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Pregnancy diagnosis and prepartum conditions affecting does
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Abstract
There are different methods utilized to diagnose pregnancy in does. Ultrasonography, hormone/pregnancy specific protein assays and radiography have emerged the most common methods used with a high degree of accuracy. Ballottement or abdominal palpation is performed when the doe is in her last trimester of pregnancy. Other methods described in literature, such as recto-abdominal palpation utilizing a rod (Hulet’s rod), have been used in the 60’s in the U.S., and still being used in other countries. Non-return to estrus 20-22 days after breeding is a good management practice utilized by producers to monitor estrus activity of the does during the breeding season. However, pathologic conditions of the uterus and ovaries, physiologic anestrus late in the breeding season and post-breeding anestrus in does bred out of season may prevent these does from returning to estrus after breeding. Choice of the method utilized in small ruminants depends on the availability of equipment, number of days after breeding, number of animals to examine, desired accuracy, need for quick results, cost to the client and experience of the examiner. A reliable technique for early detection of pregnancy would allow the producer to make decisions regarding early culling or rebreeding of barren does. Pregnancy diagnosis and estimating the length of gestation is very important in the treatment of certain prepartum conditions like pregnancy toxemia, vaginal prolapses and abdominal hernia to induce parturition in does if necessary.

Introduction
Gestation in a does is usually around five months (146-154 days). During the last decade there has been increasing awareness for the need for early pregnancy diagnosis in does. Examination of the goat for pregnancy may be done as a part of a reproductive health program or may simply be requested by the owner who would like to know the pregnancy status of his or her doe. During the last two decades, ultrasonography has been the most common diagnostic approach utilized in goats for early pregnancy diagnosis. Early applications of ultrasonography utilized amplitude or A-mode ultrasound.1 A-mode ultrasound detects fluid filled structures but they are not pregnancy specific. They send sound waves from a hand-held transducer placed externally on the skin of the abdomen and directed toward the uterus. Sound waves are converted to electrical energy in the form of audible or visual signal. They detect fluid-filled organs at the depth of 10 to 20 cm in the abdomen. Some units will emit a light or audible signal when a fluid-filled structure is detected. Units with oscilloscopes will display reflections as peaks or blips on the screen. Accuracy for A-mode is around 80-85% if performed between 60 to 120 days during pregnancy.1,2

Doppler ultrasonography utilizes the principle of detecting movement such as bloodflow and heartbeat. For diagnosing pregnancy in a doe, the Doppler ultrasound detects bloodflow through the middle uterine artery, umbilical arteries, fetal heartbeat and fetal movements.2-6 Hand held Doppler probes emit ultrasound waves. A wave reflected from motionless structures has the same frequency as the transmitted sound whereas sound reflected from a moving organ or blood has a different frequency. Differences in frequency are converted to an audible sound. Audible signals may be distinguished by the observer include the fetal heartbeat, arterial blood flow through the middle uterine artery and umbilical arteries, fetal movement and maternal intestinal movements. The transducer could be applied externally to the skin or intra-rectally using a rectal probe. Accuracy rate is higher when done in the third trimester.2-6

B-mode real-time ultrasonography is an accurate, rapid and simple imaging technique used for detection of pregnancy in goats. Trans-rectal or trans-abdominal ultrasonography applications can be used with nearly 100% accuracy rate.7 Trans-rectal ultrasonography using an adapter with a 7.5 MHz or 5.0 MHz rectal probe can be performed as early as 25 days. It is advisable to perform routine rectal ultrasonography around 35 days after breeding to confirm pregnancy. If done earlier than 35 days, the diagnosis needs to be confirmed at a later date due to the possibility of early embryonic losses. Trans-
abdominal ultrasonography is usually done 40 days after breeding. Real time B-mode produces a two dimensional image on the screen. If the doe is pregnant a moving image of the uterus with fluid, fetus and placentomes may be seen. The fetal heartbeat is detected as early as 25 days trans-rectally and 35 days trans-abdominally. Placentomes are seen as early as day 40 and they appear as echogenic densities in the uterine wall. They are C-shaped by day 45, with the concave surface directed towards the uterine lumen.7-24

