

REPRODUCTIVE ULTRASONOGRAPHY: BOVINE



BASICS

OVERVIEW

- Ultrasonography is a valuable diagnostic tool for the examination of the reproductive tract and the diagnosis of various phases of the reproductive cycle and the diagnosis of pregnancy and some reproductive abnormalities.
- The economic and medical value of this technique has been demonstrated by several studies.
- Early identification of open cows and resynchronization for artificial insemination can have a great economic value particularly in herd with poor pregnancy rates
- Controlled studies have shown that the accuracy of transrectal palpation in determining ovarian structures and some uterine and ovarian abnormalities is 60% at best.
- In the male, ultrasonography offers a direct window on the anatomy of the internal organs. It aids in the evaluation of testicular parenchyma, the epididymis, the penis and the prepuce and identifies lesions which otherwise cannot be palpated or are difficult to differentiate.
- 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

- Ultrasonography is increasingly used in beef and dairy cattle for early pregnancy diagnosis and fetal sexing

GEOGRAPHIC DISTRIBUTION

- Worldwide

SYSTEMS AFFECTED

- Reproductive

PATHOPHYSIOLOGY

- Many pathological processes in the reproductive tract result in visible ultrasonographic changes.
- Abnormal accumulation of fluid in the uterus (pyometra, hydrometra, Mucometra) or in the testis and epididymis (rete testis and epididymal cysts) can be easily visualized by their characteristic ultrasonographic features
 - Degenerative changes accompanied by fibrosis and sometimes calcification are identified by the increased echogenicity or tissue and comet tail appearance (calcification)
 - Pregnancy disorders can be identified by changes in the echogenicity of fetal fluids, fetal cardiac activity, fetal abnormal development, and appearance of the placenta.

HISTORICAL FINDINGS

- Breeding management history: estrus synchronization, artificial insemination of mating
- Abnormal vaginal discharge after positive pregnancy diagnosis

- Abnormal cyclicity or vaginal discharge
- Males with abnormal ejaculates or abnormal scrotal or epididymal enlargement in the male

SIGNALMENT

- Beef and dairy cattle of breeding age

PHYSICAL EXAMINATION FINDINGS

- Depends on the complaint.
- Animals undergoing ultrasonographic examination for cyclicity or pregnancy diagnosis do not present any abnormality on physical examination

GENETICS

- N/A

CAUSES AND RISK FACTORS

Ultrasonography is considered the gold standard for pregnancy diagnosis and evaluation of reproductive organs



DIAGNOSIS

DIFFERENTIAL DIAGNOSIS

- See imaging below

CBC/BIOCHEMISTRY/URINALYSIS

- N/A

OTHER LABORATORY TESTS

- Depends on complaint and specific ultrasonography findings.

IMAGING

Reproductive ultrasonography of the open bovine female

Technique

- Ultrasonography of the reproductive tract in cattle is accomplished per rectum.
- The objective of this examination is to visualize the cervix, uterus (and their contents) as well as the ovaries and ovarian structures.
- The technique is fundamentally based on a sound transrectal palpation of these organs
- The rectum should be emptied of fecal material and all parts of the reproductive tract identified first by trans-rectal palpation and retraction of the uterus (if possible)
- Ultrasonographic examination of the bovine reproductive tract is best accomplished using a 5 MHz linear or sector transducer. A 7.5 MHz transducer is indicated for detailed studies of the follicular dynamics as it provides a greater resolution and visualization of

follicular vesicles as small as 2 mm. A 3.5 MHz transducer is of limited use in routine examination but may be of value if the uterus or ovary are very large

- In situ examination of the female reproductive tract starts by identifying the anechoic urinary bladder ((Figure 1).

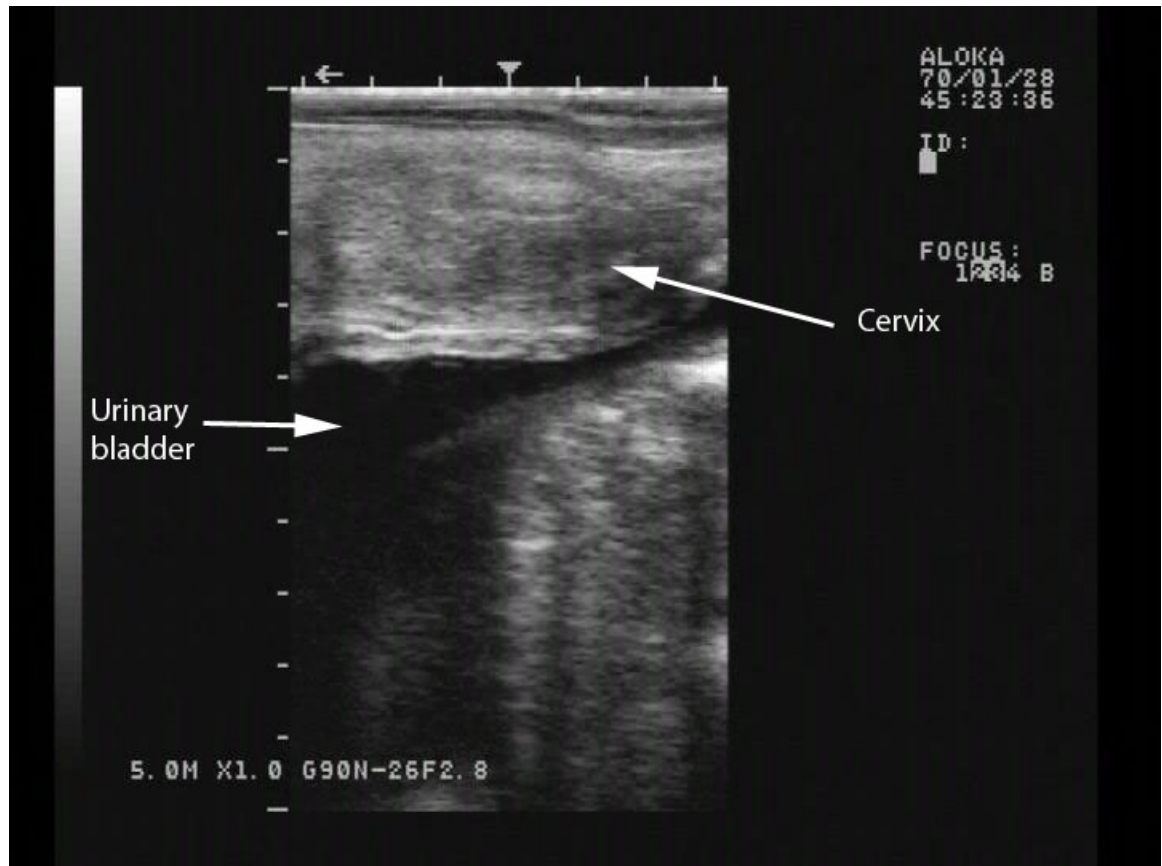


Figure 1 Ultrasonogram of the cervix and urinary bladder

- Slightly caudal to the bladder and in the midline, the cervix can be identified by its characteristic echo texture presenting dense cervical rings and a hyperechoic line representing the cervical canal (Figure 1).
- Cranial to the cervix, the uterine body is found followed by the uterine horn. The whole reproductive tract can be displaced by a full urinary bladder or by compression by other abdominal organs thus the importance of the palpation skills of the examiner (Figure 2).

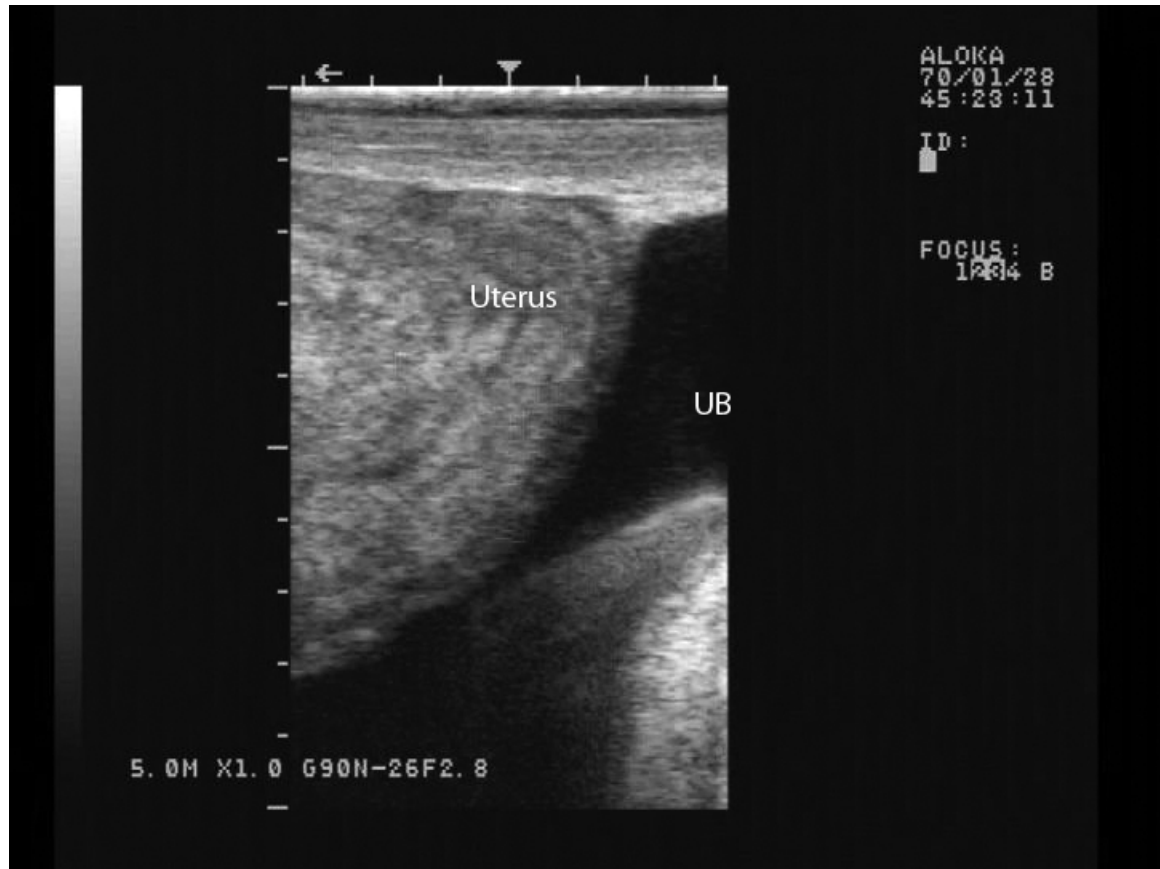


Figure 2 Ultrasonogram showing the uterine horn and urinary bladder (UB)

- With a linear transducer, the uterus should be examined by placing the transducer near the uterine horn's bifurcation to obtain longitudinal images. Use of a sector transducer usually produces multiple cross sections of the uterine horn due to their curled anatomy. Moving the transducer laterally scans the ovaries. It is important to use a sound technique to find and scan the ovaries and not try to "fish" for these organs.
- Transcutaneous ultrasonography with a 3.5 MHz transducer through the paralumbar fossa or lower abdomen (inguinal area) may be helpful in examination of very large ovaries, uterine masses or advanced pregnancy

Examination of the ovary and ovarian structures

- The ovary can be difficult to identify for the beginner if it does not have any follicular activity (Figure 3)

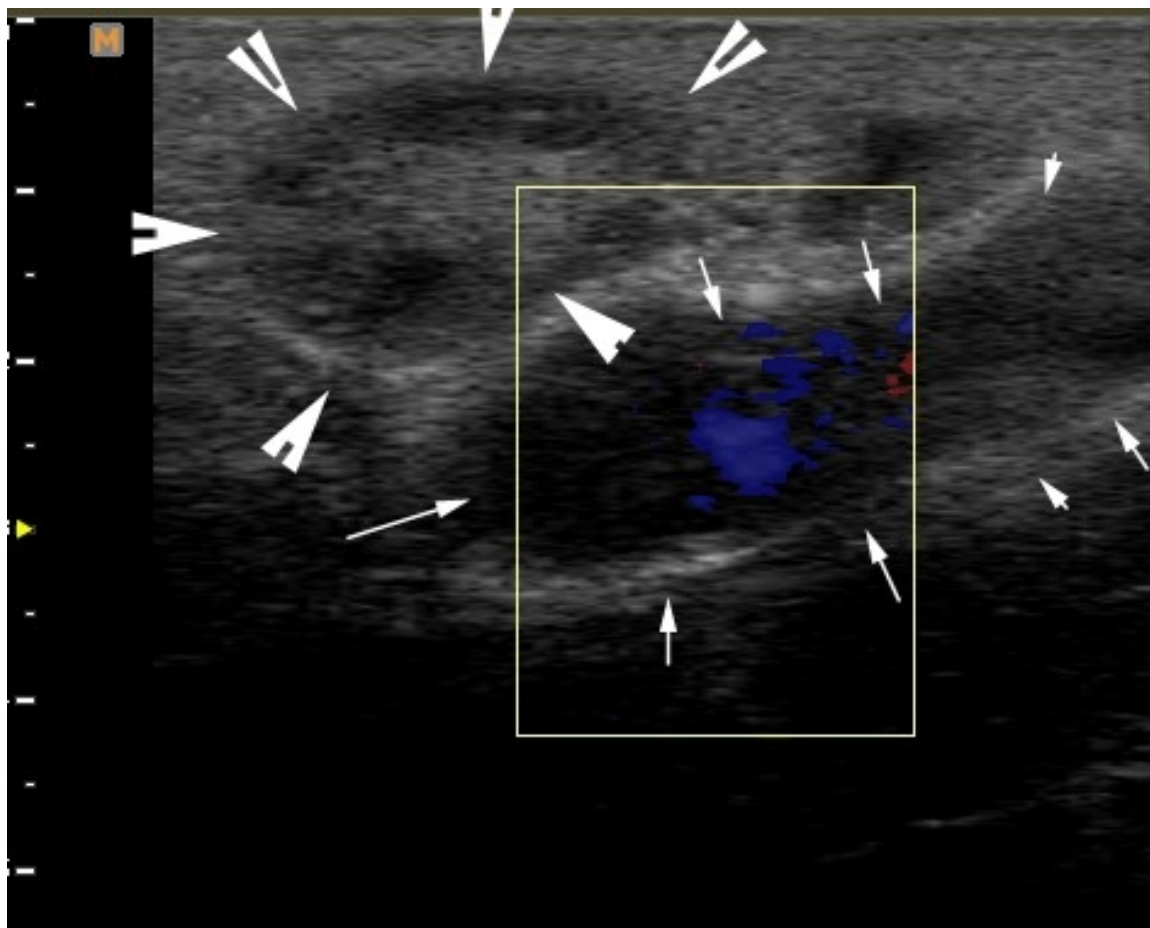


Figure 3 Bovine ovary delineated by the large arrow. Small arrows delineate the iliac artery

Follicles and follicular dynamics in the cow

- Follicles are visualized as anechoic, round structures (Figure 4)
- Large veins or arteries may confuse the beginner, as they may appear as follicular structures when viewed in cross-section (Figures 3,4).



