Veterinary Parasitology 216 (2016) 72–83

Contents lists available at ScienceDirect

Veterinary Parasitology

journal homepage: www.elsevier.com/locate/vetpar

Research paper

Liver fluke control on sheep farms in Northern Ireland: A survey of changing management practices in relation to disease prevalence and perceived triclabendazole resistance

C. McMahon[a], H.W.J. Edgar[b], R.E.B. Hanna[b], S.E. Ellison[a], A.M. Flanagan[a], M. McCoy[c], P.-E. Kajugu[b], A.W. Gordon[d], D. Irwin[e], J.E. Barley[b], F.E. Malone[b], G.P. Brennan[a], I. Fairweather[a,*]

[a] Parasite Therapeutics Research Group, School of Biological Sciences, Medical Biology Centre, The Queen's University of Belfast, 97 Lisburn Road, Belfast BT9 7BL, United Kingdom
[b] Veterinary Sciences Division, Agri-Food and Biosciences Institute (AFBI) Stormont, Belfast BT4 3SD, United Kingdom
[c] Department of Agriculture and Rural Development, Dundonald House, Upper Newtownards Road, Belfast BT4 3SB, United Kingdom
[d] Biometrics Division, Agri-Food and Biosciences Institute (AFBI), Newforge Lane, Belfast BT9 5PX, United Kingdom
[e] Agriculture Branch, Agri-Food and Environmental Science Division, Agri-Food and Biosciences Institute (AFBI), Hillsborough BT26 6DR, United Kingdom

ARTICLE INFO

Article history:
Received 19 October 2015
Received in revised form
25 November 2015
Accepted 30 November 2015

Keywords:
Fasciola hepatica
Liver fluke
Northern Ireland
Questionnaire
Survey
Faecal egg count reduction test
Coproantigen ELISA reduction test

ABSTRACT

Reports of resistance to triclabendazole (TCBZ) among fluke populations have increased in recent years. Allied to this, there has been a rise in the prevalence of the disease, which has been linked to climate change. Results from questionnaire surveys conducted in Northern Ireland (NI) in 2005 (covering the years 1999–2004) and 2011 (covering the years 2008–2011) have provided an opportunity to examine the extent to which fluke control practices have changed over a prolonged time-frame, in light of these changes.

A number of differences were highlighted. There was a significant shift away from the use of TCBZ over time, with it being replaced largely by closantel. The timing of treatments had moved earlier in the year, perhaps in response to climate change (and an altered pattern of disease). In relation to the frequency of drug treatments, there were no major changes in the overall pattern of drug treatments between the two survey points, although on both occasions approximately one-third of flock owners gave more than 3 treatments per year to ewes. In lowland areas in 2011, flock owners were rotating drug classes more often (each year and at each treatment) than in 2005, whereas in upland areas, flock owners were rotating less often and more were not rotating at all. Between 2005 and 2011, the percentage of flock owners giving quarantine treatments to bought-in stock had halved, to a very low level (approximately 10%).

Using data from a complementary TCBZ resistance survey (Hanna et al., 2015), it has been shown that the way in which data are selected and which efficacy formula is applied can influence the calculation of drug efficiency and impact on diagnosis of resistance.

1. Introduction

Successful control of fasciolosis is confronted by two major challenges: an increased incidence of the disease and the spread of resistance to triclabendazole (TCBZ), the drug most active against acute and chronic fluke infections. The upsurge in incidence has been attributed to the effect of climate change, which has favoured the snail intermediate host, and long-range forecasts have suggested that this trend will become more pronounced (Fox et al., 2011). TCBZ resistance has emerged in several areas of the World and, again, the situation is likely to become more serious in the future. Allied to this is the problem of accurate diagnosis of resistance, so that genuine cases can be separated from reports that are simply cases of "treatment failure", for whatever reason. For a more detailed discussion of these topics, the reader is referred to the reviews by Fairweather (2011a,b).

Of crucial significance to fluke control are the management strategies put in place by farmers; also, how well the farmers perceive the issues described above and how they are responding to them. Farmers are able to source and obtain advice from veter-

* Corresponding author. Fax: +44 28 90975877.
E-mail address: i.fairweather@qub.ac.uk (I. Fairweather).

http://dx.doi.org/10.1016/j.vetpar.2015.11.018
0304-4017/

inarians, the agricultural press, farm advisors, suitably qualified personnel (SQP), other farmers, government agencies and drug company representatives, for example. However, few large-scale surveys have been carried out to determine farmers' attitudes and control practices. Of those that have, more surveys have been concerned with dairy cattle (eg Mezo et al., 2008; Bloemhoff et al., 2014; Selemetas et al., 2015) than sheep (e.g. Morgan et al., 2012; Rojo-Vazquez and Hosking, 2013) and not all were restricted to fluke. This communication presents information derived from two Questionnaire surveys in Northern Ireland (NI), conducted in 2005 and 2011. They were designed to gather data on control and sheep management practices in relation to fasciolosis and how the latter may have contributed to the levels of resistance described in a separate study (Hanna et al., 2015). Particular attention was given to the pattern of anthelmintic use, the timing and frequency of treatments, drug rotation and quarantine strategy. The Questionnaires covered a time-span of more than a decade and so provide a good view of changing practices over a relatively prolonged period of time.