Hormones measured to aid in diagnosis of pregnancy are progesterone, estrone sulphate and pregnancy specific proteins.23 Progesterone assays on the blood and milk are usually done 18-22 days after breeding. Progesterone tests more accurately detect non-pregnancy than pregnancy. They are not pregnancy specific; high levels could be seen in conditions such as hydrometra, early embryonic death, pyometra and fetal mummification. Estrone sulphate tests on blood and milk are done > 50 days after breeding. Errors may arise from improper handling of samples, improper timing of collection, unknown breeding dates and other factors. Pregnancy specific protein B (PSPB) and pregnancy associated glycoproteins (PAG) have been identified in various ruminant species including cattle, sheep and goats. Pregnancy associated glycoproteins are released by the trophoblast of the placenta after four weeks of gestation.21 Pregnancy specific protein B and PAG tests are highly specific for pregnancy. Blood levels of these proteins may remain elevated for a short period after embryonic death or fetal death which could explain apparent false positive results. As with all biologic tests, false negative results are possible. Serum is used to detect these proteins and there are two laboratoires offering this test: Bio Tracking and IDEXX laboratories. They are about 95% accurate.

Prepartum conditions or diseases

The most common pregnancy or gestational conditions affecting does are pregnancy toxemia, pseudopregnancy, vaginal prolapse, injury and abortions. Pregnancy diagnosis and estimating the length of gestation is very critical in the treatment of certain prepartum conditions such as pregnancy toxemia, vaginal prolapses and abdominal hernia when deciding to induce parturition as a treatment for these conditions.

Pregnancy toxemia (PT) is a metabolic disease or condition of does that occurs in late pregnancy, and may have significant economic effect. The primary cause of PT is a decline in feed intake during the last four to six weeks of gestation. During this period, fetal growth is very rapid and energy demands are increased; this is particularly true in does carrying multiple fetuses. Since the uterus, fetuses and placenta take up an increasing amount of abdominal space, there is less room for other organs to expand during late term pregnancy. If a doe is overly fat she also has less room to hold feed. Thus feed intake decreases and the doe is forced to break down fat stores for energy. Ketone levels in the urine and blood are elevated. While the body can use small amounts of ketones as an energy source, excessive amounts lead to development and clinical signs of PT.25-29,32

Pregnancy toxemia usually occurs in the last six weeks of pregnancy in goats, with peak incidence during the last two weeks of gestation. Older, especially thin or fat does carrying triplets or quadruplets are especially at risk although females carrying a single fetus or twins may also be affected. Environmental stress, management change, diseases, poor quality or quantity of feed offered can also contribute to the decrease in feed intake and facilitate the development of PT.24,32

Early signs of PT usually exhibited by separation from the rest of the herd, depressed appetite and reluctance to move due to painful swelling of the feet. Within three to four days, the signs progress to severe depression, teeth grinding, muscle tremors and neurologic signs such as head pressing, star-gazing and blindness. Affected animals are down, unable to rise. A “fruity” or “sweet” odor to the breath may be present. Without treatment, there is high mortality in does.25

Treatment of does that are still eating consists of drenching with two ounces of propylene glycol twice a day. Drenching with baking soda solution (15-20 gr in 50 mL water), Drench Mix with Energy Malt (Advanced Agri Solutions, Stevens, PA; 4 oz powder per quart of water), or oral calf electrolyte packets mixed in water may help correct fluid deficit, electrolytes and acid-base balance. High quality feed (alfalfa, concentrates) should be offered in small quantities at frequent intervals during the last month
of gestation. Vitamin B injections and transfaunation (transferring rumen contents from a healthy goat or cow) may also provide rumen microflora and help increase appetite. Does that stop eating or ruminating should be treated with intravenous fluids with dextrose and electrolytes. In PT cases that are not responsive to medical therapy removal of the fetuses should be considered as part of the treatment. Induction of parturition or emergency cesarian section will remove the negative energy drain on the doe caused by fetuses. Kids are more likely to survive if parturition is induced within five days of term (≈145 days of gestation).\(^2\) Stage of gestation in does with unknown breeding dates may be estimated by measuring the bi-parietal and placentome diameter, monitoring fetal heartbeat, mammary secretions, and swelling and relaxation of the perineal area.

