Understanding mastitis in sheep

Better Returns Programme

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Key messages

- Mastitis can present with physical signs such as heat or swelling in the udder, watery or bloody secretions or palpable intra-mammary masses (IMM).
- Flock level incidence of clinical mastitis ranges from 0-6.6% per year.
- When one ewe has mastitis the flock is at increased risk due to its contagious and transmissible nature.
- Over 30 bacterial species have been isolated from sheep milk.
- Underfeeding protein and energy in pregnancy and lactation increases the risk for mastitis, so ensure appropriate levels are fed.
- Low body condition score (BCS) at lambing has been linked to sub-clinical and clinical mastitis.
- Poor hygiene at lambing time will allow environmental bacteria to multiply and increase the chance of infection.
- Good udder conformation is associated with decreased risk of mastitis.
- The chance of developing acute mastitis increases when ewes rear two or more lambs regardless of ewe age.
- The risk of developing mastitis increases the longer ewes and lambs stay indoors.
- It is beneficial to leave ewes and lambs in the same area, before, during and after lambing, so they are not challenged by unfamiliar bacteria.
- Although knowledge has increased, there is still no effective control strategy to prevent mastitis .
- The recommended treatment is injectable antibiotics and anti-inflammatory medicines given as soon as possible.
- It is unlikely that any one vaccine will prevent mastitis. Focus on hygiene and nutrition will always be critical for control.

Keywords:

Mastitis in ewes, mammary gland, udder swelling, intra-mammary masses (IMM), bacterial infection, *staphylococcus aureus,* nutrition, hygiene

Contents

Introduction

Mastitis is an inflammation of the mammary gland, usually caused by bacterial infection. It can present as sub-clinical infection or clinical disease; which can be acute (sudden, short-term) or chronic (long-term).

Mastitis can result in premature culling of affected ewes, loss of udder function, reduced milk yield and quality, and occasionally death. Reduced milk production leads to lower growth rates of suckling lambs and impacts on farm profitability.

Estimates suggest that mastitis costs the UK sheep industry more than £120 million per year in direct and indirect costs. It is ranked as one of the most important diseases affecting ewes.

Mastitis

Mastitis is predominately caused by bacteria, but other causes include viral infection, eg mastitis is a symptom of Maedi Visna, which is a viral disease affecting sheep.

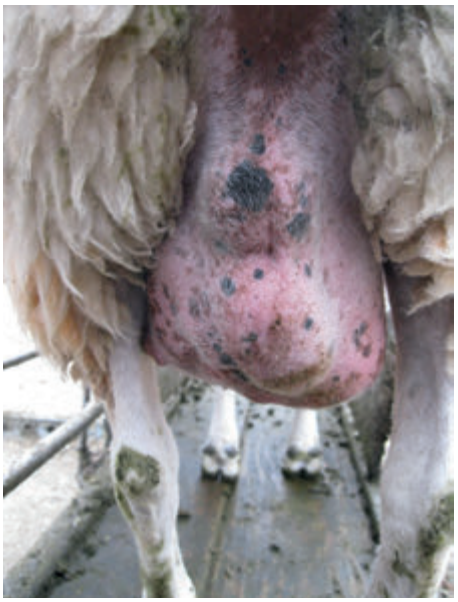
The first line of defence for the udder is the teat end, which has a sphincter that closes to protect the teat canal and prevents entry of bacteria. Bacteriostatic keratin-secreting cells in the canal also play a defensive role. During milking and suckling the teat end is open and can stay dilated for up to two hours.

Damaged teats or udder injuries can increase susceptibility to bacterial invasion, eg due to damaged keratin-secreting cells or the teat end not closing properly.

The inflammatory response is the ewe's second line of defence. This includes the accumulation of somatic cells such as leukocytes to destroy invading organisms. The magnitude of response can vary and influences disease presentation. Some bacteria release toxins which can destroy the udder, impair function and cause pain to the ewe.

Presentations

Mastitis can present physical signs such as heat, swelling in the udder, watery or bloody secretions, or palpable intra-mammary masses (IMM).



Both acute and chronic mastitis present with physical signs.

