What's new (and not so new) about sheep scab

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Abstract

Sheep scab represents a significant burden for the national sheep industry and a serious welfare issue for diseased animals. Although different treatment options are available and despite tackling of this disease being a top priority for the industry, sheep scab is currently widely spread within the UK and its control still represent a significant challenge for all the parties involved.

This article provides an overview of sheep scab, focusing on the established knowledge available for both clinical and subclinical disease. Recent advancement in the diagnosis of the disease are also presented, with an emphasis on the added value and practical use of a blood test for diagnosis of the subclinical disease and for its use in monitoring flock exposure to the parasite. Currently available and future options for treatment and disease control are discussed, especially in the light of the challenge posed by the development of drug resistance.

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Introduction

Sheep scab is the most important ectoparasitic disease of sheep in the UK and it represents a significant threat to both animal welfare and farm economics. Despite active legislation, sheep scab is currently endemic in the UK (Losson 2012), with a total of 411 notifications to the Animal and Plant Health Agency (APHA) between 2012 and 2017[1]. The earliest record of the disease in this country is from the 13th century (Lewis 2013), being successfully eradicated once and subsequently reintroduced 20 years later. Recent updates in legislation have made sheep scab a notifiable disease in Scotland, while for England and Wales, it is a criminal offence to move infested animals or fail to treat sheep visibly affected by scab.

Overview of the disease

Sheep scab is an allergic dermatitis caused by the non-burrowing ectoparasitic mite *Psoroptes ovis*. The disease is transmitted primarily by direct contact and is host specific, with the parasite spending its entire life-cycle on the sheep (van den Broek and Huntley 2003). The main source of the disease are infested neighbouring farms, purchased or returning (away-wintering, common grazing) animals, shared equipment and strays. Mites, however, can survive off the sheep and remain infective for up to 16 days (O'Brien, Gray et al. 1994), making fences and handling facilities a possible alternative source of infestation. The clinical signs are related to the faecal deposition of allergens on the skin of the host, which causes an intense inflammatory reaction, with marked pruritus, self-trauma, severe dermatitis, alopecia (Figure 1) and considerable weight loss (Kirkwood 1986). Lesions are localised initially on the withers, progressively extend to the lumbar area and if left untreated, can quickly cover the entire body. The subclinical phase (Figure 2) can persist for up to 8 months in naturally occurring disease, with absent or very limited symptoms, like head tossing, restlessness, wool staining and mild pruritus. These animals represent a challenge in clinical diagnosis and the most likely source of

[1] https://public.tableau.com/profile/siu.apha#!/vizhome/SheepDashboard_/SheepDashboard

infestation to other flocks. An interesting feature of the disease seems to be its seasonal pattern, with the majority of the outbreaks noticed in the winter months (French, Berriatua et al. 1999).

Figure 1 – Skin lesions typically seen in a clinical case of sheep scab: severe dermatitis with thickened erythematous skin, alopecia, dry scales and crusts.

Figure 2 – A lamb 6 weeks post-infestation with P. ovis mites showing very mild wool staining on the withers.

Diagnosis of sheep scab

Diagnosis of sheep scab was traditionally based on clinical observations and identification of mites (Figure 3) in skin scrapings. Skin scrapings are taken using a scalpel blade at the edge of the active lesions, the scraping being continued until enough material is available, which is then transferred onto a microscope slide with a drop of lubricant oil and observed under low magnification (x100). This approach, although representing the conventional method for diagnosis of clinical disease, is often unable to detect subclinical infestation or sub-clinical carrier as lesions are not easily identifiable and mites numbers might be low. Consequently, by the time *P. ovis* mites are detected, they have often already spread to the rest of the flock.

Figure 3 - Psoroptes ovis mite identified at microscope examination (x100 maginfication).