This paper also extends the analysis of data stemming from a field survey of TCBZ resistance in NI carried out in 2011 and published by Hanna et al. (2015). Data taken from that survey has been used to test how the calculation of reductions in faecal egg count (FEC) and coproantigen levels can be affected by the selection of data and efficacy formulae applied. The results of the 2011 survey will be compared with those of a similar field survey carried out in 2008. The combined field efficacy and Questionnaire data should give a good overall view of fluke control in the Province. The data on fluke will complement that of nematode control in NI published previously (McMahon et al., 2013a,b,c).

2. Materials and methods

2.1. TCBZ field resistance surveys

2.1.1. Field survey

The survey was carried out on 13 sheep farms, designated A–M. For details of experimental design and FEC and coproantigen ELISA methodology, see Hanna et al. (2015).

2.1.2. Field survey

The protocol as described for sampling in 2011 was based on a similar survey conducted in 2008 on 12 of the aforementioned holdings (Flanagan, 2010; Chapter 5). Raw data were obtained from the author and analysed using the approach described in the next section (Section 2.2). The inclusion of these data is intended to provide a comparison of efficacy results between different time points.

2.2. Statistical analysis of field survey data

Initial analysis of the FEC and coproantigen ELISA data was carried out as described by Hanna et al. (2015).

A second analysis was performed to examine the effect of different formulae on calculating treatment efficacy and anthelmintic resistance. As per WAAVP guidelines (although developed for gastrointestinal nematodes and not fluke specifically), anthelmintic resistance was declared when the calculated treatment efficacy was <90% (Coles et al., 2006). Reductions in FECs and coproantigen levels were calculated using Microsoft Excel. Percentage reduction was based either: on the formula of Kohapakdee et al. (1995), where percentage reduction = $[(T1 - T2)/T1] \times 100$, where T1 is the arithmetic mean FEC pre-treatment and T2 is the arithmetic mean FEC post-treatment (pt) for a group of treated animals (referred to subsequently as FECRT1); or on the iFECRT3 formula of Cabaret and Berrag (2004), where percentage reduction = $(1/n)\Sigma(100 \times (1 - [Ti2/Ti1]))$, where Ti2 is pt and Ti1 is pre-treatment eggs per gram (epg) of faeces in host I from a total of n hosts. Each host serves as its own control. Referred to subsequently as FECRT2, it is the individual animal counterpart of FECRT1.

Using the available data, 3 datasets were constructed. They represented different combinations of FEC and coproantigen ELISA data and were used to assess their bearing on the calculation of drug efficacy. The datasets were:

Dataset 1. Pre- and post-treatment epg averages, calculated using all 20 (or total number of collected) faeces samples;

Dataset 2. The pre-treatment epg average, calculated using only the values generated from sheep with a current infection (i.e. positive by coproantigen ELISA). The pt average was calculated using all 20 (or total number of collected) faeces samples; and

Dataset 3. Pre- and post-treatment epg averages, calculated using only the values generated from sheep with a current infection.

2.3. Questionnaire surveys

2.3.1. Questionnaire

The questionnaire contained 42 questions, which covered control of gastrointestinal nematodes, liver fluke and ectoparasites. The analysis of the nematode control data has been published by McMahon et al. (2013a,b).

In relation to fluke, questions referred to product use over a 5-year period (2000–2004), the timing and frequency of treatment, product rotation, quarantine treatments and perception of the prevalence of resistance. The survey was conducted by personal interview, with 81 farmers.

For further details of the survey, see McMahon et al. (2013a,b).

2.3.2. Questionnaire

The questionnaire comprised 51 questions, organised into three main sections, namely, parasite control practices (Section 1, McMahon et al., 2013a), farm management (sheep) (Section 2, McMahon et al., 2013a,b) and farm management (cattle) (Section 3, nematode control, McMahon, 2015 Thesis). Questions included the same topics as listed for the 2005 edition, but covering the period 2008–2011.

Between May and September, 2011, the questionnaire was sent to 1,000 farmers, amongst whom were sheep-only farmers, cattle-only farmers and mixed sheep and cattle farmers. There were 305 returns, of which 252 were relevant to sheep.

For further details of the survey, see McMahon et al. (2013a,b).

2.4. Recorded cases of acute fluke

2.4.1. Diagnoses of acute fasciolosis, post-mortem findings (Great Britain)

Since 1975, the Veterinary Investigation Diagnosis Analysis Database (VIDA) has documented the findings from every submission made to regional laboratories of the Animal Health and Veterinary Laboratories Agency and Scottish Agricultural College Disease Surveillance Centre (www.gov.uk/government/statistics/veterinary-investigation-diagnostic-analysis-vida-reports). The aggregate data of these 23 centres provide a useful indication of the level of disease reported across England, Scotland and Wales.

2.4.2. Diagnoses of acute fasciolosis, post-mortem findings (Northern Ireland)

Similar data are recorded for NI in the 2 diagnostic centres: AFBI Omagh (west of the Province) and AFBI Stormont (east of the Province). Information was retrieved from the AFBI Pathology Database and was limited to diagnoses of acute fluke between 2000 and 2014. The limitation to acute fluke enabled direct comparison of recorded cases in NI and GB. The data were filtered to remove carcasses or viscera received from independent researchers, other