

SMALL RUMINANT THERIOGENOLOGY FOR PRACTITIONERS

Mary C. Smith DVM, Diplomate ACT
Ambulatory and Production Medicine, Cornell University
Ithaca, NY 14853

Anatomy and Physiology of the Buck (Billy) and Ram (Buck)

The testes of the buck and ram are normally present in the scrotum at birth. Cryptorchidism occurs occasionally, is usually unilateral, and can result in retention of a testis anywhere between the kidney and the inguinal ring. The head of the epididymis is normally located on the dorsolateral aspect of the testis, the body is caudal, and the tail is positioned ventrally. The ductus deferens courses medial to the epididymis as it ascends to the inguinal ring. Compact vesicular glands and a disseminated prostate (surrounding the urethra) are present but currently have minimal clinical significance in small ruminants. The fibrous penis has a sigmoid flexure where urinary calculi tend to lodge and a urethral process which extends 3 to 4 cm beyond the glans penis. This is another common site of urinary obstruction.

The age at puberty depends on breed, birth weight, nutrition, and season. Under the influence of decreasing day length, LH secretion causes testicular development and secretion of testosterone. Testosterone will then contribute to separation of the urethral process and glans penis from the sheath, permitting intromission. As the male goes through puberty, the production of sperm increases and the percentage of abnormal sperm in the ejaculate decrease. Males are often fertile by 5 months of age and should be separated from females by 3 months if breeding is not desired.

The male searches out and follows females in estrus, sniffing urine and the female's perineum. Flehmen behavior is observed as the male analyzes the female's physiologic condition. The male may then nudge the female's hindquarters to test her before briskly mounting from behind and ejaculating rapidly. The head is thrown sharply backwards at the time of ejaculation. Male goats routinely drink at their own stream of urine or urinate on their head and forelegs after sexual arousal. The powerful odor of the buck is partly due to 6-trans nonenal secreted by sebaceous glands caudomedial to the horns. The ram has a less strong odor. He tends to be active at the beginning or end of the day, when owners may not observe the breeding behavior. Many flocks use a marking harness or grease smeared on the ram's brisket to document which females have been bred. The color of the crayon or grease is changed every 14 to 17 days, to detect ewes that recycle.

Lamb Epididymitis

Several organisms with changing names are involved in epididymitis of young rams near puberty (4 months to a year). These include *Actinobacillus seminis* and *Histophilus somni* (previously known as *Histophilus ovis* or *Haemophilus somnus*). The infection may ascend the urethra and ductus deferens and the organisms may be normal flora of the prepuce. Testosterone may be involved. Advanced cases are easy to detect by palpation. White blood cells may be recognized in the urine of lambs too young for semen collection. The testis is unusable, and the disease causes great losses to some purebred breeders. Prevention (reduction of the prevalence

to 1%) has been achieved with autogenous bacterins or the feeding of 200 mg/head/day of tetracycline. Feeding tetracycline for a 10 day period each month may be adequate.

Reference: Walker, R.L. and LeaMaster, B.R.: Prevalence of *Histophilus ovis* and *Actinobacillus seminis* in the genital tract of sheep. Amer. J. Vet. Res. 47:1928-1930, 1986.

Ram Epididymitis

Sexually experienced rams in regions where the disease exists usually have *Brucella ovis* if epididymitis is present. They become infected orally (feeding off the ground), conjunctivally (sniffing urine), or venereally (homosexual activity or mechanical carrier ewe). *Brucella ovis* is carried in the kidney, bulbourethral glands, seminal vesicles, and tail of the epididymis. It is passed in urine and semen, even if the ram palpates normally. Infection of ewes causes approximately a 20% decrease in lambs produced because of small numbers of abortions, stillbirths, weak lambs, singles rather than twins, or failure to conceive. The infected ram is still fertile, but fewer lambs are needed and more lambs produced if the flock is free of *Brucella ovis*.

The diagnosis of ram epididymitis can often be made by palpation of the epididymides, beginning 30-45 days after infection. Usually the lesion is unilateral and if the infection is acute, the epididymis is swollen, tender and hot while in chronic infections the tail is large and firm and the testis atrophied. Further aids to diagnosis include semen examination for white cells and detached heads, semen culture, and serum ELISA testing (much better than the CF test).

Control programs are based on testing and culling all positive rams. Rams should be tested before purchase, by both palpation and serology; ask to see the entire lab report, as rams should not be purchased from an infected flock. Virgin ram lambs should not be housed with mature rams. Rams should not be loaned to other flocks, and if this has occurred, the ram should be isolated on return, fed antibiotics, and subjected to a semen examination in 30 days. Vaccination is no longer recommended.

Breeding Soundness Examination

A breeding soundness examination of the male should be performed before each breeding season. An initial physical examination is directed at body condition score, estimated weight, teeth, eyes, mucous membranes for evidence of anemia, feet, and any signs of lameness or ill health. The scrotum and its contents are palpated and the scrotal circumference is recorded in cm for comparison with published charts. Although recommendations vary, a minimum acceptable scrotal circumference is 30 cm for ram lambs weighing more than 70 kg, 33 cm for 12- to 18-month-old rams, and 36 cm for adults weighing more than 110 kg. In general, bigger is better if the large scrotal circumference represents large but normal testes. Scrotal circumference correlates positively with semen production, number of ewes settled, and early maturation and ovulation rate in female offspring. The scrotal circumference will be greatest in the early fall and smallest in February in northern latitudes. A heavy wool cover or presence of mangle on the scrotum may adversely affect fertility by interfering with cooling of the scrotal contents.

