Haemonchus contortus

Haemonchus contortus (HC) is an abomasal blood sucking roundworm. Adult *H.contortus* worms, and worms approaching adulthood (L5), have the ability to remove large quantities of blood (0.05ml/day) from their host. That means a sheep carrying 5,000 *H. contortus* may lose 250ml of blood per day. This, combined with blood loss from the mucosa, produces acute disease caused by rapid anaemia with the risk of death. As few as 500 adult worms can cause disease.

Haemonchus contortus differs from other pathogenic strongyle worms in other ways to:-

- Females can produce 5,000-15,000 eggs per day, compared to 400 eggs for the *Teladorsagia* roundworm.
- It has a short lifecycle (20 days), which combined with high egg input, means there can be a very rapid build-up of *H. contortus* parasites on pasture given suitable weather conditions.
- It is found in diverse climatic conditions from the arctic to tropics, although conditions have a significant effect on the extent, timing and frequency of disease outbreaks.
- Because female H. contortus worms breed so quickly and in such large numbers, there is potential for large genetic variation in the population, giving it the ability to adapt and enhancing its survival strategies (in particular, its ability to overwinter).
- Overwintering inside the host used to be considered the main overwintering strategy, but there are reports of overwintering on pasture, with implications for management and control.
- While it is predominantly a parasite of sheep and goats, it can be ingested by cattle and there are reports of wildlife (e.g. red deer) being a reservoir. This needs to be considered when investigating outbreaks and looking for sources of the parasite.

Haemonchosis

Haemonchosis, which is the disease caused by Haemonchus, can occur in both adults and young sheep. When lactating ewes are affected there can be a profound depression of milk production leading to lamb deaths and poor growth rates. It is also reported as a cause of death in the ewes themselves, thought to be due to the *en masse* emergence of hypobiotic larvae or possibly large numbers of overwintered larvae on grass due to warmer winters. Lambs which then depend on grazing become heavily parasitised themselves, with further loss of performance and potential deaths.

In **acute infections**, resulting from the ingestion of many infective larvae over a short period of time, animals are weak and are likely to collapse if gathered. Pallor (paleness) of the mucous membranes is striking, but it should be assessed by inspection of the conjunctivae rather than the oral mucosa or skin where differentiation from a normal appearance is difficult. Tachypnoea (quick, shallow breathing) and tachycardia (increased heart rate) are also present. The onset of clinical signs may be so sudden that affected animals are still in good body condition. Acute Haemonchosis can be a cause of sudden death. Diarrhoea is not associated with predominant *H.contortus* infection and affected sheep may even be slightly constipated.

In **sub-acute infections**, sub-mandibular oedema ('bottle-jaw') may develop as a result of hypoproteinaemia and clinically this can resemble fasciolosis (liver fluke)**. Chronic infections** are characterised by a more general failure to thrive, showing signs of weight loss, poor body condition, sub-mandibular oedema, lethargy and weakness. The chronic nature of the blood loss leads to an exhaustion of iron reserves, and the development of microcytic anaemia. The degree of anaemia can be assessed using the FAMACHA® test.

Prevalence of HC in the UK

Historically, HC was considered only to be a problem in the South East of England, but in recent years, the incidence, frequency of reports and geographical range of HC in the UK has anecdotally increased. This perceived increase is supported by respondents to a SCOPS survey in January 2024 – see survey results on the SCOPS website. Participants in the survey (vets, farmers and SQPs) also reported that the season where animals were affected by Haemonchus was extending, with more outbreaks later in the autumn. The reason for this is likely to be linked to climatic climate change coupled with sheep movements.

However, data on the actual prevalence of HC is relatively sparse, in part due to the lack of affordable, accessible speciation of the strongyle species at farm level. Burgess et al (2012) found HC on 50% of

farms surveyed across the UK. Previous surveys in the 1950's found HC on a significant number of farms, even in Scotland, but at low numbers (Parnell et al., 1954). More recently, a survey of faecal samples taken at markets, carried out by Moredun, showed that 20% of samples contained some HC (McGregor, 2024), but this level may have been affected by unknown treatment prior to sale.