Figure 4 Bovine ovary with small follicle delineated by large arrows. Small arrows indicate iliac artery

- The minimum size of the follicles that can be visualized depends on the transducer frequency used. With a 5 MHz transducer it is hard to visualize follicles smaller than 5 mm in diameter. Whereas with a 7.5 MHz transducer, follicles as small as 3 mm in diameter can usually be seen. (Figure 5)

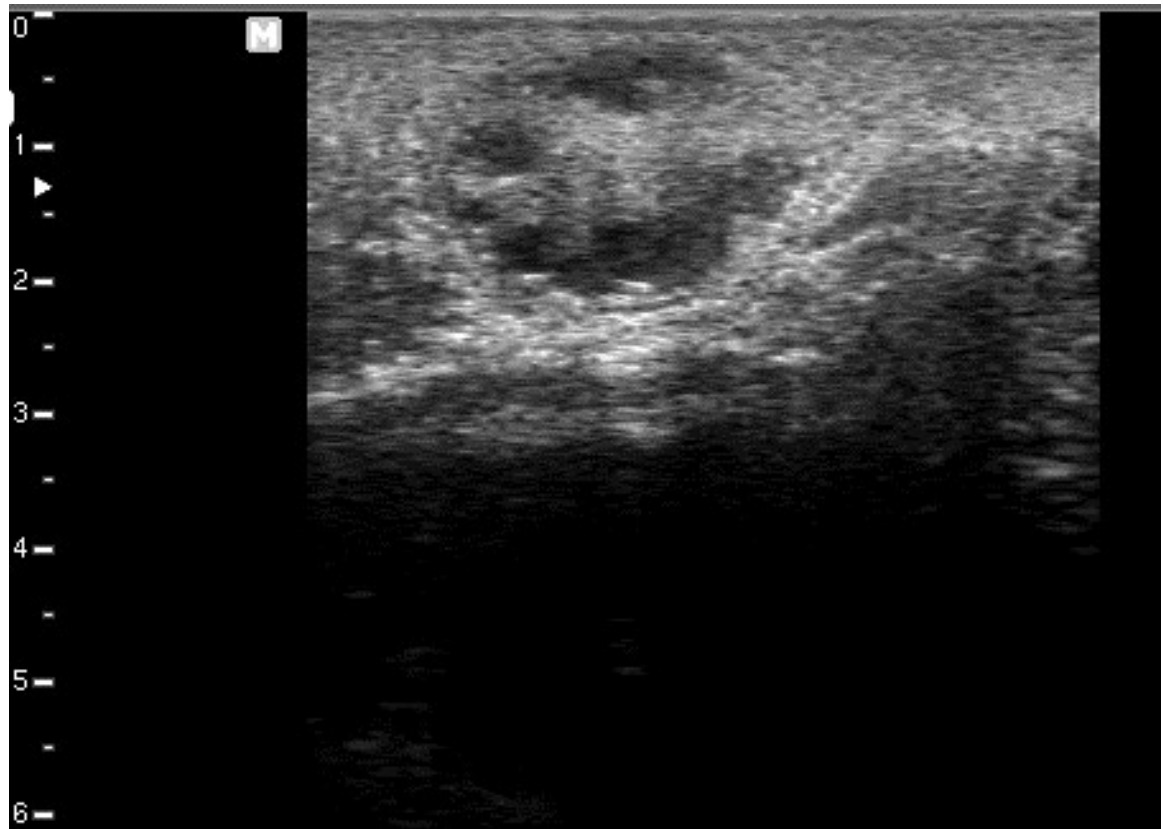


Figure 5 Ovary at the initiation of a new follicular wave (note the small anechoic follicles located at the periphery of the ovary)

- A follicle becomes dominant when it reaches 8 mm in diameter and will inhibit all the subordinate follicles. The dominant follicle will continue to grow at a rate of 1.5 to 2.5 mm per day until reaching its mature size, then will either regress (diestrus follicular waves) or ovulate in the case of estrus (Figure 6).

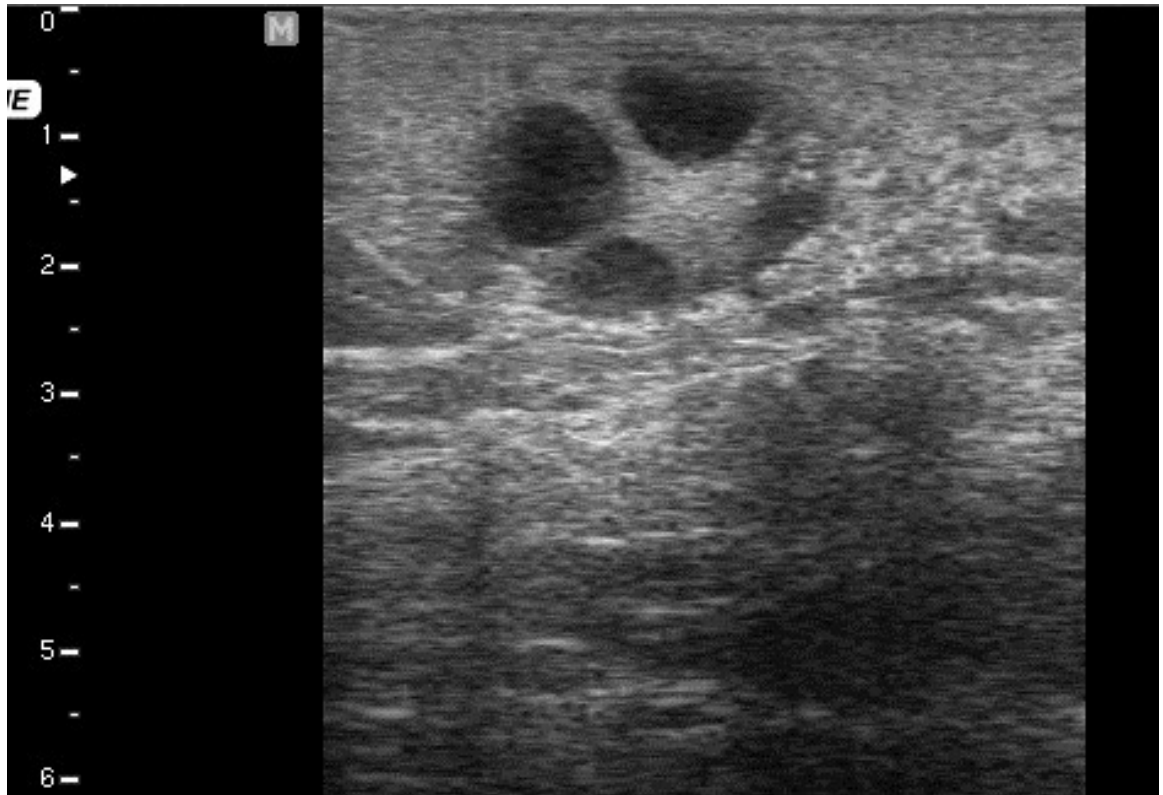


Figure 6 Ovary at the follicular deviation state (one or two dominant follicles)

- During estrus, the mature follicle ranges in size from 10 to 20 mm (average 14 to 15 mm). Estrous follicles usually reach their maximum size within 12 to 24 hours before the beginning of estrus and stop growing 36 hours prior to ovulation (Figure 7).

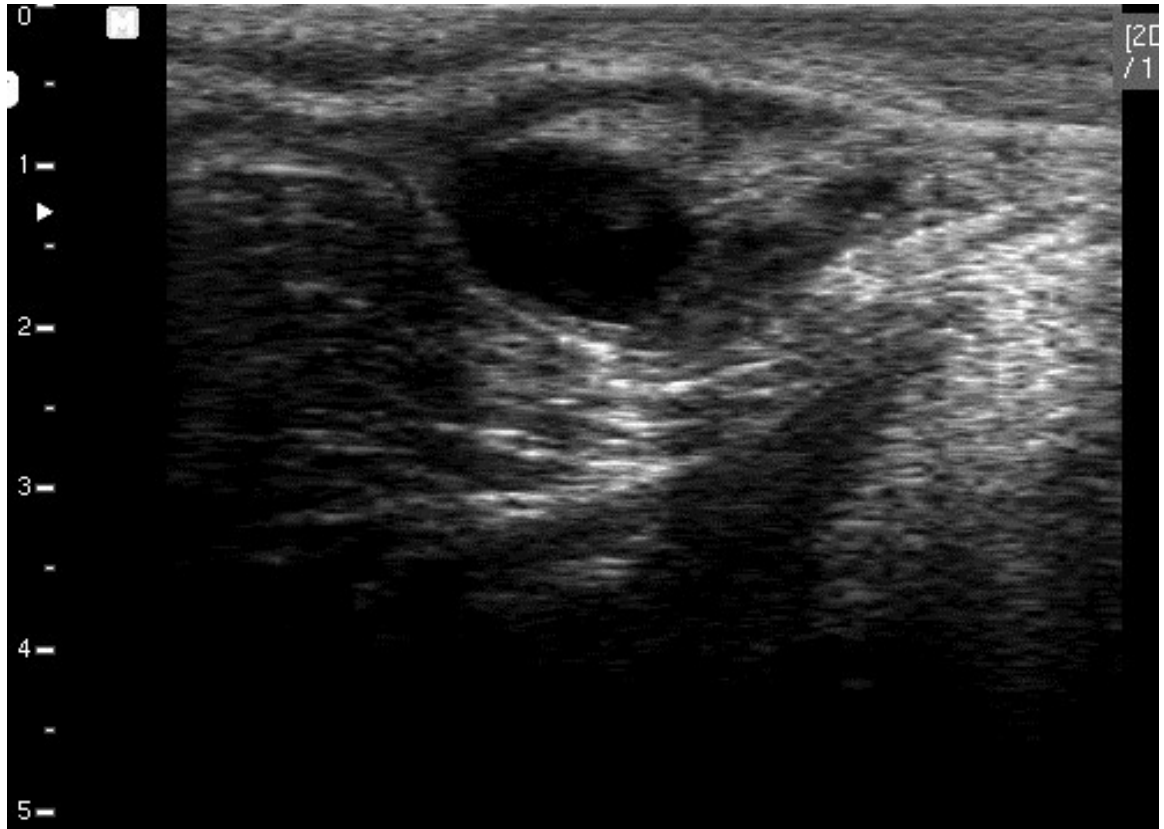
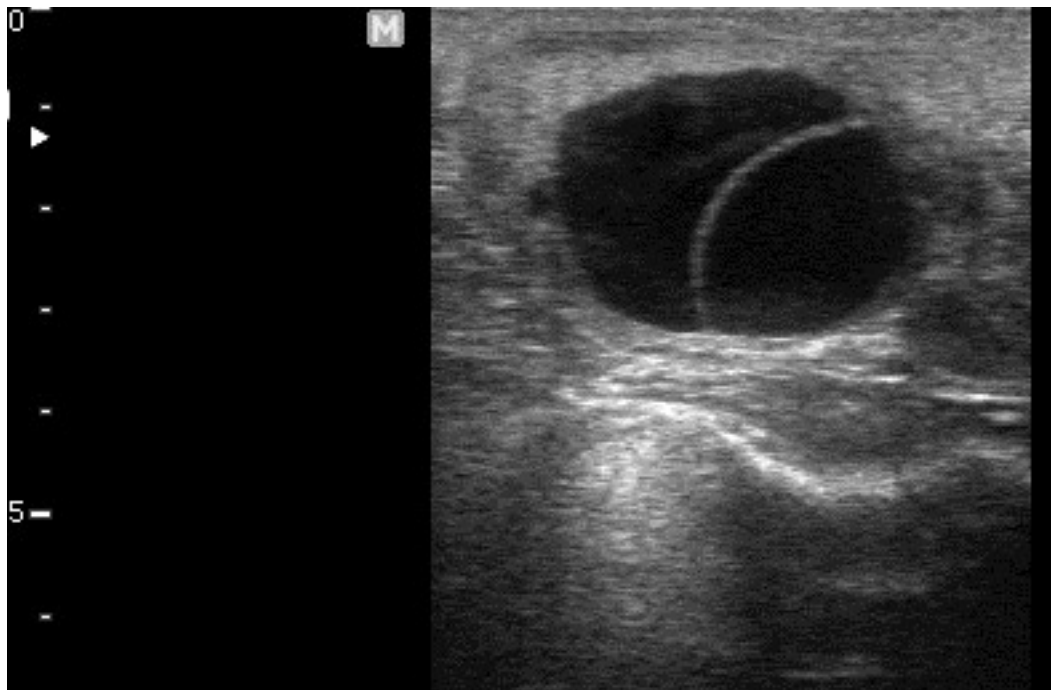


Figure 7 Dominant follicle measuring 10 mm in diameter

- The pre-ovulatory follicles may present characteristic speckling near its wall, which is thought to correspond to cumulus oophorus. This detail is more evident if the examination is performed with a 7.5 MHz transducer. In some cycles more than one mature or pre-ovulatory follicles can be found (one on each ovary or on the same ovary) (Figure 8). Follicles close to each other on the same ovary may be hard to differentiate and the overall image may seem to be oval. Careful examination will allow visualization of a thin wall separating the two follicles (Figure 9).



1. Figure 8 Pre-ovulatory follicle measuring 23 mm in diameter



2. Figure 9 Ovary presenting two dominant follicles

Ovulation and the Corpus Luteum

- Ovulation is detected by the disappearance of the mature follicle.
- Corpora hemorrhagica are difficult to detect unless the cow is scanned repeatedly during the same cycle but can be visualized at 2 days.
- The corpus luteum is identifiable from about day 4 post-ovulation.
- Corpora lutea present two ultrasonographic appearances: full echogenic corpora lutea (Figure 10) and cavitory or cystic corpora lutea (Figures 11,12).

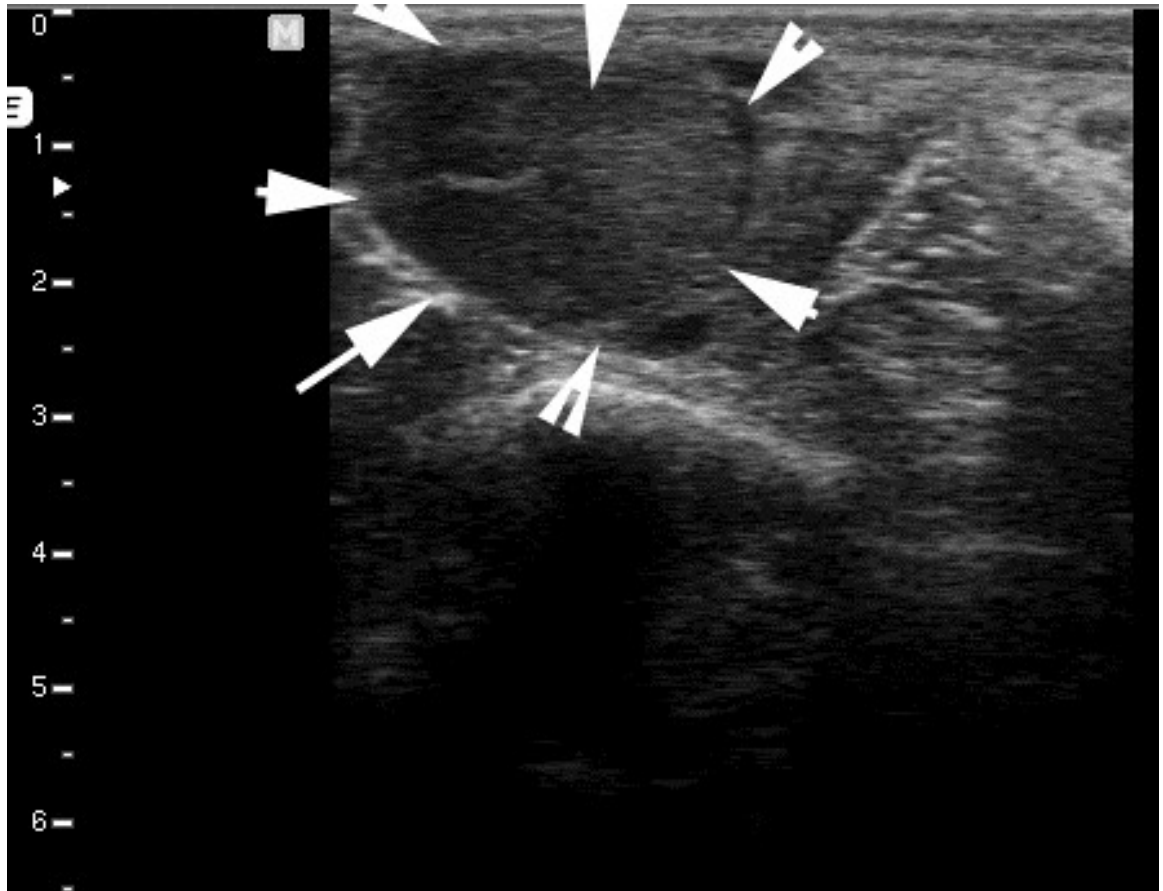
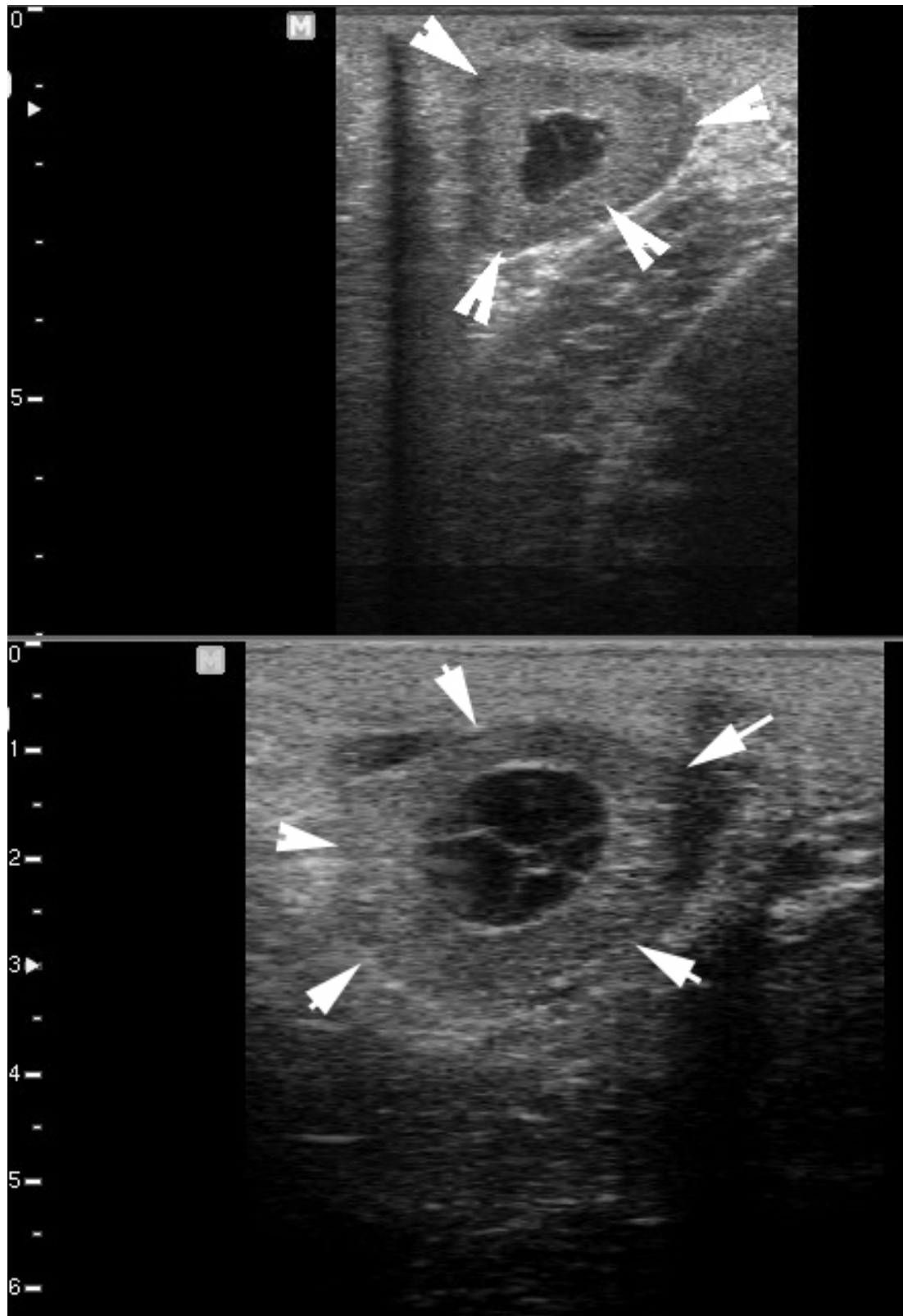