Acute mastitis can include:

+ Heat
+ Swelling
+ Pain in the udder that causes the ewe to appear to be lame in the hind leg
+ Cold, hard udder
+ Black udder
+ Milk becomes a watery or bloody secretion
+ Clots may be seen in the milk
+ A sick ewe hanging back from the flock and not eating
+ A ewe will not allow lambs to suckle
+ Lambs looking hungry

Chronic mastitis includes:

+ Palpable intra-mammary masses (IMM) in the udder

Sub-clinical infection presents no visible signs of disease but the mammary gland is still infected. Indirect indicators include:

+ Decreased yield and quality of milk
+ Poor or lower lamb growth rates than expected
+ The formation of IMM or abscesses. This underlying infection can be detected by testing the somatic cell count (SCC) of the milk, which is a measurement of inflammation

Incidence

There are limited data on the incidence and prevalence of mastitis and several factors about the disease leaves it susceptible to under-reporting. However, of the data available, the reported flock level incidence of clinical mastitis ranges from 0-6.6% per year.

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Sub-clinical infections have been reported to affect up to 50% of the flock. However, because of the difficulty in detecting sub-clinical infections the true levels may be higher.

Chronic disease, where IMM are used as an indicator, has been detected in almost 5% of ewes during pregnancy and 11% during lactation. The cycle of these lumps appearing, bursting and reappearing could affect precise measures of incidence and prevalence.

When one ewe has mastitis the flock is at increased risk due to its contagious and transmissible nature. Identifying and treating individual cases could decrease the risk of mastitis spreading to others.

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Detection of acute mastitis is more straightforward due to the visual clinical signs, than chronic disease and sub-clinical infection. Flock-level testing, testing individuals at risk, or checking individual udder health, could help identify chronic or sub-clinical infections.

Costs

Mastitis impacts significantly on farm and industry economics. This can be by direct costs, such as increased use and expenditure on treatments and indirect costs like reduced lamb growth rates.

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Culling

Affected ewes are often culled prematurely because of damaged udders/teats or loss of udder function. This decrease in milk yield and quality affects the flock's production and the farm's profitability. Between 4-6% of ewes are culled due to udder problems.

Treatment

A direct cost of mastitis is the use of treatments such as painkillers, antibiotics and possible visits from the vet. Prompt treatment of affected ewes is necessary to treat disease or infection and prevent damage to udder function. Repeat treatments may be necessary.

Mortality

In extreme cases, mastitis can lead to ewe death and potentially the lambs can die too. This causes production losses and requires extra expenditure on fallen stock removal, replacement ewes and time and feed costs for rearing the lambs.

Reduced milk yield and quality

There is a marked difference in quality, yield, content and clotting ability of milk from infected ewes. This particularly affects production costs, end product quality and profits in the dairy ewe and cheese-making industry. However, there is also a knock-on effect to any suckling lambs.

Lower lamb growth rates

One major indirect cost of mastitis is the impact it has on the growth rates of suckling lambs, due to lower milk yield and quality. It is also possible that damaged or misshapen udders or teats make it more difficult for lambs to suckle or latch on efficiently. More creep feed may be needed, weaning and sale may be delayed and there may be a lower total sale weight.

Results from the validating sheep key performance indicators project has shown that all lambs from ewes that suffered from clinical mastitis were below 17kg at eight weeks. The flock target was to achieve 20kg by eight weeks.

Signs

Acute disease

Visible symptoms, which can appear quite quickly, include a red/discoloured, hot, swollen udder or udder half, which is painful to touch. It is possible that behavioural changes due to pain arise, eg lameness to avoid hitting the udder against the rear leg, increased vocalisation, reduced activity or 'unwillingness' to lie down and not allowing lambs to suckle.

Unusual discharge might also be seen such as watery milk or a pus-like secretion. Manual expression of milk may be difficult or impossible.

Other systemic signs may be present, including increased temperature, anorexia and an increase in the SCC.

Severe cases can turn gangrenous, sometimes referred to as blue bag or black bag, as the udder turns blue or black due to the toxins secreted by the bacteria. The udder or udder half can slough off and the ewe may appear physically well after this. However, the ewe can still die and the risk of secondary infection is high.

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Sub-clinical infection

Ewes with sub-clinical mastitis appear unaffected as they do not exhibit visible signs of infection. However, when infection is present, ewes will have increased levels of somatic cells (white blood cells) in the milk. Whilst these cells can be detected by pen-side or laboratory tests, other indicators include under-performing lambs. This is because sub-clinically infected ewes may have a reduction in milk yield and quality. As a result of this, lambs can take longer to achieve their finishing weight.