If a doe is very large, has a history of multiple births, and has been confirmed to carry multiple fetuses, an increase in energy intake during the last trimester of gestation may prevent negative energy balance. Avoid sudden changes in feed and provide high quality energy-dense rations and free access to mineral mixture. During late gestation does carrying multiple fetuses should be offered 3.5 to 5 pounds of high-quality hay such as alfalfa, and one to two pounds of grain; the latter fed gradually to prevent acidosis or grain overload. Body condition scores (BCS) is helpful to evaluate nutritional status and overall health of the flock. Body condition score recommendations for all production phases are as follows: maintenance 2-2.5/5; breeding 3/5; early gestation 3/5; late gestation 3-3.5/5; lambing/kidding 3.5/5; and weaning 2-2.5/5. Provide room to exercise and treat any diseases that may result in decreased feed intake.\(^2\)

Vaginal prolapse is not very commonly seen in does. It is seen more in pygmy goats than in other breeds.\(^3\) Vaginal prolapses are usually seen in does during the last trimester of gestation, does with body condition scores of >4, does which are in small pens with lack of exercise, and in does exposed to moldy high in estrogenic content. Hereditary aspects with laxity of the pelvic ligaments may also play a role. Treatment is similar to that in other species by reducing the prolapse and placing a retaining suture or device on the perianal area. Treatment by reduction is not very successful because of complications due to reduction which include an increase in incidence of dystocia and stillbirths.\(^3\) Does with unknown breeding dates may be induced to kid after measuring the bi-parietal and placentome diameter, monitoring the fetal heart beat, mammary gland development, mammary secretions, and swelling and relaxation of the perineal area.

Injuries caused by fighting and head butting may cause weakening of the abdominal muscles leading to tears or rupture of the prepubic tendon and hernia of the viscera. The condition is mainly seen in older does which may have had three to four kid crops.\(^3\) Ruptured prepubic tendon is best managed by inducing parturition close to term, followed by performing a cesarian section in 24 hours to save the kids.

Pseudopregnancy or hydrometra is seen in does with a history of being exposed to a buck/artificially inseminated, or in does which have never been exposed to breeding. The incidence is higher in does bred during the non-breeding season and transitional period. Affected does will have elevated progesterone, appear to look pregnant with weight gain and develop a mammary gland with milk. Some will go into labor and expel fluid which is called “cloud burst.” If the condition is diagnosed early and treated these does will conceive subsequently, but the condition can reoccur. Treatment is mainly by regressing the corpus luteum with a luteolytic dose of prostaglandin.\(^3\)

Abortions in does are caused by various factors including infectious, malnourishment, environment, stress, hormones and trauma. Late term abortions are usually due to stress or infectious. It is important to remember that many of the diseases causing abortion in goats are zoonotic and can be transmitted to humans. Gloves, protective clothing and boots should always be worn when collecting samples from the abortion and hands should be cleaned carefully after handling potentially infectious material. Pregnant women or immune compromised people should not assist with kidding or handling of aborted material. Always isolate the doe and dispose of all aborted material (fetus, placenta and fluids) by burning or burying them.

Chlamyphilosis is the most common cause of infectious abortion in goats and the causative agent is *Chlamydophila abortus*.\(^4\) Clinical signs are late term abortions, a high number of stillbirths and weak kids. Naïve yearling does that have been recently introduced into an infected herd are usually the
animals that abort. *Chlamyphila* can also cause conjunctivitis (pink eye), and polyarthritis (arthritis in multiple joints), though the strains of the bacteria causing these diseases differ from those causing abortion. Organisms are usually shed in the feces. Does are exposed from direct contact with the aborted fetuses, placenta, infected vaginal discharge, or ingestion of contaminated feed. Abortions tend to occur in naïve animals. Causative organisms are *Coxiella burnetti*.

Q-fever is a bacterial infection (*Coxiella burnetti*) that causes fetal resorption, stillbirths, and late term abortions (5% to 35%). Abortions tend to occur in naïve animals. Causative organisms are transmitted through the air and inhaled or are consumed via infected aborted material, feces, urine, milk, or grazing contaminated pastures. Tick bites may also be a source of transmission. *Coxiella burnetti* remains viable in the phagosomes of free living amoebae. The ability of this organism to survive in protozoa, along with the organism’s resistance to dessication may play a role in maintaining the organism in the environment. Q-fever’s primary significance is its zoonotic potential. Q-fever infects a wide range of hosts including cattle, goats, sheep, pig, cats, dogs, and wildlife. Some does will be carriers of the disease without showing any signs. Carrier animals shed the organism in milk, feces and uterine fluid at the time of parturition. Intense agriculture practices that place large numbers of naïve animals in small intensities may further increase the risk of transmission.