Figure 10 Ultrasonogram of an ovary with a corpus luteum (arrows) on day 11 of the cycle



3. Figure 11 Ultrasonogram of cavitory corpora lutea (also called cystic CL) on day 12 of the cycle



4. Figure 12 Ultrasonogram showing blood flow (color Doppler) in a mature cystic corpus luteum with a crown.

- Full corpora lutea present a luteal tissue characterized by a grainy appearance with medium echogenicity.
- The overall shape of the corpus luteum is either oval or circular.
- Depending on the orientation of the transducer, a crown may be evident. Some corpora lutea may present a more echogenic central zone (Figure 12).
- Cavitory corpora lutea are characterized by the presence of fluid-filled, anechoic central foci with a varying diameter.
- Non-cystic and cystic corpora lutea are found with equal frequency in normal cycles and during early pregnancy and have similar steroidogenetic activity.
- Cavitory corpora lutea tend to “fill up” as pregnancy advances. Cystic corpora lutea may be a larger than non-cystic CL’s.
- The echotexture of the corpus luteum has been found to correlate very well with luteal gland mass and progesterone levels in cows.
- Corpora lutea measure on the average 14 x 20 mm at 4 days and then grow by 1 mm in width and 2 mm in length each day.
- CL’s reach a maximum size of 20 x 30 mm in mid-diestrus between days 8 and 10 of the cycle.
- CL’s start regressing after release of PGF 2 alpha but will continue to be visualized until, and sometimes beyond, the next ovulation (Figure 13).



5.

Figure 13 Ultrasonogram showing reduced blood flow (color Doppler) in a regressing corpus luteum, in presence of a dominant follicle.

- Doppler ultrasonography can help determine whether a corpus luteum is still function or not. Active CL's display a marked blood flow (Figures 12, 13)
- Detection of multiple ovulation sites (multiple CL's) is more accurate with ultrasonography than with palpation (Figure 14)

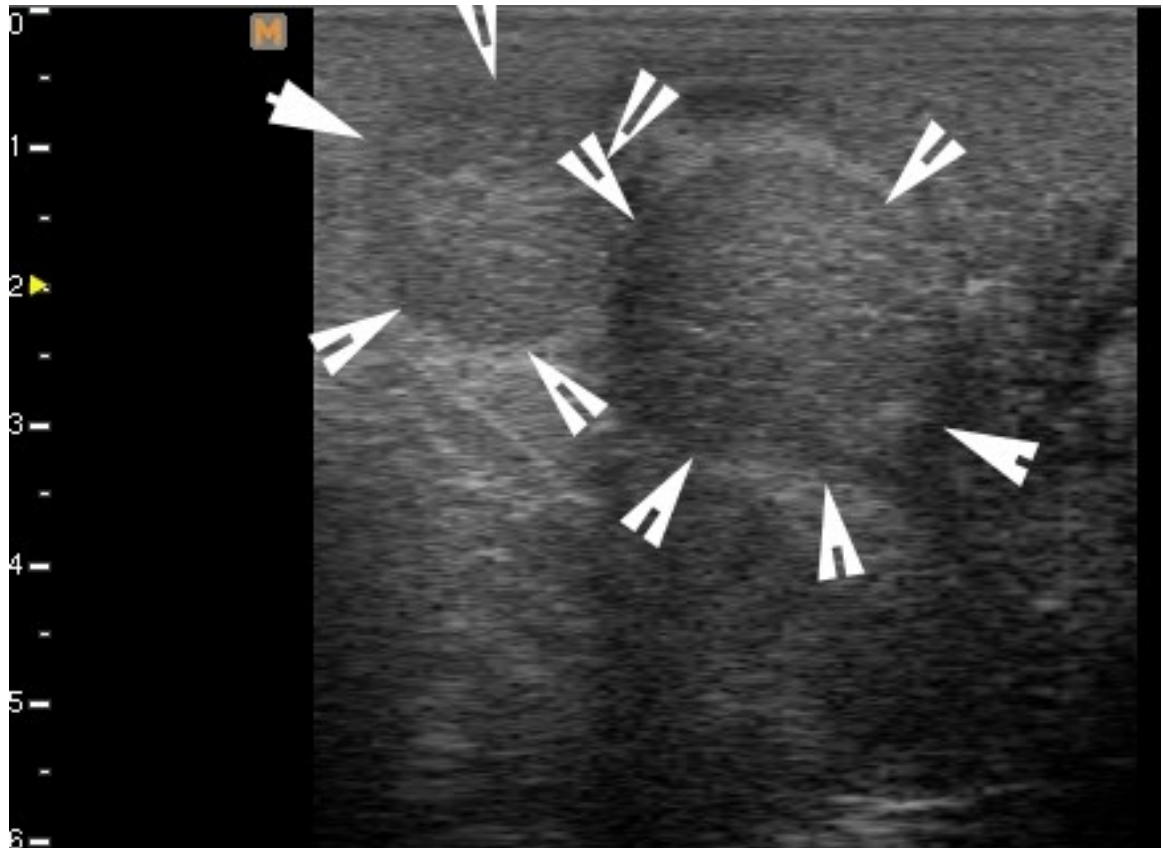


Figure 14 Ultrasonogram of an ovary with two mature corpora luteal (arrows)

Echotexture of the normal uterus

- The entire uterine horn can be visualized in a single view if the transducer and the uterine horn are positioned adequately
- The uterine horn becomes curled and increases in diameter during estrus
- In many animals, the increased tone of the uterus is accompanied by edema and accumulation of intraluminal fluid during estrus (Figure 15).
- During proestrus, estrus and metestrus, the wall of the uterus presents two distinct layers: a hyperechoic adluminal zone, and a more echoic peripheral zone.
- During diestrus, the uterus appears more homogenous (Figure 16)



Figure 15 Ultrasonogram of the uterus (delineated by arrows) during estrus. Note the presence of edema and mucus

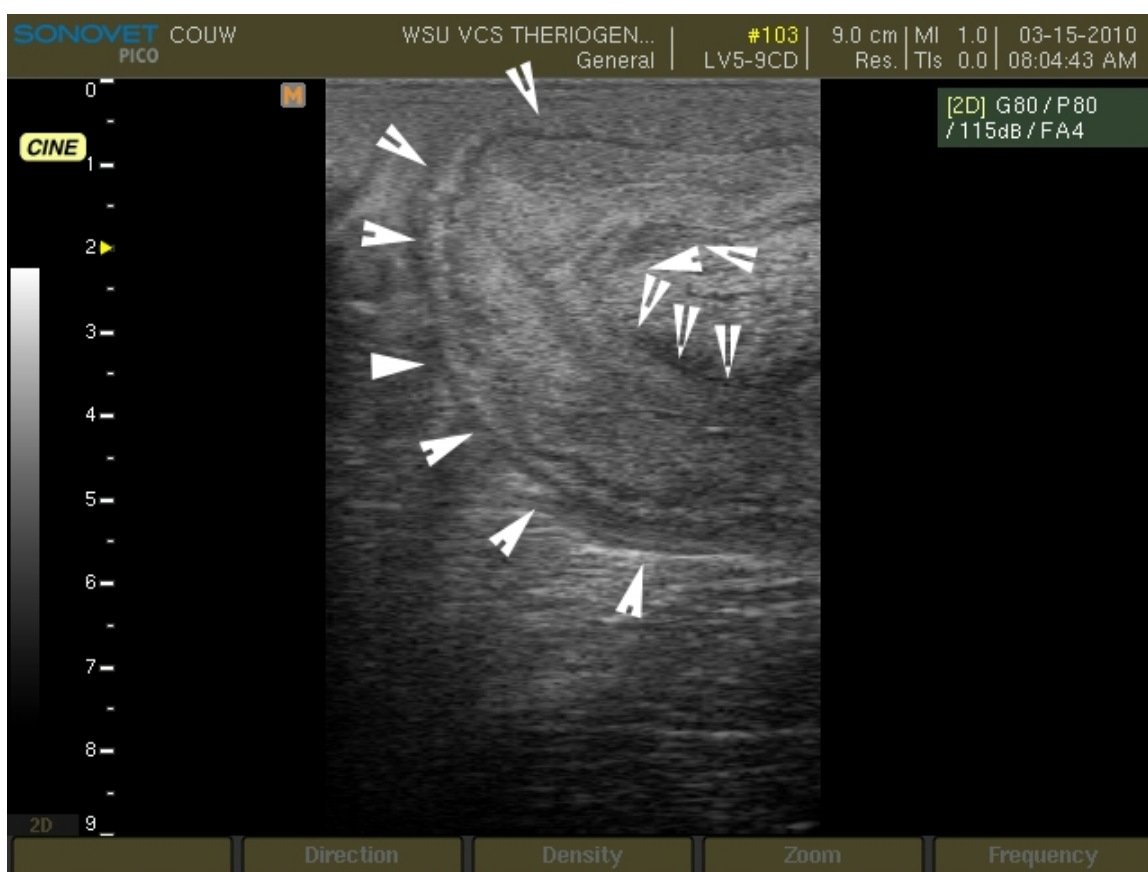


Figure 16 Ultrasonogram of the uterus (delineated by arrows) during diestrus. Note the homogenous appearance under progesterone influence

Pregnancy diagnosis, twinning and abnormal pregnancy

Normal pregnancy

- The bovine embryo does not remain spherical for a long time and undergoes an elongation phase starting about 10 days post-fertilization.
- By day 15 the embryonic vesicle is a thin, thread-like tube and by day 20 this elongated embryo covers the entire uterine cavity from the tip of one horn to the other and can measure up to one meter in length.
- This anatomical characteristics of the early embryo makes early pregnancy diagnosis very difficult in the bovine
- Accumulation of embryonic fluid within the uterine lumen can be visualized under certain conditions as early as 12 days post-fertilization.
- The fluid is usually found ipsilateral to the side of ovulation.
- The embryonic fluid appears as a thin anechoic line or star shaped area within the horn measuring between 2 to 4 mm by 3 to 7 mm.
- A real embryonic vesicle is often not visualized until day 20 after ovulation.
- From day 25 on, the amount of fluid in the allantochorionic vesicle increases rapidly making visualization of the embryonic vesicle easier (Figure 17)

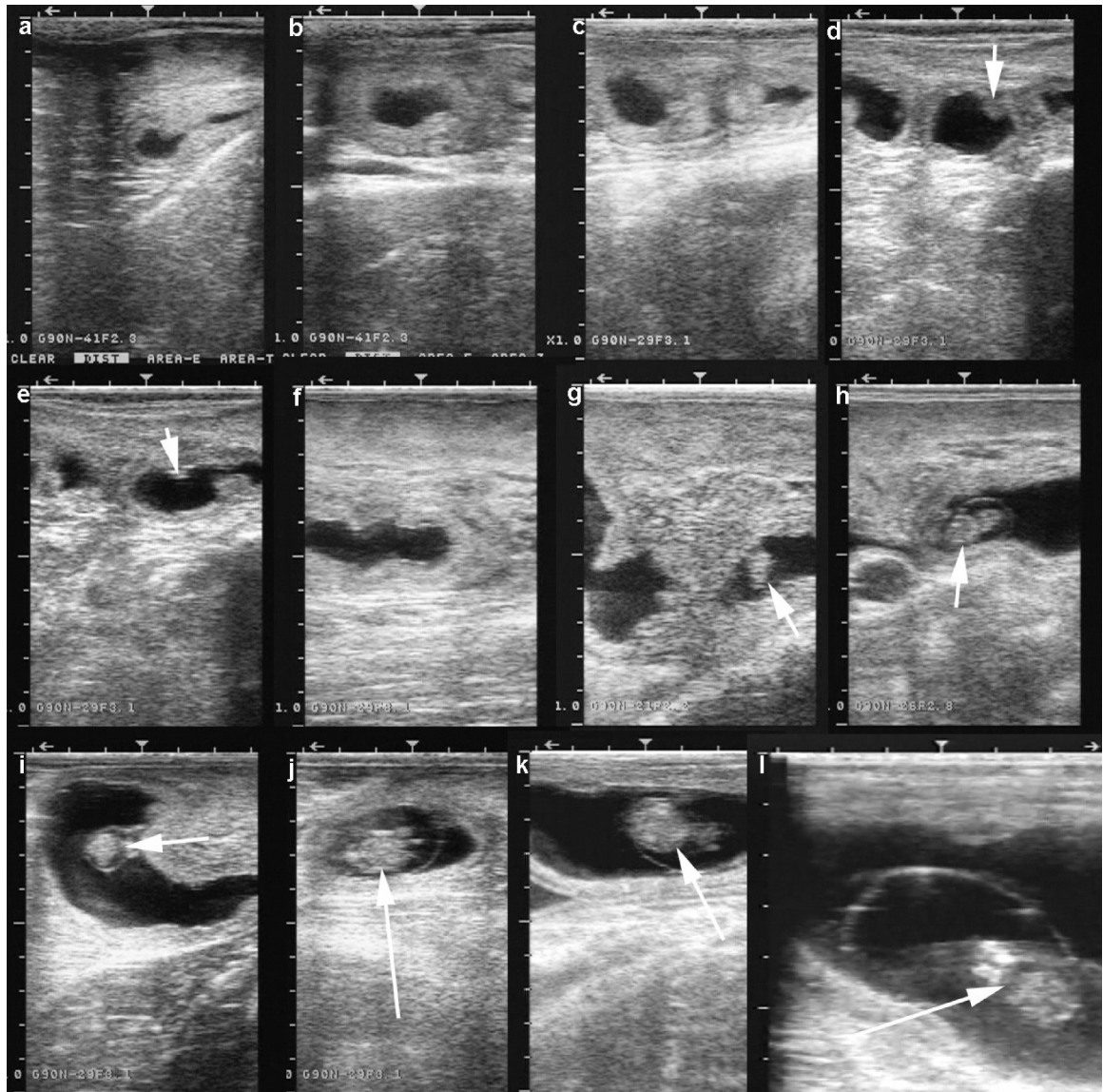


Figure 17 Pregnancy diagnosis. Ultrasonogram of different stages of pregnancy in the bovine: a) 25 days (heifer), b) 26 days, c) 27 days, d) 28 days, e) 28 days (arrow points to embryo proper), f) 29 days, g) 29 days with embryo, h) 31 days, i) 34 days, j) 36 days, note the membrane of the amniotic sac, k) 40 days, l) 45 days.

