Lameness in sheep: surely it's just blue spray?

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Introduction

There are many causes of lameness in sheep, and they are not all prevented or treated in the same way. This means that when dealing with an individual sheep or with a flock problem it is important to make a clear diagnosis. The main problems in the UK are caused by contagious diseases, with footrot, scald and contagious ovine digital dermatitis (CODD) being the most common and most problematic.

Locomotion scoring

The only remote indicator we have to identify sheep with a locomotor problem are the behaviours associated with lameness. These can then be applied in locomotion scoring systems. Due to their status as prey species, sheep can reduce pain associated behaviours when handled (Fitzpatrick and others 2006; Phythian and others 2013) and so in a field situation sheep may appear more lame when observed from a distance than when gathered and handled.

There are several published locomotion scoring systems available. One validated for use by general practitioners and sheep farmers uses a 0-3 scale (Angell and others 2015b) but often practically a simple binary system – lame/not lame - can be most useful (Phythian and others 2013). Whichever system is used, identifying sheep which are only 'mildly' lame is a difficult art and requires time, patience and consistent practice (Angell and others 2015b; Kaler and others 2009) – one farmer noted 'If I'm in a hurry I haven't got any lame sheep!'.

The 'lameness problem'

In 2011, the Farm Animal Welfare Council of Great Britain produced their opinion on lameness in sheep in the UK (FAWC 2011). They estimated that on average the lameness prevalence for the UK was approximately 10% of the national flock, and consequently they considered that therefore at any one time approximately 3 million sheep are lame in the UK, and over the course of a year 6-9 million sheep may become lame. Clearly it is a serious problem for the national flock. In that document they challenged the UK sheep industry to reduce lameness prevalence down to less than 5% by 2016 and less than 2% by 2021.

Recent questionnaire surveys suggest that lameness prevalence has decreased to approximately 5% in lowland English flocks (Winter and others 2015) possibly in response to widespread action across the industry, but further action is required to continue this reduction to below the target of 2%.

There are not many studies that consider the economic costs associated with lameness in sheep. However in 2005 a study by Nieuwhof and Bishop (2005)estimated costs associated with some of the major endemic diseases of sheep in Great Britain, one of which was footrot. The authors considered the costs associated with on farm labour, for example the labour associated with isolating and treating sheep with footrot, and they looked at costs of medicines for treating and preventing footrot. Importantly they also considered the *production* costs associated with footrot, for example lambs that may take longer to fatten or reduced fertility in ewes or rams as a result of footrot. This study was conducted at the current prices and values of the factors included at that time, but at that time they estimated that the cost of footrot to the industry was approximately 24 million a year.

Footrot and Scald

Footrot and scald (also called interdigital dermatitis) can broadly speaking be considered the same disease caused by the bacteria *Dichelobacter nodosus*, with scald considered to be early footrot and footrot a chronic scald (Beveridge 1941; Witcomb and others 2014). In a recent cross-sectional study by Maboni and others (2016) *D. nodosus* was more likely to be detected from feet with interdigital dermatitis than either healthy feet or feet with footrot, and *Fusobacterium necrophorum* was only more likely in feet with footrot. In the same study the authors also looked at bacterial load, and similarly they showed that there were greater numbers of *D. nodosus* bacteria in cases of interdigital dermatitis compared to healthy feet and those with footrot, and only greater numbers of *F. necrophorum* in cases of footrot. Both these analyses imply that *D. nodosus* is an inciting cause and *F. necrophorum* a secondary cause. Incidentally, whilst treponemes were detected in some feet, there was no association with disease.

This means that in terms of prevention and control reducing one (footrot or scald) should reduce the other. Most farmers find it difficult to eradicate footrot and scald in the UK, but farmers may find they can control it to under 2% of the flock. This can be done through a variety of approaches but one reportedly finding favour amongst many vets and farmers is the Five Point control plan developed by FAI Farms (Clements and Stoye 2014). It is not the only way to control footrot and scald and other approaches may also be suitable.

The five points of the plan include:

1. <u>Treat lame sheep early</u>
   In doing so transmission of *D. nodosus* bacteria from affected sheep to unaffected sheep is limited and in addition the affected individual can recover more quickly reducing the impact on production. Several studies have examined different treatment protocols. In Kaler and others (2010) 6 treatment groups were compared on a single farm in England (n=53 sheep). A positive control group was included where sheep were just treated with topical oxytetracycline spray. All the comparison groups also included treatment with topical oxytetracycline spray with the addition of one or more treatments including foot trimming on day 1, delayed foot trimming on day 6, the inclusion of parenteral long acting oxytetracycline, and the inclusion of an NSAID on day 1. In this study, 75% of the sheep recovered within five days, and those sheep that received a parenteral oxytetracycline injection *only* were more likely to recover within 5d than trimmed sheep with or without injection. Furthermore, trimmed sheep took much longer to get better with or without injection.