Special attention is given to palpation of the epididymides, for evidence of infectious epididymitis in rams and sperm granulomas due to congenital blockage of tubules in the head of the epididymis in bucks. The prepuce is examined for evidence of injury (as from shearing) or posthitis. Balanoposthitis, or pizzle rot, is often related to a diet too rich in protein, resulting in the presence of urea-splitting bacteria in the urine and scalding of the skin by urea released.

The male is set up on his rump to facilitate extrusion of the penis for examination. Loss of the urethral process due to a shearing injury does not usually interfere with fertility, but a previous bout of urolithiasis may have weakened bladder sphincters, resulting in contamination of the ejaculate with urine.

A semen sample is then collected. Rams are routinely electroejaculated to obtain the sample. If epididymitis is not of concern, the ram can be collected standing, into a whirl pack, but otherwise it should be placed in lateral recumbency once the glans penis has been manually exteriorized and held outside the sheath with the aid of a gauze sponge. Two or three periods of electrical stimulation of about 4 seconds duration each, followed by 4 seconds of massage with the probe in the rectum, are usually adequate to obtain a semen sample. The sample must be protected from cold shock and exposure to water and should be examined immediately on a prewarmed slide for motility. An electric frypan on its lowest setting will keep slides and reagents warm. Morphology can be judged with the aid of eosin-nigrosin or other live-dead stain. Sperm concentration is determined with a hemocytometer or calibrated spectrophotometer but can also be estimated by performing a 10 minute spin in a microhematocrit tube. In rams, at least 60% of the spermatozoa should be progressively motile and not more than 30% should have abnormal morphology. If the mature ram is judged to be a satisfactory breeder at this point, a semen culture or serum ELISA test for *Brucella ovis* is usually requested, to rule out subclinical ram epididymitis.

Bucks are less shy breeders than rams and can often be collected with the aid of an artificial vagina if an estrous doe is brought to the buck. A suitable artificial vagina is available from Nasco (see contact information below). It should be filled with water at 55°C and the optimal temperature of the inner lumen at time of collection is 40 to 45°C. Lubricant is necessary but must be non-spermicidal. The right handed person kneels on the right side of the restrained doe, ready to direct the penis into the AV. Examination of the semen collected is as for a sample obtained by electroejaculation, except that naturally ejaculated semen is usually more concentrated.

The male that passes all aspects of the breeding soundness exam still needs to be evaluated for proper conformation and production traits (wool quality, carcass characteristics, milk production and rearing ability of the dam, etc) before actually being selected for breeding. Producers often choose to limit a young ram to 25 ewes and an adult to 50 ewes for a compact breeding season. An adult ram that has "passed" a breeding soundness examination can be expected to successfully serve 100 ewes on level pasture. Multiple rams are often used on a group of ewes, for assurance or to permit the use of more than one breed to produce both replacements and market lambs from the same lambing cohort. It is commonly advised to put odd numbers of rams into the group, under the "two to fight and one left over to breed" theory.

References:

Boundy, T: Routine ram examination. In Practice 14:219-228, 1992.

Boundy, T: Collection and interpretation of ram semen under general practice conditions. In Practice 15:219-223, 1993.

Vasectomy

Vasectomy is commonly performed in order to create a teaser animal for stimulating the onset of estrus during the transition period or for detecting estrus in females to be artificially inseminated or handmated, as well as for detecting return to estrus. The surgery involves ligation and removal of a section of the ductus deferens either in the spermatic cord, above the testis, or medial to the testis in a mid scrotal location. Amputation of the tail of the epididymis will also create an infertile teaser animal. The surgery is usually performed in a cradle or deck chair under light tranquilization with xylazine and local infiltration with lidocaine. Tetanus prophylaxis is imperative, and penicillin or oxytetracycline is usually administered, as the surgery is done under field conditions. An ear tattoo ("VAS") will avoid unfortunate errors in the use of the animal in later years if his regular ear tag is lost.

Reference:

Copland, M.D.: Surgical procedures on the reproductive tract of sheep. In Morrow, D.A.: *Current Therapy in Theriogenology* 2. W.B. Saunders, Philadelphia, 1986, pp 890-893.

Lofstedt, R.M.: Vasectomy in ruminants: a cranial midscrotal approach. J. Am. Vet. Med. Assoc. 181:373-375, 1982.

Castration

Males that are not needed for reproduction but that will be sold before reaching puberty are commonly left intact, to take advantage of more rapid weight gain and leaner carcass characteristics. Additionally, ethnic markets often require an unblemished male for religious feasts.

Young males are commonly castrated with a rubber ring (elastrator), with due attention to counting two testes trapped in the scrotum below the ring before removing the applicator. The short scrotum technique of banding below the testes, forcing them up against the abdominal wall where testosterone production can continue but increased temperature impairs fertility is not 100% effective in rendering the animal sterile. Older bucks and rams can be castrated with a larger rubber band, such as the Callicrate bander® (P.O. Box 748, St. Francis, KS 67756, phone 1-800-858-5974, <http://www.nobull.net/bander/SmartBander.html>). Wool or long hair should be removed from the neck of the scrotum and the band should be positioned low, just above the testes, to avoid creation of a large skin defect when the scrotum sloughs. Local anesthesia can be provided by infiltration of lidocaine in the neck of the scrotum before banding. Remove the scrotum an inch or so below the band a few days later. Tetanus prophylaxis is imperative.

Young animals will be protected by colostral antibodies if their dams were boosted in late pregnancy, but animals older than 3 months should ideally receive 2 doses of tetanus toxoid in advance. If this is not possible, an injection of 500 IU of tetanus antitoxin is given at the time of banding.