- The non-pregnant status of a cow can be diagnosed between day 20 and 23 based on the small size of the corpus luteum (< 20 mm) and the absence of fluid in the uterine cavity. A positive diagnosis can only be made if an embryo is identified.
- Pregnancy diagnosis becomes relatively easy after day 25 as the embryo becomes more and more obvious. In one study the overall sensitivity and specificity for pregnancy diagnosis by ultrasonography was 40% and 67%, 94 and 70% and 96 and 88% at less than 24 days, 27 days and 29 days respectively. Standard pregnancy diagnosis examinations on many dairies begin at approximately 27 days using ultrasonography. Pregnancy should be reconfirmed after 40 days because of the rate of early embryonic

- loss, which can reach 15% between days 24 and 40 of pregnancy. False negative diagnosis may be as high as 20% when ultrasonography is performed before day 28.
- Fetal heartbeat can be clearly identified by day 27.
 - The crown-rump length measures 12 mm, 15 mm and 20 mm respectively at 30, 35 and 40 days.
 - The amniotic vesicles are visible from about day 29, but become clearly visible on day 35.
 - The placentomes are visualized for the first time between days 35 and 40 as knobs protruding from the uterine wall. (Figure 18)



Figure 18 Ultrasonogram of 82 day pregnancy showing placentomes (P)

Twin pregnancies

- Presence of twins is almost always accompanied by the presence of two corpora lutea (Figure 19)
- However, diagnosis of twins based on the presence of two corpora lutea may falsely increase the twinning rate
- Diagnosis of twins should be made only if two distinct conceptuses/fetuses are present (Figure 20).
- Accuracy of diagnosis increases after 30 days.
- Diagnosis of twins becomes difficult after 80 days, particularly in dairy cows because of the difficulty in visualized the entire fetus when the uterus become too ventral



Figure 19 Pregnancy diagnosis: A) Unilateral 31 day twin pregnancy. B) two corpora lutea ipsilateral to the twin embryos



Figure 20 Unilateral dead twin fetus at 52 days

Fetal sexing

- Performed between 48 and 119 days but accuracy is best between 60 and 85 days

- Early fetal gender determination is based on the location of the genital tubercle (fetal penis closer to the umbilicus, clitoris closer to the tail) (Figure 21)
- Later in gestation, males are identified by the presence of genital swelling (scrotum) or the presence of a prepuce just caudal to the umbilical cord (Figure 22). Female are identified by the presence of an echogenic mammary gland with visible teats (Figure 23)

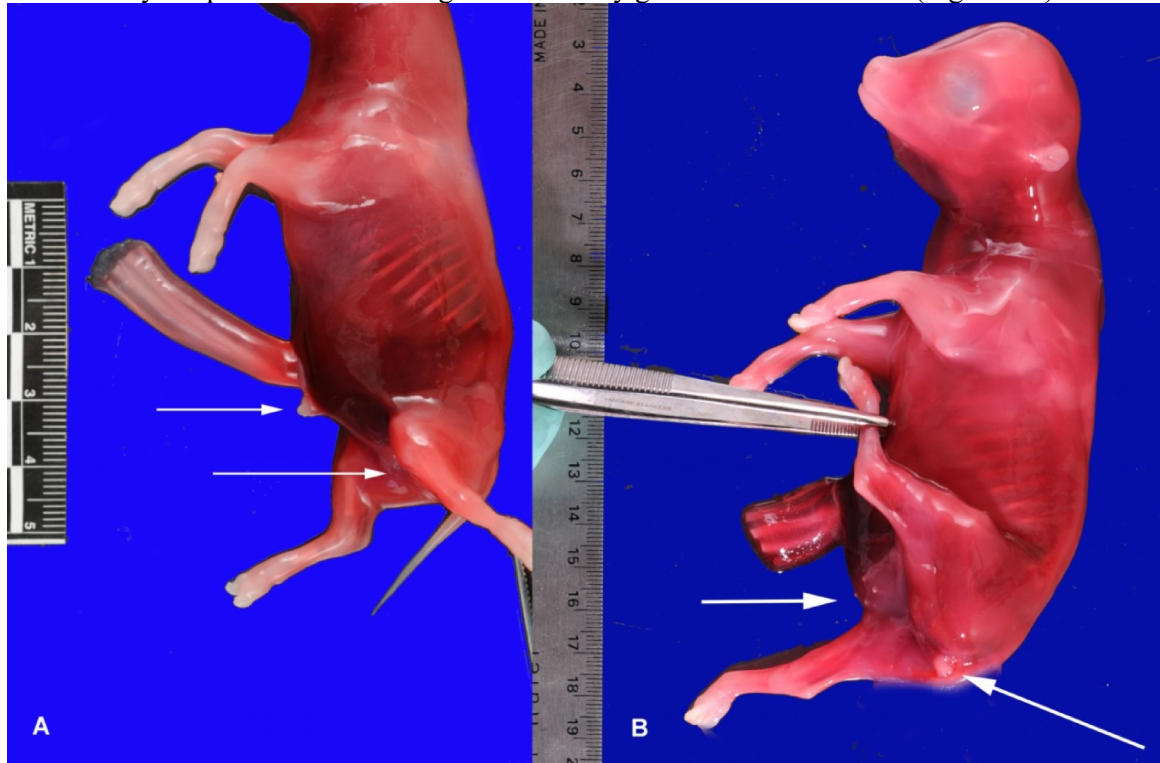


Figure 21 A) Male bovine fetus showing the main anatomic structures used for fetal sexing. 1) prepuce and glans penis (above arrow) located just caudal to the umbilical cord and 2) scrotum (lower arrow). B) Female bovine fetus showing the main anatomical structures used for fetal sexing. 1) vulva and clitoris (right arrow) located just below the anus often hidden by the tail and 2) mammary gland (left arrow) Female fetus

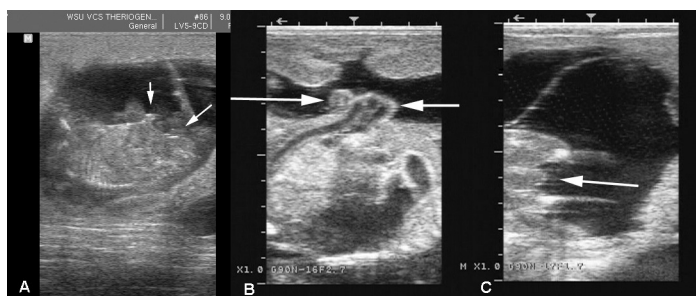


Figure 22 A) 58 day pregnancy. Male fetus. Prepuce (left arrow) and scrotum (right arrow). B) 60 day pregnancy. Male fetus. The prepuce (left arrow) is located just caudal to the umbilicus (right arrow). C) 60 day pregnancy. Male fetus. Note the tri-lobed aspect of the scrotum (arrow) between the hind legs

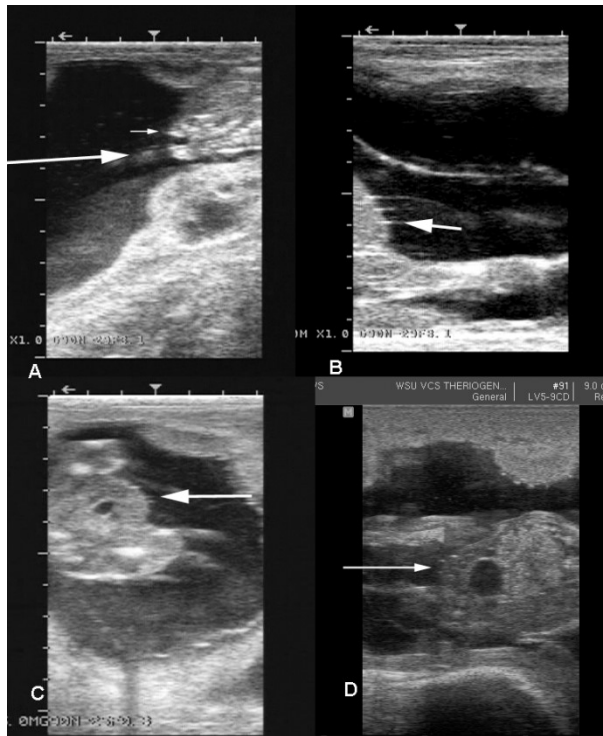


Figure 23 A) 72 day pregnancy. Female fetus. Tail (bottom arrow) and vulva (top arrow). B) 70 day pregnancy. Female fetus. Arrow indicates the mammary gland with its echogenic teats. C) 68 day pregnancy. Female fetus. Transverse view showing the mammary gland (arrow). D) 88 day pregnancy. Female fetus. Arrow points to the mammary gland. Luteal cysts

Early embryonic death

- Early embryonic loss rate between days 22 and 40 of pregnancy has been estimated at 10 to 15%.
- First signs of impending embryonic death are an undersized embryo, reduced amount of embryonic fluid and the presence of echogenic speckles within the embryonic vesicle (Figure 24,25)

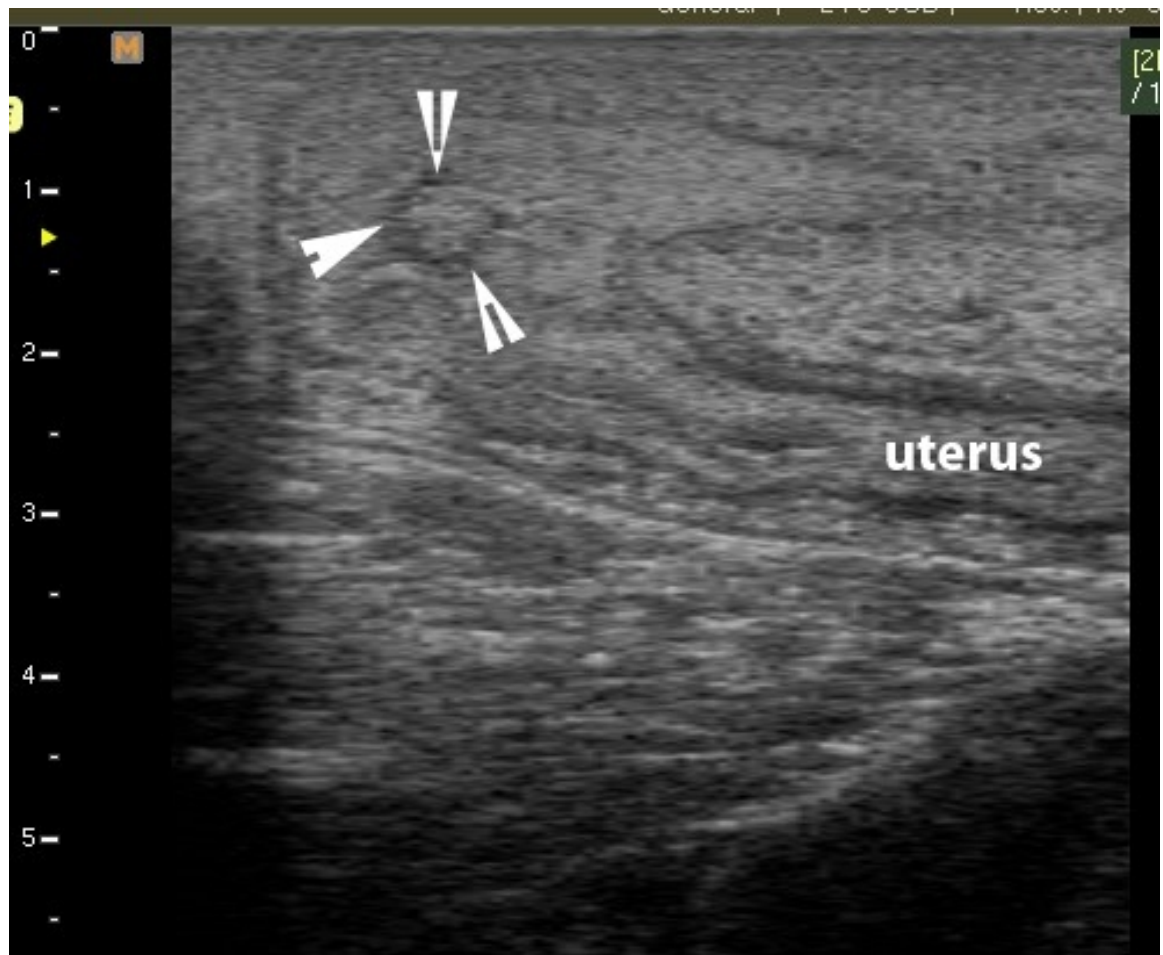


Figure 24 Early pregnancy loss at 35 days (arrows indicate conceptus) - note lack of fluid and collapse of the amniotic vesicle

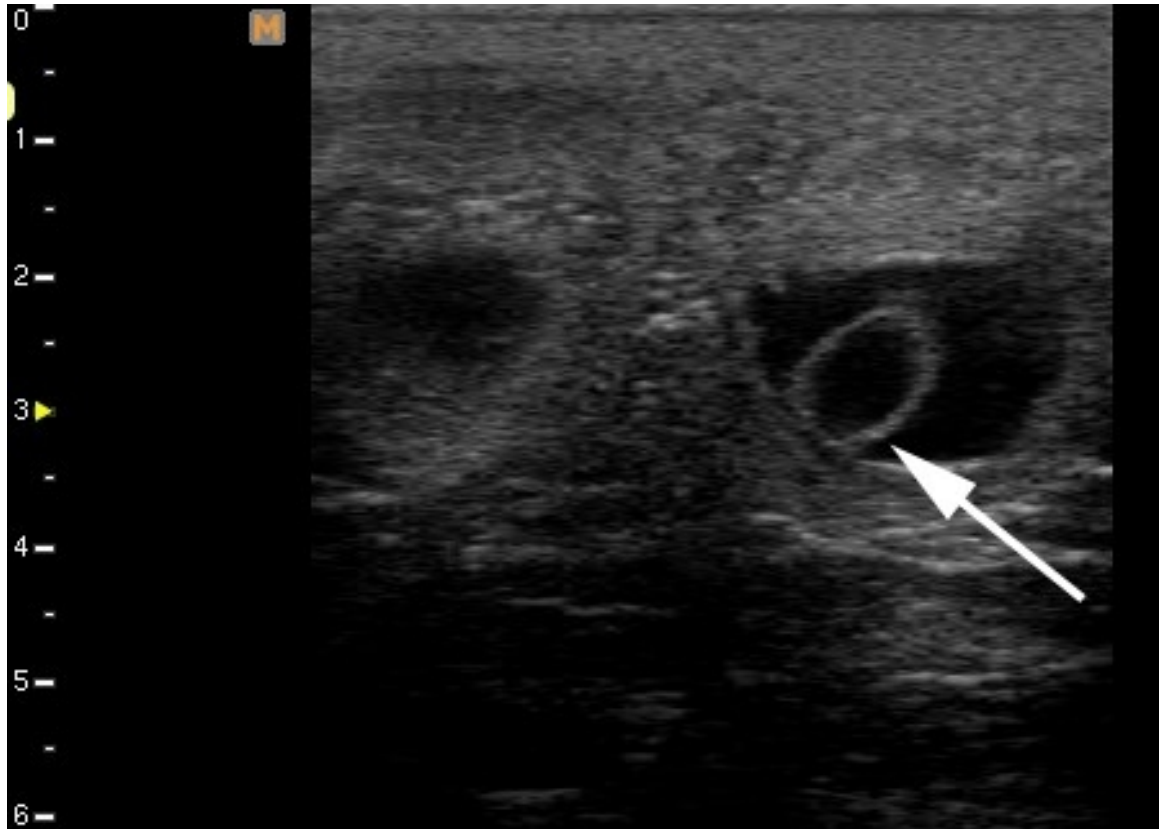


Figure 25 Early pregnancy loss at 45 days: Note the disorganized vesicle (left) and echogenic fluids (right). Arrows indicate fetus

