Pregnancy Disease - A Flock Perspective

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Pregnancy disease (pregnancy toxemia, twin lamb disease, lambing sickness, lambing paralysis or lambing ketosis) typically affects ewes during the last 2 to 4 weeks of pregnancy and is a common cause of ewe and lamb loss in Michigan flocks. Over-conditioned or thin ewes, usually pregnant with multiple fetuses, are most commonly affected and clinical cases are generally limited to older ewes during their second or subsequent pregnancies. Pregnancy disease is rare in both bred ewe lambs or yearlings bred for their first pregnancy.

Clinical cases of pregnancy disease usually follow a period of negative energy balance in the diet (the ewe is "burning" more calories than she is consuming in her feed) resulting in low blood sugar levels in the affected ewe. This destabilization of the blood sugar (glucose) level forces the affected ewe to utilize body fat reserves to stabilize her blood glucose levels and to adequately meet the energy requirements of the dam and her developing fetuses. This "breakdown" of body fat reservoirs to produce much needed blood glucose is commonly referred to as fat catabolism. While fat catabolism temporarily addresses the energy needs of the ewe, it also produces waste by-products (known as ketone bodies or simply ketones) which can be measured in the blood and urine of affected ewes. These ketone bodies suppress appetite and are the origin of the term lambing ketosis or pregnancy ketosis.

In the "real world" of purebred and commercial production systems there are a host of nutritional, metabolic and management factors that contribute to pregnancy disease. These include: 1) increased nutritional demand related to the developing fetus, 2) reduced rumen capacity, 3) improper, declining or interrupted nutrition, 4) management, environmental, transport, shearing and predator stresses, 5) concurrent disease and 6) ewe susceptibility. When flock involvement occurs, a more simplified system involves dividing the causes of pregnancy disease into the four broad categories of: 1) primary pregnancy disease , 2) fat ewe pregnancy disease, 3) starvation pregnancy disease and 4) secondary pregnancy disease. ***Primary pregnancy disease*** results from a drop in the plane of nutrition during late pregnancy and/or management changes that create a brief period of fasting. ***Fat ewe pregnancy disease*** results from an over-conditioning (too fat) of the ewe flock during early pregnancy, followed by a late gestational decline in nutrition. ***Starvation pregnancy disease*** involves excessively thin ewes whose condition usually results from mismanagement of feed resources or unavailability of feed following periods of drought or heavy snowfall. ***Secondary pregnancy disease*** has a more sporadic occurrence and is the result of concurrent disease in affected ewes (foot rot, pneumonia, etc.). Notice the management slant to both of the preceding lists.

Occasional cases: Clinical cases of pregnancy disease occur sporadically, unpredictably, and at a low level in most flocks - independent of adequate management and feeding practices. Affected ewes generally involve less than 1% to 2% of the ewe flock, yet death rates often exceed 80% of affected animals. Mortality is especially high (even in treated animals) when producers delay treatment until affected animals become recumbent. Additionally, sporadic cases often involve animals with concurrent health problems (post-shearing pneumonia, age-related poor dentition, lameness, etc.) that force an individual "off feed," resulting in fat catabolism and ketosis. *Occasional cases of pregnancy disease, even in well managed flocks, suggest that certain genetic lines or families may be predisposed to developing pregnancy disease. Therefore, off-spring from affected ewes should not be retained for flock replacements.*

Flock involvement: Pregnancy disease also occurs at the flock level, characterized by numerous clinical cases of pregnancy disease during the last month of gestation. Affected animals often comprise 5% to 15% of the ewe flock with mortality rates often exceeding 80% of affected, untreated individuals. When flock involvement occurs, economic losses can be substantial. In Michigan, flock involvement typically results from improper feeding management decisions or sudden weather changes that generate nutritional, environmental, or psychological stresses that impact the pregnant ewe.

What happens in susceptible & resistant ewes

Unstable blood sugar levels: Producer experience suggests that most clinical cases of pregnancy disease can be prevented by balancing the nutritional intake of the ewe with the increased late pregnancy needs of the dam and her fetus. Late pregnancy energy requirements are substantial - 1.5 times (ewe with a single lamb) to 2 times (ewe with twins) above that of an open ewe. Furthermore, 80% of fetal birth weight (size) is deposited during the last 6 weeks of gestation. During this time the fetus is supplied almost entirely by glucose, consuming 40 per cent of the blood sugar produced by the mother. Thus, fetal energy requirements increase, just as rumen capacity is compromised by the developing fetus. The 150-lb ewe pictured to the right produced nearly 30 lbs of triplets - leaving minimal rumen capacity for feed intake.