From a practical perspective, it is important to remember that the presence of HC in a faecal sample does not mean that there is, or will be, clinical disease (haemonchosis). Outbreaks of haemonchosis are still relatively uncommon in the UK, occurring sporadically, even on farms with a history of the disease. This is quite a different epidemiology compared to tropical areas, with summer rainfall which are more typically associated with HC (e.g. eastern Australia) and where much of the research into the control of this parasite has been carried out.

Importance of Quarantine Treatments should not be overlooked. Given that there are still a significant proportion of sheep farms that do not have HC or farms without or limited AR in the HC population on their farm, preventing the importation of the parasite is the first line of defence. The SCOPS Gold or silver Quarantine routine will remove HC and those resistant to the older 3 anthelmintic groups. *(Link to case study)*

Diagnostics

Haemonchosis usually presents a clinically distinct picture compared to other gastrointestinal (GIN) infections. As described above, an outbreak can occur very suddenly following a small window of favourable weather and animal conditions. The main differential is liver fluke, which is often confused with HC because many of the symptoms are similar, which is made more complex because closantel is effective against both fluke and HC. If used as the treatment, a positive response may be seen but the causative parasite remains unknown and the problem potentially unresolved.

- **Post-mortem –** HC are relatively easy to see with the naked eye in the abomasum during post-mortem. The red spiral can be seen which gives them their familiar name 'Barbers Pole'.

- **FEC -** the first sign that there may be a problem is often an unexpectedly high strongyle count in a faecal egg count (FEC) from ewes or lambs. Egg count is highly correlated to the number of adult worms in the abomasum (see Chapter 2. SCOPS Principles, 2.7 Use Anthelmintics only when necessary, 2.7.2 Faecal Egg Counts (FECs)). With the high fecundity of *HC*, a count of several thousand is common, compared to the *T.circumcinta* for example where counts of several hundred are more common. None of the current FEC methods can reliably differentiate HC eggs from other strongyle eggs so additional methods are required (see below).
  NB. Some laboratories may claim to be able to differentiate HC eggs from other strongyles based on morphology. While this is possible, it is difficult and without supporting confirmation can lead to misleading results and inappropriate actions.

- **Staining** - confirmation of the presence of *HC* can be done by PNA (peanut agglutination) staining of eggs. Adult worms can also be seen with the naked eye in the abomasum on post-mortem examination.

- **Larval differentiation –** strongyle eggs are hatched so that the HC present can be differentiated from other strongyles by larval morphology. This is offered by some labs, but it is expensive and although will confirm the presence/absence of HC it cannot be used to reliably ascertain the proportions of the different species because of variable hatching rates.

- Molecular techniques (e.g. Nemabiome) are currently not available commercially but are used in a research context and may become more readily accessible in the future.

- **Sub-acute / chronic disease markers** - these include Body Condition score (BCS) and FAMACHA® . Flocks with access to EID and auto weighing equipment are also able to monitor weight change in ewes on a regular basis, which may give them early warning of a challenge. In

these situations, only a proportion of the animals are usually affected so it is possible to think in terms of a targeted selective treatment (TST) approach, treating only those displaying a loss in condition/body weight or low FAMACHA® score.

*****The **FAMACHA©** is based on the evaluation of the mucous membranes of the conjunctivae using a 1-5 colour chart score (1 – normal to 5 – severe anaemia), with animals showing a score at 3 or higher selected for treatment. It is, however, only applicable for *Haemonchus contortus* infection and not the other trichostrongyles. FAMACHA® colour charts are only available to certified individuals. Online certification is available from the University of Rhode Island (https://web.uri.edu/sheepngoat/famacha/).

Monitoring

Where H*aemonchus* is found to be present on a farm, additional monitoring and management effort within the worm control strategy is required to minimise the risk of production losses and mortality. This is made more complex by the fact that haemonchosis is not normally a consistent threat, either within or between years. It tends to be sporadic, occurring when the climatic conditions combine with pasture contamination to produce a high challenge. Affected farms can go several years between outbreaks, making it important that they understand the factors that combine to present a risk on their grazing areas and have monitoring in place.