- Death of the embryo can be easily ascertained by a lack of fetal heartbeat.
- Embryos may show signs of impending death and maintain a heart activity for several days.
- Normal bovine heart rate is 150 beats per minute during the first 45 days of pregnancy.
- Embryos that show a slow heart rate are considered at risk.
- In later stages of pregnancy, embryonic death is followed by increased echogenicity of embryonic fluids and a disorganization of embryonic structures, which appear as floating debris within the uterine cavity (Figure 26)

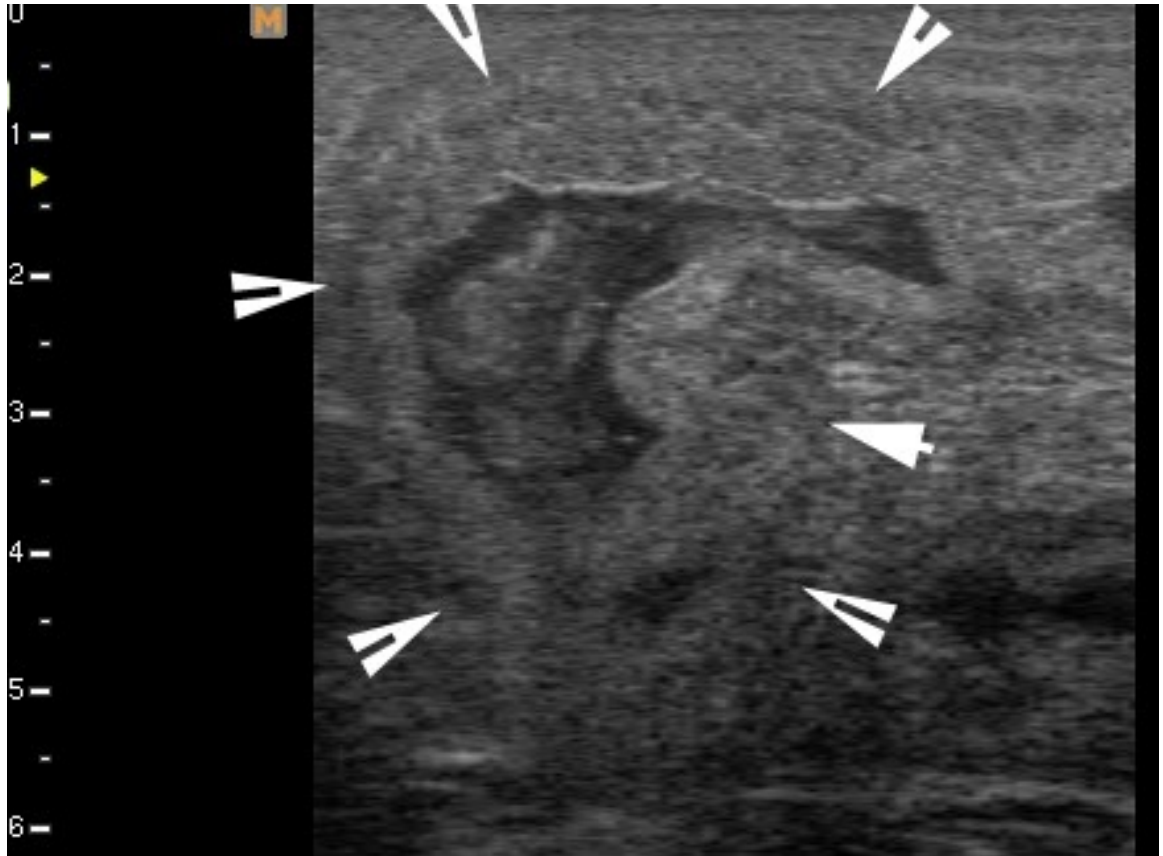


Figure 26 Pregnancy loss at 50 days. Note the floating fetal membranes within the uterus and uterine edema (arrows delineate the uterus)

Fetal mummification and maceration

- Fetal mummification is easily diagnosed by trans-rectal palpation
- On ultrasonography the uterine cavity is devoid of any significant amount of fluid and the fetal mass is identified as an echogenic structure immediately adjacent to the uterine wall.
- The early stage of fetal maceration is detected by the increased echogenicity of the amniotic fluid and loss of fetal form (Figure 27). Hyperechoic echoes from the bony part can be easily differentiated from the soft tissue.

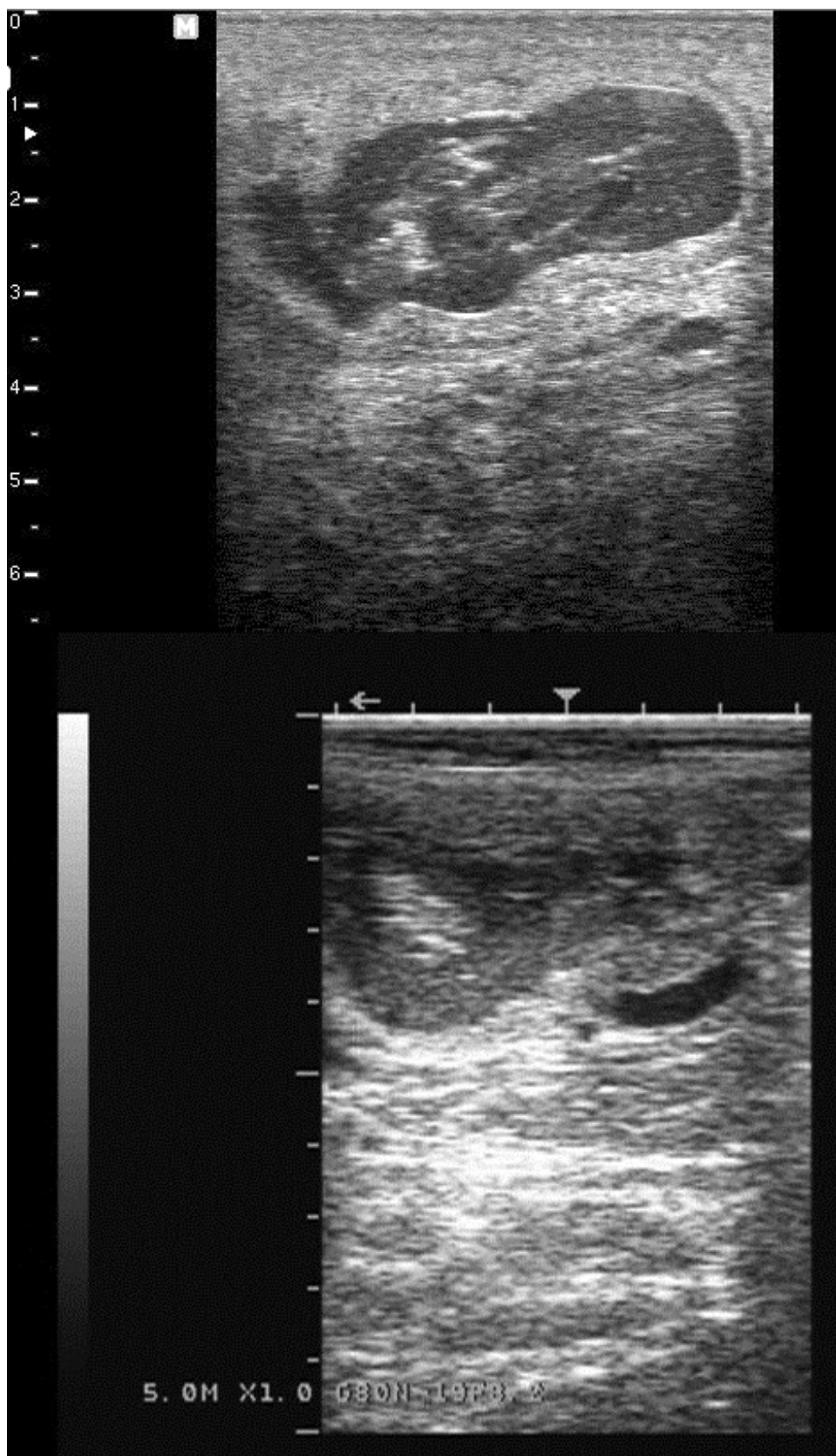


Figure 27 Fetal maceration

Postpartum evaluation of the uterus

- Evaluation of the uterus in the immediate postpartum period may be very difficult without the use of a 3.5 MHz transducer.
- In the early postpartum period the most obvious feature of the uterus is the presence of caruncles.
- The placentomes present a dense periphery and a less echogenic core.
- Hyperechoic lines are generally visualized at the hilus of each caruncle
- The uterine lumen is characterized by the absence of free fluid in the first 48 hours postpartum.
- Presence of lochia within the uterine lumen become more obvious after the 3rd day postpartum and fluid may be present for up to 15 days even in healthy animals.
- Caruncles may remain detectable until day 25 postpartum.
- Uterine health may be monitored by the changes in uterine horn diameter.

Diagnosis of diseases of the reproductive tract in the cow

Abnormalities of the ovaries

Cystic ovarian disease or ovarian cysts

- Cysts are defined as large follicular structures.
- Generally any thin-walled structure that is greater than 25 mm in diameter and persisted for more than 10 days without evidence of cyclicity is considered a cyst.
- Cysts can be either follicular or luteal.
- Cysts are generally round or oval in shape. Multiple cysts can be identified by the presence of a separating membrane.
- Follicular cysts (Figure 28) are large anechoic structures that may reach 5 cm in diameter or more. They have a thin wall.
- Luteal cysts or luteinized cysts present a thicker wall usually 3 to 5 mm in thickness (Figure 29). The wall is of the same density as the corpus luteum. Luteinized cysts may also present a heterogeneous cavity with a network of echoes.
- Efficacy of treatment of follicular cysts with hCG or GnRH can be evaluated by serial ultrasonography to monitor luteinization.
- Not all cysts can be considered pathological particularly in the presence of a corpus luteum of a pregnancy.

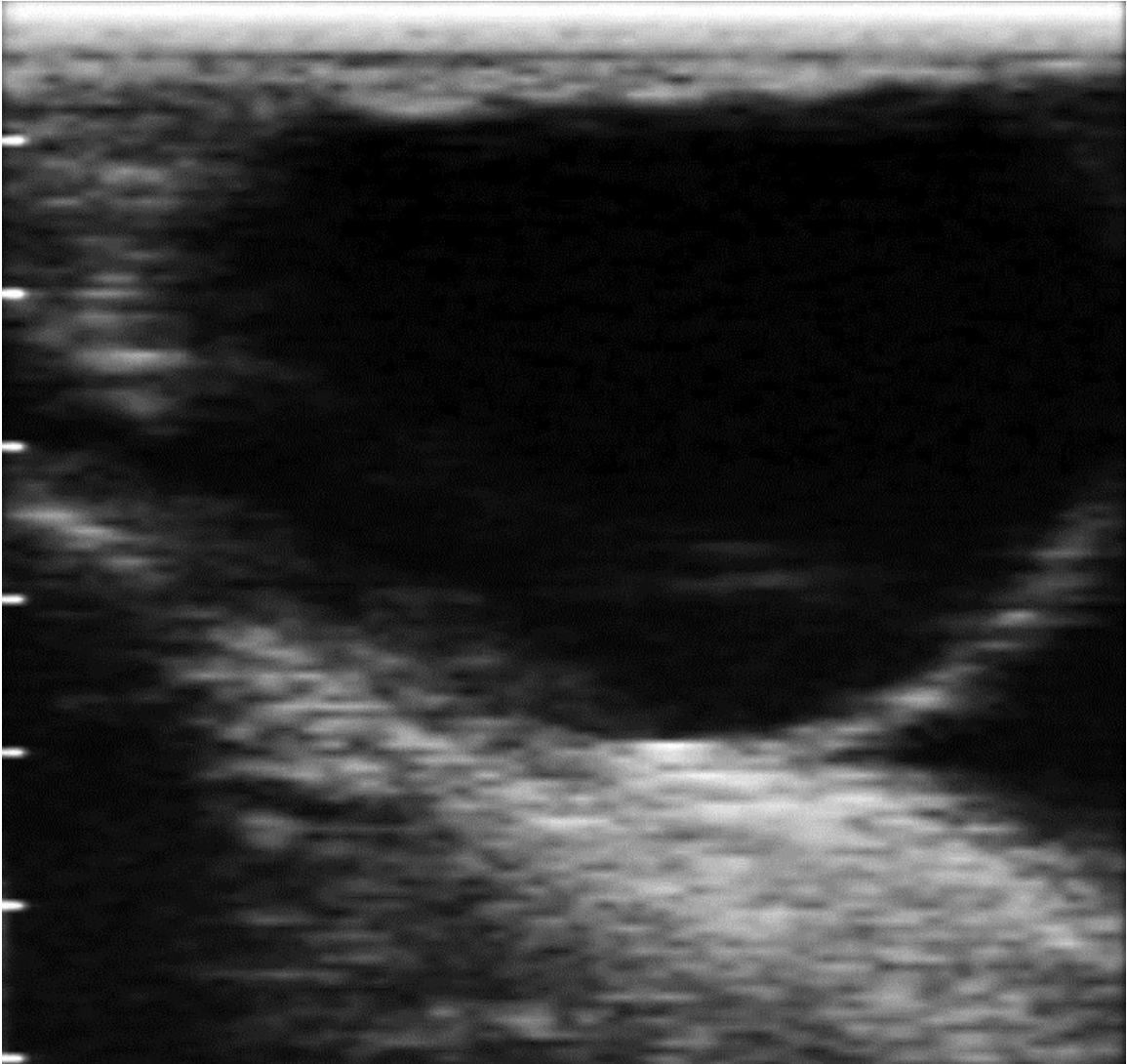


Figure 28 Follicular cyst

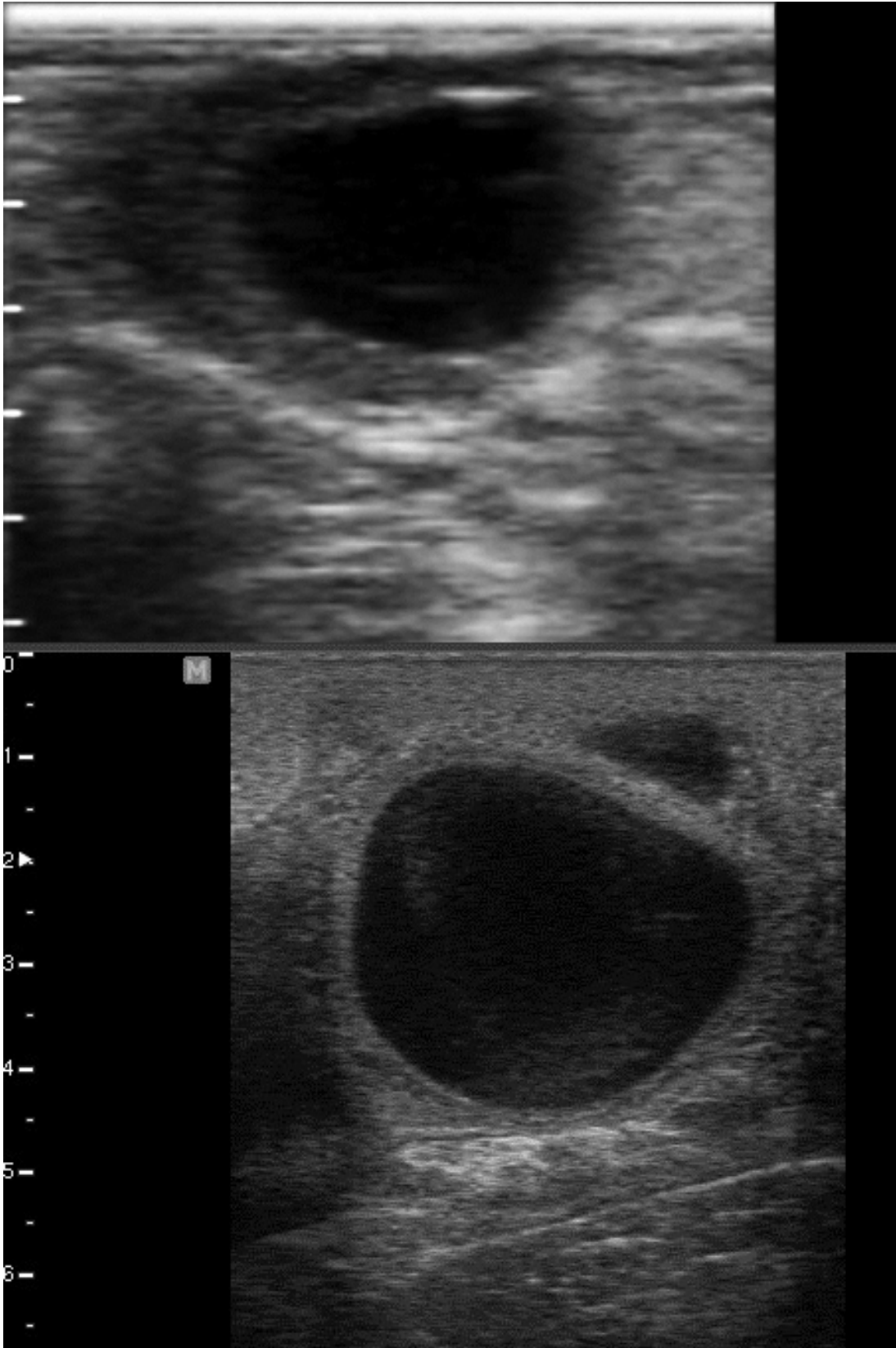


Figure 29 Luteal cysts

Anovulatory follicles

- Anovulatory follicles have been described in cattle as a follicular structure of 20 to 25 mm in diameter, which persist for several days.