The recent development by the Moredun Research Institute of a serum indirect ELISA for the detection of antibodies specific to a mite allergen (Pso o 2) has proven a highly sensitive diagnostic test for both clinical and subclinical sheep scab (Nunn, Burgess et al. 2011). The blood test can be very valuable to exclude other common diseases causing similar clinical signs (e.g. pruritus and wool loss), like other ectoparasites (mainly lice and other manges), photosensitization or other dermatitis (fleece-rot or dermatophilosis). Although skin scraping is still considered the routine technique for clinically evident sheep scab, it is relatively time consuming and requires a skilled operator for microscopic identification of ectoparasites. In this case, all the animals showing clinical signs of the disease or a proportion of the affected ones can be sampled.

The ELISA test can also reliably diagnose sheep scab as early as 2 weeks post-infestation, where at least half (6/11) of the animals showed elevated serum IgG responses, while detection of mites using skin scraping would only achieve below 20% rate (2/11 animals) (Burgess, Innocent et al. 2012). The test, therefore, represents a significant improvement in the diagnosis of the subclinical disease, which might not have been possible due to the lack of clinical signs and high percentage of false negative skin scraping results. This test can also be applied as a screening tool when animals are quarantined after being bought in, returning from away wintering or rented to other farms for mating. In this case, a suggested sampling of 12 animals, coupled with flock management data, would provide valuable information on the disease status of the flock and its exposure to the parasite[2].

At the same time, there has been a growing need for low-cost, rapid and reliable diagnostic tests in veterinary medicine. In the context of sheep scab, the time from sample collection to result acquisition and the cost of the test might represent an issue. Although commercially available, the test is usually run once a week for a cost of £6/sample on a minimum of 12 animals per flock. In the case of an outbreak, the farmer would either have to wait potentially for a whole week or might decide to treat before having received the results. Furthermore, due to the antiparasitic drugs being

2 http://www.biobest.co.uk/assets/files/news/Sheep-scab-ELISA-Test-Press-Release.pdf

relatively low-cost, the expenses of blank treatments would likely be cheaper than the overall cost of testing (including labour cost for gathering animals twice) (Nieuwhof and Bishop 2005). It is obvious that having this assay as a low-cost POC test would further improve the diagnosis and appropriate usage of anti-parasitic drugs for sheep scab. Research is currently undergoing to transfer this test into a point-of-care assay, based on the exploitation of modern engineering technologies which could provide a low-cost and rapid "pen-side" test for sheep scab (Busin, Burgess et al. 2015).

Options for treatment and control of the disease

At present, two classes of antiparasitic drugs are available for treatment and control of sheep scab: the organophosphapte (OP) dip diazinon and the injectable macrocyclic lactones (ML). The licensed antiparasitic drug available in the UK are reported in Table 1.

Table 1 – Licensed antiparasitic drugs for sheep scab treatment. OP: Organophosphate. ML: macrocyclic lactones. (Updated March 2018).

Category	Active principle	Commercial name	Treatment regime	Persistency	Meat withdrawal
OP plunge dip	Diazinon	Osmonds Gold Fleece Paracide 62	Dip animals for one minute with head dipped twice	Up to 4 weeks protection	49 days 70 days
ML injectables	Ivermectin	Ecomectin 1% Ivomec Classic Noromectin 1% Panomec Paramectin Premadex 1% Qualimec 10mg/ml	2 injections SC 7 days apart	Contact between treated and uninfected sheep to be avoided for 14days	37-42 days
ML injectables	Doramectin	Dectomax 10mg/ml	1 injection IM	Contact between treated and uninfected sheep to be avoided for 14days	70 days
ML injectables	Moxidectin	Cydectin 1%	2 injections SC 10 days apart	28 days Contact between treated and uninfected sheep to be avoided for 22days	70 days
ML injectables	Moxidectin LA 2%	Cydectin 20mg/ml LA	1injection SC (base of the ear)	60 days	104 days

The choice of treatment should be tailored to the individual farm and specific situation, taking into consideration some important points. Plunge dipping has some advantages over injectable macrocyclic lactones as they kill mites within 24 hours and provide residual activity for several weeks. They also control other ectoparasites, like blowfly strike, headfly, lice, ticks and keds. Plunge dipping, however, requires a special license for administration, has relevant issues for disposal and is usually more labour intense. It should also be avoided in heavily pregnant sheep and in flocks with CLA, erysipelosis and ORF issues.