Young animals can be castrated by crushing the cords above the testes with a Burdizzo emasculatome. Two crushes are done on each side (first one high, second one lower) with careful attention to trap the cord between the jaws of the instrument but to not cross the midline of the neck of the scrotum. This bloodless castration technique results in atrophy of small testes, but in animals over about 3 months of age the testis remains as a palpable mass in the scrotum, even if its parenchyma is necrotic. Owners then tend to distrust the completeness of the castration.

Surgical castration with an equine emasculator is another option. Lidocaine (1 or 2%) is infused into the bottom of the scrotum and directly into the testis or into the top of the spermatic cord to provide anesthesia. Mature ram and buck testes often equal or exceed equine testes in size and blood supply. Crushing with a much-used emasculator for at least 2 minutes and ligating the neck of the scrotum with gauze should prevent serious bleeding will prevent fatal hemorrhage. So will transfix ligation of the cord above the emasculator.

Anatomy and Physiology of the Ewe and Doe

The ovaries during the breeding season will typically contain follicles on the surface (up to 1.2 cm diameter) or, after ovulation, corpora lutea will protrude from the surface. The uterine tubes (oviducts) are long and sinuous, and the uterine horns are also long and coiled. Approximately 120 caruncles with a concave surface, arranged in four rows in each horn, are very distinct, even in virgin animals. Older, parous animals commonly have melanin pigment in the caruncles and intercaruncular endometrium. The short body of the uterus joins with the firm and fibrous cervix. The cervix has a number of transverse annular rings, often about five. The cervical rings are well aligned with each other in the doe, which makes passage of a pipette relatively easy in goats, when compared with difficulties presented by the more tortuous cervix of the sheep.

Well-fed females of European breeds commonly reach sexual maturity and begin to show signs of estrus at 6 to 8 months of age, during the autumn of their first year. In Pygmy goats puberty may occur as early as 3 months, and occasionally even doelings of the larger breeds cycle this young. Introduction of a buck or ram will synchronize puberty in a group of doelings or ewe lambs during the breeding season.³ Generally, breeding should be delayed until the animal has attained 60 per cent or more of its adult weight.

During the normal breeding season (August to March, and especially October to December in temperate northern latitudes), sheep and goats are polyestrous. Near the equator, native breeds cycle year round. Photoperiod, and in particular the secretion of melatonin from the pineal gland during hours of darkness, are important signals for the onset of cyclicity in autumn. The end of the breeding season (transition to anestrus period) is believed to occur because the female has become refractory to short days rather than because of small increases in day length after the winter solstice. Introduction of a male can advance the breeding season. The normal estrous

cycle of the dairy goat is approximately 20 to 21 days, while Pygmy goats are variously reported as having average cycles of 18 to 24 days. The average estrous cycle length of the ewe is 16 days. The estrous cycles are usually more erratic at the beginning and the end of the breeding season. Short cycles of less than 12 days, and often of only 5 to 7 days, are quite common in goats, especially in young does. Short cycles are often associated with premature regression of the corpus luteum.

Proestrus often lasts about 1 day. It is a period when the male or teaser closely follows the female, but she will not stand to be mounted. Estrus, or standing heat, lasts a variable time, often 12 to 24 hours. Metestrus is the time from refusal to mate until formation of one or more corpora lutea. Ovulation is variously reported to occur 12 to 36 hours after the onset of standing heat and may be hastened by the presence of a male. Diestrus, the period of corpus luteum function, is the longest portion of the cycle. Progesterone values reported during the luteal phase (typically 4 to 8 ng/ml, but over 1 ng/ml) are variable and depend on the number of corpora lutea present and the assay procedure used.

Intersexes

In European breeds of goats (Alpine, Saanen, Toggenburg) there is a strong association between the intersex and polled conditions. The polled trait (P) is autosomal dominant. The horned trait (p) is recessive. Thus PP and Pp goats are polled while pp goats are horned. Pp animals often have unsightly horny bosses. The same or a closely linked autosomal gene controls sexual development, but in a recessive fashion. A current theory holds that this gene, when homozygous, causes expression of the HY antigen. (The HY gene is normally on the Y chromosome.) Thus Pp polled goats and pp horned goats are unaffected. PP polled goats have impaired fertility. The PP polled goat that is a genetic (XX) female becomes an intersex and is always sterile. It may have a shortened vagina, a large clitoris, or an increased anogenital distance. With the arrival of the breeding season, it often develops a buck-like head and neck, buck odor and buck behavior. The gonads (usually testes or ovotestes) may be scrotal, inguinal or internal. Even very masculine appearing intersexes with scrotal (albeit small) testes do not produce sperm. A karyotype reveals these infertile "males" to be XX genetic females. The same range of phenotypes is seen with freemartins but these goats (and sheep) are XX, XY blood chimeras due to placental anastomosis with a male littermate. The PP polled goat that is a genetic (XY) male is initially fertile but often develops sperm granulomas in the epididymis later in life.

This type of intersex can be avoided totally if the homozygous polled condition is avoided. This means that polled x polled matings are avoided, which is the same as always having one horned (at least at birth) goat in every pair mated. The fertile polled doe must be heterozygous, because if homozygous for the polled gene she would be an intersex.

Estrus Detection and Natural Mating

A teaser or breeding buck is best able to elicit and detect signs of estrus in the doe. If a buck is introduced into the herd at the beginning of the breeding season, the does will show heat in an average of 5 to 8 days. Standing and riding behavior among does is not as common as with

cows. Many does will not cycle visibly unless a buck or another source of the buck odor such as a burlap bag that has been rubbed all over the buck, is present in the environs. A common method of heat detection for small herds is to rub a rag on the rank buck's scent glands, caudomedial to his horns, and store this rag in a tightly covered container to be opened and presented daily to the doe. When in estrus, she will be very interested in the buck jar. If the buck himself is present, the two animals will stay close together. If separated, they will restlessly search the perimeter of their enclosures for a means of escape. Some does will not permit breeding by a descended buck.