Other ovarian abnormalities

- Other ovarian abnormalities that can be detected by ultrasonography include ovarian hematoma, ovarian abscesses and ovarian tumors.
- Ovarian hematoma is recognized by the presence of a characteristic large mass of medium echogenicity, which slowly organizes into a structure resembling the corpus luteum (Figure 30).



Figure 30 Ultrasonogram of an ovarian hematoma measuring 11 cm in diameter

- Ovarian abscesses are large, more echogenic and do not show follicular activity or show some follicular vesicles surrounded by thick echogenic tissue.
- Ovarian tumors may be dense, echogenic masses or may present a heterogeneous cavitory appearance. The most common neoplasma of the ovary in cattle is Granulosa Theca Cell Tumor (GTCT) (Figure 31)

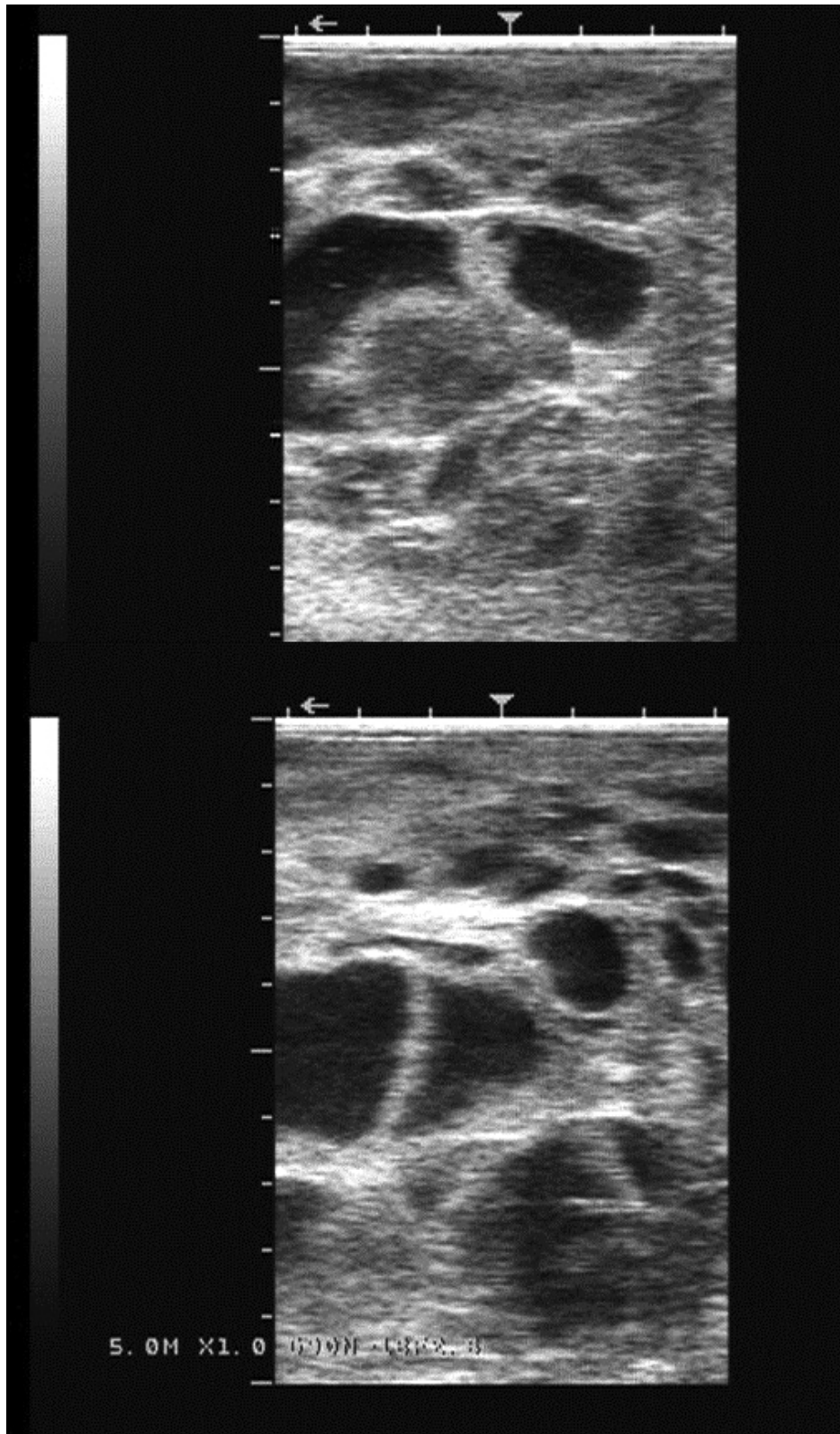


Figure 31 Ultrasonography of a granulosa theca cell tumor in a heifer

Abnormalities of uterine tubes

- The most common problems identified at the level of the uterine tubes are salpingitis, hydrosalpinx and pyosalpinx.
- Fluid accumulation inside the uterine tube makes the organ easily identifiable by ultrasonography.
- Because of the tortuous anatomy of the uterine tube, the ultrasonogram presents multiple compartments (Figures 32, 33, 34).



Figure 32 Ultrasonogram of hydrosalpinx: Note the dilated tortuous fluid-filled uterine tube (oviduct)

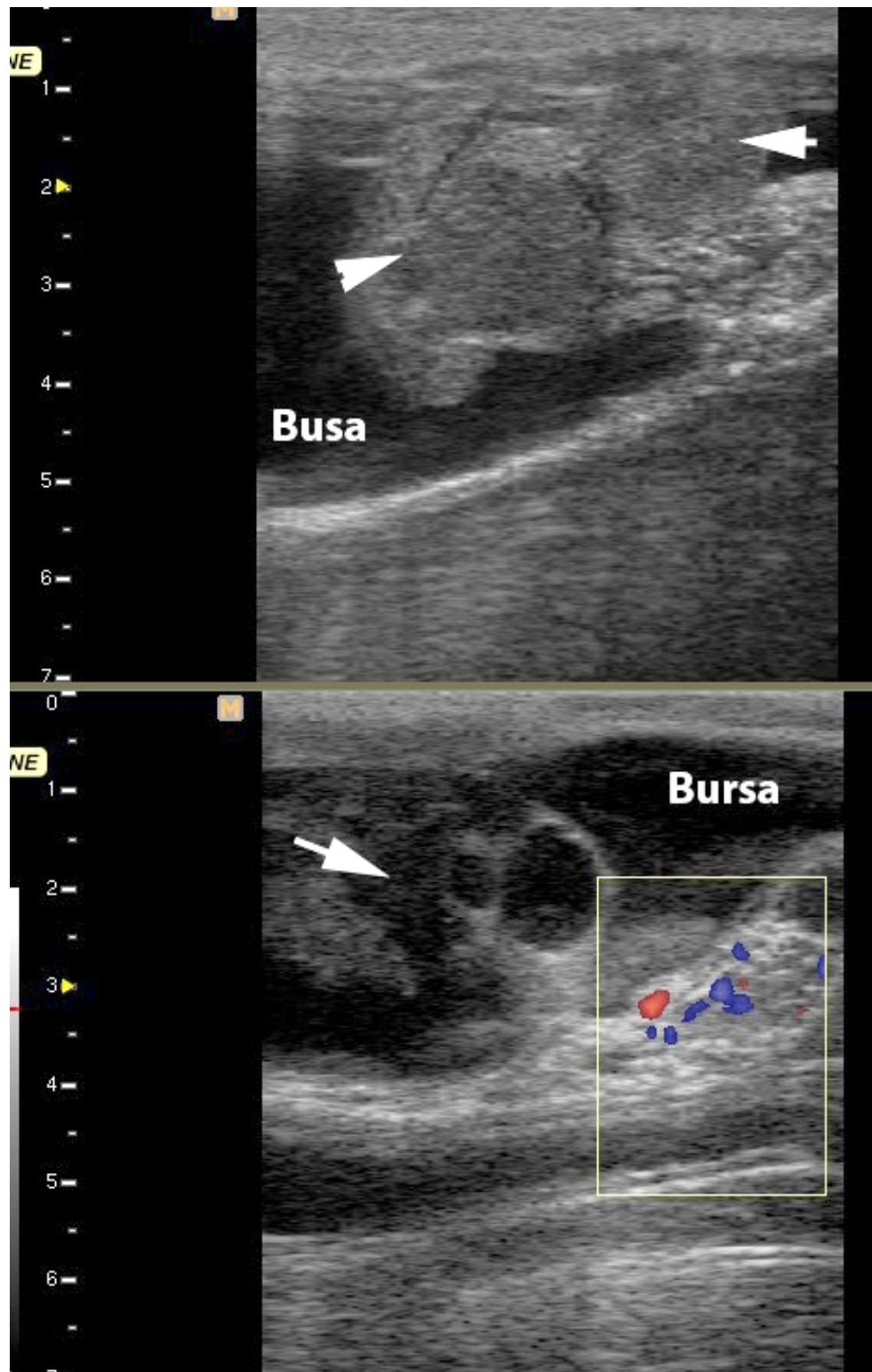


Figure 33 Ultrasonograms of hydrobursitis (accumulation of fluid in the ovarian bursa). Arrows indicate the ovary (note the presence of a corpus luteum on the left and follicular activity on the right). Color Doppler ultrasonography shows dilated utero-ovarian arteries (right).

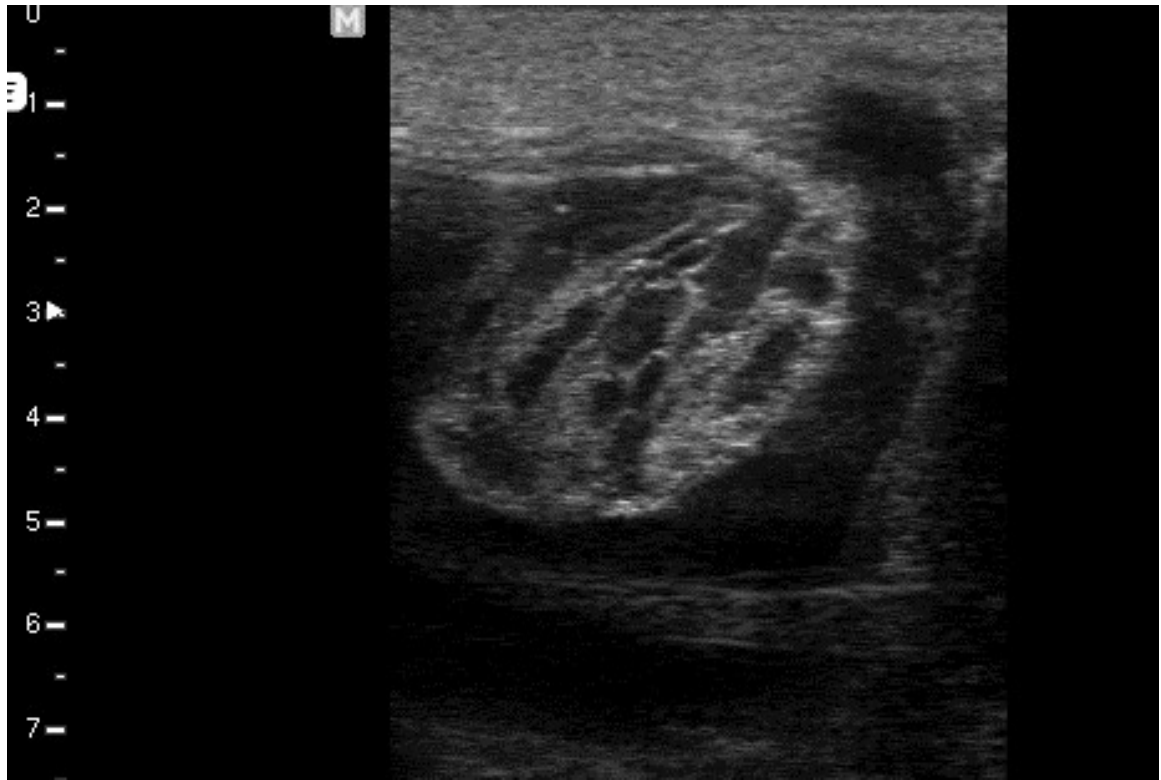


Figure 34 Ultrasonogram of ovario-bursal adhesions

Abnormalities of the cervix and uterus

Endometritis/Metritis

- Intraluminal fluid accumulation in the uterus may be indicative of endometritis
- In the case of chronic endometritis, the amount of fluid may be very little and detected in only one area of the horn.
- Acute or severe endometritis is characterized by the presence of a significant amount of fluid.
- Fluid from an endometritis is not anechoic as in the case of estrous cows and shows some debris giving a general snowy appearance.
- Increase in thickness of the uterine wall and size of blood vessels at the ventral border of the uterus may be seen in some cases of endometritis.
- Intrauterine infusion of iodine results in an increased echogenicity of the uterus, which persists for a long time.

Pyometra

- Pyometra is characterized by the accumulation of thick (echogenic, snowy) fluid.
- The wall of the uterus may be thickened or thin (Figure 35).
- Presence of anechoic fluid (mucometra, hydrometra) may be the result of segmental aplasia of the uterine horn.