Isolate aborting does from the herd for at least three weeks. Placentas and fetuses should be removed and burned or buried. To minimize exposure, ensure that all feed and water sources are protected from contamination. Treating all does in an abortion outbreak with tetracycline may reduce additional abortions by up to 50%. There is a vaccine approved for use in sheep in the US. The vaccine should be administered four weeks before breeding.

*Toxoplasma gondii* is a protozoan parasite that can infect goats and is second in importance only to *Chlamydia* as a major cause of infectious abortion in the mid-west. Cats are the primary or definitive host for toxoplasmosis, becoming infected by eating infected rats or mice. Most warm blooded animals (birds and mammals) are intermediate hosts. The parasite matures in the intestine of the cat and infective eggs or oocytes are passed in the feces which can infect goats and other animals if consumed. Other than cat feces, the only source of infection for does is by consuming the infected placenta or birth fluids from aborting does. Younger cats are more of a threat to spread the disease than are older cats. Less than 4% of persistently infected animals will transmit the parasite vertically through transplacental transmission. Cats develop immunity as they get older thus neutered adult males and adult females are less likely to be a source of infection.

If does are infected early in gestation fetal death and resorption usually occur. Infection late in gestation results in mummification, stillbirths, and birth of weak neonates. Not all fetuses from the infected dam may demonstrate the organism. Aborted fetuses do not have significant lesions. Twin and triplet abortions often reveal fetuses in variable postmortem conditions – mummified to fresh. Diagnosis maybe based on the appearance of the placenta, small greyish white foci of necrosis, “rice gain” lesions typically found on the cotyledons. Another common finding is focal necrosis in the cerebral white matter in the brain of stillborn and weak kids.

During gestation, all cats should be kept away from pregnant does. Remove all feed which may have been contaminated with cat feces and prevent cats from defecating in feeders, on hay bales, water troughs and bedding. There are no vaccines available in the U.S. for toxoplasmosis. Feeding decoquinate or monensin throughout pregnancy has been shown to have some protective effect and may reduce the incidence of abortion.

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areas can result in exposure and reinfection of pregnant animals. Signs include stillbirths and late term abortion. Aborted fetuses are often fresh with little evidence of autolysis. The placenta is often the only tissue affected and is extremely useful in confirming a diagnosis. Cotyledons are often diffusely thickened and multiple areas thickened, leathery, covered with greyish/white to brownish/red exudate. Some aborted goats will have a retained placenta.34 There has been conflicting information on whether treatment of pregnant does during a Q fever abortion storm has an effect on the course of the disease. Manure should be composted for at least five months and spread only on still days. The organism is resistant to drying which means it aerosolizes and can be inhaled. This is a zoonotic disease meaning it can be contracted by humans so a mask should be worn when scraping manure or sweeping the area. Colostrum and milk have high levels or organisms so all milk should be pasteurized before drinking. There is currently no effective vaccine available.

Brucellosis can cause abortions in does and orchitis in bucks. While brucellosis in goats is usually caused by *Brucella melitensis*, they can also become infected with *Brucella abortus*. Historically, the number of *Brucella melitensis* abortions has been extremely low in North America, but more recently, sporadic outbreaks have been reported in goats in Texas and Colorado. *Brucella abortus* is rare in the United States, but can cause late term abortions, stillbirths and weak kids. Does may develop systemic illness and show fever, depression, diarrhea, lameness, mastitis, and weight loss.34 There is no effective treatment and infected animals should be slaughtered. Wear protective gloves, clothing, and boots when assisting with birthing problems or abortions. Any brucellosis cases must be reported to state veterinarians. The disease is spread to humans by direct contact or by drinking unpasteurized milk or consuming products made from infected milk.