The external genitalia may be more swollen, reddened and more moist during estrus but these signs are not dependable with all does. Rapid side-to-side or up-and-down tail flagging is a good sign of heat that can often be detected in the absence of a buck. The behavior probably serves to spread odors from the doe's vulva to any nearby males. Restlessness and a tendency to be more vocal than usual are also commonly observed. Urination may increase in frequency. Milk production and appetite may decrease and somatic cell count often goes very high.

A speculum examination of the cervix may be helpful in detecting estrus. At the beginning of heat, the vaginal mucosa is reddened and moist, but little mucus is present. As heat progresses, initially transparent mucus turns cloudy and finally is cheesy white at the end of heat. This normal white discharge should not be mistaken for pus. Conception is best when the doe is bred at the stage at which her cervical mucus is cloudy and the cervical os is relaxed.

Sheep owners are far less inclined than goat owners to watch their ewes for estrus, preferring to breed with a natural male or to use a vasectomized animal as a teaser. The ram is less odoriferous than the buck and its presence more acceptable even on small hobby farms. The ram is provided with a marking harness or smeared over the brisket with colored grease, and estrous cycles or breedings are recorded based on the marking of the ewe's rump.

Artificial Insemination

Artificial insemination of dairy goats is the norm in several European countries and is used by some American breeders for introduction of new or improved genetics to the herd. The cervix of the doe in estrus is relatively easy to penetrate with a straw gun. A test tube or duck-billed speculum permits observation of the external os of the cervix, and the straw is then worked gently past each of about 5 cervical rings to allow insemination just within the uterine body. Owners are often introduced to the technique at a producer workshop but may request veterinary assistance if the semen is particularly valuable or the owner timid.

Transcervical artificial insemination of ewes is possible, using specialized equipment to fix and stretch out the cervix, but the technique has given somewhat disappointing results. Laparoscopic artificial insemination is much more routinely performed and yields excellent results (approximately 70% conception rate). This is an area where a practitioner with the appropriate equipment and interest can develop a specialty service.

Superovulation and embryo transfer are well established procedures in small ruminants but beyond the scope of this discussion.

References:

Campbell J.W. et al.: Transcervical insemination in sheep: an anatomical and histological evaluation. *Theriogenology* 45:1535-1544, 1996.

Chemineau, P. et al.: Training Manual of Artificial Insemination in Sheep and Goats. FAO Animal Production and Health Paper 83. FAO, Rome, 1991.

Hill, J.R. et al.: Factors affecting pregnancy rates following laparoscopic insemination of 28,447 Merino ewes under commercial conditions: a survey. *Theriogenology* 49:697-709, 1998.

Ishwar A.K. and Memon, M.A.: Embryo transfer in sheep and goats: a review. *Small Rum. Res.* 19:35-43, 1996.

Synchronization of Estrus

The simplest method of initiating estrus in a group of small ruminants is the introduction of a male during the transition period and after a month or more of segregation of the females from the sight, sounds, or smells of the male. The so-called “male effect” will cause ovulation (though not always with behavioral estrus) in most females within 7 or 8 days. If an infertile teaser animal is used and then replaced after 2 weeks, cycles will still be clustered and the ovulation rate will often be higher when the breeding males are introduced.

Photoperiod control can be used if out of season breeding is desired. After 2 months of artificially long days (18 to 20 hours), typically in January and February, the animals are allowed to return to ambient daylength, and cycling will often begin in approximately 6 weeks. In temperate latitudes, it is important to provide light treatment for the males in a separate location so their libido will be adequate for the breeding asked of them. Melatonin treatment is available in some countries to mimic short days. Genetic selection for animals that will breed year round has many long-term advantages, as added expenses of electricity and hormone treatments are not required.

Actual synchronization of estrus in a group of animals for controlled mating, as by artificial insemination, can be achieved in many ways, most of which are not strictly legal in the United States where extralabel use of drugs for production purposes is not approved. Feeding of melengestrol acetate at 0.125 mg per head morning and night for 11 days will synchronize estrus in sheep. In Canada, the MGA is fed in a pellet and PMSG is given 8 hours after the last feeding, 300 IU in season and 500 IU out of season, to increase fertility on the first cycle. In other countries, intravaginal fluorogestone acetate or medroxyprogesterone pessaries (sponges) and progesterone impregnated CIDRs (Controlled Internal Drug Releaser) are marketed for small ruminants. They are typically placed for 7 to 14 days and an injection of prostaglandin is given at the time of removal, to destroy any pre-existing corpus luteum. Although these protocols work well during the breeding season, repeated FSH injections after or a single treatment with PMSG just prior to progestogen removal is usually needed to achieve good fertility out of season. As PMSG is not marketed commercially in the United States, some veterinarians

substitute the swine product PG 600® (Intervet) which contains 400 IU of PMSG and 200 IU of HCG per ml, as a source of PMSG.

Reference:

Chemineau, P. et al.: Control of sheep and goat reproduction: use of light and melatonin. *Anim. Reprod. Sci.* 30:157-184, 1992.

Mismating Treatment

Bucks very commonly find their way through the fences into a pen of does which the owner does not want bred. The does may be too small or breeding may have been postponed to provide milk or kids outside the regular season. The first step to take is to evaluate the male for sexual maturity. If the penis has not yet separated from the sheath, no further action is needed except to improve the fencing. If the buck is deemed capable of breeding, a luteolytic dose of prostaglandin (5 to 10 mg of dinoprost, 125 to 250 mcg of cloprostenol) is given to all exposed females 7 to 10 days after mismating may have occurred. A second dose of prostaglandin 4 hours later appears to give a greater assurance that the pregnancy will be interrupted. As the goat depends on progesterone from the corpus luteum to maintain its entire pregnancy, treatment will still be successful if delayed. However, does that are induced to abort after about 3 months are anecdotally reported to have difficulty reestablishing normal estrus cycles during the current breeding season.