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Chronic disease

With chronic disease, IMM in the udder can be palpated. These lumps are of abnormal consistency when compared to the rest of the udder and are abscesses that have formed as a result of an infection. Their size does not correlate with severity. These abscesses can rupture, spreading infection around the udder and can reform at a later date.

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Progression

It is likely that chronic disease starts as acute disease or sub-clinical infection.

Ewes that have had acute mastitis are 12 times more likely to develop IMM than ewes that did not have acute mastitis.

Bacteria species involved

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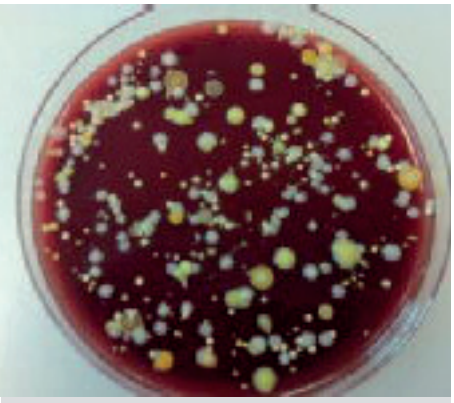

The major causative bacterial species for mastitis in sheep are *Staphylococcus aureus, Mannheimia haemolytica*, *Streptococcus sp.*, *Escherichia coli* and coagulase-negative *staphylococci* (CNS).

Staphylococcus aureus is one of the most frequently detected species responsible for acute mastitis. However, it has also been associated with sub-clinical infection and chronic disease, where closely related strains of this species have been found in IMM.

Mannheimia haemolytica has also been highlighted as a significant causative species. It is thought to be the most common cause of acute mastitis in certain parts of the UK and Europe for meat sheep. Australian research has shown that it can also persist, linking it to chronic disease.

Escherichia coli infection from the environment can cause acute mastitis and is more commonly the causative agent for gangrenous (black or blue bag) mastitis.

The CNS pathogens are thought not to have as much ability to cause disease as the others, although they have been linked to both sub-clinical infection and acute disease.

The transmission of bacteria within the flock could be via the environment, eg *Escherichia coli* or contagiously spread from sheep to sheep, eg *Staphyloccocus aureus*, through milking equipment or the hands of milkers in dairy flocks, or cross-suckling lambs in flocks of meat sheep. The actual transmission patterns or pathways are still to be fully established.

The presence of these bacteria in milk does not always mean infection. It has been demonstrated that healthy individuals shed or carry bacteria such as *Staphylococcus aureus*. Intra-mammary microbial communities exist that include many species of bacteria. Fluctuations in these communities could initiate or predispose the ewe to mastitis.

Risk factors

Nutrition

Feeding a ration that meets the ewes' requirements for energy and protein during pregnancy and lactation is important so they can produce healthy lambs and have sufficient milk.

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Dairy cow research has shown that feeding heifers the correct balance of energy and protein has been identified as important for them to have a healthy immune system and especially important at the onset of lactation. Cows in negative energy balance have depressed immune systems and increased risk of intra-mammary infection.

In sheep, underfeeding protein in pregnancy is associated with increased risk of acute mastitis in lactation. Protein is involved in mammary development and if protein is insufficient in the diet, there will be inadequate milk supply for lambs. Hungry lambs lead to possible trauma of the teats and udder through over-eager suckling, which can then lead to acute mastitis.

Underfeeding energy in pregnancy and lactation is associated with an increased risk of IMM and acute mastitis. The ewe is under increased physiological stress during these times, whilst experiencing increased energy demands.

Underfeeding protein and energy in pregnancy and lactation increases the risk for mastitis, so ensure appropriate levels are fed.

Increased risk of sub-clinical and acute mastitis have been linked to vitamin A deficiency and selenium deficiency. However, results and evidence are varied on the effectiveness of the role of these vitamins and nutrients. More investigation is needed.

See BRP manual on **Improving ewe nutrition for Better Returns** for more details on metabolisable energy and protein requirements of ewes in late pregnancy and early lactation. Email brp@ahdb.org.uk or call 024 7647 8834 to get a free copy, or download it from beefandlamb.ahdb.org.uk

Body condition score (BCS)

Low BCS has been linked to sub-clinical and clinical mastitis. Ewes in poor body condition at lambing (below BCS 3 for lowland ewes), or with inadequate nutrition, may not produce enough milk for their lambs. Hungry lambs will butt the udder and perhaps bite teats in their attempts to draw more milk, which can lead to udder damage and teat lesions.