*Campylobacter fetus* subsp. *fetus*, *Campylobacter jejuni* subsp. *jejuni*, and *Campylobacter lari* can infect goats. *Campylobacter* (vibriosis) can cause late-term abortions; however they are rare in goats. The organism colonizes the intestinal tract of the adult animal usually without showing any signs of diarrhea. A bacteremia may occur in susceptible pregnant animals leading to infection of the uterus, fetal septicemia prior to abortions. *Campylobacter* is transmitted via ingestion of feces, vaginal discharge, aborted fetus and placenta of infected does. A common sign is a bloody, pus-like vaginal discharge before or after abortion. Cotyledons are enlarged, yellowish, and covered with a brownish/red suppurrative exudate. Intercotyledonary areas are often edematous and hyperemic and usually lack any exudate. Variable amounts of serosanguinous fluid with fibrin are present in both the thoracic and peritoneal cavities. The liver may show multiple multifocal areas of necrosis. Diagnosis is by culture of the internal organs. There is a vaccine available labeled for sheep.34

Other bacteria such as *Leptospira*, *Listeria*, and *Salmonella* can cause abortions. *Leptospira hardjo*, *Leptospira pomona*, *Leptospira castellonis* and *Leptospira icterohaemorhagiae* have caused abortions in goats. Leptospira is usually a subclinical infection in goats but during the bacteremic phase they may show fever and develop renal disease. Leptospira are usually transmitted by the urine of infected does. Producers should ensure that feed and water sources are not contaminated with feces or urine and control rodents and other animals that may be a source for these diseases.

Listeriosis caused by *Listeria monocytogenes* can cause mid-to late-term abortions. The organisms are mainly spread by ingestion and inhalation. Metritis and septicemia are seen does after abortions. Salmonellosis can cause mid to late term abortions. The disease can cause systemic signs and uterine infection after abortions. Does become infected following ingestion of the bacteria which are shed in the feces of various animals including cattle, birds, dogs, cats, rodents, and some wildlife.

Viruses can also cause abortions in goats. Viruses causing abortions in does are BVD, caprine herpes, bluetongue and Cache Valley virus. See the table for the clinical signs, diagnosis, prevention and control.34

**Summary**

Pregnancy diagnosis and estimating the length of gestation is very critical in the treatment of certain prepartum conditions including pregnancy toxemia, vaginal prolapse and abdominal hernia when considering induction of parturition as treatment for these conditions. Measuring the diameter of the
placentome and biparietal diameter, with other signs such as mammary development, mammary secretions and fetal heartbeat could be used to make a decision to either perform cesarian section or induce parturition in the does with pregnancy toxemia. Late term abortions are usually due to stress or are infectious in nature. It is important to remember that many of the diseases causing abortion in goats are zoonotic and can be transmitted to humans. Good management of pregnant does with adequate housing, good nutrition, strict biosecurity, vaccination and prevention of undue stress could prevent late term abortions in does.
## Table. Summary of infectious abortions in goats

<table>
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<tr>
<th>Disease</th>
<th>Transmission</th>
<th>Clinical Features</th>
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<th>Diagnostic Aids</th>
<th>Control</th>
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<tbody>
<tr>
<td>1. <strong>Enzootic Abortion</strong> (EAE, Chlamydial or Chlamydophila abortion): Caused by <em>Chlamydophila abortus</em> that affects sheep, goats, occasionally cattle and humans. They cause late term abortions. Abortion strains differ antigenically from strains producing polyarthritis (sheep and cattle) and conjunctivitis in sheep and goats (pinkeye).</td>
<td>Transmission is mainly by ingesting contaminated feed, water and the environment with vaginal secretions, placenta and aborted fetuses. Spread is more rapid when does are confined. Many carriers are seen in endemic herds. Infection at birth in kids kept as replacement does may be carriers through to their first pregnancy.</td>
<td>Late term abortions, stillbirths and birth of weak infected progeny are the most common clinical signs seen. Fetal mummification is occasionally seen. Female fetuses exposed in utero may abort during their first pregnancy; does infected in the last month of pregnancy may not abort until the next gestation period. Does seldom abort more than once.</td>
<td>A chorionitis with chorionic epithelial cells packed with elementary bodies appears to be the essential lesion. Cotyledons are pale, greyish white and are necrotic with a dark brown exudate. Intercotyledonary areas are necrotic, thickened, opaque and leathery.</td>
<td>Impression smears of the cotyledon, placenta and vaginal discharge (but not fetal stomach) stained by the modified Ziehl-Nielsen or Gimenez stain. Organisms can be cultured in yolk sac of embryonating chicken eggs. PCR techniques on placental trophoblasts, spleen and liver are useful. Serology on the dam is unrewarding. But detecting antibodies in the fetal fluids is also useful.</td>
<td>Vaccine available; must be given to males and females 4-6 weeks prior to breeding, or use 150 mg of tetracyclines per head per day in the feed for 2-3 weeks prior to breeding: may continue this in their feed through the first half of gestation. Controlling abortion outbreak with tetracyclines (limited success): (1) 400 mg/head/day in feed or water for the last 60 days of gestation. (2) Use slow-release tetracycline (LA 200) 20 mg/kg injectable to start during the last 60 days of gestation. Owing to their long incubation period, once-a-week protocol may be adequate to decrease losses and is much less expensive. (3) Treat weak newborns with tetracycline. (4) Isolate aborting females and also those with weak born kids. Prevention: 1) LA oxytetracycline, 90 days and 120 days of gestation is very effective in preventing abortions. Onset of therapy after the start of abortions will only reduce abortion rate. 2) OTC or Aureomycin 4 gm Crumbles at the rate of 1 lb/8 ewes (500 mg/hd/day).</td>
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2. **Toxoplasmosis:**