Because production of progesterone in the ewe is taken over by the placenta after the first trimester, induction of abortion in the case of ovine mismating is more difficult to achieve. Also, periods of refractoriness to prostaglandin have been reported in ewes: before day 5, days 12 to 26, and after day 55. Cloprostenol (250 mcg, 1 cc of Estrumate®) appears to be more effective than dinoprost (10 mg, 2 cc of Lutalyse®) in aborting ewes. If the ram has been with the ewes for less than a week, a single injection 5 days after ram removal is usually adequate. If he was with the ewes for a longer period, two injections, 2 weeks apart, are indicated.

Reference:

Audicana, L. and Harvey, M.J.A.: Termination of early pregnancy in sheep with dinoprost or cloprostenol: comparison of two commercial preparations. *Vet. Rec.* 133:574-576, 1993.

Pregnancy Diagnosis

Gestation is approximately 146 days in sheep and 150 in goats. Check for return to estrus at 16 (sheep) or 21 (goat) days. Progesterone concentration is a nonpregnancy test, as animals without progesterone are not pregnant. Late in pregnancy, the ligaments around the tailhead soften because of high estrogen concentrations.

The best means of definitive pregnancy diagnosis is real-time ultrasound, from the right inguinal area. This area is wool free in sheep but may need to be clipped in goats if use of contact gel, mineral oil, or alcohol is not liberal. Use a 3 or 5 MHz head; a 5 MHz equine rectal probe is

commonly used externally. Caruncles look like cups and donuts, outlined by black fluid. Fetuses can be counted if you have a sector scanner. Pregnancy diagnosis is easiest at 45 to 90 days; earlier in gestation you must search close to the brim of the pelvis or transrectally (20-30 days), later there is less fluid and the abdomen of fetus looks like abdomen of dam on ultrasound. A big differential, especially in goats, is false pregnancy with hydrometra. These does will show clear fluid (or with white debris on ultrasound) but no caruncles or fetus. Recheck if there is minimal fluid, in case it was an early pregnancy. Practitioners should charge for ultrasound pregnancy diagnosis by the head or by the hour, depending on the quality of the handling system.

Amplitude-depth ultrasound is less accurate than real time ultrasound, especially in goats (false pregnancy gives a false positive) and late gestation (reduced amount of free fluid in the uterus). Doppler techniques of pregnancy diagnosis by listening for the fetal heart beat have also fallen out of favor. Radiography (blindfold for restraint) may be helpful for determining if an animal is pregnant more than 90 days or if a fetus is retained in a Pygmy goat, if ultrasound is not available.

The urinary estrone sulfate test is often used by goat owners as a pregnancy test. Sensitivity and specificity are near 100% after 50 days. Some does with elevated estrone sulfate (made by the placenta) at 40-50 days are later found to be pseudopregnant, suggesting that early embryonic death may have occurred. The test is marketed to owners by B.E.T. Reproductive Laboratories, 1501 Bull Lea Rd, Ste 102, Lexington, KY 40511. phone 859-273-3036, <http://www.betlabs.com/>. Several other diagnostic laboratories also offer this test.

False Pregnancy of Goats

False pregnancy is a relatively common problem of goats, especially pets or dairy animals, that are housed separate from males and thus experience estrous cycles without the opportunity to conceive. Previous breeding is not necessary. It also can occur after early embryonic loss in goats or sheep.

The diagnosis is suspected if the goat fails to show estrus when it cannot possibly have been bred but is in a herd where heat detection is good. Serum progesterone concentrations are elevated and abdominal enlargement suggestive of pregnancy may occur. The urinary estrone sulfate test for pregnancy is negative. Amplitude-depth ultrasound for pregnancy is positive because of fluid in the uterus. Rectal doppler may indicate increased blood flow to uterus, but no fetal heart sounds are heard. Real-time ultrasound reveals fluid but no fetus or caruncles in the uterus. The animal should be rechecked if fewer than 40 days have elapsed since the last possible breeding. In advanced hydrometra, large fluid-filled compartments are seen separated by undulating tissue walls, which represent the uterus coiled back on itself. The fluid is cloudy and flocculent if aspirated through the abdominal wall.

Spontaneous correction is common, and varies from red discharge suggestive of early abortion to "cloudburst" where the stall is drenched and the goat's abdomen shrinks. No placenta is passed. Treatment of false pregnancy is with prostaglandin, but remember that this will abort the goat if it has a true pregnancy!! An initial dose of 5-10 mg dinoprost (Lutalyse^R) or 125-250 mcg cloprostenol (Estrumate^R) is given and repeated in 12 days. Estrus and emptying of the uterus

occur in 1.5 to 4 days. Oxytocin (50 IU bid for 4 days) will cause corpus luteum regression, but treatment with oxytocin is normally reserved for goats that still retain fluid in the uterus after prostaglandin therapy. The doe frequently becomes pregnant within a few days to weeks after termination of a false pregnancy if a buck is available. Sometimes hydrometra recurs.

The causes of false pregnancy are unknown. Suggestions for prevention have included selenium supplementation and breeding on the first heat of the season. The prevalence is probably increased in herds where breeding is delayed in order to obtain winter milk and in does manipulated hormonally to breed out of season. Routine pregnancy diagnosis of goats with real-time ultrasound should be advised to permit rebreeding during the same season.