   In a separate study by Wassink and others (2010), again on a single lowland farm in England, two treatments were compared. In the control groups, sheep with footrot or scald were treated by the shepherd with foot trimming and oxytetracycline spray as part of their normal routine, and in the intervention groups sheep with footrot and scald were treated by the researchers using oxytetracycline injection and oxytetracycline spray within 1-3 days of observing a sheep to be lame. In the groups treated with parenteral oxytetracycline and spray as opposed to trimming and spray, the number and severity of lameness events was significantly reduced. The researchers also calculated that the gross margin at 2006 costs was improved by £630 in the intervention group when compared to the control group.

2. <u>Vaccination</u>
   There have been several studies looking at the effects of a footrot vaccine for sheep. In a recent study by Duncan and others (2012) on one farm with mixed infections of footrot and

CODD, fattening lambs were randomly allocated to either receive just parenteral antibiotics if they had a foot lesion, or to receive a footrot vaccine and parenteral antibiotics if they had a foot lesion. In this study, the new infection rate was significantly reduced in the vaccine group compared to the just antibiotics group, with an overall vaccine efficacy estimated at 62%. Interestingly this vaccine also had a small effect against CODD (32%), possibly due to the association between footrot and CODD.

3. Cull repeat offenders
   With regards to culling out repeat offenders – that is those sheep that get footrot, are treated and get better, and then get it again, there is no specific experimental evidence. The logic of this point is that those sheep that repeatedly get disease are potentially those that are genetically more susceptible, but there is no specific evidence for this. In a recent questionnaire survey by Winter and others (2015) culling was not associated with a greater or lower prevalence of lameness, however those farmers that avoided breeding from ewes that were repeatedly lame did have a lower lameness prevalence. It may not be a crucial element to control, however it seems logical and may help on some farms. To carry out culling of repeat offenders, record keeping is essential to know which sheep get footrot repeatedly, and therefore which ones to cull.

4. Avoid spread
   Again, there is limited evidence for this part of the plan, however it may be logical to assume that the spread of bacteria can happen more easily where sheep gather together e.g. through gateways, around water/feed troughs, handling pens etc. Keeping these areas clean and disinfected e.g. with lime may help reduce the spread of infection.

5. Quarantine new sheep
   In two observational studies the quarantining of sheep on arrival was associated with a lower prevalence of lameness or footrot (Wassink and others 2003; Winter and others 2015). As to how long is long enough, in Winter and others (2015) reported that those farmers that quarantined their sheep for 3 weeks or longer had less footrot. It is likely that on many farms a quarantining period of one month may be suitable for many health reasons allowing enough time for farm vaccination policies to be implemented, quarantine drenching to occur etc, and it is also a message that is easily communicated.

   Together with this, the isolation of lame sheep at treatment in a 'lame' field for example can help reduce spread to the rest of the flock and can also help with monitoring the response to treatment and the need for re-treatment. Quarantining new sheep on to a farm is essential to reduce the introduction of **all** infectious diseases on to a farm. For footrot, it gives a farmer time to treat any sheep with disease before mixing them with the rest of your flock.

Contagious ovine digital dermatitis (CODD)

Contagious ovine digital dermatitis is a relatively new cause of lameness in sheep having first been identified in 1997 (Harwood and others 1997). The number of farms with CODD has increased over the last 20 years and now approximately half of UK sheep farms have CODD (Angell and others 2014; Dickins and others 2016).

The aetiopathogenesis of CODD is still under debate, but since the early identification of a spirochete closely related to the tissue destructive spirochaete of humans - *Treponema vincentii* (Collighan and

others 2000), attention has focused on these treponeme bacteria. A more recent investigation by Sullivan and others (2015) found very strong associations between treponemes already associated with bovine digital dermatitis and CODD lesions. These treponemes specifically are named *Treponema medium*, *Treponema phagedenis* and *Treponema pedis*. In that study 58 lesions typical of CODD were identified, and in all of these one or more of these bovine digital dermatitis associated treponemes were found. Furthermore, in healthy foot tissues from sheep without CODD, none of these treponemes were found. These feet were also tested for the presence of *D. nodosus* and *F. necrophorum* and these pathogens were found in only some of the CODD lesions.

In another study looking at the histopathological changes in feet with CODD lesions, immunohistochemistry revealed strong anti-*Treponema* antibody labelling associated with the active processes of disease in those tissues (Angell and others 2015c).