Where a farm has a history of HC it is vital that an effective monitoring regime is in place. This includes the diagnostic options mentioned above coupled with a detailed appraisal of the management, animal and climatic conditions that indicate when there is a high risk that a challenge may occur.

- Post-mortems – regular checks on sudden deaths
- FECs – regular monitoring for lambs (every 3-4 weeks) and targeted FEC sampling in ewes
- Speciation (see above) – particularly during identified high risk periods and/or where a high FEC is seen
- BCS / FAMACHA® (or simply checking the colour of mucous membranes) – regular monitoring of adult sheep - for example 10% of sheep checked whenever they are gathered and where a risk period is anticipated.

Acquired Immunity

Contrary to previous advice that adult sheep do not develop a strong acquired immunity to haemonchus, current thinking is that suppressive treatment regimens and/or the sporadic nature of the challenge reduce the ability of sheep to develop and/or maintain their immune response. Research suggests that when naïve sheep are exposed, the process takes 6-9 weeks, by which time they reduce L3 establishment to zero. As with all immune responses, the overall nutritional status of the animals and previous exposure have an important bearing on how well they will be able to withstand a challenge. However, in circumstances where there is a sudden and massive increase in larval challenge, even the most robust immune response can be overcome due to the speed and magnitude of the ingested L3s. We do not know how long the immune response remains primed once the challenge from HC has waned. It is likely however, that this is a significant factor for adult and second season grazing sheep if they do not experience a 'trickle' challenge for an extended period. This may be a factor in cases where sheep are moved off onto forage crops or dairy pastures where there is no challenge over winter and are then moved back to heavily contaminated pastures in the spring.

Genetic resistance in sheep

A certain degree of genetic resistance has been demonstrated in sheep to HC (heritability of around 0.3) and egg counts are highly correlated to the number of adult worms in the gut, so are a good marker. Sheep with genetic 'resistance' establish their immune response more quickly and therefore reduce overall worm burdens. This could be considered an additional tool in the box of longer-term control measures, if included in the selection of replacement ewes in a well-recorded flock.

Anthelmintic Resistance (AR)

There is very little data available on the prevalence of AR resistant strains of HC in the UK. It has often been assumed that the situation will be like that in summer rainfall areas of Australia and South Africa where multi-resistant strains are common. However, even in Australia the situation is very different in the more temperate winter rainfall areas (Western Australia for example, which much more closely resembles the UK climate) as can be seen in the Table 1 below (courtesy of Brown Besier). This means that it is likely options remain for individual flocks providing we monitor and investigate.

Table 1. Anthelmintic Resistance in HC in Australia

Anthelmintic	Summer rainfall areas	Winter rainfall areas	UK estimate
Benzimidazoles	+++	++	?
Levamisole	+	Little reported	?
Ivermectin	+++	++	?
Moxidectin	++	+?	?
Monepantel	Little reported	Little reported	None reported
Derquantel/abamectin	Little reported	Little reported	None reported
Closantel	+++	Little reported	None reported?

+ = detected at relatively low incidence; +++ high incidence

The increased pressure for selection for resistance where suppressive regimes have been employed is well documented (e.g. the original 'Wormkill' programme in Australia) https://archive.dpi.nsw.gov.au/content/agriculture/sheep/wormill-basics and is exacerbated by the low population of L3 *in refugia* when many treatments were given. The use of such tactics is not recommended in the UK for this reason.

We must not make assumptions regarding the anthelmintic resistance (AR) status on a farm. The implications for treatment options are huge. Even if the AR status is well documented for other roundworms, it is not advised to assume the same status applies to HC. It is imperative that drench checks and speciation carried out to establish if treatments have been effective AND if survivors are HC and/or other worm species. (See specification section).