References:

Pieterse, M.C. and Taverne, M.A.M.: Hydrometra in goats: Diagnosis with real-time ultrasound and treatment with prostaglandins or oxytocin. *Theriogenology* 27(6)813-821 1986.

Taverne, M.A.M. et al.: Aetiology and endocrinology of pseudopregnancy in the goat. *Reprod. Dom. Anim.* 30:228-230, 1995.

Abortion Diagnosis and Prevention

There are many, many infectious causes of abortion of small ruminants, most of which are zoonotic. An infectious abortion disease should be expected if the abortion rate exceeds 2%. Diagnosis requires laboratory examination of fetus and placenta; paired serology may be helpful. While awaiting laboratory results, consider treating late pregnant herdmates and weak neonates with long-acting tetracycline at 20 mg/kg q 3 days. Chlortetracycline in feed at 200-500 mg/head/day during the last 2 months of gestation has been used for chlamydia control, although this is not strictly legal in the US.

Toxoplasmosis causes abortion at any stage of pregnancy, mummification, weak neonates, and white foci in cotyledons. Keep the farm and feeds free of young kittens. A negative serologic test rules out toxoplasmosis. Chlamydiosis causes abortion in the last 4-6 weeks; inter-cotyledonary areas of the placenta are thickened and organisms are acid fast. The sheep or goats abort at the pregnancy following exposure. Shedding in vaginal secretions when in estrus will spread the infection, with the male serving as a fomite. Chlamydial vaccine must be given before pregnancy begins to be effective. Campylobacteriosis is more common in sheep than in goats; vaccination (with sheep, not cattle strains) is helpful in the face of an outbreak. Other causes of abortion include Q fever, listeriosis (often from spoiled silage or baylage), salmonellosis, leptospirosis, Cache Valley virus, iodine or selenium deficiencies, and stress in goats.

Animals that have aborted should be isolated from the rest of the flock. Aborted fetuses and placentas should be disposed of carefully, and disposable gloves should be worn when correcting dystocias or removing products of conception from the pen. In many instances the aborted female will be immune and can be kept for rebreeding, but animals that abort due to chlamydiosis should be culled as they will continue to shed the organism even though they are unlikely to abort again for another 3 years.

Metabolic Diseases Associated with Late Pregnancy

Pregnancy toxemia is a common problem in late pregnant small ruminants, and can be primary (unable to consume enough nutrients to meet the needs of twins or more) or secondary to some other condition that puts the animal off feed. Check the urine for ketones to confirm the presence of pregnancy toxemia. Hold off the sheep's nose to induce urination, but give up before 45 seconds, as the bladder may be empty! Increased energy demands of multiple fetuses in the last 6 weeks of pregnancy are compounded by excess fat in the abdomen of obese animal and reduced available rumen volume, especially if the forage is of poor quality. Overfeeding grain may cause indigestion, which is followed by ketosis and possibly polioencephalomalacia. Treat early cases of pregnancy toxemia with 60 ml glucose IV (diluted in saline or sterile water), 60 ml propylene glycol orally 2 or 3 times a day, increased energy in feeds, B vitamins, and 60 ml calcium gluconate SC. More severe cases need 5 liters IV fluids with bicarbonate and 20-25 mg dexamethasone (induces parturition after 139 days in sheep or 141 days in goats, prepares fetal lungs to breathe). A Caesarian section may be needed if the animal does not respond quickly to medical therapy, as hormonal induction of parturition takes too long and is undependable in toxic animals. Likewise, surgery may be required to save the dam's life even if the fetuses are too premature to be viable.

Late pregnant or heavily lactating small ruminants occasionally develop hypocalcemia severe enough to cause recumbency. In sheep there is often a history of forced exercise. The animal's hind limbs may go out behind it as it struggles to rise, and it may show dyspnea suggestive of pneumonia or pulmonary edema, as it breathes with head and neck extended. Calcium borogluconate 23% (60 ml to a 120 - 150 pound animal) brings a rapid response when given slowly intravenously, but can also be divided into 4 subcutaneous injections.

Prolapses

A prolapsed uterus is easily replaced after administration of a caudal epidural block (with approximately 4 mg xylazine in the 2 ml of lidocaine for longer effect, published dose of xylazine 0.07 mg/kg), cleansing of the prolapse, and elevation of the hindquarters. Systemic antibiotics and tetanus prophylaxis are advised, but the animal usually breeds back and the prolapse does not recur at the next parturition. In an older animal, 60 ml of calcium borogluconate should be given subcutaneously in 4 sites in case the animal is hypocalcemic.

Replacement of a vaginal prolapse is also easier with epidural anesthesia. Elevating a large prolapse will usually unkink the urethra, thereby allowing emptying of the bladder trapped inside. A plastic paddle (Bearing retainer, Nasco and others) inserted into the vagina and tied to the wool near the point of the hips can be used to keep the vagina in place, assuming that the vaginal wall is in good condition. An alternative is a commercial or homemade rope truss that puts external pressure on both sides of the vulva. Both these methods permit unassisted parturition. Mattress sutures across the vulva or a pursestring of the vulva requires very close supervision. If there is a flock outbreak of prolapsed vaginas, improve the nutrition of the pregnant females, beginning with provision of higher quality roughage, and provide exercise. Often animals that have experienced a prolapsed vagina will dilate poorly when parturition

actually begins. Other causes of ringwomb (failure of the cervix to dilate in an animal in labor) are poorly understood, and a Caesarian section may be required to deliver the fetuses. Prolapsed vagina may have a hereditary component or be linked to a very short tail dock. Prolapsed vaginas frequently repeat (40%) in the next gestation, so cull the dam and its offspring.

Reference:

Scott, P.R. et al.: The use of combined xylazine and lignocaine epidural injection in ewes with vaginal or uterine prolapses. *Theriogenology* 43:1175-1178, 1995.