Macrocyclic lactones can be used to control nematodes as well, which, depending on the time of the year, could be regarded as a desirable or non-favourable option. They are safer for the operator and less stressful for the sheep. However, they take up to 7 days to kill mites (with persistency of clinical signs during this time) and can have prolonged withdrawal times.

Irrespective of the treatment chosen, all sheep must be gathered and correctly treated[3]. Handling pens, equipment and fields should also be considered contaminated for at least 17days after removal of infested sheep.

The option for control, at present, rely on a combination of antiparasitic drugs and biosecurity measures, with the aim placed on avoiding introducing the disease in the first place. Strict biosecurity should be observed, mainly through quarantine (and possibly treatment) of all incoming animals, maintenance of good fencing and disinfection of vehicles and equipment. The sheep scab ELISA has also been advocated to monitor flock status and to aid selective treatment to seropositive flocks (Jacober, Ochs et al. 2006). Furthermore, due to the highly contagious nature of this disease and its methods of transmission, it is important to consider that control options should be coordinated at a regional (or potentially national) level, with veterinary involvement playing an essential role in coordination and training campaigns.

Moxidectin resistance

Very recently, the first report of resistance to injectable moxidectin has been published. Following reported treatment failure from four farms, mites collected were exposed to different concertation of the compound and, even when exposed to very high concentrations, they were able to survive (Doherty, Burgess et al. 2018). Furthermore, the possibility of cross-resistance to the other ML compounds represent a likely possibility. However, these findings should not have come as a surprise. The use of injectable ML for management of sheep scab is still predominant among farmers (Bisdorff and Wall 2008) as well as being among the most commonly used drugs for nematode control (Morgan, Hosking et al. 2012). In light of these problematics, there is definitely no indications for indiscriminate prophylactic treatments. On the contrary, an approach based on a wider use of diagnostics and a better collaboration between farmers vet and the industry should be advocated for effective control of this disease.

Alternative methods for control

Alternative methods for control, which are currently under study, include the development of vaccines, genetic selection for resistance and the use of biological control (like nematodes, bacteria, fungi or viruses). Sheep infested and successfully treated tend to have lower number of mites and reduced lesions size, which suggest there is development of acquired immunity following infestation (Bates 2000). Candidate antigens which could be included in a commercial vaccine and provide

3 http://www.scops.org.uk/external-parasites/scab/

protective immunity to the disease are currently evaluated, with some promising results showing a reduction in lesion size and parasite numbers in vaccinated animals (Burgess, Nunn et al. 2016).

Furthermore, research is ongoing to test other chemicals, like the growth regulators (Dunn, Prickett et al. 2016) in order to expand the class of treatment available or to evaluate the acaridicidal effect of fungal pathogens (*Metarhizium anisopliae*) to control mites within the sheep (Wall 2007).

Conclusions

Through a better understanding of the pathogenesis and an additional diagnostic test for the disease, the tools available to combat sheep scab have now considerably broadened. Research is ongoing in multiple directions to allow for further improvements in the control of the disease and the results are very encouraging. As for many other animal diseases, the pillar for the effective control is thorough a genuine and close collaboration between farmers, vets, scientists and the industry to identify practical and effective solutions to solve a shared problem.

Key points

- Sheep scab, caused by the ectoparasite *Psoroptes ovis*, is an allergic dermatitis which can present as clinical or subclinical disease.
- Subclinical disease represent the most challenging for correct diagnosis and the likely source of infection to other flocks.
- The recent development and commercialization of a blood test ELISA has allowed a substantial improvement in diagnosis of the subclinical disease. The test can also be used for monitoring purposes.
- The available options for control/treatment have not changed significantly, but the recent report of moxidectin resistance poses questions on the sustainability of the current control methods.
- Alternative methods for control are currently under investigation (vaccination, genetic selection and alternative compounds) which would increase our options to reduce the impact of this disease on the national flock.