Consequently, these treponemes are considered a necessary cause of disease, but the true to aetiopathogenesis is still being unravelled.

Treatment prevention and control

Biosecurity for all farms is extremely important. Not all flocks have CODD and so those farmers need to be especially vigilant for purchasing infected sheep. In a questionnaire study, Angell and others (2014) described that when farmers were asked how CODD had first arrived on their farms, those farmers that knew, reported that CODD had arrived through the purchase of an infected sheep. With this knowledge and due to the fact that not all sheep with CODD are lame (Angell and others 2015d), farmers are recommended to inspect the feet of all sheep on arrival at their farm in order to identify those with early CODD lesions and to quarantine them.

Two recent studies have identified the presence of the CODD associated treponemes on both hoof knives (Sullivan and others 2014) and gloves used to handle affected sheep (Angell and others 2017). In addition, in the study on gloves the authors demonstrated that the treponemes could survive for up to three days in air, but were also readily killed by washing in various disinfectants (Angell and others 2017). These data suggest that fomites and personnel could potentially spread treponemes between sheep and between flocks and so rigorous cleaning and disinfection practices are warranted including the changing of gloves between sheep affected and unaffected with CODD.

Various risk factors have been associated with CODD, however the largest risk factor identified by Angell and others (2015d) was co-infection with footrot (Angell and others 2015d). That is those sheep with footrot were more likely to have CODD as well compared to those without. This evidence was strengthened in a randomised controlled trial carried out on a farm with both footrot and CODD, whereby those sheep that received a multivalent footrot vaccine were less likely to develop CODD lesions subsequently compared to controls (Duncan and others 2012).

In Angell and others (2015d) the seasonal variation and environmental risk factors are similar to those associated with footrot in other studies. It is not known therefore, whether there is a synergism between *D. nodosus* and the CODD associated treponemes, or whether they are simply influenced by similar environmental conditions and farm practices. However, given this similarity (but without understanding the mechanism), interventions that serve to reduce the prevalence of footrot are likely to also reduce the prevalence of CODD concurrently.

The CODD associated treponemes have been shown in a single study to be sensitive to several different types of antimicrobial, although penicillin and the macrolide antimicrobials demonstrated the lowest MICs/MBCs (Angell and others 2015a). Clinically however, there have been only a handful

of well-designed treatment trials aimed at treating sheep with CODD. Two have shown that treatment with a single long acting amoxicillin injection at a dose rate of 15 mg/kg led to a cure rate of approximately 70% (Duncan and others 2012; Duncan and others 2011), and in an uncontrolled study of 58 sheep with CODD, all of them recovered when treated with two doses of tilmicosin injection administered twice two weeks apart at a dose rate of 10 mg/kg (Angell and others 2016).

In this latter study, the authors' primary study question was whether the use of this extended treatment, together with the isolation of clinical cases, enhanced biosecurity and the metaphylactic treatment of clinically unaffected sheep could lead to the clinical elimination of CODD from affected flocks for up to one year. In that study 6/13 flocks clinically eliminated CODD, but so also did one flock from the control group (1/11). Clinical elimination of footrot did not occur in any flock. This high failure rate, coupled with the need to use critically important antimicrobials responsibly (WHO 2011) has meant that this approach to clinical elimination cannot be recommended.

Conclusions

In summary therefore, a holistic and practical approach to lameness control is required whereby an understanding of the risk factors for sheep developing contagious foot diseases is applied to individual farm situations. Biosecurity and quarantine practices can usually be improved on most farms, and identifying lame sheep early, treating them with an appropriate product and isolating them from unaffected sheep if possible are all likely to be beneficial. Vaccination may be useful in some flocks, together with culling policies and limiting spread in areas associated with high transmission.

Some useful online resources

Detailed up-to-date information on controlling **lameness** in sheep to maximise productivity and profitability can be found at AHDB web pages:

http://beefandlamb.ahdb.org.uk/wp-content/uploads/2016/03/BRP-Reducing-lameness-manual-7-080316.pdf

Specific detailed information on **footrot** can be found at Warwick University web pages:

http://www2.warwick.ac.uk/fac/sci/lifesci/research/greengroup/farmersandvets/footrotinsheep/

Specific detailed information on **CODD** can be found at the University of Liverpool web pages:

https://www.liverpool.ac.uk/infection-and-global-health/research/food-safety/codd/

A video on **locomotion scoring** can be found at the University of Liverpool web pages:

https://www.liverpool.ac.uk/infection-and-global-health/research/food-safety/codd/locomotion-scoring/

A video on the Five Point Plan from FAI Farms can be found at:

https://www.youtube.com/watch?v=-Lv7hs2koF8

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