

# A clinician's guide to what kills lambs and kids, as diagnosed by necropsy

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## Abstract

It is common for neonatal losses to exceed 10% of lambs and kids delivered. A simple on-farm necropsy technique for examining these animals and determining the probable cause of death is described. Important categories for mortality include abortion, stillbirth, dystocia, hypothermia and starvation, umbilical infections, diarrheal diseases, septicemia, pneumonia, and abomasal bloat. Once the relative importance of these conditions in the herd has been determined, appropriate samples can be sent to a diagnostic laboratory and suggestions for management changes can be tailored to address the problems of the greatest economic importance.

**Key words:** small ruminants, necropsy

## Résumé

Il est courant pour les pertes à dépasser 10 % des agneaux et chevreaux livrés. Une simple technique d'autopsie à la ferme pour l'examen de ces animaux et de déterminer la cause probable du décès est décrit. Catégories importantes de mortalité : l'avortement, de mortinatalité, la dystocie, l'hypothermie et la famine, maladies diarrhéiques, infections ombilicales, septicémie, pneumonie, et ballonnement caillotte. Une fois que l'importance relative de ces conditions dans le troupeau a été déterminé, des échantillons appropriés peuvent être envoyés à un laboratoire de diagnostic et des suggestions pour les changements de direction peuvent être adaptées pour répondre aux problèmes de la plus grande importance économique.

## Introduction

It is common for 15 to 25% or more of the lambs or kids on larger farms to die within the first week after birth.<sup>7,8</sup> All too often, no use is made of the losses and corrective measures are not taken. The goal relative to perinatal mortality should be for less than 10% to be stillborn or die early; less than 5% is achievable in intensively managed herds.<sup>2</sup>

### Necropsy Technique for Neonates

In preparation for investigation of a neonatal mortality problem, farm personnel should be instructed to label each untagged dead animal with dam identification, date, and

circumstances of its death, using plastic tape on the leg or bag. The veterinarian should plan to examine many lambs or kids briefly, to get an overview of what is causing the majority of losses.

Necropsies are best performed in a warm, well lit area, on a surface that can be easily sterilized or a plastic sheet that can be disposed of afterwards. Disposable gloves are imperative; zoonotic diseases commonly cause abortion, stillbirth, and weak neonates. Pregnant women are advised to not necropsy lambs and kids because of the risk of zoonoses.

Supplies such as sample containers, formalin, culture swabs, markers, and paper or a recorder for taking notes should be organized before the first body is opened. A digital camera to record lesions is desirable, especially if an assistant with clean hands is available to take the pictures. A sharp necropsy knife is ideal but a 22 scalpel blade can substitute for the knife, while sheep foot trimmers are used to cut ribs and open the skull.

Start by weighing the lamb or kid if possible and recording ear tag or other identification, sex, estimated weight, and any grossly visible abnormalities, including yellow staining of the fiber. Palpate the limbs for fractures or swollen joints from septic arthritis. If there is evidence of predation, do not assume that the animal was healthy or even alive when an eye was pecked out or the body partially consumed. Complete a necropsy on the remainder of the body, searching for underlying problems that would have made the lamb or kid an easy target.

Although others may suggest a different orientation of the body,<sup>4,6,7</sup> the author prefers to place the neonate on its left side as this approach provides an excellent view of lung, liver, and abomasal lesions. The two right limbs should be reflected out of the way after cutting the skin over the axilla and inguinal area. The two openings in the skin are then connected and the skin flaps are peeled off the side of the carcass dorsally and ventrally. The skin is also incised up the neck to expose the thyroid gland and the mandibular symphysis is cut to allow easy access to the mouth and tongue.