Key words

sheep scab, antiparasitic drugs, vaccination, ELISA, biosecurity

References

Bates, P. (2000). "Differences between primary and secondary infestations with the sheep scab mite, Psoroptes ovis." Veterinary Record **146**(18): 528-529.
Bisdorff, B. and R. Wall (2008). "Control and management of sheep mange and pediculosis in Great Britain." Veterinary Parasitology **155**(1-2): 120-126.
Burgess, S. T., G. Innocent, F. Nunn, D. Frew, F. Kenyon, A. J. Nisbet and J. F. Huntley (2012). "The use of a *Psoroptes ovis* serodiagnostic test for the analysis of a natural outbreak of sheep scab." Parasite & Vectors **5**: 7-17.
Burgess, S. T. G., F. Nunn, M. Nath, D. Frew, B. Wells, E. J. Marr, J. F. Huntley, T. N. McNeilly and A. J. Nisbet (2016). "A recombinant subunit vaccine for the control of ovine psoroptic mange (sheep scab)." Veterinary Research **47**: 8.
Busin, V., S. Burgess and N. Sargison (2015). "Sheep scab, future perspective for disease diagnosis and control." Livestock **20**(3): 156-159.
Doherty, E., S. Burgess, S. Mitchell and R. Wall (2018). "First evidence of resistance to macrocyclic lactones in Psoroptes ovis sheep scab mites in the UK." Veterinary Record.

Dunn, J. A., J. C. Prickett, D. A. Collins and R. J. Weaver (2016). "Primary screen for potential sheep scab control agents." Veterinary Parasitology **224**: 68-76.
French, N. P., E. Berriatua, R. Wall, K. Smith and K. L. Morgan (1999). "Sheep scab outbreaks in Great Britain between 1973 and 1992: spatial and temporal patterns." Veterinary Parasitology **83**(3-4): 187-200.
Jacober, P., H. Ochs, P. R. Torgerson, M. Schnyder and P. Deplazes (2006). "A method for sheep scab control by applying selective treatment based on flock serology." Veterinary Parasitology **136**(3-4): 373-378.
Kirkwood, A. C. (1986). "History, biology and control of sheep scab." Parasitology Today **2**(11): 302-307.
Lewis, C. J. (2013). "Sheep psoroptic mange: An update on history, control and present situation in the United Kingdom." Small Ruminant Research **110**(2-3): 71-74.
Losson, B. J. (2012). "Sheep psoroptic mange: An update." Veterinary Parasitology **189**(1): 39-43.
Morgan, E. R., B. C. Hosking, S. Burston, K. M. Carder, A. C. Hyslop, L. J. Pritchard, A. K. Whitmarsh and G. C. Coles (2012). "A survey of helminth control practices on sheep farms in Great Britain and Ireland." Veterinary Journal **192**(3): 390-397.
Nieuwhof, G. J. and S. C. Bishop (2005). "Costs of the major endemic diseases of sheep in Great Britain and the potential benefits of reduction in disease impact." Animal Science **81**: 23-29.
Nunn, F. G., S. T. Burgess, G. Innocent, A. J. Nisbet, P. Bates and J. F. Huntley (2011). "Development of a serodiagnostic test for sheep scab using recombinant protein Pso o 2." Molecular and Cellular Probes **25**(5-6): 212-218.
O'Brien, D. J., J. S. Gray and P. F. Oreilly (1994). "Survival and retention of infectivity of the mite *Psoroptes ovis* off the host." Veterinary Research Communications **18**(1): 27-36.
van den Broek, A. H. and J. F. Huntley (2003). "Sheep Scab: the disease, pathogenesis and control." Journal of Comparative Pathology **128**(2–3): 79-91.
Wall, R. (2007). "Ectoparasites: Future challenges in a changing world." Veterinary Parasitology **148**(1): 62-74.

Figure 1

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Figure 2

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Figure 3

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