Furthermore, the uptake of glucose by the fetus is independent of blood sugar regulation in the dam. Thus, as glucose production in the dam declines, fetal glucose demands remain satisfied - at the expense of the stability of blood glucose level in the dam. Although often detrimental to the dam (and ultimately the fetus), this fetal glucose safety mechanism assures short-term fetal viability, even in the presence of declining blood sugar levels in the dam. *Disruption of this glucose*

homeostatic(stabilizing) mechanism in the ewe is thought to be the metabolic event that initiates pregnancy disease in the ewe. However, this does not explain why many ewes develop extremely low blood glucose levels during late pregnancy - yet only certain individuals develop clinical signs of pregnancy disease.

While disruption in blood glucose homeostasis (stability) in *susceptible ewes* appears to trigger the symptoms associated with pregnancy disease, it is important that producers and their veterinarians recognize that flock populations contain individuals that are either susceptible or resistant to pregnancy disease. Recent research suggests that *susceptible* ewes have impaired insulin function and are, therefore, unable to regulate blood sugar stability during late pregnancy. This impaired insulin function is most likely an inherited trait, suggesting that pregnancy disease may be very similar to insulin-dependent diabetes mellitus in humans. From a practical perspective, genetic susceptibility or resistance to pregnancy disease might help explain the wide variations in flock management that appear able to initiate clinical cases of pregnancy toxemia. This may also explain why it is not uncommon to observe long-established flocks, with inadequate feeding practices, experiencing very few cases of pregnancy disease each spring. In these flocks, susceptible individuals may have been naturally culled (died due to pregnancy disease) from the flock gene pool.

How can I tell if a ewe has pregnancy disease?

Early clinical signs of pregnancy disease often go unnoticed. Affected ewes act sluggish and approach feeders with the remainder of the flock, yet fail to eat. Affected ewes usually appear pregnant with multiple fetuses and are usually in the last 2 or 3 weeks of pregnancy. As the disease progresses, affected ewes separate themselves from the flock. They appear blind, disoriented, and often wander into objects or stand for long periods of time in the same area of the barn. Head pressing, teeth grinding, muscle tremors, lip twitching, a "star-gazing" posture to the head and neck, and constipation are often noted. As the disease progresses, weakness and mental dullness increase and the ewe goes down and is unable to stand. Recumbency usually develops 3 to 4 days after observation of early clinical signs and is followed by death in another 3 to 4 days. Fetal death (inside the ewe) may also occur. Urine ketone test strips (see your veterinarian) and a ketone smell (fruity) to the ewe's breath may also be helpful diagnostic aids. Recovery may result if lambing occurs, or if the fetuses are removed by Cesarean section or steroid-induced parturition. Other disease considerations might include milk fever (low blood calcium), listeriosis (circling disease), and brain worm infection.

Post mortem findings - what your vet might see: Necropsy findings will vary according to the body condition of the ewe at the onset of the disease and the initiating cause. Sporadic cases of pregnancy disease in well-fed ewes are often secondary to other disease conditions (pneumonia, internal abscesses, chronic lameness, etc.) that have little to do with flock feeding or management practices. The uterus of most affected ewes contain multiple fetuses, that due to in-utero fetal death, are in various stages of decomposition. Due to fat infiltration of the liver, *fat ewes* will exhibit enlarged, friable, pale yellow-colored livers. However, this finding alone is not sufficient for a diagnosis of pregnancy disease. Fatty infiltration of the liver is a normal event during late pregnancy (the liver of normal ewes may increase from 3% to up to 30% fat). Stress related enlargement of the adrenal glands

is also common.