*Toxoplasma gondii* affects a wide range of animals as well as man. It is widespread and has been reported in Australia, New Zealand, Britain, Turkey, USSR, and North America. Cats and other Felidae are considered the primary host and excrete oocysts; species such as goats and man are regarded as secondary hosts. In these species, the organism is found in two forms: tachyzoites, which are actively multiplying and invasive, and found in the acute state of the disease, and cysts containing bradyzoites found in the chronic phase of the disease.

| Oocysts excreted in cat feces are thought to provide the major source of infection. Congenital transmission from does to kids is also established. Further epidemiologic knowledge is required to establish how the disease spreads during an epidemic. | Does infected in the earlier stages of pregnancy either resorb the embryo, or fetal death and undergo mummification (often only one of a twin pair) may occur. Twin or triplet abortions, have variation in fetal ages — mummification to fresh fetus. Infection in late pregnancy leads to abortion and perinatal losses of kids. Many congenitally affected kids survive. Disease in the adult is generally asymptomatic, occasionally CNS signs develop. In endemic areas only younger does usually are affected, and may show the above clinical signs. | Placental changes may be the only gross lesions observed. Gross lesions of the cotyledons (numerous grey-white foci 1 to 3 mm in diameter) are indicative of the disease. Not all cotyledons are equally affected, and such lesions should be differentiated from nonspecific calcification. Focal leukoencephalomalacia in the CNS of stillborn kids, or kids dying shortly after birth is a common finding. | Histology of the cotyledon to demonstrate local areas of necrosis, mineralization and the organisms. Histology of fetal brain to demonstrate foci of glial cells and leukoencephalomalacia. Microscopy of the brain and cotyledonary villi sections to see tachyzoites and immuno histochemistry for antibodies is necessary to confirm your diagnosis. Precolostral serology of the kids is useful, but maternal serology is unrewarding. | Prevent exposure to barn cats. Don’t allow cats to consume aborted fetuses in a toxoplasma abortion. Treatment: Decoquinate 2 mg/kg/day Or Monensin 15-30 mg/kg/head/day throughout gestation |
### 3. Salmonellosis

*Paratyphoid abortion:*

*Salmonella abortus ovis*, *S. typhimurium* and *S. dublin* have been associated with abortion in does.

- **Ingestion of** contaminated food and water; usually shed from carrier animals.
- **Does in later** pregnancy appear more susceptible?
- **Overcrowding and** other forms of stress favor an outbreak.
- Unless the infecting dose is large or the strain exceptionally virulent, infection seldom causes clinical disease in the absence of some other predisposing factors resulting in stress.

- **Abortions, stillbirths,** births of weak infected progeny that usually die within 7 days of birth.
- **Does may show** high fever before aborting; most recover, but some die from metritis and/or septicemia. Some does and newborn kids show diarrhea; in the kids this is usually fatal. Kids up to two weeks of age may show bronchopneumonia.
- **When infection is** endemic, abortions tend to be confined to the younger does.

- **No specific placental** lesions seen. Swollen, pale hemorrhagic cotyledons with necrosis. Aborted fetuses show usual signs of intrauterine death. Septicemia lesions may be seen in those kids dying during or shortly after birth.

- **Culture of organisms** from fetus, placenta and uterine discharge.

- **Antibiotic treatment on flock basis** is not effective and is very expensive. Avoid overcrowding or stressing of does. Do not feed on the ground unless a new area can be used each day. For valuable individuals, supportive therapy (fluids) and antibiotics are recommended.