Next the abdominal cavity is entered through an incision just caudal to the costal arch. The abdominal wall is reflected and the diaphragm is severed along its attachment to the ribs. Small ruminant foot trimmers, a necropsy knife, or a scalpel blade is then used to cut each rib at the costochondral junction. The rib cage of a neonate can then be reflected dorsally by breaking the ribs near the backbone or cutting them with the foot trimmers. The thoracic and

abdominal cavities are now exposed and very little further manipulation is needed to diagnose most losses that are not induced by abortion diseases. The umbilical vein to the liver and the umbilical arteries on each side of the bladder should be identified. Hemorrhage in the arteries is an indication that the lamb was alive when it separated from its placenta. Both kidneys should be located, incised and inspected. A mild hydronephrosis may reflect failure of the dam to stimulate urination. The liver should also be sliced, looking for abscesses. The lungs are examined visually and by palpation. Removing the pluck from the tongue back or after transecting the esophagus and trachea at the thoracic inlet will expose the left side of the lungs and rib cage; note fractures. The pericardial sac should be opened, and the four chambers of the heart should be examined if there is any indication of heart failure. The nature and quantity of abomasal contents should be assessed, as well as intestinal contents, including retained meconium. The perineum should be inspected for evidence of diarrhea. Finally, the head can be disarticulated from the spine and the skin removed from the top of the skull. Using foot trimmers and starting at the dorsolateral aspects of the foramen magnum, the skull cap is reflected to permit inspection of the brain. Check for hydrocephalus or hydranencephaly, which can result from in utero bluetongue virus or Cache Valley virus infection.

After necropsies have been completed, the carcasses should be disposed of safely and properly, according to state laws. Composting, deep burial and landfill disposal are typical choices to prevent contact with people, pets, other livestock, or scavengers. Equipment and surfaces should be sanitized and contaminated gloves disposed of properly, with due consideration for the risks of zoonotic diseases.

### Abortion Diseases

If more than 2% of ewes abort an infectious cause should be suspected.<sup>3</sup> Goats are prone to stress-induced as well as infectious abortions. Dead lambs delivered before lambing is due to start will likely be abortions, but once normal lambing is underway it may be difficult to determine if fetuses have been aborted or died of some other cause. If an abortion disease is suspected by the timing or magnitude of losses, laboratory support will be needed to make an etiologic diagnosis.<sup>4</sup> Refer to the sampling directions provided by the local diagnostic laboratory or send multiple fetuses with placenta and maternal blood directly to the lab. Typical requirements are lung, abomasal contents, and placenta fresh; placenta, lung, liver, brain, and heart in formalin, and serum from the dam. If abortion diseases are ruled out by laboratory testing, noninfectious causes of abortion (nutritional deficiencies, pregnancy toxemia, improper handling, other stress, liver flukes, etc.) should be investigated.<sup>2</sup>

In some instances, a gross examination will provide helpful clues to the cause of abortion. Chlamydiosis is usually accompanied by regional or generalized placentitis that in-

volves both cotyledons and intercotyledonary areas. Smears can be made of placenta, umbilicus, or mouth and submitted for acid fast stains or fluorescent antibody tests. *Coxiella burnetii* (Q fever) also can cause a generalized placentitis with acid fast organisms, or may be shed in the placenta at normal lambing. Campylobacteriosis is associated with autolyzed fetuses but a normal placenta. Less than 15% of *Campylobacter* lambs show necrotic liver lesions. Cultures of abomasal contents are useful for diagnosis. Campylobacteriosis is much less common in goats than sheep. Toxoplasmosis may cause fetal mummification or an autolyzed fetus accompanied by an apparently healthy lamb or kid. A mummy will be a uniform brown color with sunken eyes and elongated nose. The intercotyledonary placenta is normal with toxoplasmosis but white, necrotic and mineralized foci may be demonstrated by pressing a cotyledon with a glass slide or holding it under running water. Remember the zoonotic potential for these diseases and keep pregnant women away from the fetuses and placentas. Pregnant ewes should be removed to a clean pen or pasture, leaving the aborted ewes isolated in the contaminated area.<sup>4</sup> Treatment with oxytetracycline might be started while waiting for laboratory results in the case of an abortion storm.

