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Research paper

An observational study of ewe treatments at lambing on early infection in lambs on UK sheep farms

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ABSTRACT

Anthelmintic treatments to ewes around lambing time, often with long acting products, have become common practice on UK sheep farms, but these treatments have also been shown to be highly selective for anthelmintic resistance in New Zealand and Australia, with field data supported by modelling results. The purpose of this study was to determine (1) the effect of treating or withholding anthelmintic treatments and (2) the effect of treatment of ewes with a persistent or non-persistent anthelmintic, on early infection in lambs in the UK. Faecal egg count data for 10–16 weeks old lambs collected over a three year period (2012–2014) was analysed. Samples were grouped according to whether the ewes on the farm had or had not been treated with an anthelmintic at lambing. For both analyses, data for early infection were analysed by generalised linear mixed model. There was no effect of withholding or treating ewes on subsequent early infection in lambs. In addition, there was no effect of region, farm type or management type on the faecal egg counts. There was, however an effect of year, with lambs having lower counts in 2014 than in 2012 and an interaction between year and ewe treatment, with data suggesting lower infection levels over time for those farms withholding anthelmintic treatments altogether. There was no effect of drug type on early infection in lambs nor region, farm type or treatment on the lamb faecal egg counts. However, there was an effect of year and an interaction between year and drug type with lower egg count over time with the short acting drugs. Our study supports data generated by other researchers suggesting that the practice of treating ewes at lambing to reduce contamination on pasture and minimise subsequent disease may not in fact always result in lower levels of infection in lambs. The study also demonstrated no significant benefit in early infection in lambs when ewes were treated with long acting compared to short acting anthelmintics. This provides further evidence to support the potential benefits of a more targeted approach to anthelmintic treatment on sheep farms.

1. Introduction

Healthy adult ewes are mostly immune to infection with gastro-intestinal parasites and as a result there is rarely a requirement for treatment with anthelmintic drugs. Around lambing, however, this immunity is lost, worm burdens increase, faecal egg counts (FECs) rise and farmers are more likely to treat the ewes to improve condition and also to reduce the potential contamination of pastures that will be grazed by naïve lambs with little resilience. Anthelmintic treatments around lambing time have become common practice on UK farms (Sargison et al., 2012) as well as in other countries with a large sheep producing industry such as New Zealand (Brunsdon et al., 1983; (Lawrence et al., 2007). These treatments have been shown to be high risk for selection for anthelmintic resistance (AR) (Dash, 1985) (Michel, 1985) and data have been supported by modelling results (Leathwick et al., 1995) the timing and choice of anthelmintics can also influence the risk of resistance development. If pastures are heavily contaminated, selection for anthelmintic resistance (AR) can be minimised but the benefit of treatment, in terms of a reduction in exposure of the lambs to infection, will also be minimal. Repeat or persistent treatments can help to reduce pasture contamination levels but there may be a prolonged period before ewes re-establish a nematode infection from the *in refugia* population and this again is highly selective for resistance. Guidelines for sustainable control of parasites in sheep (SCOPS) have been produced in the UK which include recommendations for treatments to ewes. Our experience suggests that farmers tend to select products containing a macrocyclic lactone (3-ML) for treating ewes around lambing. Many farmers rely on persistent actives from the 3-ML

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class with a perception that this will bring a production advantage. Persistent anthelmintics have a residual activity of several weeks and so can be administered at turnout before major infection occurs. More than 70% of farmers participating in a three year UK field study evaluating the use of SCOPS guidance on commercial farms, selected anthelmintics from the 3-ML group for ewe treatments at lambing and > 20% selected moxidectin (MOX; the only persistent 3-ML available to farmers in the UK) (Learmount et al., 2016a). However, other data generated as part of this field study suggest that farmers following the SCOPS principles use significantly fewer ewe treatments compared to traditional farmers with an increasing number withholding ewe treatments altogether with no obvious observed effect on subsequent lamb production (Learmount et al., 2016b). As lamb production is a major driver in management/treatment choices by farmers, this is an important observation. The purpose of this study was, therefore, to determine (1) the effect of treating or withholding anthelmintic treatments and (2) the effect of treating ewes with a persistent or non-persistent anthelmintic on early infection in lambs.