### 4. Brucellosis

*Brucella melitensis* affects goats and sheep and other species including man. It is seen in Europe, Mediterranean countries, Africa, Central America and rarely in the United States. *B. abortus* occasionally affects does. *B. ovis* affects rams – epididymitis, can cause infertility, early and late term abortions, still births and weak kids.

- **Ingestion is the main** method of transmission, especially during the kidding period. Droplet inhalation and entry both through the conjunctival membrane and broken skin occasionally occurs. Venereal transmission following natural mating is rare.

- **Abortions in late** pregnancy, stillbirths and birth of weak infected kids may occur. Congenital infections may persist throughout life (especially *B. melitensis*). Systemic effects may be seen in the dam with fever, lameness (associated with joint swellings), sometimes central nervous system (CNS) signs.

- **The essential lesion** is placentitis, with edema and necrosis of cotyledons. The intercotyledons membrane may be thickened, yellow-brown necrotic areas, often with adjacent hemorrhage. Mucopurulent material may be adherent to the allantochorion. Fetus shows usual signs of intrauterine death.

- **Culture and direct** microscopy are used to identify organisms that are plentiful in the placenta, fetal stomach and vaginal discharge of the doe. Modified Zielh-Nielsen technique is satisfactory for staining for direct microscopy. Complement fixation ELISA, CF and PCR are available on sera of aborting does.

- **Test and slaughter policy** can be used when the disease is prevalent. Testing of replacement animals. General hygiene at kidding.
### 5. Listeriosis (L. monocytogenes or L. ivanovii)

- **Mainly ingestion.**
  - Abortion, stillbirths and weak kids. Autolysed fetuses seen. Abortion occurs from day >50 of gestation. Some born alive but die. Metritis and septicemia common in females. Placentitis, around the cotyledon and intercotyledon areas. Kids grafted to the aborting females can contract listeriosis through the milk, develop septicemia and die.
- **Necrotic, greyish white foci (1 or 2 mm diameter) is seen in the liver, spleen, kidneys, lungs, heart and adrenals; leathery placenta.**
- **Culture from fetal stomach, liver and placenta.**
- **Fluorescent antibody test on the placenta.**
- **Isolation of aborting females.**
- **Do not feed spoiled silage or poorly fermented silage.**
- **During outbreak administration of long acting tetracycline at 20 mg/kg every 72 hours. Chlortetracycline in the feed 300 mg/head/day.**

### 6. Leptospirosis (L. icterohaemorrhagiae, L. grippotyphosa, L. pomona, L. hardjo, L. canicola, L. castellonis and L. bratislava have been reported as primary causes of abortions in goats)

- **Secreted in the urine. Transmission is through skin or mucousal abrasions.**
  - Fetal organs will be hemosiderin stained due to autolysis. Some edema of the intercotyledonary regions.
  - Dark field microscopy, Immunofluorescence testing and silver stains on placenta, fetal tissue and fluids. FA on the kidney. PCR on the urine. Paired serum samples from aborting does.
  - **Vaccine Rodent control clean water supply Isolation of aborting females.**
  - **During outbreak administration of long acting tetracycline at 20 mg/kg every 72 hours. Chlortetracycline in the feed 300 to500 mg/herd/day during the outbreak.**

### 7. Q-Fever (Coxiella burnetii)

- **Inhaling dust, grazing contaminated pastures and tick bites. Infected does can shed in the feces after parturition.**
  - Abortion primarily in the naïve animals. Late term abortions. Fresh fetuses. Some kids born alive. Aborting does usually retain their placenta.
  - Late term abortion and stillbirth. Placentitis with intercotyledonal areas thickened and leathery. Cotyledons are diffusely thickened with multiple areas of necrosis, covered with grayish/white to brownish/red exudate.
  - Serological testing is of little use. Paired serum samples may give a retrospective study of the flock. IFA is commonly used. ELISA along with IFA would strongly suggest coxiella infection.
  - **Producers should burn or bury the placenta. Oral chlortetracycline 200 mg/head/day for 3 weeks. Long acting tetracycline 20 mg/kg given s/c or i/m every 3 days for 5 treatments.**