Correction of Dystocia

Be clean, be gentle, and use lots of lubricant. The owner and the veterinarian should wear plastic sleeves to protect the dam from metritis and the person from zoonotic diseases. Follow the 30-30-30 rule relative to intervention - check internally 30 minutes after placenta or fetus shows, again 30 minutes later if everything seemed normal but no progress has been made (and deliver the fetuses at that time), and check 30 minutes after delivery of one fetus if the next has not been born. Meconium staining of the fetus justifies immediate intervention. If the fetus is in anterior presentation, usually only the head and 1 front limb need to be in position for delivery to occur; if in posterior presentation, the fetus can be delivered with only 1 hind limb presenting. A head snare (available as a “lamb puller” from numerous supply houses) is very useful for retrieving a retained head. Do not hesitate to cut off a swollen head with a scalpel blade if the fetus is dead and room is needed to retrieve a retained front limb. Subcutaneous fetotomy techniques quickly remove limbs of tangled dead twins and triplets. Cut through the skin encircling the leg just above the carpus and it will be easy to pull off the front limb of an autolyzed fetus. Reposition the dam (roll over or elevate the hindquarters) to aid manipulation or repulsion of the fetus. Flunixin (1 ml per 100 pounds IV) is used for pain relief. A lidocaine - xylazine epidural early in a dystocia will provide analgesia, limit straining, and simplify a C-section if surgery is ultimately required. Antibiotics by injection are indicated after a difficult dystocia or delivery of emphysematous fetuses.

Caesarian sections are relatively easy to perform on small ruminants. Left flank, right flank, and ventral midline approaches (directly in front of the udder) have all been used. Surgery can be done standing or down. Likewise, the anesthesia can be supplied with a line block, inverted L block, paravertebral block (1 ml lidocaine above and below the tips of the transverse processes of L1, L2, and L4), epidural injection of lidocaine with xylazine, or gas anesthesia. Avoid xylazine tranquilization of the dam if possible, as pulmonary alveolar hemorrhage and depression of both dam and fetuses are likely adverse sequelae. A blindfold is very helpful for restraining small ruminants. Normally all fetuses are removed through one incision. If fetuses are fresh and the uterus intact at the time of surgery, the prognosis for rebreeding is good.

Care of the Neonate

Human involvement during indoor lambing begins with “Clip, Dip, Strip, Sip”. Shorten the umbilical stump with scissors if it is long and dip the umbilicus into 7% tincture of iodine. A film canister holds the right amount of iodine and avoids contamination of a larger stock bottle.

Strip the plugs out of each teat so that the lamb or kid doesn't have to suck very hard to get its first drink, then leave mother and young together but watch closely that the neonate actually sucks. A lamb or kid that has eaten will have a bulging belly when held up by the front legs. If the forage locally is selenium deficient and the dams have not been adequately supplemented throughout pregnancy, an injection of vitamin E/selenium may improve the strength and immune function of the newborn.

The ewe needs time and protection from interference (lamb stealing) while she licks her lambs dry and learns to recognize and count them. The lambs have to find the udder and learn to recognize their mother. Counting is difficult for sheep, so the ewes are typically kept in a claiming pen (also called a jug or jail) for one day for every lamb being raised. Thus a ewe with a single is released to the mixing pen after one day, a ewe with twins stays two days, and the ewe raising triplets is given three days to figure everything out.

Colostrum is very important for the future health of the newborns. During the first 24 hours, the lamb or kid should consume 1 ounce of colostrum per pound body weight three times. Thus an 8 pound lamb would receive 8 ounces (about 240 ml) every 8 hours for 3 feedings if handfed. Owners with lots of time can divide this into more, smaller feedings. In metric circles, the protocol commonly proposed is 50 ml colostrum per kg four times the first day. Lambs and kids too weak to suckle are easy to stomach tube using an 18 French red rubber feeding tube that is inserted through the mouth to the level of the last rib. No mouth gag is needed in the neonate and the stomach tube can be palpated between the trachea and the cervical vertebrae when positioned properly. A 60 cc dosing syringe fits on the stomach tube. Colostrum or milk can be delivered by gravity, using the barrel of the syringe as a funnel, or can be injected slowly. Obviously, if the lambs or kids are nursing their dams normally you have no way to know how much they are drinking - just that they are active, not hunched, and look full. If lambs die of starvation at 24 hours but the mother's udder is full of colostrum at that point, check for protein deficiency in the diet, leading to delayed colostrum production.

Hypothermia develops quickly if the lamb or kid is not licked dry by the dam or towed dry by the caretaker. The chilled neonate will be hunched, with a body temperature less than 100°F (38°C). Rewarming can be done in a box or dog crate with warm air forced through it, monitoring the temperature with a thermometer to avoid overheating. This is preferable to a simple heat lamp, which may overheat one side or start a barn fire if knocked down. Another method of rewarming used by some producers is to place the lamb in a water tight plastic bag, tied around the neck, and submerge all but the head into warm water. It is also possible to heat several large bath towels in the clothes drier, turn the drier off, and install the chilled lamb into the warm nest of towels. If one lamb in a litter needs to be revived, remove the entire litter so that the mother is more apt to accept the treated one when it is returned along with its siblings.

The brown fat around the heart and kidneys that supplies nonshivering heat production is often exhausted by 5 hours if no colostrum is consumed. Then the lamb or kid becomes hypoglycemic as well as cold. The older starved lamb or kid that cannot hold its head up requires intra-peritoneal dextrose before rewarming, to avoid convulsions. Prepare a 20% solution of dextrose in water, warm it, and inject 1 inch lateral to and one inch caudal to the umbilicus. Suspend the lamb by its front limbs and aim the 1 inch 20 gauge needle downwards towards the pelvis. A

large lamb gets 50 ml, a medium lamb 35 ml, and a small lamb 25 ml of the dextrose solution. A subcutaneous injection of antibiotic should also be given. Now rewarm the lamb and feed it.