Low body condition score at lambing has been linked to sub-clinical and clinical mastitis.

Hygiene

Good hygiene reduces the risk and spread of infectious diseases. Poor hygiene at lambing time, eg wet and dirty bedding and high stocking densities, will allow environmental bacteria to multiply and increase the chance of infection.

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Infections can also be spread between ewes via contaminated hands or clothing. The practice of testing milk supply can also contaminate bedding, if the milk is squirted freely around rather than being collected into a container.

Presence of lumps

Lumps in the udder (IMM) are a physically detectable mass of abnormal consistency compared to the rest of the glandular tissue. They come in all shapes and sizes.

A common practice is palpation of the udder at weaning or before tupping to detect IMM. Ewes with IMM are sometimes culled, as they are thought to be poor milk producers and are reservoirs of infection that could spread throughout the flock in the next lactation.

A recent UK study found that as the percentage of the flock with IMM in the udder in pregnancy increased, so did the risk of IMM in lactation in individual ewes. This suggests that IMM can be a source of infection to other ewes in the flock. Depending on the bacterial species present, transmission possibly occurs through the cross suckling of lambs.

Intra-mammary masses are not always present at palpation. This is because they are typically abscesses, which develop and rupture as part of their maturation cycle. Rupture facilitates the spread of bacteria within the mammary gland, which then may reform abscesses elsewhere within that gland. On rupture, abscesses can leave behind fibrotic scars. Therefore, IMM may come and go. They may feel different, change size and location.

However, once a ewe has had IMM she is much more likely to have IMM again at a later date, than a ewe that has never had IMM. She is also at greater risk of acute mastitis. The presence of IMM makes teat lesions more likely, possibly because milk supply is affected.

Teat lesions

If a ewe's teats are damaged her mastitis defence mechanism will not be as effective as it should be. It is possible that these lesions create an entry point and an environment suitable for bacterial survival and multiplication.

The skin on teats can be physically damaged by the teeth of lambs during suckling, resulting in cuts and broken skin known as traumatic lesions.

First-time lambers may be more prone to these kinds of lesions as the skin on their teats have not hardened up yet. Their mammary tissue is still developing, so lambs need to feed for longer or more often to obtain sufficient milk, making teat lesions more likely.

The skin on teats can also be affected by growths or lesions, often caused by orf and known as non-traumatic teat lesions.

A ewe of any age that has teat lesions may be reluctant to allow lambs to suckle due to pain. The lamb will need to make repeated suckling attempts to feed.

Increased frequency of suckling increases the chances of bacteria entering the udder and could lead to acute or sub-clinical mastitis. If lambs are prevented from suckling due to teat lesions, this could lead to a build-up of milk in the udder, which can also cause mastitis. The teat lesions themselves can become infected which may make it easier for bacteria to invade the udder.

Teat position and udder conformation

Good udder conformation is associated with a decreased risk of mastitis.

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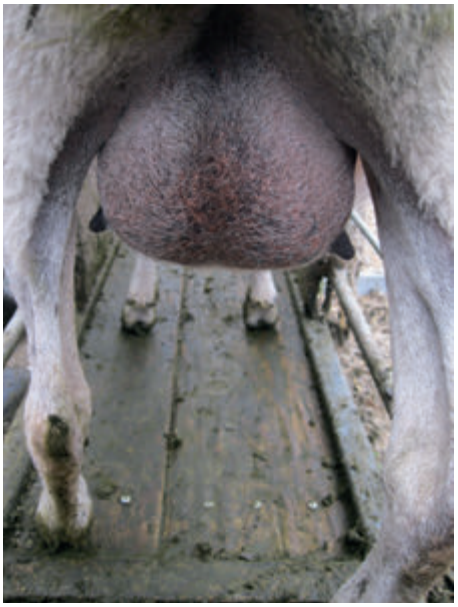


A number of linear scoring systems of udder traits have been developed to assess udder conformation measuring:

- Udder drop
- Udder attachment
- Teat position
- Teat length
- Teat angle
- Degree of separation of the two halves of the udder

In some dairy sheep breeds, udder traits have been included in breeding programmes with the aim of improved machine milking ability. For this, the ideal udder conformation includes vertically aligned teats. However, a different udder shape is more suitable for suckling ewes where lambs feed to the side.

