camelids

GEOGRAPHIC DISTRIBUTION

- Worldwide

SYSTEMS AFFECTED

- Reproductive

PHYSIOLOPATHOLOGY

- The echotexture of different reproductive tissues provides important information on the health and function of the organ.
- In the female,
 - Ovarian follicular dynamics and events following ovulation can be visualized by the characteristic echotexture of the follicles and corpus luteum. In addition, changes of the echotexture of uterus and cervix follow very closely cyclic hormonal changes (estrogens for the follicular phase and progesterone for the luteal phase)
 - Abnormalities of follicular dynamic or presence of ovarian pathologies (neoplasm, hematoma, abscesses) alter the echotexture of the ovarian stroma
 - Abnormalities of the uterus that results in variation of the echotexture of the uterine wall or uterine content can be easily detected. These include, presence of adhesions, masses (uterine neoplasia) or abnormal fluid (pyometra, mucometra, endometritis)
 - Pregnancy can be diagnosed with the identification of the embryonic vesicle and conceptus. Growth of the concepts, fetal cardiac activity and echogenicity of fetal fluids

and thickness of placenta all provide important clinical information on the health of the pregnancy

- In the male, the echotexture of the testis, epididymis and surrounding tissue change to reflect pathological processes occurring in any of these compartment that are not often easy to detect by palpation.

HISTORICAL FINDINGS

- Recent breeding (Pregnancy diagnosis)
- Abnormal behavior or repeat breeding for infertility work-up
- History of pregnancy loss or other reproductive disorders
- Poor conception rate in males

SIGNALMENT

- All camelids male and female
- Breeding age females may present for pre-breeding reproductive examination, pregnancy diagnosis or because of infertility or other reproductive disorders
- Breeding age males presenting for breeding soundness examination, prepurchase examination or reproductive disorders complaints

PHYSICAL EXAMINATION FINDINGS

- Clinical signs depend of the reason for examination. Most animal presenting for pregnancy diagnosis or regular prebreeding examination appear healthy.
- Animal with suspected congenital defects may show various external genitalia abnormalities
- Animals presenting for a reproductive emergency may show various degrees of pain, depression and other clinical signs

GENETICS

- N/A

CAUSES AND PREDISPOSING FACTORS

- Ultrasonography is required for any state of the art management of breeding in camelid operation
- Ultrasonographic evaluation of the fetus and placenta should be part of any evaluation of the sick or distress female



DIAGNOSIS

DIFFERENTIAL DIAGNOSIS

- See imaging below

CBC/BIOCHEMISTRY/URINALYSIS

- Depends on complaint and specific ultrasonography findings.

OTHER LABORATORY TESTS

- Depends on complaint and specific ultrasonography findings.

IMAGING

Equipment

● Ultrasound equipment is different from one application to another: A multipurpose ultrasound machine should allow the use of both M and B real mode ultrasonography as well as the choice between linear and array transducers. The most common transducers and frequencies used in reproductive evaluation are:

- 5 to 8 MHz linear transducer for transrectal ultrasonography
- 2.5 to 3.5 MHz convex or sector transducer for percutaneous transabdominal ultrasonography

Examination technique

● Ultrasonographic examination of the genital tract of camelidae is done per rectum, per vaginam or externally (percutaneous abdominal).

● Examination per rectum is the most common technique used for the evaluation of the vagina, bladder, cervix, uterus and ovaries in the non-pregnant female. It is also used for early pregnancy diagnosis and for the examination of the accessory sex glands and the pelvic urethra in the male.

● Transabdominal technique is used mainly for pregnancy diagnosis (more than 45 days) when palpation is not possible (small llamas and alpacas) and when large uterine content or reproductive masses are suspected. This technique is also critical for the evaluation of the health of the placenta and fetus in advanced pregnancy. Transbdominal ultrasonography is useful for determination of the location of the testes in cryptorchid animals

● Transvaginal ultrasonography is used primarily in research and advanced reproductive techniques such as ultrasound-guided follicular aspiration or site-specific treatments (e.g., aspiration of uterine cysts, intrafollicular injection, aspiration of embryos, and injection of embryos). Vaginal ultrasonography can also be used for early pregnancy diagnosis but the author discourage it because of risk of contamination.

Transrectal ultrasonography of genital organs

● Transrectal ultrasonography of the genital tract is preferably performed on the standing animal restrained in a chute for llamas and camels and with the animal in a sitting sternal position in alpacas. Painful or straining animals may require sedation or even an epidural anesthesia.

● If possible, the animal should be examined by palpation per rectum before ultrasound examination.

● In large llamas and camels, the transducer is introduced into the rectum after providing ample lubrication.

● In small llamas and alpacas transrectal ultrasonography requires mounting the linear transducer on an extension handle (Figure 1) or the use of a long rigid human prostate probe



1. Figure 1 Extension handle, ultrasonography

- In the female, the genital tract is examined in the following: Vestibulo-vaginal sphincter, vagina, cervix, body of the uterus, each uterine horn, the ipsilateral uterine tube, ovary and ovarian bursa. Thorough examination necessitates that the transducer be in very close contact with the rectal mucosa in order to obtain clear images. When using an extension handle, the rectal cavity should be filled with lubricant or a coupling gel in order to improve contact with the rectal mucosa. Rough manipulation of the rectum may cause injuries.
- In the male, the internal genitalia is examined in the following order: Bulbourethral glands, pelvic penis and bladder. There are no seminal vesicles in camelids.

Transcutaneous abdominal ultrasonography

- Trans-abdominal ultrasonography of the uterus is a technique used mainly for pregnancy diagnosis and evaluation of fetal well-being
- A linear 5 MHz, convex or sector 3.5 MHz transducer is used for this purpose
- The transducer is directly applied to the skin after application of a good layer of coupling gel to prevent interference with air. Fiber needs to be removed prior to placement of the transducer.
- It is usually recommended to practice abdominal ultrasonography on fasted animals to allow a better visualization of the genital tract and avoid interference by intestinal gas
- In advanced pregnancy, it may be necessary to clip the fiber on the ventral abdomen from the xyphoid to the base of the mammary gland in order to visualize the uterus and fetus.
- The transducer is positioned just in front of the udder; the bladder is usually visualized at this level. Scanning is best performed from the right side moving forward toward the xyphoid region in advanced pregnancy.
- In the cryptorchid male the retained testis can be located by either transrectal ultrasonography or transabdominal ultrasonography in the inguinal area.

Examination of the open female

The vestibulovaginal sphincter and vagina

- The vestibulovaginal sphincter is clearly identified by its muscular appearance at the level of the urethral fold (Figure 2).
- The vagina is not well defined unless there is presence of fluid (pyovagina due to adhesions, urovagina or mucocolpos) (Figure 3).