### Autolytic Changes

If the lamb or kid dies in utero and is retained for several hours, it is common to find reddish, gelatinous fluid accumulated under the skin. This is an autolytic change and should not be interpreted as hemorrhage. Likewise, gas bubbles in the lung may result from postmortem growth of bacteria that ascended through the cervix and were swallowed or inhaled into the lungs of the fetus in utero.

### Stillbirth

The stillborn lamb or kid will have lungs that are not inflated and do not float in water. Occasionally a small fraction of the lung is inflated, indicating that the lamb was not quite dead at delivery. Placenta may cover the nose because it was passed when the dead lamb was expelled or because failure of the amnion to break caused suffocation. Stillborn lambs will have a normal amount of brown fat around the kidney and heart. Sometimes autolysis or the weight of other bodies previously piled on top makes it hard to evaluate the lungs visually. If the navel has been dipped, or the lamb or kid has been ear tagged, or there is milk in the abomasum, or the soles of the feet are dirty instead of being unstained and rounded, the animal was not stillborn!

Iodine deficiency is a possible cause of abortion or stillbirth. The normal weight of the combined thyroids is less than 0.04% of the body weight.<sup>1</sup> Enlarged thyroids (goiter) usually result from failure to supply dietary iodine, but feeding of cruciferous plants during gestation and inherited thyroid diseases are other possible causes.

Copper deficiency can lead to abortion or weak neonates and a deficiency of selenium or vitamin E will predispose to slow parturition, poor colostrum intake and poor immune response to infectious agents. When losses are otherwise poorly explained, or for routine monitoring, trace mineral analysis of neonatal livers is valuable.

### Dystocia

A lamb that becomes anoxic during the birth process will defecate in utero and become stained yellow from the meconium. The staining is less evident on kids, as hair does not seem to hold the feces as readily as wool does. A swollen head and tongue are good indications that the fetus was stuck part way out long enough for pressure from vulva or vagina to restrict venous return from the head. A lamb or kid that is compressed during a dystocia or is stepped on afterwards may experience a rupture of the liver capsule. Blood leaks into the abdomen, causing hemoperitoneum and killing the lamb, presumably from hypovolemia. Ribs may be fractured during a dystocia or if the lamb is stepped on after delivery. Closer supervision, training of personnel to recognize dystocia, and selection for lambing ease are possible responses to excess dystocias. Cache Valley lambs with arthrogryposis will cause dystocia; the ewe or doe will be immune the next year. Losses can be limited by not breeding during the mosquito vector season.

### Hypothermia and Starvation

The lamb or kid that dies of hypothermia before starvation has time to develop is difficult to diagnose with certainty or to differentiate from infectious postnatal losses. Some brown fat remains, seen on the kidney and pericardium. Usually the abomasum is empty except for a little amniotic fluid or scant colostrum. Some meconium may remain in the intestines. The lamb may have a wet coat because the ewe did not lick it dry. Subcutaneous hemorrhages over the limbs, visible if the skin is removed, are evidence of hypothermia before death.<sup>5</sup> Small lambs or kids, triplets or quadruplets, and neonates from sick or inexperienced dams are at greatest risk. A history of cold or rainy weather heightens the suspicion of hypothermia.

The brown fat is rapidly metabolized for nonshivering thermogenesis if the neonate does not get colostrum. Instead of almost completely hiding the kidney, it will be reduced to small remnants of red tissue. The abomasum and intestines are usually empty in the starved neonate, but may contain milk if the caretaker tube fed the animal shortly before it died. Early and adequate colostrum (an ounce per pound three times the first day or 180 to 210 ml/kg during the first 24 hours,<sup>2</sup> tube fed if the neonate is weak) and monitoring subsequent milk intake by evaluation of abdominal fill and behavior of the lamb or kid will prevent these conditions. As part of a flock problem investigation, total protein can be

determined by refractometry on 10 to 20 lambs at one day of age, with plasma values greater than 6.5 g/dl indicating adequate colostrum absorption.<sup>7</sup> Less information is available on desirable total protein values in day old kids, but 5.4 g/dl in serum has been suggested as a cut-off.<sup>8</sup> Claiming pens may improve bonding and lamb coats and hovers decrease the risk of chilling. If the lamb or kid is both chilled and starved it will need intraperitoneal dextrose before warming and feeding.<sup>2,5,7</sup>