Dairy ewes with pendulous udders (high udder drop) are more prone to poor udder health and research in suckler ewes has shown that pendulous udders are associated with a higher milk SCC. Dairy ewes with low udder drop at or below the hock, are also more prone to intra-mammary infections and udder damage.

Low, pendulous udders are closer to the ground and have a larger surface area. They are more likely to come into contact with environmental bacteria when the ewe is standing and lying down, as well as being difficult to milk by machine.

Pendulous udders may also be difficult for lambs to suckle effectively resulting in repeated suckling attempts, possible milk retention in the udder and increased trauma to the teats. This could lead to an increased risk of teat lesions and intramammary infection.

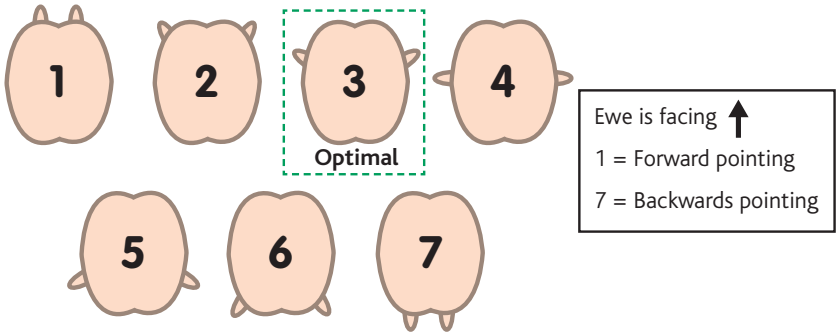
In a research study, an optimum teat angle score of 5 (a 45˚ angle on the udder - see Figure 1) was associated with greater weight gain in lambs. This optimum teat angle was also associated with decreased risk of traumatic teat lesions caused by lambs.

More recent work in suckler ewes, has found that teat angles pointing downward and a forward-pointing teat position were associated with an increased risk of acute mastitis. This might be because teats at these angles and positions are less protected by the non-woolly skin in the flank and more exposed to climate and soil environments, where potential pathogens such as *Escherichia coli* live. They might also be difficult for lambs to suckle effectively. However, it is noteworthy that teat angles that are sought in dairy sheep (vertically aligned, score 1 in Figure 1) to aid machine milking, are rare in suckler sheep and associated with increased risk of acute mastitis.

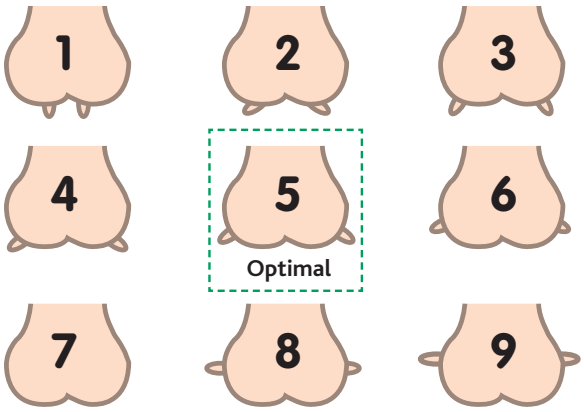
Teat position, teat angle and udder drop have been linked to the risk of mastitis see Figure 1).

Figure 1. Linear scoring system of udder conformation traits with optimal conformation for non-dairy ewes indicated (adapted from *Casu et al.*, 2006).

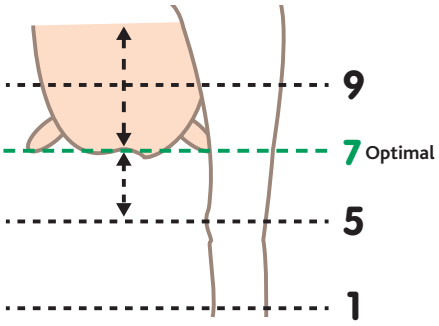
Teat position - The placement of the teats on the udder on a horizontal plane.



Teat Angle - The placement of the teats on the udder on a vertical plane.



Udder Drop – The distance of the ventral abdominal wall when viewed from behind.



Rearing two or more lambs

A number of studies have found that the chance of developing acute mastitis increases when ewes are rearing two or more lambs, regardless of ewe age.

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Lambs carry the bacteria *Mannheimia haemolytica*, a primary cause of mastitis, in their mouths, nasopharynx and tonsils. It has been shown these bacteria can be transferred to the teat canal during suckling. The action of suckling can also push other bacteria, which may be found naturally on the skin or in the vaginal tract, such as *Staphylococcus aureus*, or environmental bacteria that may be contaminating the teats or mouths of lambs, into the teat canal.