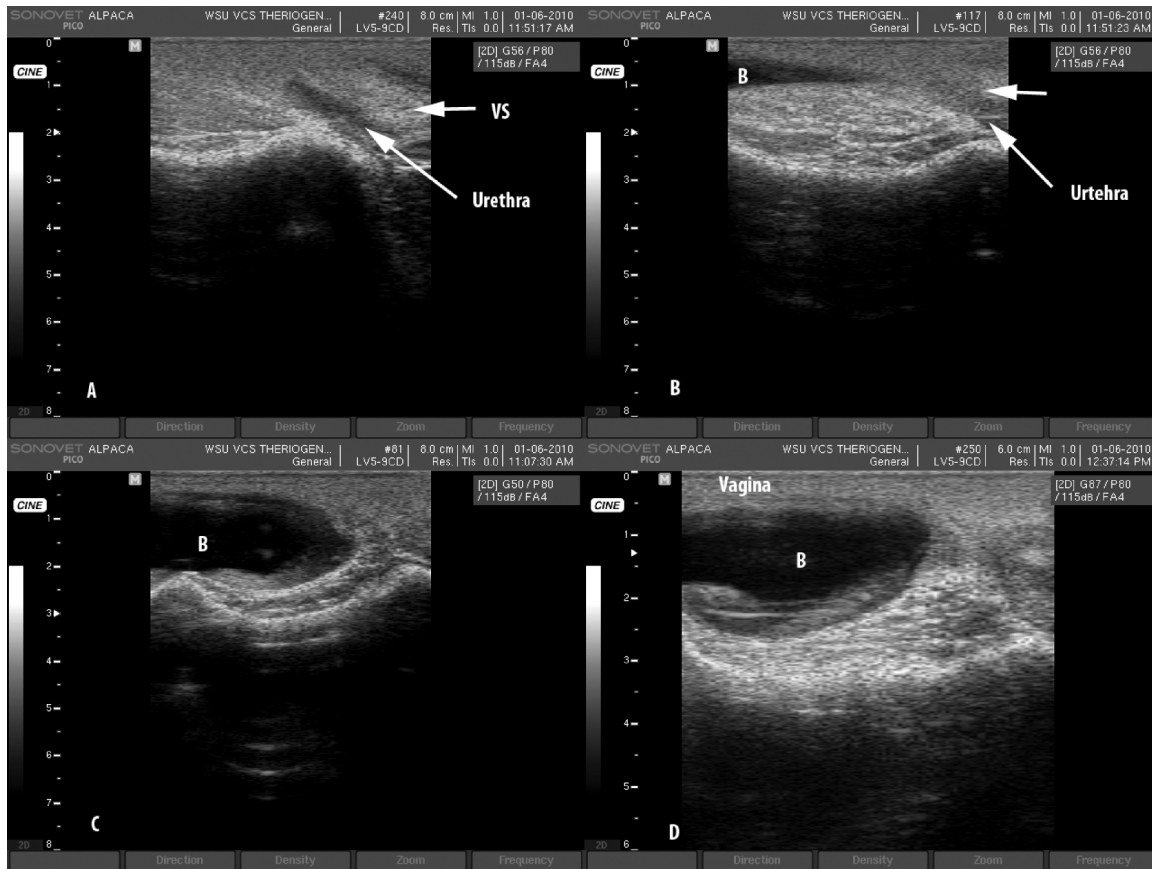


Figure 2 Ultrasonogram of the vestibule-vaginal area. A) Vestibular sphincter (VS) and urethra, B) the transducer is advanced slightly more cranial to show the urinary bladder (B), C) Bladder, D) transducer in a more cranial position showing the urinary bladder (B), and vestibular sphincter. The walls of the vagina are collapsed.

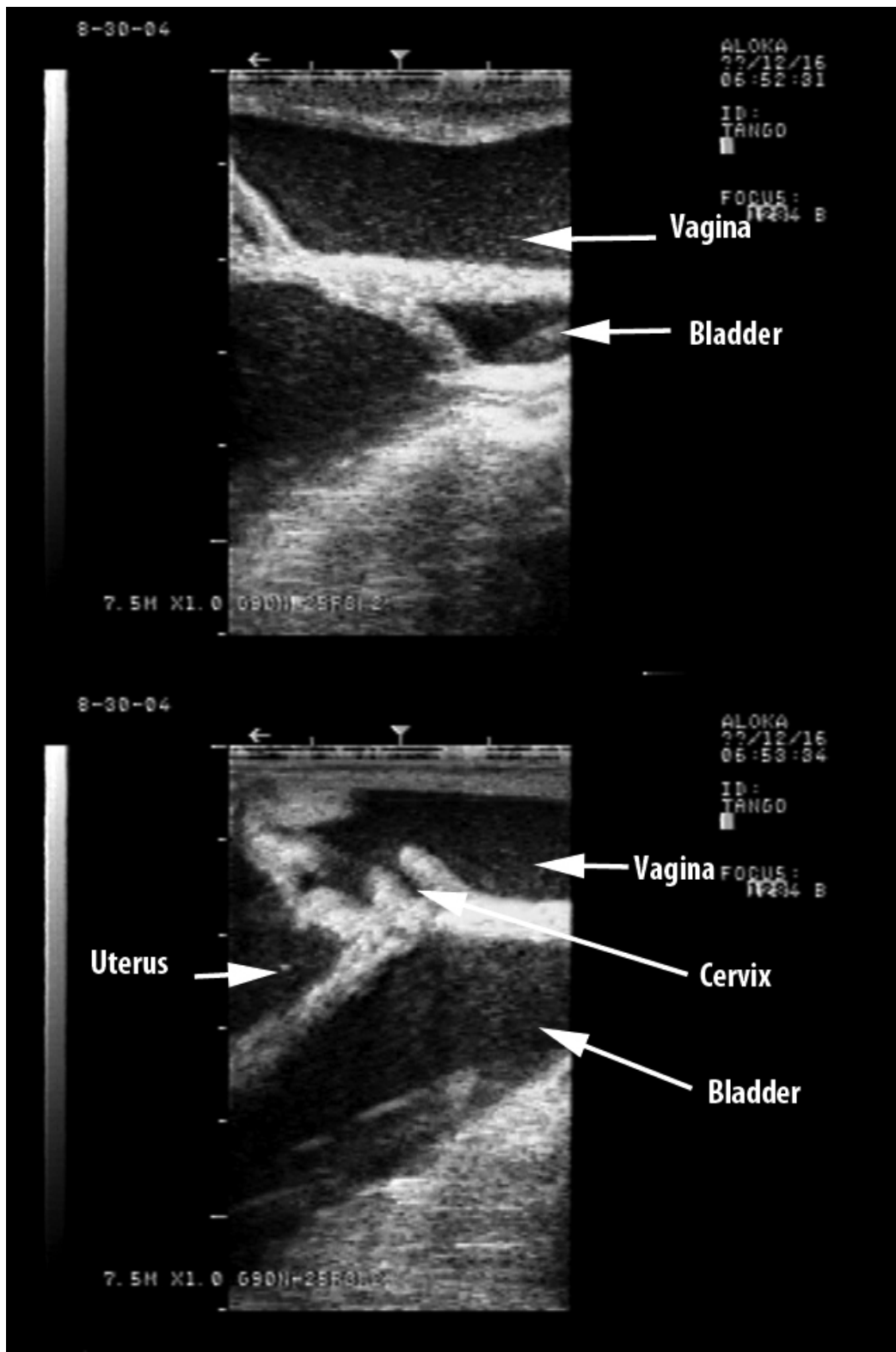


Figure 3 Ultrasonogram of a female alpaca with a mucocolpos (accumulation of mucus in the vagina) and mucometra. Note the open cervix with communication of between the mucometra and mucocolpos.

The cervix

- The cervix is located dorsal to the urinary bladder, it may be deviated to the right if the animal is sitting in a sternal position.
- The echo-texture of the cervix varies during the different phases of the cycle.
- During the follicular phase the cervix is contracted and dark due to the presence of intercellular fluid (edema). Its contour is not very clear (Figure 4).
- In diestrus and pregnancy the cervix is tight and more echogenic (Figure 5).
- The cervical rings are hyperechoic under prolonged progesterone effect (pregnancy or persistent luteum).
- Abnormalities of the cervix include presence of abscesses or adhesions.



Figure 4 Ultrasonogram of the cervix during the peak follicular phase. UB= Urinary bladder, U= uterus, BL= broad ligament vasculature. The arrows indicate the cervical rings



Figure 5 Ultrasonogram of the cervix in early pregnancy. Arrows indicate the tight echogenic cervical rings (UB=Urinary bladder)

The uterus

- Ultrasonography is a very valuable tool for the evaluation of the different components of the uterus (endometrium and myometrium), as well as the content of the uterine cavity.

The normal uterus

- The echo-texture of the uterus is important for the determination of the stage of the “cycle” and the health of the organ.
- The uterus is “T” or “Y” shapes and lies just cranial to the urinary bladder.
- Uterine horns may be tilted to the right particularly in the sitting animal.
- The left uterine horn is generally larger than the right horn in multiparous animals
- The echo-texture of the uterus in camelidae varies in response to ovarian activity.
- During the follicular phase the uterus is contracted and the uterine horns are straight or slightly curled to the side, especially in the presence of a mature follicle
- The echo-texture of the uterus is usually heterogeneous and shows increased edema and endometrial folds giving the uterine horn a characteristic appearance. The degree of edema increases toward the end of the follicular phase and disappears slowly (over a 2 to 3 day period) following mating (Figure 6).
- The uterine cavity can show increased echogenicity due to the presence of thick mucus. Hypoechoic content can be visualized in some instances just after breeding and corresponds to semen deposited in utero.
- In the presence of a regressing or an anovulatory follicle the uterine echo-texture is variable and cannot be used alone to predict reproductive status.
- During the luteal phase the uterus is homogeneous with a medium degree of echogenicity (Figure 6). The edema that gives a dark appearance to the uterus during the follicular phase completely disappears during the luteal phase and reappears as soon as the corpus luteum is dismissed and another dominant follicle emerges.
- Evaluation of the uterus after parturition is important for the management of early postpartum breeding in camelids.
- The early postpartum period (first 10 days) is characterized by a highly vascularized uterus and a large diameter of the uterine horns.
- The uterine cavity usually presents some fluid up to 5 days postpartum.
- Focal areas (2 to 3 mm in diameter) of increased echogenicity may be observed and

- correspond to thick mucus accumulations.
- The uterus is contracted and has a heterogeneous echo-texture in the early postpartum period, then becomes more homogeneous after evacuation of all fluid and decrease of uterine edema.
 - After 3 weeks postpartum, the uterus should regain the normal echo-texture.
 - In older females, the vasculature within the broad ligament may be observed for several weeks.