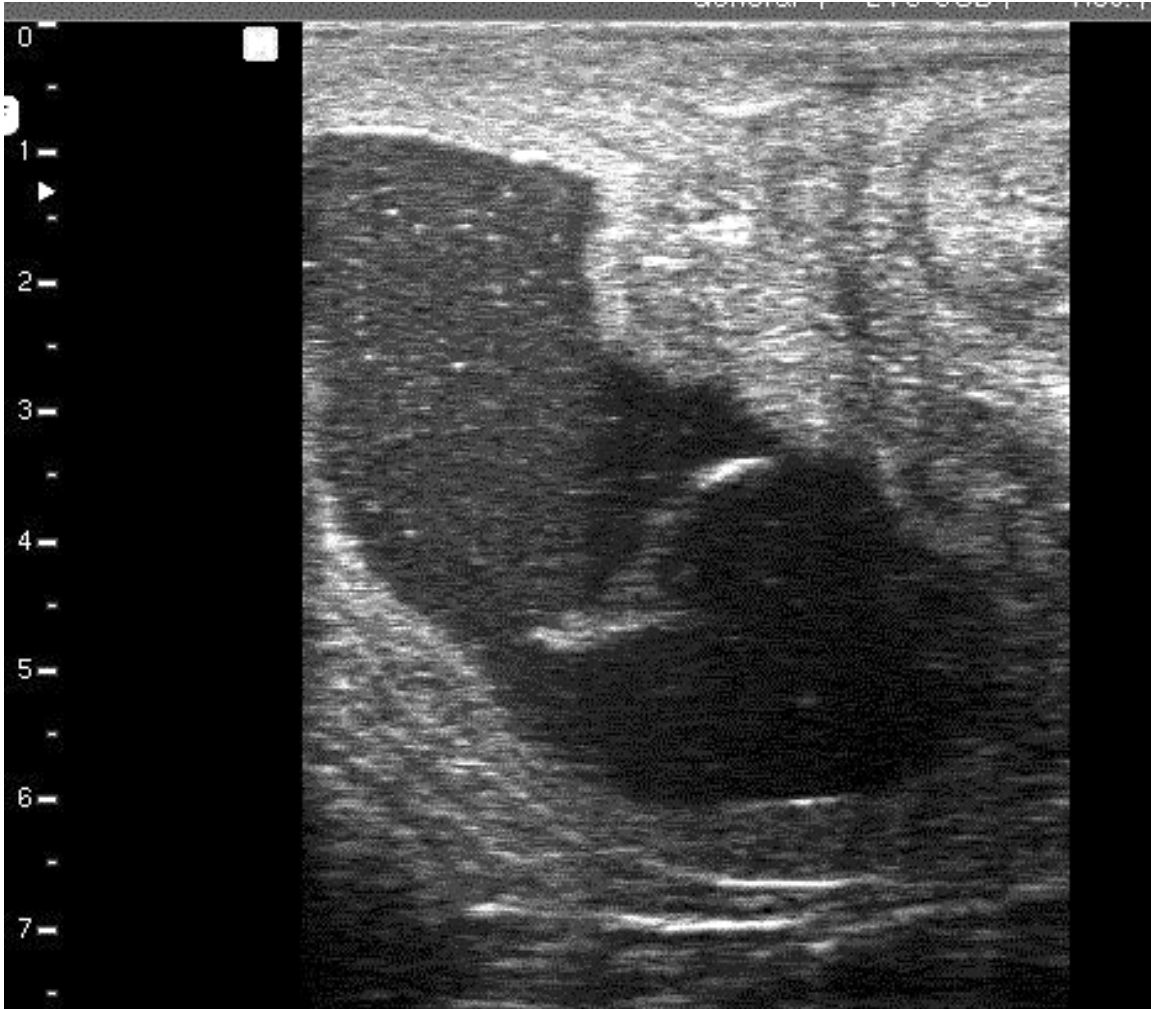


Figure 35 Ultrasonograms of pyometra. Note the echogenicity of the intraluminal fluid (pus)

Adhesions, Abscesses and Tumors

- Uterine abscess or tumors may be visualized at the level of the cervix and uterus.
- Most of these abnormalities present more or less circumscribed areas of increased echogenicity (Figures 36, 37).

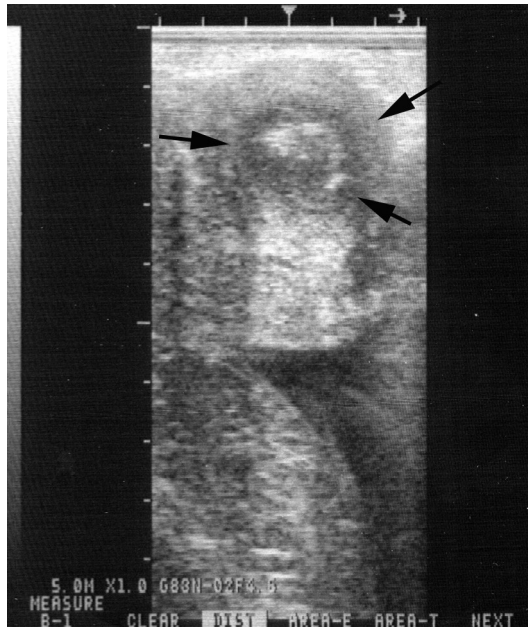


Figure 36 Ultrasonography of a cervical mass later diagnosed as an abscess

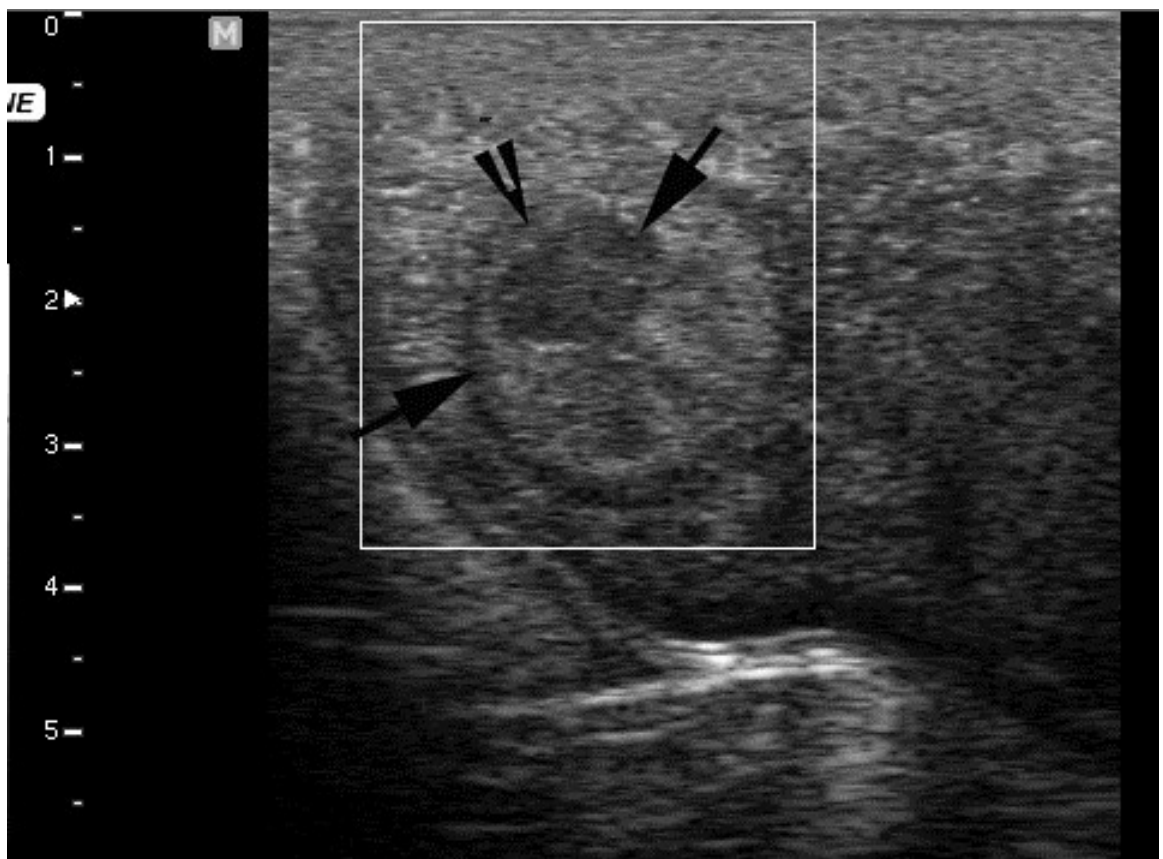


Figure 37 Ultrasonogram of a uterine abscess

Ultrasonographic evaluation of the reproductive tract in the bull

- Routine use of ultrasonography does not add significant information concerning the breeding ability of a bull
- The technique is indicated in valuable bulls with reproductive problems in order to assess testicular parenchyma, scrotal swelling, epididymal morphology and internal sexual organs, particularly seminal vesicles
- Ultrasonography allows visualization of lesions that may not be palpable (testicular cysts, early stages of neoplasm, etc.)

Evaluation of the penis and prepuce

- Ultrasonography of the external genitalia in the bull is indicated for the differentiation of different causes of preputial and penile swelling such as penile hematoma, penile abscesses and urethral rupture.

Evaluation of the scrotum and its contents

- Ultrasonography offers a non-invasive method for the examination of the testis and its surrounding envelopes.
- A 5 MHz transducer is usually appropriate for the examination of the scrotum and its contents in the bull.
- Each testicle should be examined separately by scanning it along its entire surface in a longitudinal (with the transducer placed in a vertical position) and transverse (transducer placed horizontally) manner.
- Spermatic cord
 - The normal spermatic cord presents a tortuous testicular artery surrounded by a network of veins (Pampiniform plexus) (Figure 38). Abnormalities of blood flow may be evident by increased size. The surrounding tunics may also be affected during hernias or hydrocele.

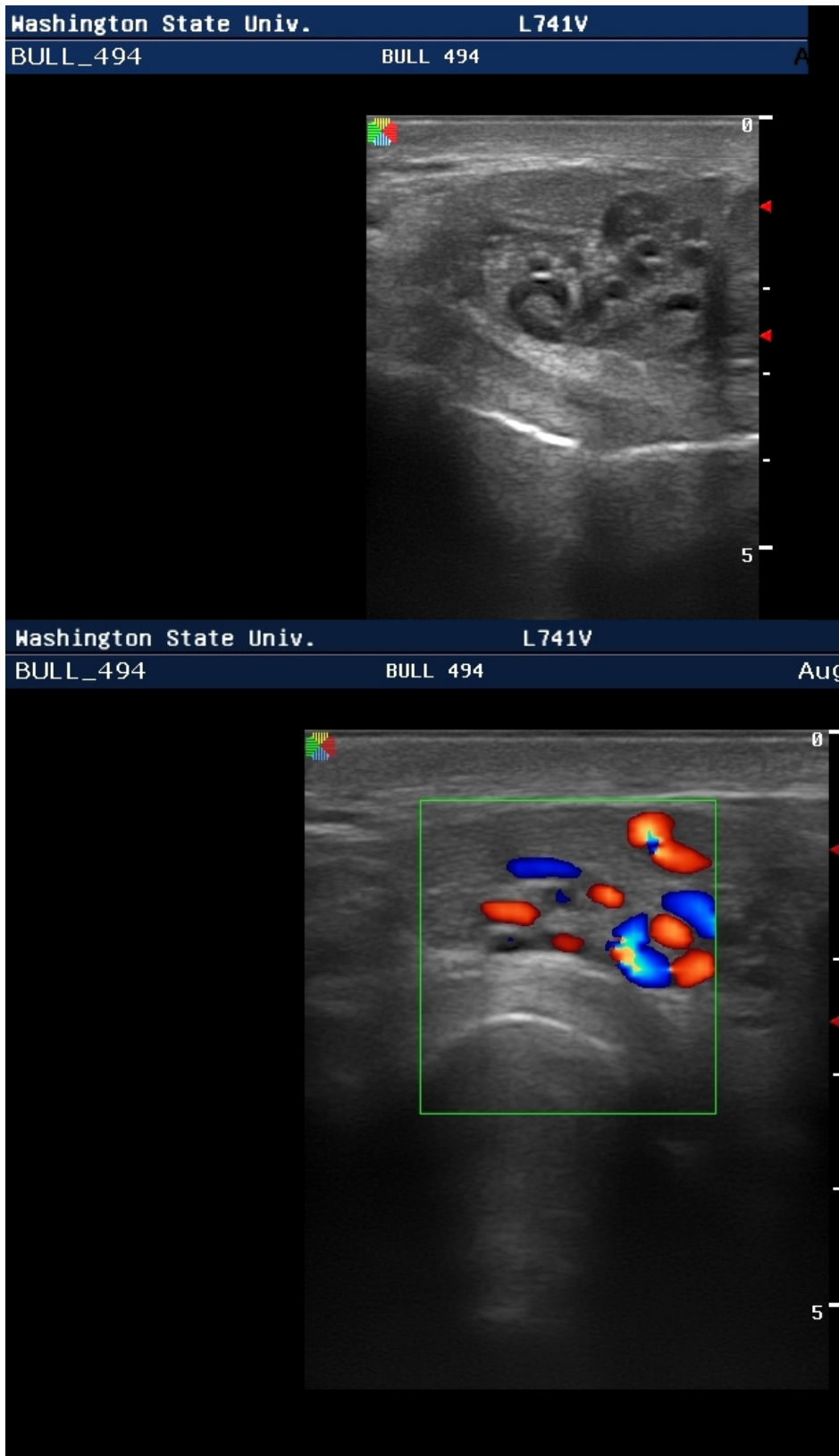


Figure 38 Ultrasonogram of the spermatic cord. Color Doppler (bottom) shows the testicular artery

- Testicular envelopes:
 - The tunics of the testicles are not identifiable as separate structures unless fluid is present in the vaginal cavity (Hydrocele)
 - Enlargement of the vaginal cavity and presence of omentum or intestines is evident in cases of indirect inguinal hernia
 - Increased thickening of the dartos and testicular envelopes and presence of fibrin and echogenic fluids is consistent with peri-orchitis (Figure 39)



Figure 39 Ultrasonogram of the scrotal contents in a case of periorchitis. Arrows indicate disruption of the tunica vaginalis

- Mediastinum testis
 - The mediastinum testis is identified as a hyperechoic longitudinal region (line) in the middle of the testicle (Figure 40).



Figure 40 Ultrasonogram of a normal testis. Arrows indicate the echogenic mediastinum testis

- The thickness of the mediastinum testis varies from 2 mm to 4 mm.
- The mediastinum testis is wider and easier to identify in young animals (< 2 years) than in older bulls (> 4 years)
- No fluid should be present in this region.
- Hypoechoic distension of the rete testis has been associated with oligozoospermia and azoospermia due to blockage of sperm flow or segmental aplasia of the epididymis (Figure 41)



Figure 41 Ultrasonogram showing small fluid dilation of the mediastinum testis

- Testicular parenchyma
 - Testicular parenchyma presents a medium echogenicity and should be homogenous (Figure 40); however, areas of different echogenicity may be seen in testicles from young bulls and the significance of these are not clear
 - Increase echogenicity may be associated with testicular degeneration and fibrosis. In some cases mineralization may be present. (Figure 42)
 - Changes in the echogenicity of testicular parenchyma may signal the presence of neoplasia. (Figure 43)



Figure 42 Ultrasonogram of a testis undergoing degeneration showing several areas of fibrosis (echogenic speckles)

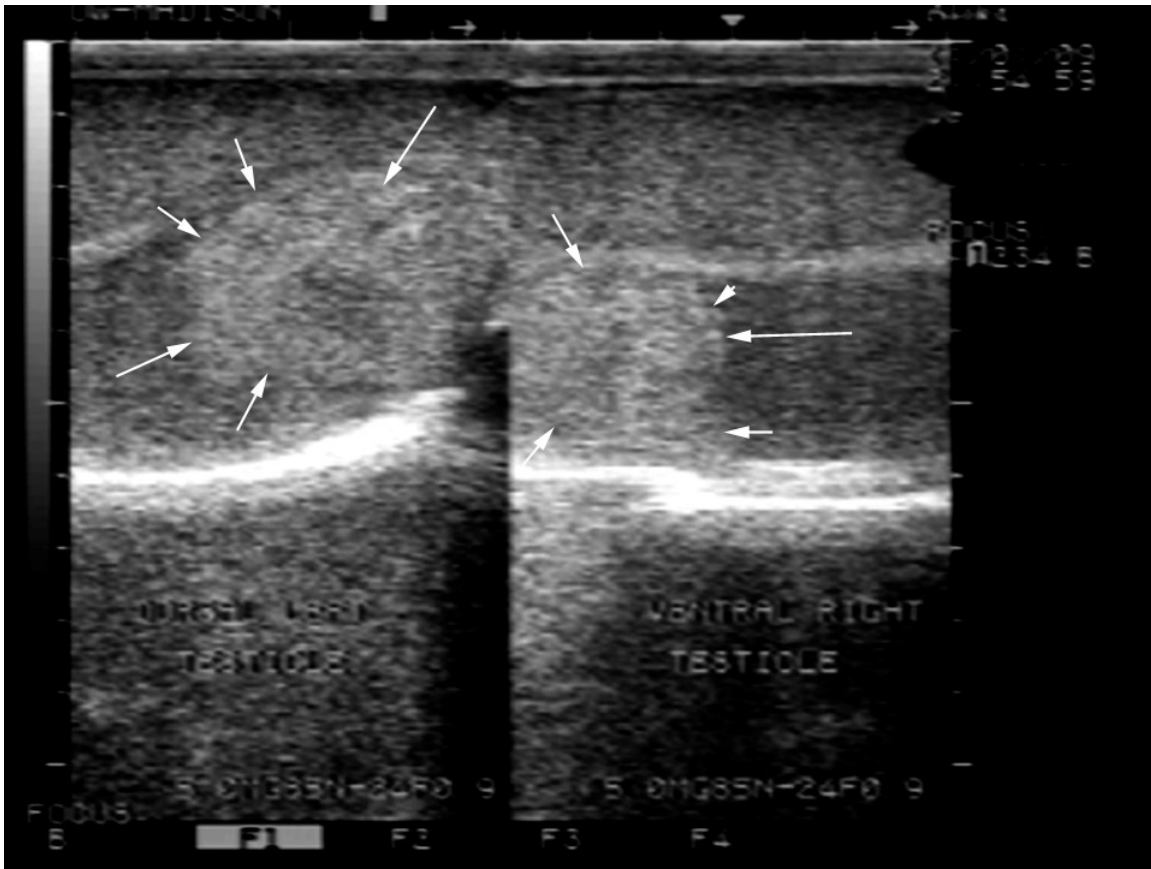


Figure 43 Ultrasonogram of a seminoma (arrows delineate the lesion)