If a ewe is rearing more than one lamb she will be suckled more often, giving bacteria more opportunity to enter the teat canal and travel up to the udder. Ewes rearing two or more lambs are also more likely to develop teat lesions, will have greater nutritional demands and may have lower body condition scores.

A ewe rearing twins often produce 40% more milk than a ewe rearing a single lamb, so there will be a bigger demand on her body and udder.

Cross suckling

Cross suckling is likely to occur when a lamb is not getting enough milk from their own mother because she has sub-clinical, chronic or acute mastitis.

When they do attempt to suckle another ewe, they may transfer some bacteria from their dam's udder and teat canal to the new ewe, spreading infection. Cross suckling is more likely where ewes are rearing larger litters, have teat lesions, are malnourished or where ewes and lambs are housed together in small spaces.

Age of the ewe

There is an increased risk of sub-clinical, chronic and acute mastitis in older ewes more than four years old. Older ewes are also more likely to have lower BCS and poorer udder conformation.

Aged ewes may be more likely to suffer from other health issues, which may make them more susceptible to mastitis.

First time lambers are also at risk of mastitis, possibly due to an increased risk of teat lesions from suckling lambs, the skin of the teat has not quite hardened yet and it being the first time exposed to such bacteria, while the mammary gland is still developing.

One study has demonstrated that first time lambers take longer to feed their lambs than older ewes, so increasing the risk of teat lesions and udder damage.

Maedi Visna

Most mastitis in ewes is caused by bacterial infection. However, the Maedi Visna virus, which was introduced into the UK through imported sheep, can cause mastitis presenting as lesions and hardening of the udder.

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The virus has a long latent period, during which it propagates and spreads in the body without any clinical signs, possibly for months or years. Infection persists for life.

Respiratory disease with nasal discharge is a common symptom of Maedi Visna infection and the virus is primarily transmitted via this secretion. This means it can spread rapidly when sheep are housed. Maternal transmission may also occur from ewe to lamb via colostrum and milk.

Infection can be detected by blood testing. In the UK there is a voluntary Maedi Visna Accreditation Scheme (MVAS). Membership means all sheep in the flock have been tested and are free of Maedi Visna. It is advisable to have the flock tested to join the MVAS and only to purchase sheep from other accredited flocks.

Indoor or outdoor lambing

The incidence of clinical mastitis increases when lambing indoors compared to outdoors. The risk of developing mastitis increases the longer ewes and lambs stay indoors.

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Increased stocking densities means ewes are much closer together, increasing bacterial load and infection can spread more easily. There is also greater chance for cross suckling. Contaminated bedding or damp, warm conditions can also favour bacterial growth.

It appears that ewes with twins born indoors are less likely to get mastitis than ewes rearing twins outdoors. It is possible ewes with larger litters receive more attention and better feeding when inside. A lack of nutrients, competition for food and reduced checks for the outdoor multiple birth ewes, could increase the risk of mastitis.

When lambing indoors, appropriate flooring and the provision of fresh straw every day, can reduce the risk of mastitis. The flooring needs to offer good drainage and be easy to clean to prevent bacterial growth.

It is beneficial to leave ewes and lambs in the same area, before, during and after lambing, so they are not challenged by unfamiliar bacteria.

While not always practical, it is beneficial to leave the ewes and lambs in the same area before, during and after lambing, so they are not challenged by unfamiliar bacteria. For example lambing in a shed, moving to a covered area just outside the shed, then to a neighbouring field. Using areas that are in the same vicinity to each other increases the chances of the environments having similar bacterial communities.

Moving during these times increases mastitis levels. This could be because the ewe has adapted to the bacteria in her environment. If she is moved when her teat orifices are open, she may not adapt quickly enough.

Early weaning or extended lactation

There is currently no evidence on the effect or impact of early or late weaning on mastitis. However, it is important to pay attention to ewe and lamb nutrition as part of an effective weaning strategy.

It is possible to wean early or late by ensuring the ewes and lambs have an adequate diet to meet their nutritional demands. This could include the addition of creep feed and manipulating protein and energy levels in the ewe diet.