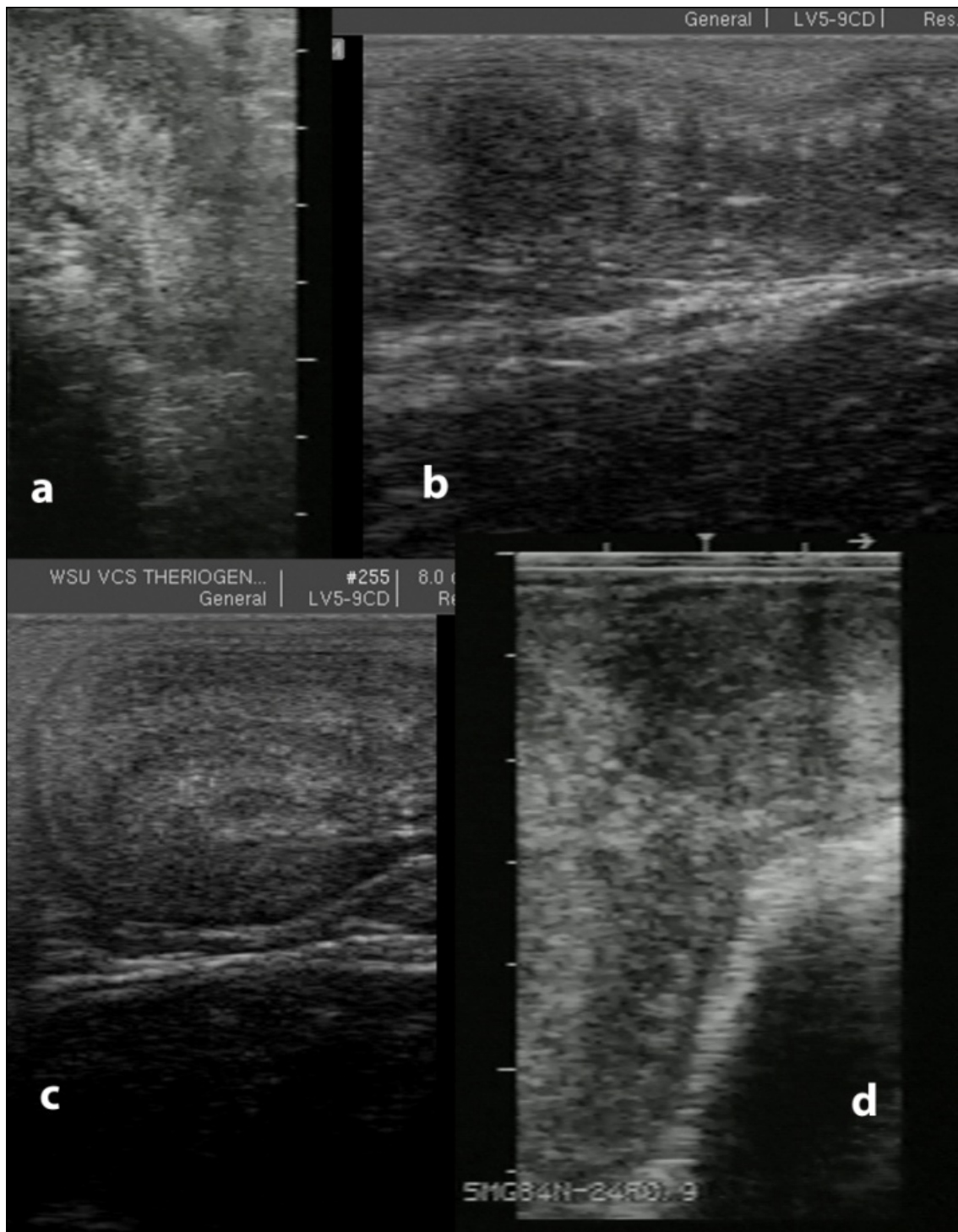


Figure 6 Ultrasonogram of the uterus. a-b uterine horn showing increased edema and tone during follicular dominance (receptivity). c-d) uterus under progesterone influence (luteal phase), more relaxed and homogenous.

Uterine disorders

- Abnormalities of the uterine ultrasonogram can be of two types: abnormalities of the uterine echotexture and abnormal uterine content (Figure 7).
- The uterus is heterogeneous and presents several degrees of echogenicity in cases with chronic inflammatory processes.
- The contour of the uterus becomes less well defined in the presence of periuterine adhesions.
- Masses may be visible in the uterine wall in some cases of neoplasia.
- Abnormal uterine content can vary from free fluid to localized cysts or abscesses.
- The presence of large amount of fluid in the uterus of camelidae (i.e pyometra or Mucometra), in the absence of pregnancy, is usually due to cervical or vagina adhesions or segmental aplasia.
- Broad ligament hemorrhage are not common but can results from traumatic injury during breeding or intrauterine manipulation of the uterus (flushing catheters, pipette).

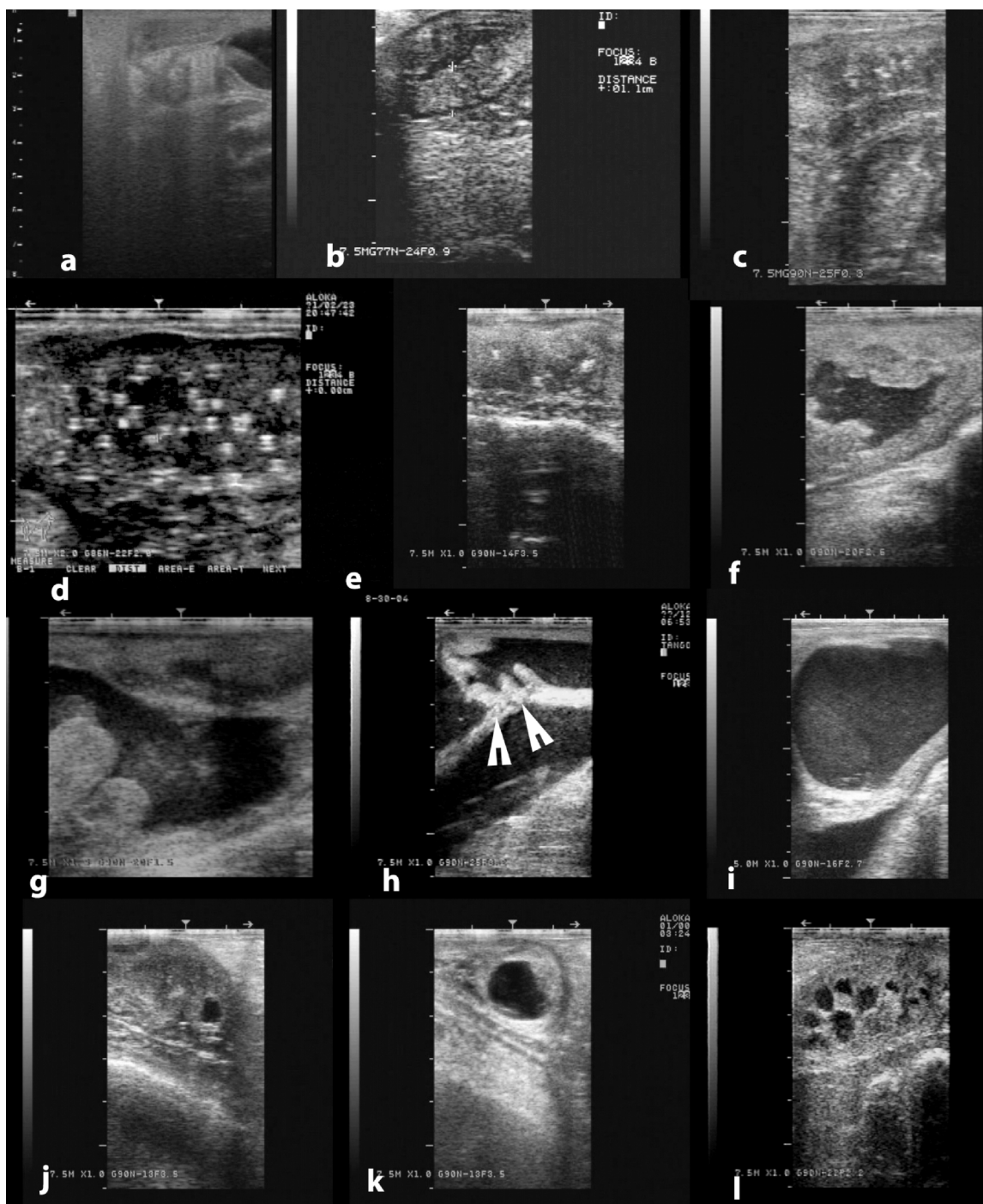


Figure 7 Disorders of the uterus. a) infantile uterus; b) endometritis with fluid accumulation; c and d) chronic endometritis with areas of fibrosis; endometrial abscesses; e) cervical adhesions; f-g) pyometra post-fetotomy pyometra; h) mucometra due vaginal adhesions, note the open cervical rings (arrows); i) mucometra due to vaginal aplasia; j-l) uterine cysts.