In contrast, *thin ewes* typically exhibit signs of starvation (a lack of and/or a clear, "watery" appearance to kidney and cardiac fat and enlarged adrenal glands), much like hypothermia and starvation lambs. When starvation is the primary cause of pregnancy disease a large, single fetus is not an uncommon post-mortem finding. Interestingly, microscopic examination of brain tissue reveals brain damage resulting from low blood sugar levels (hypoglycemic encephalopathy). This neurological damage probably explains the dullness, stupor, and other assorted nervous signs noted with pregnancy disease.

Individual treatment options

Flock owners often fail to recognize the early signs of pregnancy disease until the ewe is in the recumbent, terminal stages of the disease - when treatment is difficult and unrewarding. Therefore, producers should carefully evaluate individual animal treatment options, costs and prognosis *before* treatment is initiated. Unless affected animals are valuable breeding stock, the potential economic value of the lambs (not the ewe) is of primary concern. Thus, commercial producers generally choose to medically support individual animals until lambing, recovery, or death occurs - electing not to involve intensive type therapy, labor induction, or C-section. If affected individuals are extremely valuable, they can be treated intravenously with replacement electrolytes, fluids and glucose, and intramuscular injections of insulin. However, considering production costs and the economic value of most cull ewes, this type of intensive individual animal therapy is usually impractical. Realistically, *prevention of pregnancy disease in the remainder of the flock is much more important and cost effective than individual animal therapy.*

Practical therapy for individual animals: When economic constraints are a consideration, treatment should be aimed at correcting energy, electrolyte and acid-base imbalances, rectifying dehydration, and stimulating appetite. Traditional treatments usually include: daily oral drenching (2 to 4 times/day) with 100 to 200 mls of propylene glycol solution (or corn syrup) and intravenous administration of 250 mls of 20% dextrose or 500 mls of 10% dextrose (usually administered by your vet during the farm visit). Propylene glycol and 50% dextrose solution are commonly used in large animal practice for treatment of bovine ketosis and are available from most large animal veterinarians. Additionally, B-vitamins and/or 50 to 125 mls of a 20% calcium borogluconate solution (used by vets for treating " milk fever" in cattle) are often administered (sub-cutaneously) for the purpose of stimulating appetite and rumen motility. Oral calcium gel preparations (marketed for milk fever treatment and prevention in dairy cattle) can be used in place of subcutaneous administration of calcium solutions. Ewes exhibiting very early signs of pregnancy disease should be immediately drenched with 2 to 4 ounces of propylene glycol 2-3 times/day until appetite is restored, lambing occurs or more intensive treatment is warranted. If recognized ***early***, most affected ewes will respond to drenching. Affected ewes should also be separated from the flock to facilitate observation, retreatment, and to decrease feed bunk competition.

Newer ideas for individual animal medical treatment: Clinical research suggests that the low blood sugar levels, electrolyte imbalances, and dehydration of affected ewes are best treated by the administration of oral calf scour electrolyte replacement solutions. Commercially available calf scour rehydration solutions (ex: Scourlyte, Enterim-5, Biolyte, etc.) typically contain varying concentrations of glucose, sodium chloride, glycine, and other electrolytes. Affected ewes are administered 3 to 4 quarts of solution (mixed per label directions for calves) via a "stomach" tube or drenched (3 to 4 times per day) with 160 mls of a concentrated preparation of the product. Rehydration may also be helpful in addressing the dehydration and constipation commonly observed in affected ewes. Research suggests that this type of therapy elevates blood glucose levels higher than those achieved following a propylene glycol drench (conversion of propylene glycol to glucose requires a healthy liver which has often been damaged by the fat breakdown occurring in pregnancy disease).

Other treatment options for individual animals: Treatment may also be aimed at removing the source of glucose drain on the ewe (remember that the developing fetuses are causing the drain). This usually involves removing the lambs by C-section or by inducing labor. However, lambs that are born more than 7 days premature will seldom survive (most producers can only guess at due dates). Unless an accurate breeding date is available, C-sections and labor induction are usually reserved for saving the life of the ewe - at the expense of her lambs. Producers and their veterinarians should reserve C-section or induction for the early stages of pregnancy disease - before the ewe's condition is irreversible and fetal death has occurred. Induction of labor usually involves treating the ewe (SQ, IM or IV) with 20 mg of dexamethasone (Azium). In normal ewes, lambing typically occurs about 48 to 72 hours post injection. However, during the later stages of pregnancy disease, induction of labor is both variable and often unreliable.