Use the ewes' BCS, lamb daily liveweight gain and feed availability to decide on weaning date. If grass supply is restricted then ewes and lambs end up competing with each other for feed. The lambs should be the priority for feed quality and quantity.

Udder chilling and dagging

Chilling of the udder in cold weather, or over-exposure from short tail docking or excessive crutching or lack of shelter, has traditionally been thought to predispose ewes to acute mastitis. However, there is no scientific evidence to support this, although there are anecdotal reports of a higher incidence in cold, harsh weather conditions.

It could be that in such conditions ewes are unable to graze sufficiently to produce enough milk to feed their lambs and keep themselves warm. Lambs increase their demand for milk to keep warm, putting increased physiological pressure on the ewe, making them more prone to diseases like mastitis.

Dagging, the process of shearing dirty wool from around the rear of the sheep, can be helpful during warmer weather to reduce fly numbers. However, a link between flies and mastitis in sheep has yet to be made.

Seasonal effect

In dairy cows, summer mastitis is a known issue and often referred to as 'August bag'. Mastitis levels increase during the warmer months and seem to coincide with an increase in flies, particularly the sheep headfly (*Hydrotaea irritans*).

Whether they are acting as vectors, or it is just a coincidence that the flies also favour the same temperatures as the mastitis-causing bacteria, is not known. But if a farm has a lot of flies, using repellent is advisable.

Most cases of mastitis are actually seen two to four weeks post-lambing and this coincides with peak milk yield. Mastitis cases later in the summer occur when lambs are weaned or near weaning and not as reliant on ewe's milk by this stage.

Prevention

Managing risk factors

Mastitis is a multi-factorial disease. Although knowledge of causative agents and possible transmission route has improved, there is still no effective control strategy in place to prevent mastitis.

Although knowledge has increased regarding causative agents and possible transmission routes, there is still no effective control strategy in place to prevent mastitis.

Managing risk factors is one way of reducing the possibility of ewes developing mastitis.

+ Maintaining ewes BCS at 3+. This may involve adapting feed rations to include more protein during pregnancy and more energy and protein during lactation
+ Extra supplementation for thin ewes and old ewes or cull older animals
+ Consider culling ewes with poor udder conformation
+ Check the udder for abnormal masses to ensure that chronic mastitis is not being overlooked
+ Separate ewes with mastitis from the rest of the flock and manage as a separate flock to reduce transmission between healthy and diseased animals
+ Keeping ewes and lambs in the same field or shed before, during and after lambing, as they have grown accustomed to the bacteria in that area
+ Ensure there is shelter for the flock during bad weather
+ Provide extra nutrition for ewes with multiple lambs
+ Test for Maedi Visna
+ Adopt good hygiene practices to prevent bacteria spreading from ewe to ewe
+ Remember to put freshly weaned ewes onto a low plane of nutrition for two weeks to ensure they dry off and to reduce the risk of mastitis post-weaning

Dry therapy

The dry, non-lactating period is an essential stage for repair of the mammary gland.

It allows the lining of the udder to be restored so that when lactation starts again, milk production will be as good as it could possibly be.

The dry period can be a risk factor for acquiring an udder infection in the following lactation for dairy cows. Quarters infected during the dry period are significantly more likely to go on to develop mastitis.

Dry cow therapy (DCT) is part of the five-point plan that was initially developed in the 1960s. A long-acting antibiotic preparation is placed into the mammary gland via the teat. The antibiotic's function is to remove pre-existing infections and prevent new ones during the dry period. Sometimes a teat sealant is also used, as the long-acting antibiotic may not provide sufficient coverage or protection over the whole dry period.

The use of the five-point plan and DCT has not reduced levels of mastitis in dairy cows. Rather it has changed the bacteria that cause mastitis.

The dairy industry is currently moving away from using DCT in all cows and making it a bespoke treatment for cows that need to recover from long-term infection.

Dry cow therapy is unlikely to become standard practice in sheep due to cost and the need to minimise antibiotic use to situations where it will definitely benefit the animal treated.

These long-acting antibiotics may not be as effective for sheep, as the dry period is longer than in cows.

In sheep DCT may help reduce clinical mastitis if levels are very high, however, it has not been seen to reduce SCC or improve lamb growth rates.

Treatment

Effective rapid treatment of mastitis is needed to prevent damage to udder function and to minimise sources of infection for the rest of the flock. Removing infected milk from the affected gland into a container and disposing carefully might help with recovery from mastitis. This is not always possible; sometimes the gland is swollen or hard and cannot be milked.