The uterine tubes (oviducts) and bursa

- The normal uterine tube is not visible on ultrasonography
- It becomes visible as a tortuous structure when surrounded by hypoechoic tissue or fluid.
- The most common abnormalities detected at this level are hydrosalpinx, pyosalpinx, and ovariobursal adhesions (Figure 8)
- Fluid-filled structures may be seen in the mesosalpinx and correspond to para-ovarian cysts. (Figure 8)

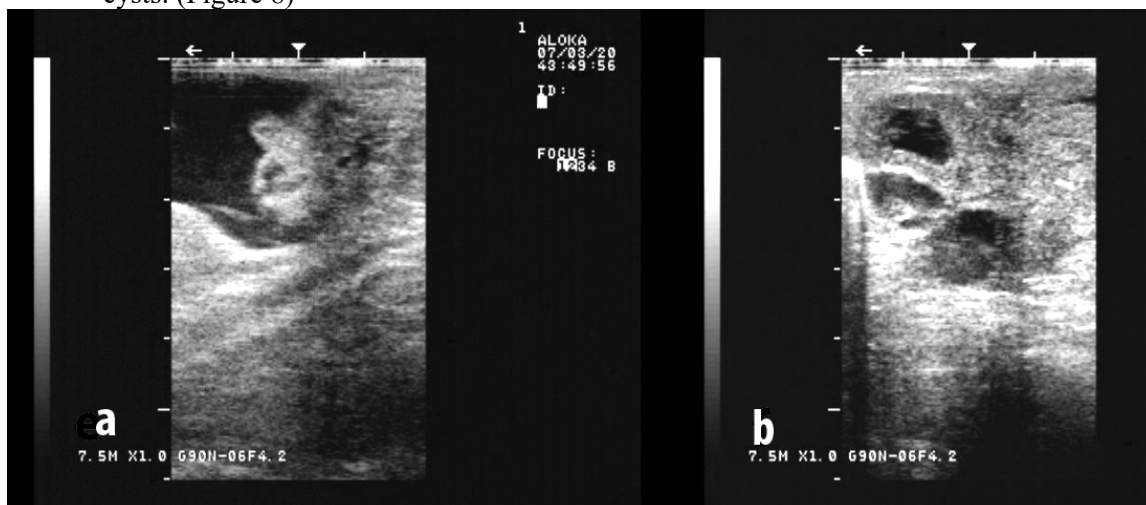


Figure 8 Uterine tube disorders: a) hydrobursitis; b) hydrosalpinx

The ovaries

Normal structures

- Examination of the ovaries is always done per rectum
- The ovaries are scanned by following the uterine horn all the way to its tip, then by moving the probe slightly caudally and laterally.
- The ovary is usually easy to identify if it has some follicular activity
- Quiescent or inactive ovaries are more difficult to identify for the untrained clinician.
- The echo-texture of the ovary is very characteristic. It is more echogenic than the surrounding tissue and appears elliptical. The periphery of the ovary is hypoechoic and correspond to the germinal epithelium (Figure 9).
- It is common for the beginner to mistakes the cross-section of a blood vessel for follicles.
- Growing follicles are identified as round dark (fluid-filled) structures on the surface of the ovary. Dominant follicles are spherical and protrude from the ovary (6 to 7 mm in diameter in SAC and 8 to 10 mm in camels). Large follicles are considered pre-ovulatory (7 to 12 mm in llamas and alpacas and 9 to 25 mm in camels) (Figure 9).
- Ovulation is detected by the disappearance of the mature follicle 30 to 48 hours after mating or ovulation induction treatment (GnRH or hCG)
- The corpus hemorrhagicum may be visible 2 to 4 days after ovulation
- The Corpus luteum is easily identified by its characteristic liver-like echo-texture day 6

after ovulation. Corpora lutea may have a central cavity (Figure 10). They usually measure 10 to 15 mm in SAC and 18 to 25 mm in camels

- Corpora lutea continue to grow in the first 30 days of pregnancy
- Regressed corpora lutea may be visible up to the next receptive period

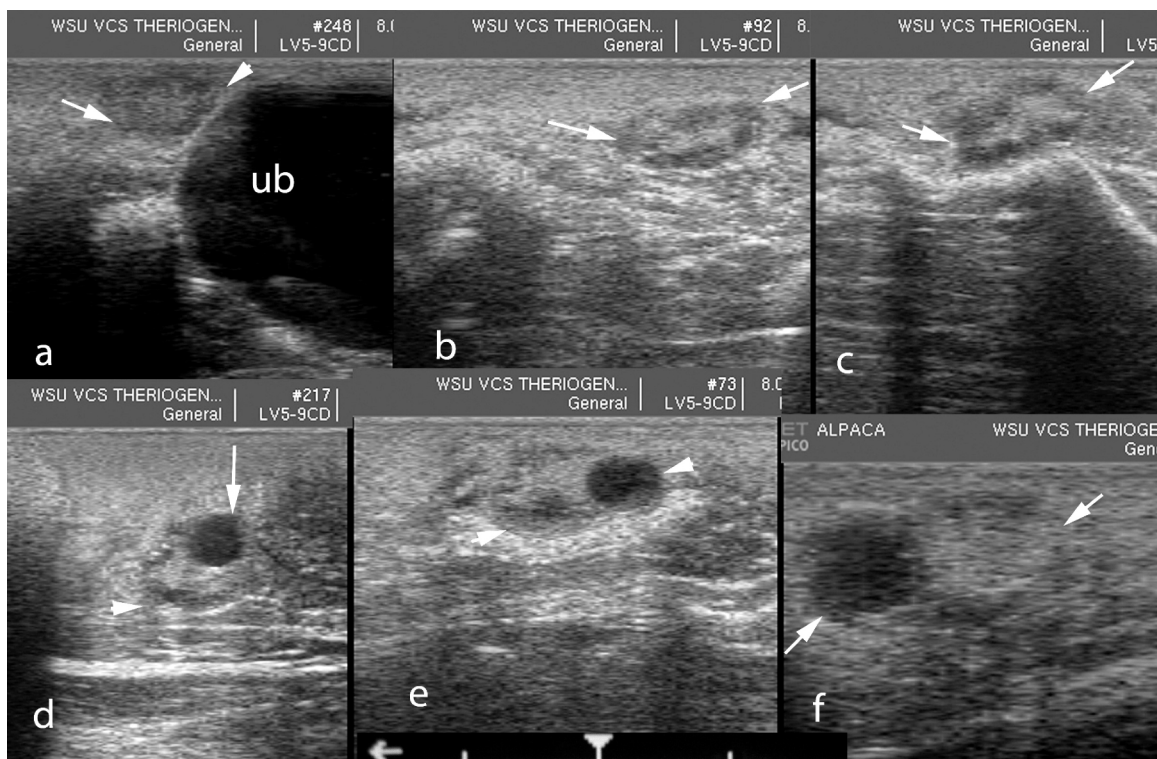


Figure 9 Ultrasonographic imaging of follicular dynamics in camelids. a) Quiescent ovary (arrows), ub= urinary bladder. b) and c) follicular recruitment, d) follicular dominance, e) mature follicle, f) regressing follicle. Note the hyperechoic ovarian stroma and the more hypoechogenic cortex.