Economic implications for the producer

Economic information regarding pregnancy disease in the U.S. sheep population does not exist; however, the following personal observations seem appropriate. Income losses associated with pregnancy disease occur from both loss of the ewe and her unborn lambs and expenses related to treatment and prevention. While producers often fail to recognize the loss of the lamb(s) as an income potential not realized, the loss of a ewe at the end of the winter feeding period is an expense that most producers understand. Dependent upon the production system, ewe feed costs (mostly wintering costs) account for about 50% of the annual ewe budget. In Michigan, the estimated costs associated with the loss of a ewe with pregnancy disease would amount to $105 to $180/ewe, plus any incurred treatment costs. This figure includes the replacement value of the ewe ($80 to $120 for ewes delivered in mid to late gestation) and previous winter feed costs ($25 for grazing-oriented flocks up to $40 - $60 for semi-confinement operations).

It is important that producers understand the economic implications of these figures. When a ewe dies from pregnancy disease, most of the annual costs of maintaining that ewe (except the lactation diet) have already occurred - yet no annual income from the sale of her lambs has been or will be generated. However, *an economic loss of $105 to $180/ewe creates an expense barrier that limits individual animal treatment options - except in the case of valuable breeding stock.* From a veterinarian's

point of view, economic necessity suggests that practitioner recommendations should focus on prevention of pregnancy disease in the remainder of the flock instead of individual animal treatment.

Prevention of pregnancy disease in the ewe flock

Production Level	Suggested Body Condition Score
Maintenance	2
Breeding	2.5
Early Pregnancy	2.5 - 3
Late Pregnancy	3 - 3.5
Lambing	3.5
Weaning	2 - 2.5

What should occur: Flock problems with pregnancy disease can normally be prevented by designing a practical nutritional program tailored to the production requirements of the flock and the feeding system utilized by the producer. Feeding recommendations, however, are only as effective as a producer's ability to comply. Sheep, as forage-based animals, receive very limited amounts of grain (concentrate) in their diet. Concentrates, when fed at all, are generally limited to breeding, late pregnancy, and lactation. Additionally, late pregnancy feeding recommendations must also address reduced rumen capacity (due to rumen/uterine competition by the developing lambs for a limited amount of abdominal space) and the greatly increased energy needs (>200% above maintenance) of the late pregnant ewe. Ewes that are in a 2.5 to 3 body condition score 6 weeks before lambing are in an ideal condition to respond to increases in energy in the late gestational diet. During the last 6 weeks of pregnancy, ewes carrying singles usually increase body weight by about 10%. Ewes carrying twins typically increase body weight by about 18%. Thus, the flock should at least maintain or gain condition to a 3 to 3.5 score by lambing.

Suggested body condition scores (1-5 scale) at various stages of production are given to the right. Note the increase in condition score as parturition approaches. Body condition scores should also be monitored to ensure that: 1) ewes are not becoming excessively fat during early gestation and 2) the plane of nutrition rises during the second half of gestation. Shearing the ewe flock 4 weeks prior to the expected lambing date can aid producers in detecting poor or excessive condition.

What if ewes are too fat? (notice the excessive tail-head fat deposition on both ewes on the right side of the picture): *Excessively fat ewes should be fed to reduce body condition during maintenance or early pregnancy.* ***Reductions should not take place during late pregnancy***. Weight reduction during late pregnancy often precipitates clinical cases of pregnancy disease. For Michigan producers, pregnancy disease resulting from over-feeding during early pregnancy is a

common problem for: 1) small farm flocks, 2) beginning producers, and 3) in feeding systems where high energy forages (wheat hay, oat hay, corn silage, excellent quality alfalfa hay or balage, etc.) are fed free-choice.

In contrast, pregnancy disease initiated by under-feeding and starvation (photo at right of thin ewes with pregnancy disease) is a common problem with larger, grazing-oriented commercial flocks. Larger flocks are severely impacted by drought-induced feed shortages. Adverse weather conditions and lack of housing facilities (both increasing energy demands) further add to negative energy balances.

Feeding recommendations hay and grain diets:
Although feeding recommendations will vary from farm-to-farm, the following guidelines are useful for producers unfamiliar with standard feeding practices for pregnant ewes. The guidelines assume a 160-lb commercial ewe carrying twins.