A normal, dry neonate that is nursing well can withstand very cold temperatures. Shearing the ewe prelambling encourages her to seek a sheltered spot to lie down and permits heat transfer from mother to the offspring lying beside it. The weak lamb or kid may benefit from a knitted sweater, old sock with the toe cut out, or a sweatshirt sleeve as a coat. Cut holes for the front legs and provide a slit ventrally for urination by the male. The warmth goes with the lamb wherever it goes and there is no danger of a barn fire. In rainy climates, plastic raincoats have been used successfully to keep young lambs alive in wet cold spring weather. The coat may only stay on a few days or weeks but certainly saves lives if the weather is bad.

Lambs are occasionally grafted onto a different mother. A slime graft is performed by rubbing birth fluids or placenta onto an orphan lamb and putting that lamb in front of the ewe that delivered a dead lamb or a single and has enough milk for another lamb. Acceptance may be improved by placing a gloved fist into the dam's vagina for several minutes, then popping the hand out to simulate passage of another fetus. A skin graft is performed by cutting the skin off the ewe's own dead lamb and putting the skin onto an orphan as a coat. The coat is removed a few days later after the ewe's milk has passed through the lamb. An older and vigorous orphan can have its limbs tied together to make it flop around more like a neonate. Tying or stanchioning the ewe so it can't evade or headbutt the lamb may also lead to adoption after a few days to a week or more.

Records Analysis

You treasure what you measure. Reproductive difficulties cannot be documented and progress in profitability and flock health cannot be made without keeping and analyzing records. These can be handwritten or computer records, but will require permanent ID of adults, by tag or tattoo. Lambs and kids also need to be identified. A pocket-sized lambing book is very convenient for keeping records in the barn. Record the birth date, dam, sex, and ear tags of the lambs or kids. Also record any difficulties (dystocia, poor mothering) or abnormalities such as entropion or arthrogryposis.

Most flocks can benefit from keeping track of most if not all of the following items:

- conception rate - pregnant females as a percentage of females exposed to the male
- abortion rate - aborting females as a percentage of pregnant females
- prolificacy - number of lambs or kids per female giving birth, same as lambing percentage
- birth weight, at least of the first 10 to 20 born in a lambing or kidding period, as an indication of nutrition (in the absence of abortion diseases)
- number delivered alive
- number alive at weaning
- number alive to market age
- death rates for various ages
- causes of mortality, as determined by on-farm or diagnostic laboratory necropsy
- culling rate and reasons

average age to reach market weight
 feed costs per lamb or kid marketed and feed costs per female per year

Once these numbers are known for the most recent year, goals can be set and appropriate plans can be formulated to address the most important impediments to production and profitability or other concerns of the owner. Some targets for sheep, as published in *Herd Health Food Animal Production Medicine*, 2nd edition by Radostits, Leslie, and Fetrow, W. B Saunders Co, 1994 are given below. The flock records will need to be reviewed preferably with the help of veterinary and nutritional advisors, on at least an annual basis. Goat parameters should be similar.

Parameter	Definition	Target
Lambing rate	% ewes mated that lamb	>95%
Abortion rate	% pregnant ewes that abort	<5%
Stillbirth rate	% of term lambs born dead or dead within first 24 hours	<2%
Perinatal lamb mortality rate	% lambs born alive that die from birth to weaning	<5%
Ewes weaning lambs	% of ewes weaning at least one lamb	>90%
Average daily gain, birth to weaning	adjusted for sex and litter size	0.3-0.5 kg/d
Weaning rate	lambs weaned per female exposed to ram, per breeding period	1.5 - 1.7
Ewe death rate	% ewes dead per year	<5%
Culling rate	% of ewes culled out of average number of ewes in flock per year	20%

General References:

Henderson, D.C.: *The Veterinary Book for Sheep Farmers*. Ipswich, Farming Press, 1990.

Morrow, D.A.: *Current Therapy in Theriogenology 2*. W.B. Saunders Co., Philadelphia, 1986.

Pugh, D.G.: *Sheep & Goat Medicine*. W.B. Saunders Co., Philadelphia, 2002.

Smith, M.C. and Sherman, D.M.: *Goat Medicine*. Lea & Febiger, Philadelphia, 1994.

Suppliers of Small Ruminant Equipment and Drugs:

The following companies are useful sources of equipment as well as advice to owners.

"Shepherds Choice" - Pipestone Veterinary Supply
1300 So. Hwy 75/ P.O. Box 188
Pipestone, MN 56164
1-800-658-2523 for orders
<http://www.pipevet.com>

Premier
2031 300th Street
Washington, IA 52353
1-800-282-6631
<http://www.premier1supplies.com>

Colorado Serum Company
P.O. Box 16428
Denver Colorado 80216
1-800-525-2065
<http://www.colorado-serum.com/>

Nasco
901 Janesville Avenue
P.O.Box 901
Fort Atkinson, WI 53538-0901
1-800-558-9595
<http://www.nascofa.com/>

Jeffers
P.O. Box 100
Dothan, AL 36302-0100
1-800-533-3377
<http://www.jefferslivestock.com/ssc/>

PBS Livestock Health
P.O. Box 9101
Canton, OH 44711-9101
1-800-321-0235
<http://www.pbsanimalhealth.com>

Caprine Supply
P.O. Box Y
DeSoto, KS 66018
1-800-646-7736
<http://www.caprinesupply.com>