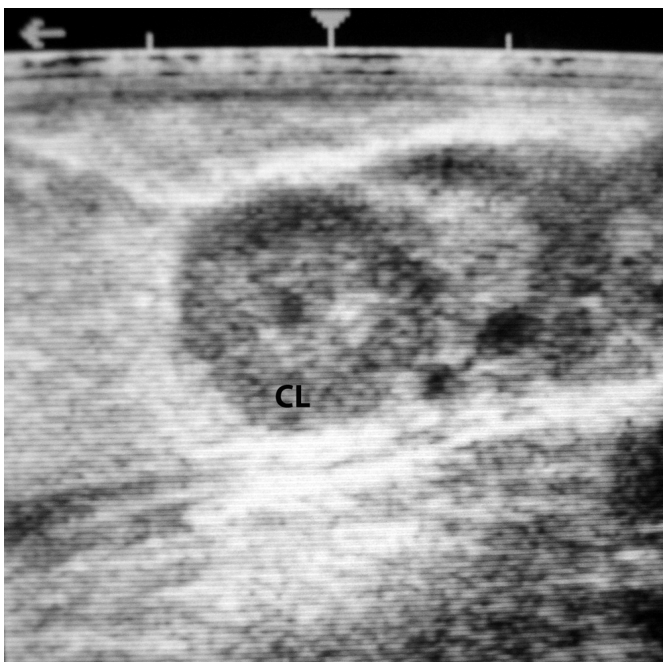


Figure 10 Ultrasonogram of corpus luteum. Note the size and the small central cavity

Abnormal structures

- Anovulatory follicles
 - Regressing follicles are identified by increased echogenicity of their periphery because of increased wall thickness.
 - In 30 to 40% of camels the preovulatory follicle continues to grow and gives rise to large anovulatory follicles with variable size and degrees of echogenicity
 - Anovulatory follicles present different ultrasonographic appearance depending on their stage of evolution and content (Figure 11).
 - Central echogenic strands or honey comb appearance is characteristic of hemorrhagic anovulatory follicles.
 - Increased echogenicity of anovulatory follicles is sometimes due to an incomplete process of luteinization (luteinized follicles) (Figure 11).

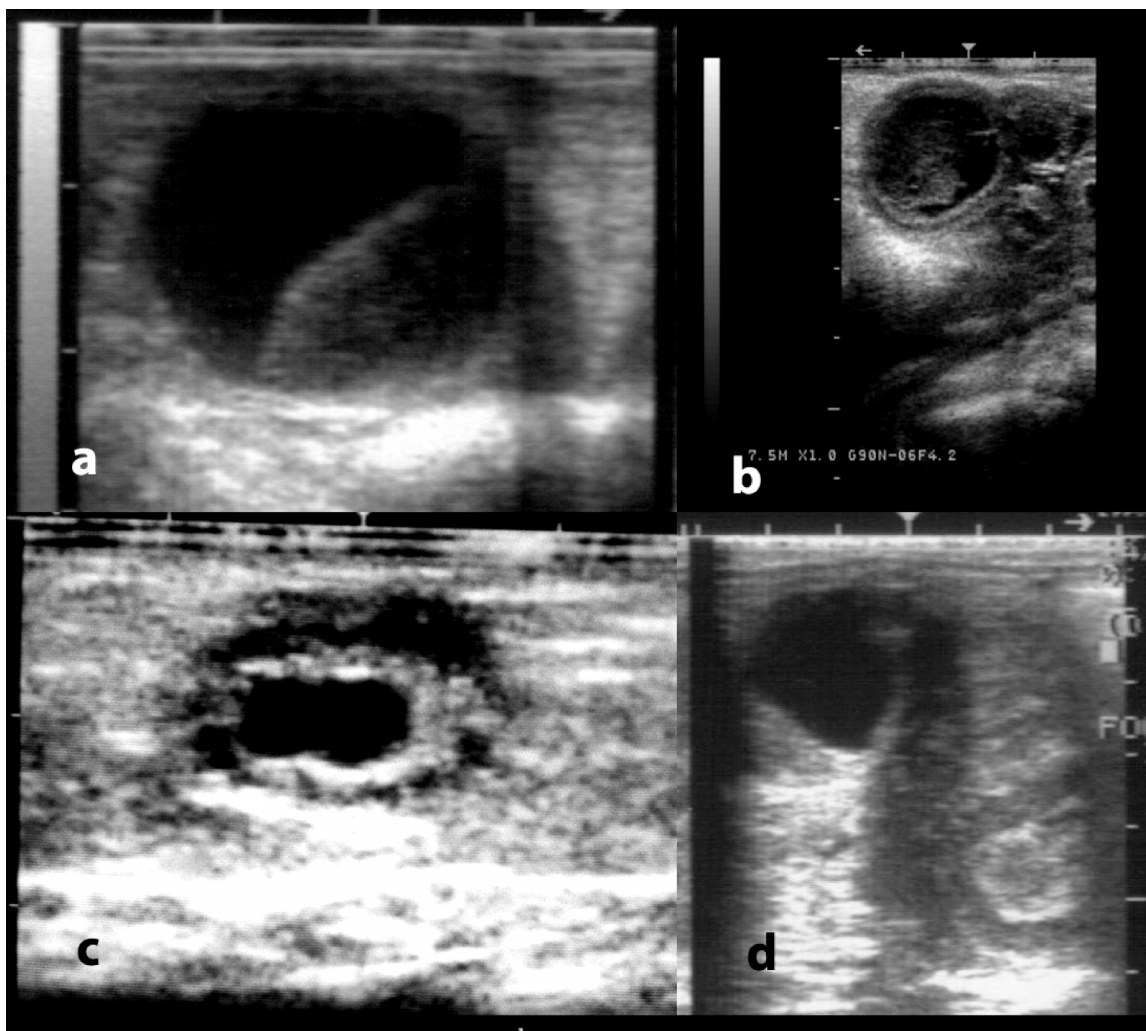


Figure 11 Ovarian disorders: a) large anovulatory follicle; b) luteinized/hemorrhagic anovulatory follicle; c) cystic rete ovarii; d) ovarian teratoma

- Ovarian hypoplasia
 - Hypoplasia of the ovaries is suspected by the lack of evidence of ovarian tissue rather than by a characteristic ultrasonographic appearance.
 - Hypoplasia can be acquired or congenital
- Cystic conditions
 - Usually easy to diagnose by ultrasonography, these conditions should be differentiated from large anovulatory hemorrhagic follicles which occur commonly in the absence of ovulation-inducing stimulus
 - Paraovarian cysts are not rare and should be differentiated from enlarged oviducts (hydro or pyosalpinx).
- Ovarian inflammation (oophoritis or ovaritis)
 - Suspected when the ovarian size is normal or slightly increased and does not show clear delineation from the rest of the tissue.

- These affections are usually accompanied by peri-ovarian adhesions that change the echo-texture of the region
- Ovarian tumors
 - Suspected in the case of enlarged ovaries or those with abnormal echo-texture
 - The ultrasonographic appearance of the ovary in this case depends on the type of neoplasm
 - It can be completely homogeneous with varying degree of echogenicity such as in the case of teratomas, or heterogeneous with multiple hypoechoic pockets within an echogenic tissue in case of granulosa-theca-cell tumors. (Figure 11)

Pregnancy diagnosis and pregnancy disorders

- Pregnancy diagnosis by ultrasonography per rectum is possible as early as 9 days post-mating in llama and alpacas and by 13 days in camels
- This diagnosis is based on two main criteria: 1) visualization of an embryonic vesicle and 2) visualization and maintenance of a corpus luteum of pregnancy
- The embryonic vesicle in camelidae is difficult to visualize in early pregnancy because it is elongated, the embryonic fluid is dispersed, and the uterus is relaxed.
- In the early stage (14 -16 days post-mating), the embryonic vesicle appears and a cross-section of the uterine horn is a star-shaped anechoic area (Figure 12).
- The vesicle is almost always present in the left uterine horn.
- As pregnancy advances, the embryonic vesicle increases in size and becomes more visible and round in cross section and oblong in longitudinal view of the uterus. At 18 days of pregnancy, diagnosis of embryonic vesicles should not pose any problem for an experienced examiner.
- The conceptus becomes visible within the embryonic vesicle around day 20 post-mating.
- Fetal heartbeats become visible between days 22 and 25 of pregnancy (Figure 12)
- All parts of the fetus and its envelopes are easily identifiable by 50 days of pregnancy. Visible fetal parts and their ultrasonographic appearance depend on the orientation of the fetus and that of the transducer (Figure 13).
- All pregnant animals should have at least one functional corpus luteum.
- The presence of two, and up to 4, corpora lutea during pregnancy has been reported in Camelidae
- Trans-abdominal ultrasonography is the method of choice for pregnancy diagnosis in llamas and alpacas after 45 days (Figure 13)