> ***Early pregnancy rations*** usually consist of 100% forage diets incorporating 4 lbs of medium quality, first cutting grass/mixed hay (8-10% crude protein, 52% TDN).
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> ***Late gestation diets*** usually include 3.5 to 4 lbs of a better quality hay (>10% crude protein and >55% TDN) and a once-daily feeding of 1 to 1.5 lbs of concentrate (whole shelled corn is most economical in Michigan). In commercial flocks, concentrate feeding generally begins about 4 weeks prior to the projected arrival of the first lambs. Initially, grain is fed at the rate of about 0.5 lbs/head/day and gradually increased to about 1.5 lbs/head/day about two weeks before lambing. *If ewes are thin, shorn and weather stresses are severe; concentrate amounts are often increased to as much as 2 to 3 lbs/head/day (split into two feedings).* Thus, pregnancy disease is avoided by increasing the energy density of the diet at a time when requirements increase and rumen capacity declines.

Unfamiliar feeds often contribute to flock outbreaks: While hay and concentrate late pregnancy rations are the norm for most Michigan flocks, flock outbreaks of pregnancy disease commonly occur when producers switch to, or are forced to utilize, unfamiliar feed ingredients. *Problem feedstuffs commonly include energy dense small grain hays and high moisture (bulky) feeds such as corn silage and haylage*. **Small grain hays** can be (depending on harvest quality) extremely energy dense (70-75% TDN) and are very palatable. If fed free-choice during early gestation, consumption approaches 6 to 7 lbs/head/day (on an as fed basis). Thus, energy intake during early gestation can exceed requirements by as much as 200 - 300%. Free-choice feeding of small grain hays during early pregnancy can lead to excessively fat ewes - ripe to develop pregnancy disease during the last four weeks of pregnancy. However, if small grain hay quality is poor, the opposite problem of starvation can occur. This scenario illustrates the importance of forage testing.

Silage and haylage can lead to similar problems if fed free-choice during early gestation. Haylage is extremely palatable, and corn silage is both palatable and a high energy feed. Over-consumption of either haylage or corn silage can lead to excessive energy intake during early pregnancy (fat ewes). During early pregnancy, free-choice consumption of corn silage or haylage approaches 12 lbs/head/day (on an as-fed basis). *Most early gestational energy requirements are met with 6 to 7 pounds of corn silage or haylage*. Moisture content (bulk) of these feeds may also contribute to pregnancy disease if these feeds are unsupplemented during late gestation. Reduced rumen capacity combined with the bulk and moisture content of the feeds limits intake. *Forage analysis and ration formulation are especially important when feeding high moisture feeds, small grain hays, and other atypical feeds. Most flock outbreaks of pregnancy disease can be prevented with proper feeding practices.*

Many less tangible feed management factors can also contribute to the prevention of flock outbreaks of pregnancy disease. When possible, the flock should be separated into feeding groups related to single, twin, or triplet pregnancy status and fed accordingly. Ultrasound scanning can be helpful in sorting ewes into various feeding groups, but is not commonly practiced in the state. Lack of facilities may also prevent this type of sorting. When scanning and sorting is not possible, producers should feed the flock for a lambing rate that is consistent with flock history. Most Michigan producers feed late-pregnant ewes for a level of production associated with twins. To allow *all* ewes to gain access to concentrate and roughage, sufficient bunk space (1 ft/ewe) should be available.

Producers should also be aware of flock behavioral differences when adding purchased ewes to a native flock. This is especially important when western range ewes are imported into existing farm flocks. Many western ewes are unfamiliar with machinery noise and intensive bunk feeding practices typical to Michigan farm flocks. Range ewes are often timid and fail to compete with native ewes for supplemental concentrate feeds. Pregnancy disease may be limited to the newly-introduced range ewes, while native ewes appear to be free from clinical signs. Housing and feeding new additions as a separate group (the first season) may help to decrease competition with native ewes and reduce the likelihood of timid ewes developing pregnancy disease. Finally, adjustments in feeding programs also need to address weather conditions, fleece status, and housing availability - all of which affect energy requirements. Producer attention to a variety of factors that influence body condition scores is necessary if pregnancy disease is to be prevented.