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8. **Caprine herpesvirus**  
Direct – nasal and genital routes. Latent infection in adults and spread during stress.  
Kids – viremia and enteritis. Ulcerative and necrotic lesions the entire GI tract. Adults – Vulvovaginitis, balanoposthitis, respiratory disease and abortions.  
Clinical signs: Multifocal white necrosis in liver, spleen, kidney and lungs, mesenteric lymph nodes, thymus and liver.  
BoHV-1 positive virus isolation on nasal and vaginal swab. PCR – blood and swabs. Intranuclear inclusion bodies in the placenta and internal organs of the aborted fetus.  
Avoid stress. Buy animals from a clean herd. Avoid commingling with calves and sheep. BoHV-1 Infect sheep and goats but they are subclinical. CpHv-1 can infect sheep and calves and become latent. Reactivation has not been successful in sheep and calves.

9. **Border Disease**  
(hairy shaker disease). The cause is infection of the pregnant ewe and doe with a pestivirus closely related to, if not identical with bovine viral diarrhea (BVD) virus. The disease has been described in Britain, North America, New Zealand, Australia, Greece and Ireland. Several strains appear to be involved.  
Vertical transmission from ewe to lamb during gestation is well established, and venereal spread of the disease seems likely. Surviving lambs can transmit the virus both vertically and laterally for years. Most of the more obvious clinical signs result from infection of pregnant ewes in the first half of gestation. Severe loss is likely if susceptible pregnant ewes are introduced to infected flocks or if infected ewes are mixed with resident ewes having no immunity to the disease.  
A loss of potential progeny at any stage during pregnancy and in the postnatal period occurs. Infertility with a marked increase in barren ewes, fetal mummification and/or maceration, abortions, stillbirths and losses of lambs born alive are all features of the disease. When the fleece has developed, it tends to be hairy and may be pigmented. If born alive, lambs may show muscular tremors causing incoordination and difficulty in nursing.  
Colyledons tend to be small for fetal age; they occasionally show areas of focal necrosis (1 to 3 mm). Fetal mummification; hairy pigmented coats if the wool has developed; fetus small for gestational age; muscular tremors and incoordination if lambs are born alive. When late gestation fetuses or young lambs encounter the disease, nodular periarteritis, which is slow to resolve, may occur.  
CNS shows hypomyelinogenesis and the skin shows characteristic lesions on histologic studies. BVD-neutralizing antibodies in the serum of dam or lamb to virus isolation PCR.  
Prevent commingling of pregnant does and ewes with cattle.

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<th>10. <strong>Bovine viral diarrhea</strong></th>
<th>Commingling with cattle. Persistent infection of lambs, kids and calves born when mothers were infected during pregnancy.</th>
<th>Stillbirths; weak kids do not survive. Shaker kids with no changes in hair coat. Abortions at any stage. Skeletal defects on aborted fetus - arthrogryposis, anasarca and mummified fetuses. PI kids possible when a pregnant doe exposed to PI calf.</th>
<th>Necrotizing placenta</th>
<th>Virus isolation PCR</th>
<th>Prevent commingling of pregnant does with cattle.</th>
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<tr>
<td><strong>Cache Valley virus</strong>&lt;br&gt;and Akabane virus</td>
<td>Arthropod borne disease – mainly by mosquitoes and flies (Culicoides)</td>
<td>Infection in early pregnancy can result in wide range of deformities in the fetus, microencephaly, hydrocephalus, arthrogryposis and muscle atrophy. Joint malformation may cause dystocia. Late gestation can cause premature and still born kid.</td>
<td>Clinical signs&lt;br&gt;Serology- precolostral serum or fetal serum for antibodies.</td>
<td>Serology on the doe. Virus isolation on the aborted kids may be difficult.</td>
<td>Fly and mosquito control.</td>
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<tr>
<td><strong>Bluetongue virus</strong></td>
<td>Culicoides</td>
<td>Goats are subclinical, infected ewes are febrile, swollen discolored tongue, mucosal ulceration, pulmonary edema, lameness and abortions. Infection early in gestation leads to fetal resorption. Affected late term may cause abortions, stillbirths, weak kids and kids with neural and ocular defects.</td>
<td>Clinical signs.&lt;br&gt;Abortions - placenta is normal. Fetuses - lesions in the brain.</td>
<td>Serology – Sera from aborted fetuses and precolostral serum tested for antibodies to BTV. Virus isolation and PCR.</td>
<td>Fly control and vaccination.</td>
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References