2. Materials and methods

2.1. Selection of study farms

All study farms were those previously reported (Learmount et al., 2015) and had a range of sheep breeds, flock sizes and grazing systems to ensure that they were representative of UK commercial sheep farms. Flock sizes were between 80 and 1200 ewes and the study followed a 3 × 2 factorial design as previously described (Learmount et al., 2015). In summary, farms were assigned to one of two experimental treatments: 1. SCOPS, for farms that were already using or were willing to implement the SCOPS guidelines; and 2. TRADITIONAL, for farms that wished to continue employing their traditional worm control without regard to SCOPS guidance. The farms were self-selecting to treatment group: farmers were given information about the trial and then, if they wished to participate, selected whether they did or did not wish to carry out worm control using SCOPS guidance. Farmers in the SCOPS treatment group pro-actively adopted low-risk management practices while farmers in the TRADITIONAL treatment group were known to have adopted several high-risk management practices. All study farms had a private veterinarian, responsible for animal welfare, sample and data collection, who also developed a formalised farm plan for worm control and advised on diagnostic results for each of the SCOPS farms. The SCOPS guidelines advocate a 'toolbox' of resistance delaying control methods, with their deployment dependent on individual farm requirements. Hence, evolving strategies were devised for each farm based on annual veterinary advice with each vet visiting and monitoring their assigned farms at least ten times across a three-year period. As two other factors (Region and Farm Type) might have affected the epidemiology of gastrointestinal worms (Coyne et al., 1991; Crofton, 1965; Gibson et al., 1981), these were equally represented in SCOPS and TRADITIONAL treatment groups. Regional (South west or North east) grouping was carried out to account for the possible effects of climate on the measured effects and farms were divided for type (Lowland or Upland) using the criteria previously described (Learmount et al., 2015)

2.2. Infection levels in lambs

Faecal samples were collected from 20 randomly selected animals from a tagged cohort of 40–50 twin lambs (the monitored flock). Where possible, faeces (> 4 gms) were collected by rectal sampling; otherwise, fresh faeces were collected from the ground. FECs were carried out in the laboratory, using a modified McMaster technique (Ministry of Agriculture Fisheries and Food, 1986) and FEC results were reported in eggs per gram (epg) and larval culture and species differentiation undertaken to determine genera where mean counts were > 150 epg. For the analysis, FEC data for 10–16 weeks old lambs were selected so that the counts were mainly representative of contamination that may have been due to egg shedding by the ewes during the peri-parturient rise. However, it is also possible that contamination may have been due to overwintering larvae. In the majority of cases, treatments for *Nematodirus battus* were carried out in early May but no counts were within 21 days of a treatment and the data were prior to any other anthelmintic treatment for gastro-intestinal nematodes.

2.3. Anthelmintic use

Full data sets for anthelmintic use on each of the farms were collected in the autumn each year after the lambs had been finished. For the first analysis (does withdrawal of treatment at lambing have a negative effect on early infection in lambs) the treatment data were evaluated and the infection data for lambs grouped according to whether ewe treatments had been carried out at lambing. In some cases the farmers had treated a proportion of the ewes and these were grouped in the treatment category although it is recognised that proportional treatments may bring a lower risk of anthelmintic resistance than blanket treatment (Leathwick et al., 2012).

The second analysis compared the effect of treatment with the main persistent anthelmintic available to UK sheep farmers, moxidectin (MOX), which is a 3-ML and shorter acting drugs, which may have belonged to any of the older anthelmintic classes (benzimidazole [1-BZ]; imidazothiazole [2-LV], 3-ML) on early infection in lambs. The infection data were again interrogated and grouped according to whether ewes had been treated with MOX or a short acting drug.

2.4. Statistical analysis

For both analyses, data for early infection were analysed by generalised linear mixed model fitted with a negative binomial distribution and a log-link function. Farm identity was included in the model as a random effect to account for the variability between farms. The number of animals tested on the farm in each year was included as a fixed term in the model as occasionally the number of animals differed between farms (for example, if insufficient faecal material had been collected to carry out an FEC). Although the samples were collected on the same farm over time, because they were collected from different animals any possible autocorrelation was ignored. For the first analysis (to evaluate the effect of withholding treatment at lambing on early infection) fixed terms included in the model were region, farm type, treatment, year and ewe treatment. An interaction term between ewe treatment and year was also included to evaluate the effect of ewe treatment across years.

For the second analysis, fixed terms included in the model were region, farm type, treatment, year and drug type. An interaction term between drug type and year was also included to evaluate the effect of drug type across years.

All analysis was carried out using GenStat Version 16 (VSN International Ltd, Hemel Hempstead, UK).

3. Results

3.1. Analysis 1 (effect of withholding anthelmintic treatments to ewes at lambing)

Five hundred and ninety lamb samples were obtained from farmers who had previously treated their ewes, whilst 270 samples were obtained from farmers that had left their ewes untreated.

Table 1 and Fig. 1 show the predicted mean and 95% confidence intervals for trichostrongyle EPG for each of the factors considered: region; farm type; treatment; year; ewe treatment and the interaction between ewe treatment and year. The predicted means and 95% confidence intervals in Table 1 are based on an average farm and have been