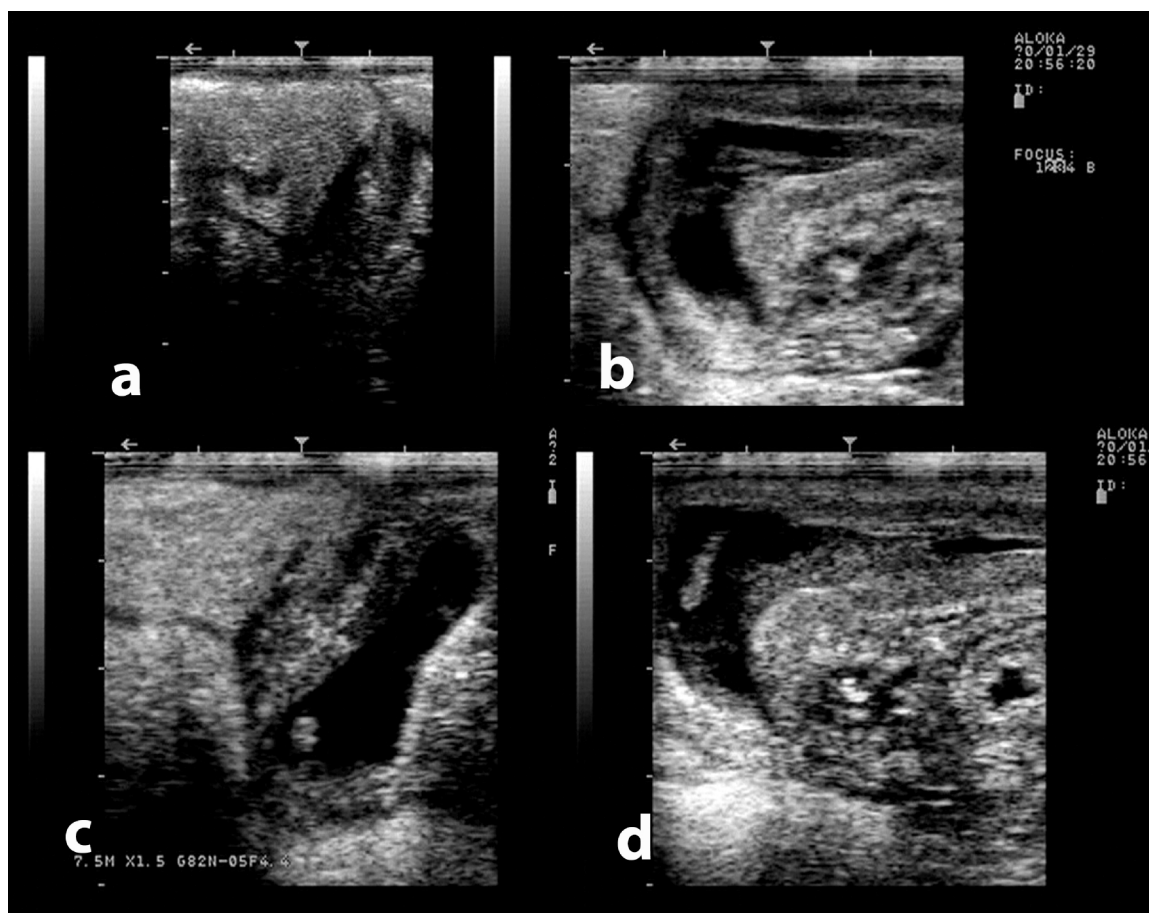


Figure 12 Pregnancy diagnosis by transrectal ultrasonography. a) 14 days; b) 16 days; c) 22 days; d) 27 days

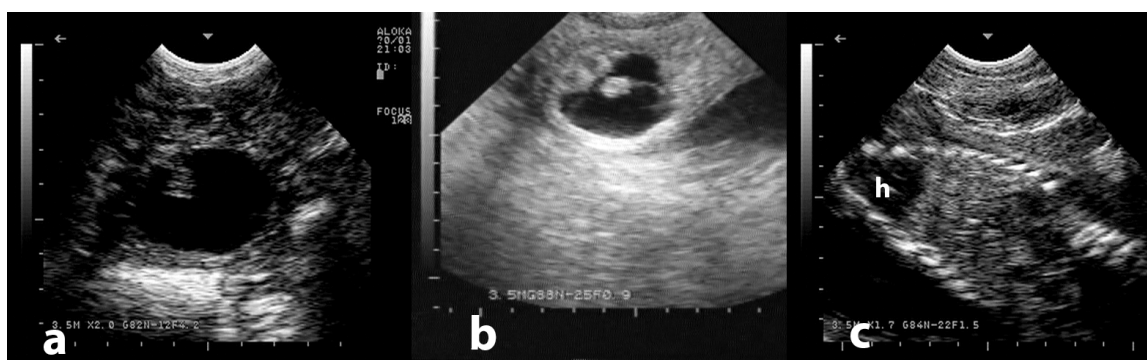


Figure 13 Pregnancy diagnosis by transabdominal ultrasonography (3.5MHz sector transducer). a) 40 days, b) 60 days, c) 80 days (h= heart silhouette)

Determination of stage of pregnancy

- Determination of the stage of pregnancy is very important in camelid management in order to have a projected parturition date and allow close observation of the female.

- The practitioner is often asked to determine the approximate stage of gestation, especially in the case of mismating or group breeding.
- Age of the fetus can be estimated by specific measurements.
- In the llama and alpaca a formula has been given for the determination of gestation stage from the measurement of fetal head and trunk diameter. This formula can be used with a relatively good accuracy (error of 10 to 18 days) if 4 measurements are made between 60 to 75 days after mating until 250 days of pregnancy
- It is important to note that these measurement are not always precise given the large variability in gestation length in these species

Evaluation of embryo/ fetal health

- Camelidae have a very high incidence of embryonic loss compared to other domestic species
- Criteria used to determine the health of a pregnancy include shape and growth of the embryonic vesicle, echogenicity of embryonic fluids, cardiac activity of the fetus, growth of the fetus, and fetal movement.
- In the early stages of pregnancy the most important criterion is the shape of the embryonic vesicle and the echogenicity of its contents.
- The normal embryonic fluid is anechoic. It becomes slightly echoic or contains echogenic debris in case of embryonic death. (Figure 14)
- Fetal hearth beats are good indicators of embryo viability at all stages of pregnancy where the rib cage can be visualized without a problem. Normal fetal heart rate is usually 1.5 to 2 x that of the dam's (90 to 120).



Figure 14 Disorders of pregnancy. a) Pregnancy loss at 45 days; b and c) broad ligament hemorrhage and uterine edema due to a uterine torsion.

Ultrasonography in the male camelidae

Scrotum and testis

- Examination requires the use of linear transducer (7.5 MHz for alpacas and llamas, 5 MHz for camels)
- Use large amounts of coupling gel or a standoff pad may be necessary for better evaluation
- The author recommends testicular ultrasonography as a routine procedure for all pre-purchase examination or breeding soundness examination in camelids
- The testicular parenchyma is homogeneous with medium echogenicity. The mediastinum testis is more echogenic (Figure 15).

- The normal epididymis is difficult to visualize.
- Loss of the homogeneous echo-texture of the testis should be considered an abnormality particularly when the affected testis feels different from the other testicle or when there is a history of infertility.
- The most common abnormality encountered during the ultrasonographic evaluation of the scrotum and testis are:
 - Presence of fluid between the parietal and visceral vaginal layer of the tunica (hydrocele). This is relatively frequent in llamas during the hot season and may be a manifestation of heat stress.(Figure 16)
 - Presence of testicular cysts (mediastinum and seminiferous tubules) (Figures 17)
 - Presence of epididymal cysts (segmental aplasia) (Figure 18)
 - Orchitis (Figure)
 - Hemorrhage/hematoma
 - Neoplasia