- The epididymis
 - The tail of the epididymis appears as a “peaked cap” upon the testicular parenchyma and presents numerous sonolucent tubular structures.
 - It is well demarcated from testicular tissue.
 - Echogenicity of the tail of the epididymis is lower than that of the testicular parenchyma.
 - The head of the epididymis is seen at the proximal and cranial aspect of the testicle.
 - It is well demarcated from and less echogenic than testicular parenchyma. The body of the epididymis is difficult to identify.
 - The most common abnormalities seen in the epididymis are cystic dilations due to segmental aplasia, blockage or increased echogenicity (fibrotic and inflammatory changes). Cyst of the appendix epididymis (remnant of the proximal mesonephric duct) may be present but do not affect fertility. (Figure 44)



Figure 44 Ultrasonogram of the epididymis: Epididymal cyst

Evaluation of the internal genitalia

- Ultrasonography can be used in bulls to visualize in order (from caudal to cranial): The bulbourethral glands, the pelvic portion of the penis and urethra, the prostate, the seminal vesicles, and ampules of the deferent ducts.
- The bulbo-urethral gland are found just cranial to the anal sphincter they are homogenous. No abnormalities have been described in this region in bulls.
- The pelvic penis/urethra are visualized on midline. The urethral muscle is hypoechoic contrasting with the hyperechoic cavernous tissue surrounding the urethra. (Figure 45)

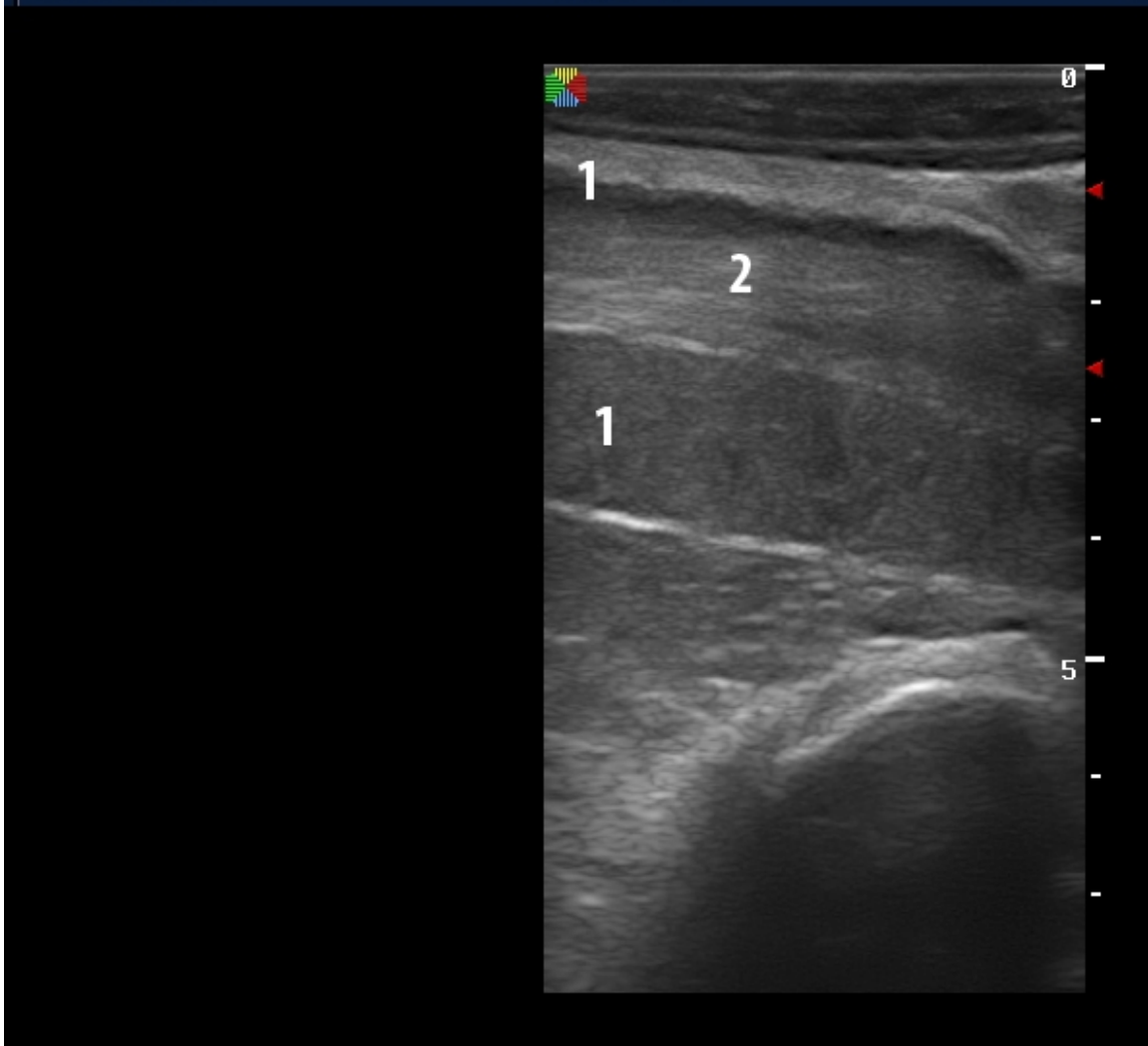


Figure 45 Ultrasonogram of the pelvic penis just caudal to the prostate. 1) urethral muscle, 2 cavernous tissue

- The prostate is visualized at the cranial end of the pelvic urethra. It is moderately echoic and homogenous (Figure 46)

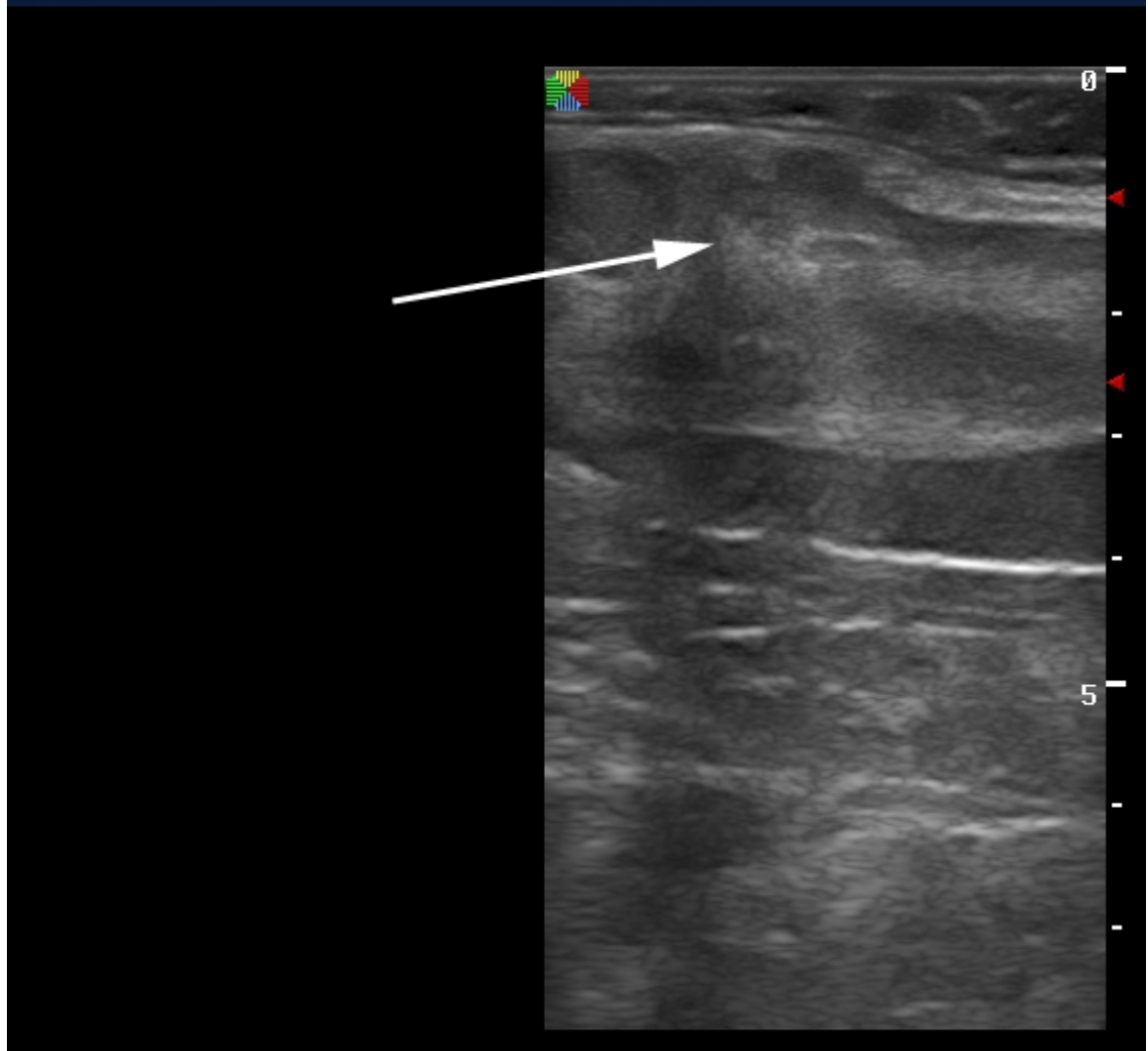


Figure 46 Prostate gland (arrow)

- The seminal vesicles are imaged on each side of the bladder, they appear as lobulated glands of medium echodensity surrounded by hyperechoic tissue. The glands ducts appear as hypoechoic (fluid-filled) areas within the glandular tissue (Figure 47)

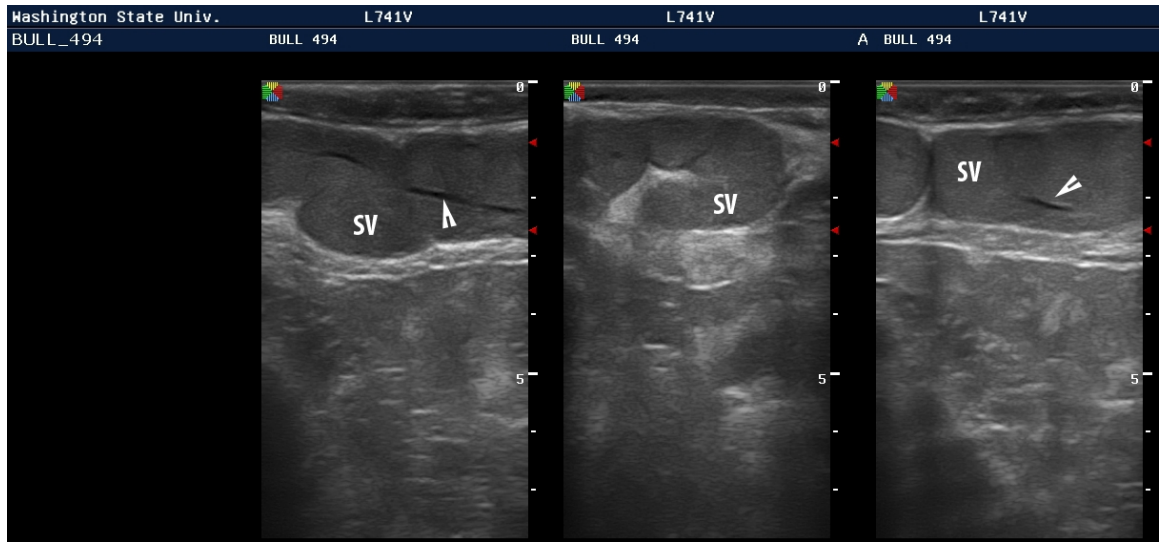


Figure 47 Ultrasonogram of the seminal vesicle (SV). Arrows indicate a glandular duct

- Seminal vesiculitis is the most common accessory sex gland disorder in bulls. It is accompanied by a variety of ultrasonographic changes including increased size, loss of lobulation, presence of fibrosis or a large accumulation of fluid.
- The ampullae of the ductus deferens are indentified medially to the seminal vesicles on the dorsal aspect of the bladder (Figure 48). Dilation due sperm accumulation within the lumen may be due to aplasia.



Figure 48 Ultrasonogram of the ampulla (delineated by arrows), UB=urinary bladder

Other uses of ultrasonography in cattle 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 49)
- Monitoring of the response to synchronization
- Monitoring of artificial insemination technique
- Ultrasound-guides biopsy
- Ultrasound-guided testicular injection
- Ultrasound-guided follicular aspiration

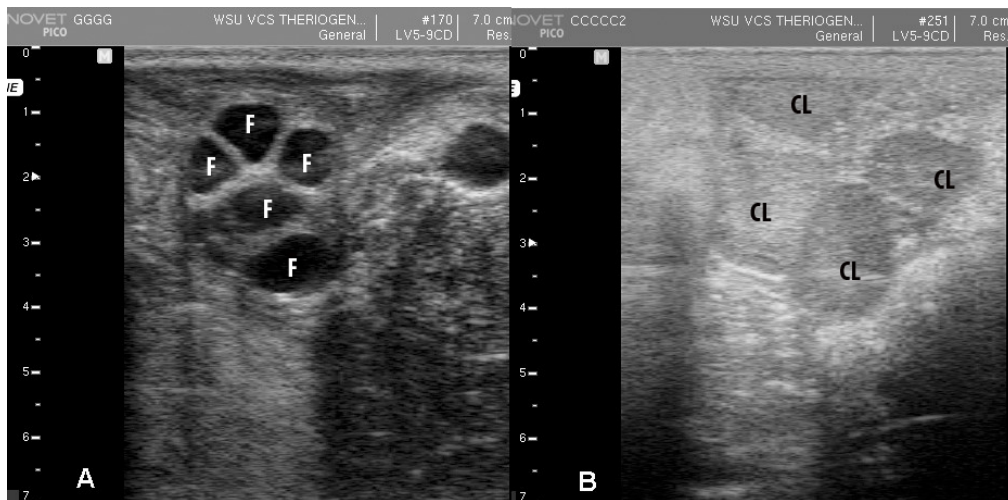


Figure 49 Response to superovulation: A) Ovary following FSH treatment. There are 5 visible follicles. B) Ovary of superstimulated cow 7 days after insemination showing 4 CL

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 tears may occur with aggressive technique particularly for fetal sexing

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

- Intraluminal fluid accumulation in the uterus may be indicative of endometritis

- In the case of chronic endometritis, the amount of fluid may be very little and detected in only one area of the horn.
- Acute or severe endometritis is characterized by the presence of a significant amount of fluid.
- Pyometra is characterized by the accumulation of thick (echogenic, snowy) fluid.
- The wall of the uterus may be thickened or thin.
- Presence of anechoic fluid (mucometra, hydrometra) may be the result of segmental aplasia of the uterine horn.

AGE-RELATED FACTORS

- Fetal sexing is performed between 48 and 119 days but accuracy is best between 60 and 85 days
- Location of the genital tubercle (fetal penis closer to the umbilicus, clitoris closer to the tail)
- Male diagnosis if genital swelling is present (scrotum)
- Female may be diagnosed by the presence of echogenic mammary gland with visible teats

ZOONOTIC POTENTIAL

- Herd experiencing brucellosis, leptospirosis

PREGNANCY

- The anatomical characteristics of the early embryo makes early pregnancy diagnosis very difficult in the bovine

BIOSECURITY

- N/A

PRODUCTION MANAGEMENT

- Incorporation into resynchronization protocols in dairy cattle

SYNONYMS

- N/A

ABBREVIATIONS

- CL= corpus luteum
- GnRH= gonadotropin releasing hormone
- hCG= human chorionic gonadotropin
- MHz = Megahertz
- PGF2 alpha= Prostaglandins F2 alpha

SEE ALSO

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

Suggested Reading

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