Injectable antibiotics

The recommended treatment for mastitis in sheep is injectable antibiotics and anti-inflammatory medicines given as soon as possible. There is no one most effective antibiotic and it is advisable to talk with the vet so the correct antibiotic is used.

The recommended treatment for mastitis in sheep is injectable antibiotics and anti-inflammatory medicines given as soon as possible.

There is evidence that treating when the mastitis is mild is most likely to lead to recovery. So careful checking of ewes daily, or twice daily from lambing is important.

Tilmicosin is licensed for treatment of ewe mastitis, but a vet must administer this.

Other long-acting antibiotics that are used include oxytetracycline or amoxycilin. These do not need daily injections and it is not necessary for the vet to inject them.

Treating with anti-inflammatory drugs or painkillers will aid recovery and help ewes cope with the systemic effects of toxic mastitis.

Anti-inflammatories will also encourage the ewe to eat which will halt the loss of BCS.

Udder treatments

Antibiotic tubes can be used to treat mastitis, although this is not common practice.

The antibiotic is administered via the teat into the mammary gland by a trained operator, who will carefully align it with the teat end before injection. This prevents pushing bacteria up the teat canal and damaging any keratin protection already present.

This process will need repeating depending on the acting life of the antibiotic.

Suitable meat and milk withdrawal periods will apply as these drugs are 'off-licence', normally being used in cows.

Consult a vet before using any off-licence product. Please note that using off-licence products also increases the meat withdrawal to 28 days (even if the withdrawal in cattle is a lot less). If withdrawal in cattle in more than 28 days it will remain the same in sheep.

To summarise, withdrawal period of off-licence product in sheep is 28 days OR the number of days it says for licensed animal – whichever is longest.

Antibacterial spray

There is currently no evidence for the use of sprays against mastitis.

Treatment outcomes

Ewes can die from mastitis, especially rapid onset toxic mastitis. Giving anti-inflammatory medicines may prevent death, but ewes might lose function in the affected gland for the rest of the lactation and probably future lactations.

Ewes that do survive and regain milk supply to the gland may also develop IMM afterwards. These ewes should be culled at weaning. Remember these ewes will be carriers and sporadically infectious.

Future vaccine possibilities

Vaccine availability for mastitis is still in its infancy, with little or limited options available. In the UK, there is currently no vaccine licensed for sheep, although there are some for cattle.

Vaccines of varying efficacy and older technology can defend against *Staphylococcal* infections, but mostly these only manage to reduce clinical symptoms of mastitis.

In Portugal there is a vaccine for small ruminants against sub-clinical infection caused by *Staphylococcus aureus* or CNS, which lowers the severity of the symptoms of clinical mastitis.

It is unlikely that any one vaccine will prevent mastitis. Several different vaccines may need to be developed and then one or two of them selected depending on the bacteria most persistent on the farm. In any case, a focus on hygiene, nutrition and prevention of spread, will always be critical for control.

It is unlikely that any one vaccine will prevent mastitis and focus on hygiene, nutrition and prevention of spread will always be critical for control.

Breeding for resistance

Genomic selection

Genomic selection can identify genetic markers associated with increased resistance to certain diseases. Breeding disease-resistant animals can reduce the impact of diseases such as mastitis and provide a sustainable way of controlling them.

An estimate for the heritability for chronic mastitis is about 10%.

The inflammatory response to infection and invasion is heavily influenced by genetics. Recent work has reported that favouring genetic traits that tend to have lower SCC scores, lowers the risk of intramammary infection and susceptibility to mastitis.

The Texel Sheep Society is currently involved in an Innovate-funded project with Scotland's Rural College to understand whether a genomic test for resilience to mastitis can be identified in the Texel breed.

Good udder and teat conformation

Breeding from ewes that have a symmetrical, non-pendulous udder with teats at a 45° angle could help to reduce the risk of mastitis.

Good teat and udder conformation will also help lambs suckle, reducing the risk of teat damage that could lead to mastitis.

The majority of ewes examined had good udder conformation, with over 50% achieving the optimal score for each udder and teat conformation trait. Ewes with extremely forward or downward pointing teats and udders, at or below the hock, should not be used to breed replacements.

Ewes whose mothers did not have mastitis

There may be advantages to breeding ewe lambs from mothers that have never had mastitis. It may be that these mothers also have lower SCC scores.

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