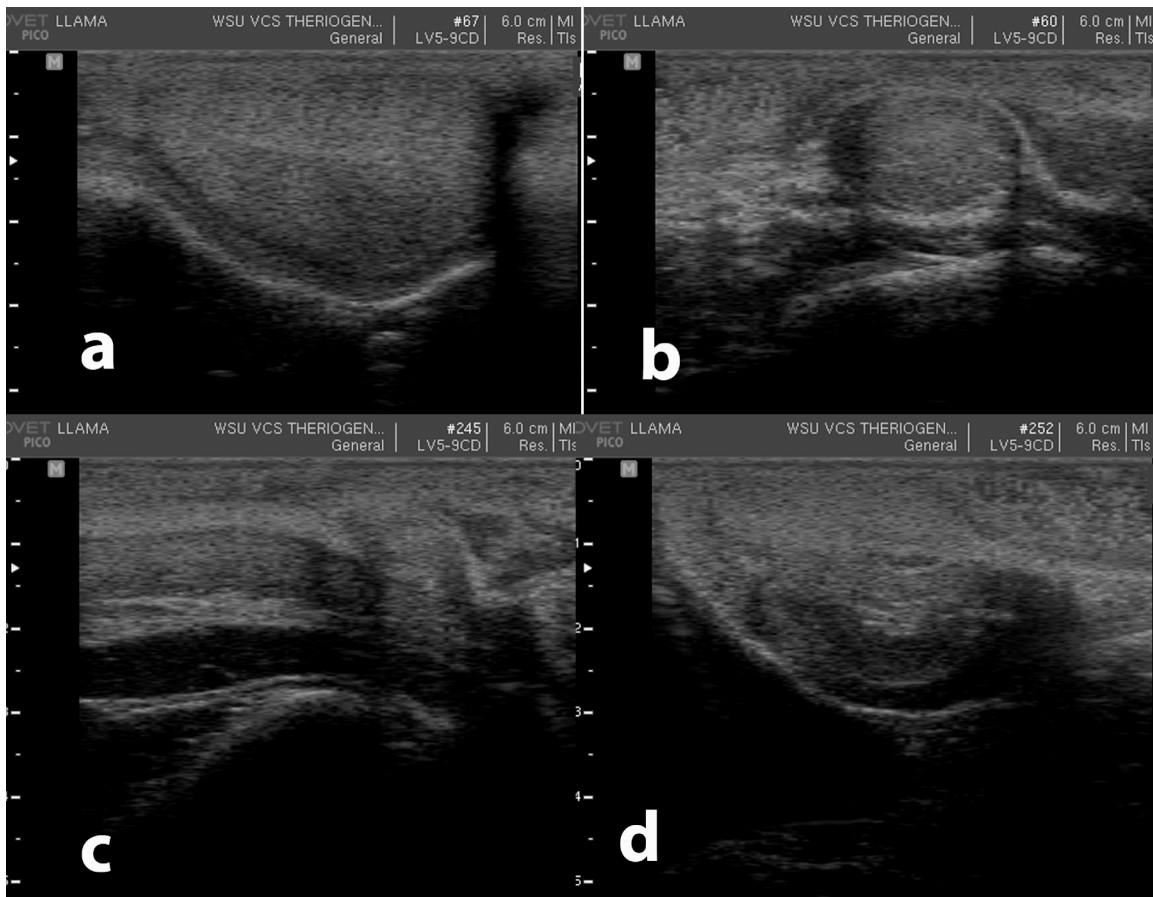


Figure 15 Normal ultrasonogram in a male llama a) testis b) bulbourethral gland; c) pelvic penis and urethra; c) prostate.

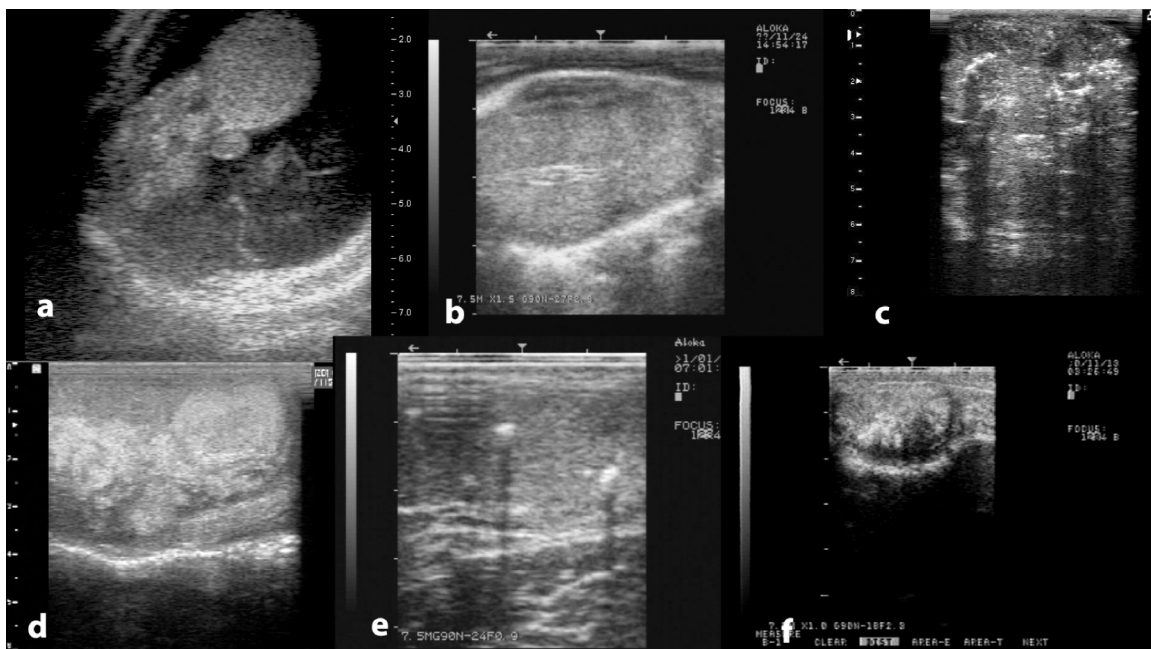


Figure 16 Ultrasonograms of various testicular disorders. a) testicular hemorrhage and hydrocel, b) testicular hematoma, c) orchitis, d) seminoma; e) testicular calcification; f) fibrosis and atrophy

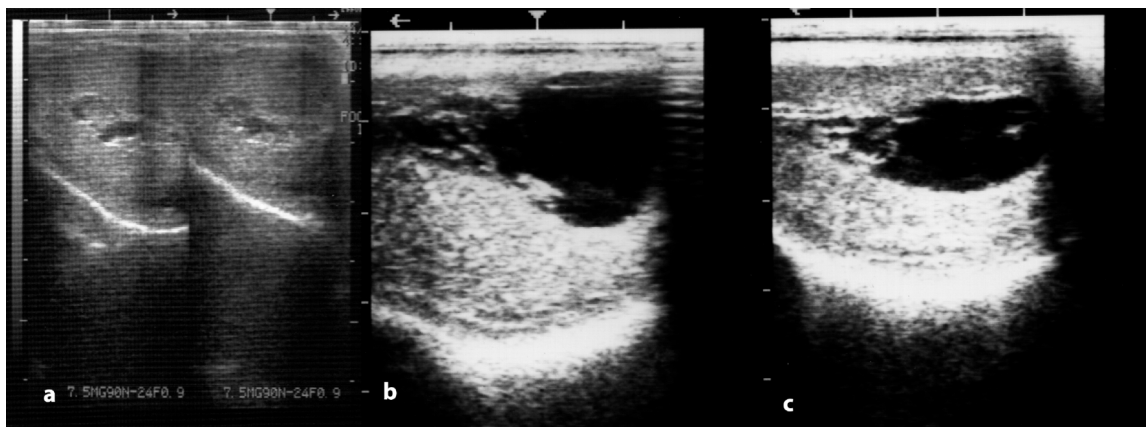


Figure 17 Ultrasonograms of rete testis cysts

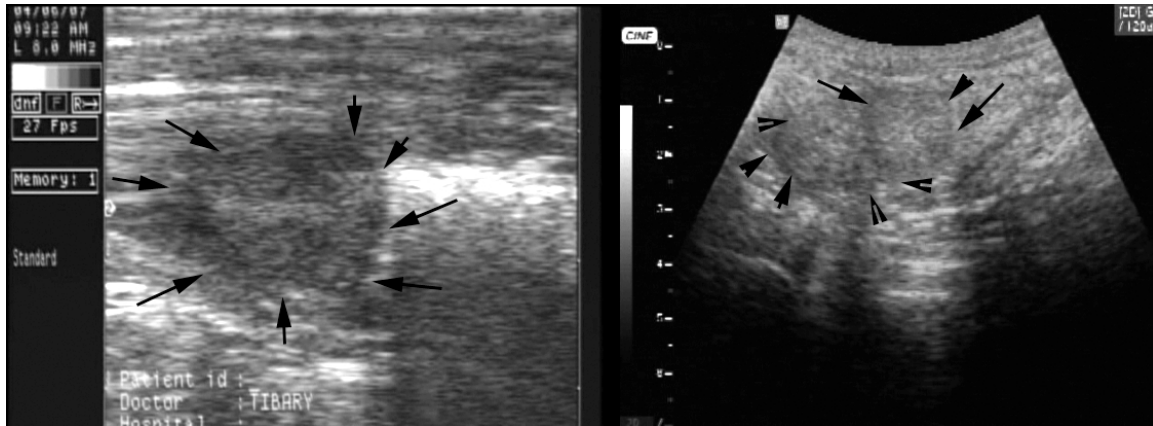


Figure 18 Transabdominal ultrasonogram of an intraabdominal testis (arrows) in a cryptorchid alpaca

Penis and prepuce

- Ultrasound examination of the prepuce is indicated in case of swelling of the region. It should be performed under sedation
- Allows differential diagnosis of urethral rupture, cellulites, abscesses, hematoma (Figure)

Accessory sex glands

- Indicated in case of straining or abnormal ejaculation
- Ultrasonography of the accessory sex gland is done per rectum
- The bulbourethral glands are just cranial to the anal sphincter on each side. They are round with medium echogenicity. They may present some fluid if the male has been sexually stimulated (Figure 19)
- The prostate is found at the cranial aspect of the pelvic portion of the penis. (Figure)
- Abnormalities found include enlarged bulbourethral glands or prostate, dilated urethra