### Pneumonia

Cranioventral bronchopneumonia from which *Mannheimia haemolytica* can be isolated is a common cause of death of lambs and kids. Inhalation pneumonia from improper bottle feeding or white muscle disease or a cleft palate will appear similar. The right cranial lobe is involved first and often most severely, as it has a separate bronchus off the trachea. In an acute, active pneumonia the involved lung lobes are firm and swollen. A fibrinous pleuritis may also be present. If the lung is not firm, no matter what color it is, there is no pneumonia. As the lesion resolves, previously pneumonic lung may be depressed relative to normally inflated portions.

### Umbilical Infections

Abscesses may involve the remnant of the umbilical vein that goes to the liver, with exudate or a scab visible on the overlying skin. Large *Fusobacterium* abscesses in the liver should prompt you to check if the navel was properly dipped with iodine (7% tincture of iodine remains the gold standard) and lambing jugs are clean and dry. Smaller milliary abscesses in half of the liver might also have come from the umbilicus but spared part of the liver because of laminar blood flow.

### Septicemia

Lambs that have been septicemic with *Listeria monocytogenes* due to infection crossing the placenta or passed through the milk frequently develop fever and diarrhea before dying. A classic granular multifocal necrosis of the liver may be visible grossly in some lambs, or may be detected only by histologic examination.

Failure of passive transfer can also lead to septicemia. The presence of fibrin strands in the thorax or abdomen is suggestive of such an infectious process. Septic arthritis in multiple lambs or kids should prompt a review of feeding of the dam (relative to colostrum production), management of lambs and kids in jugs, and colostrum delivery protocols.

### Diarrheal Diseases

Numerous agents can cause diarrhea in the neonate but laboratory support will be required for diagnosis. Enterotoxigenic strains of *Escherichia coli* are rarely involved in diarrhea of lambs and kids unless conditions are unhygienic

and crowded. However, a condition termed watery mouth (because of profuse salivation) does occur in twin and triplet lambs 24 to 36 hours old with *E. coli* colonization of the intestine; these lambs are often constipated.<sup>7</sup>

Cryptosporidiosis is a relatively common cause of herd outbreaks of diarrhea in young lambs and kids, often beginning at three to seven days of age. Oocysts can be demonstrated with an acid fast stain of fecal smears or by examination with a high dry lens after a sugar flotation. Stress improvements in sanitation, colostrum provision and milk intake to prevent cryptosporidiosis and supply supplemental oral electrolytes to prevent death by dehydration. Also remind farm workers that this parasite is zoonotic.

### Abomasal Bloat

Artificially reared lambs and kids occasionally bloat and die rapidly at several weeks of age. The abomasum will be massive distended and sometimes the wall is emphysematous. Prevention may entail smaller meals, cold milk replacer, more attention to hygiene of the milk replacer and feeding equipment, or selection of a low lactose milk replacer.

### Conclusions

When a herd problem with neonatal losses exists, gross necropsy of as many lambs or kids as possible will permit categorization as to probable cause of death. The number dy-

ing of abortion, stillbirth, dystocia, hypothermia, starvation, pneumonia, umbilical infections, diarrhea and abomasal bloat can be tallied, with less sure estimates made for hypothermia and septicemia. The total losses and the number in each category should be compared with the number of lambs or kids delivered during the time period under investigation. This will allow the veterinarian and caretaker to prioritize problems to be addressed by laboratory testing, improved nutrition of the dam, colostrum management, umbilical care, hygiene and bedding in the claiming pens and similar interventions.

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