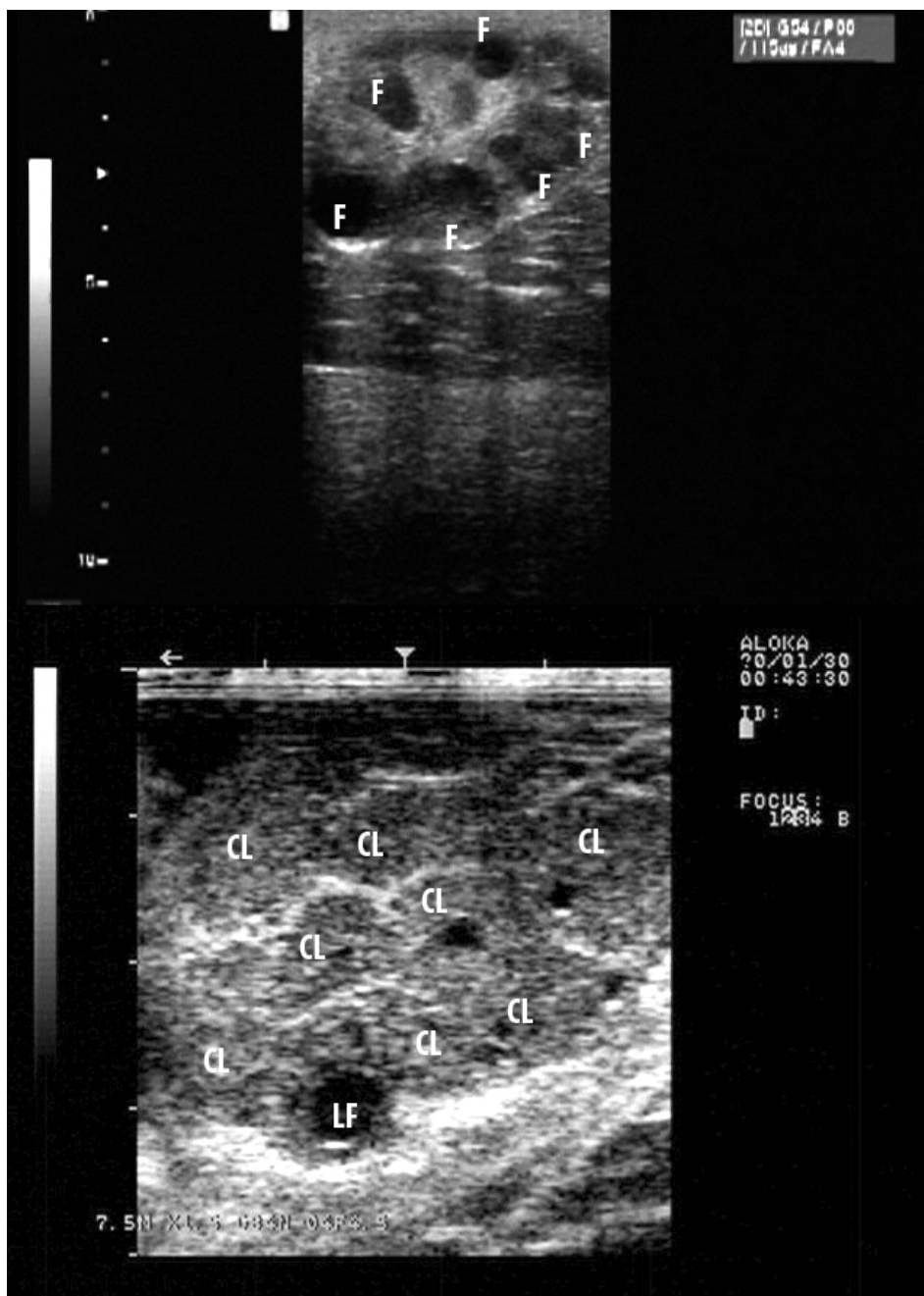


Figure 19 Ultrasonogram of an alpaca ovary after superstimulation with FSH showing multiple follicles (top, F=Follicles) and multiple corpora luteal (bottom, CL= corpus luteum) 7 days after mating.

Other uses of ultrasonography in camelid reproduction

- In addition to uses involving direct observation of the normal and abnormal ovarian and uterine activity ultrasonography is valuable in the following area:
- Monitoring of the response to superovulation (Figures)
- Ultrasound-guided follicular aspiration

OTHER DIAGNOSTIC PROCEDURES

- Depends of complaints and ultrasonographic findings

PATHOLOGIC FINDINGS

- Depending on diagnosis

**TREATMENT****THERAPEUTIC APPROACH**

- Depends of complaints and ultrasonographic findings

SURGICAL CONSIDERATIONS AND TECHNIQUES

- Depends of complaints and ultrasonographic findings

**MEDICATIONS****DRUGS OF CHOICE**

- Depend on diagnosis

CONTRAINDICATIONS

- Appropriate milk and meat withdrawal times must be followed.

PRECAUTIONS

- N/A

POSSIBLE INTERACTIONS

- N/A

**FOLLOW-UP****EXPECTED COURSE AND PROGNOSIS**

- Depend on diagnosis

POSSIBLE COMPLICATIONS

- Rectal or colonic perforation is transrectal ultrasonography is not done correctly

CLIENT EDUCATION

- Pregnancy confirmation should be done at a later date is early pregnancy diagnosis is done

PATIENT CARE

- Depend on diagnosis

PREVENTION

- Depend on diagnosis



MISCELLANEOUS

ASSOCIATED CONDITIONS

- Infertility
- Early embryonic loss or abortion

AGE-RELATED FACTORS

- Staining due to enlarged prostate is common in alpaca around puberty
- Young female should be suspected of congenital ovarian hypoplasia if the ovaries cannot be visualized

ZOONOTIC POTENTIAL

- Herds experiencing brucellosis, Q-fever, toxoplasmosis, leptospirosis

PREGNANCY

- See discussion above

BIOSECURITY

- Transmission of diseases from a flock/herd to another is possible if the transducer and extension handle are not cleaned.

PRODUCTION MANAGEMENT

- N/A

SYNONYMS

- N/A

ABBREVIATIONS

- GnRH= gonadotropin releasing hormone
- hCG= human chorionic gonadotropin
- SAC= South American Camelid

SEE ALSO

- Anestrus
- Breeding Soundness Examination: Camelids
- Camelid:Reproduction
- Infertility and Subfertility Issues
- Orchitis and Epididymitis
- Ovarian Cystic Degeneration
- Ovarian Hypoplasia, Bursal Disease, Salpingitis
- Pregnancy Diagnosis: Camelid
- Pyometra
- Reproductive Tumors
- Testicular Disorders: Camelid

Suggested Reading

Gazitua FJ, Corradini P, Ferrando G, Raggi LA, Parraguez VH. Prediction of gestational age by ultrasonic fetometry in llamas (*Lama glama*) and alpacas (*Lama pacos*). *Anim Reprod Sci*. 2001 Apr 30; 66(1-2): 81-92.

Tibary A. and Anouassi A. Reproductive disorders in the female camelidae. In: *Theriogenology in Camelidae: Anatomy, Physiology, Pathology and artificial breeding*. Actes Edition, Institut Agronomique et Veterinaire Hassan II, Morocco.

Author Ahmed Tibary

Consulting Editor Ahmed Tibary

Table 1. Estimation of llama and alpaca gestation age (in days) from fetal measurements (mm) taken by ultrasonography.

Species	Formula	Remarks
Llamas	$\text{Log GSD}^* + 1.2649/0.0546$	Trans-rectal ultrasonography (5 MHz) between 9 and 34 days, $r=0.77$ (Parraguez et al 1997)
Llamas	$3.79 \text{ BPD} + 18.8$	Trans-abdominal ultrasonography (5MHz) between days 66 and 235, $R^2=0.98$ (Haibel and Fung 1991)
Alpacas	$\text{Log GSD} + 1.2339/0.0585$	Trans-rectal ultrasonography (5MHz) between days 7 and 34, $r=0.85$ (Parraguez et al 1997)
Alpacas	$0.41 \text{ CR} + 34.31$ $3.89 \text{ BPD} + 1.14$	Trans-rectal (5 MHz) between 40 and 70 days, trans-abdominal (3.5 MHz) between 60 and 240

	$2.73 \text{ CW} + 18.52$	days. $R^2=0.53$ for crown-rump (CR), $R^2=0.65$ for biparietal width (BPD) and $R^2=0.83$ for Chest width (CW). (Richland et al 1992)
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*GSD= Gestational sac diameter