AR status will vary between farms, so it is not acceptable to make assumptions. However, it is possible to make an initial risk assessment by considering the following:

- previous anthelmintic use including frequency of treatments,
- accuracy of application,
- use of refugia,
- product choice for other parasite treatments, for example scab or liver fluke treatments with ML/closantel when deciding which class of product is most likely to remain effective.

Currently we are not aware of any confirmed cases of AR in HC to closantel in the UK.

Over wintering of HC

Historically, it was assumed that the over wintering strategy for HC was 'hypobiosis' (nn arrested stage of development), with L3 larvae ingested in the late summer / autumn going into an arrested L4 state in the gut until the following spring when they reemerge. In Australia, evidence suggests that more L3 are now continuing to complete their lifecycle in the autumn within the host and then surviving on pasture, with reduced hypobiosis. However, it is not clear what the situation is in the UK and further work is required.

In Australia, it has been reported that the degree of hypobiosis has reduced significantly, with few L4 being found on sequential post-mortem trials (1979-71 v. 2005-6) (Roeber et al., 2013) and in part, this has been attributed to the warmer temperatures over the winter months. However, another factor

involved in this change is thought to be the major influence of anthelmintics that kill inhibited larvae and therefore select for the survival of non hypobiotic strains.

Together with selection pressures that allow continued development of L3s at lower temperatures, shorter pre-patent periods, adaptations of egg size etc, there are a number of factors at work. We need to better understand the situation in the UK and the implications for successful management of HC. If HC are indeed more prone to completing their life-cycle following ingestion well into the autumn, there are important questions to be answered regarding sheep management. For example, outwintering may perpetuate this situation while removal of sheep could lead to a rapid decline in levels on pasture as larvae run out of energy reserves and die in the absence of a host. We must also consider the impact of reduced anthelmintic treatment of adult ewes on both selection within the HC population and the magnitude of the overwintered population of HC when combined with management practices.

Factors involved in an outbreak

In winter rainfall and cool temperate climates, (i.e. the UK) HC outbreaks of clinical disease are sporadic. While research in these areas is sparser, we can learn from Western Australia (WA) which has a climate much closer to the UK situation. In WA, they have found that the key factors in explaining/predicting when an outbreak will occur are the local epidemiology (weather/climate factors) and the timing of sheep management routines together with any animal factors such as nutritional stress. These can be summarised as follows:

1. Weather / climate factors

Outbreaks of HC are closely linked to weather conditions associated with a sudden change to conditions that favour the HC – for example dry periods followed by a warm wet spell coupled with the high biotic potential of HC can lead to a sudden high challenge. To help predict when the combination of conditions is most suitable for HC, there are models under development (SCOPS will provide more details in due course). However, it is important to note that these models DO NOT predict the likelihood of clinical disease. They are a very useful indicator of favourable conditions only and must be viewed alongside the other potential predisposing factors for an individual flock.

2. Animal factors

Condition/nutritional status – degree of stress the animals are under, if they are in poor condition at a time when the weather and other risk factors (heavily contaminated pastures) are in play

Previous exposure to HC – e.g. new replacements may have had none; for older ewes, how long ago was the last outbreak?

Age/status of lambs involved.

3. Management factors

- Lambing / lactation – ewes under stress / unable to maintain an immune response PPRI
- When was lambing relative to other factors? Age of the lambs relative to high-risk period
- Weaning – lambs under stress / coincides with weather pattern that favours HC
- Grazing – likely level of contamination on pastures
- Overwintering policy for the sheep.

On farms known to be affected by HC, careful monitoring and mapping of areas where infection levels are high is essential so that avoidance tactics can be employed (see Chapter 2. SCOPS Principles, 2.4 Reduce Dependence, 2.4.2. Pasture based assessments).

Mixed infections of strongyles

It is possible that HC will be found as a mixed infection with other roundworms. However, the prevalence of this is unknown in the UK. In mixed infections with *T. circumcincta* / *T. axei*, *Haemonchus contortus* is known to be compromised due to an increase in abomasal pH. This may help to explain why a sudden high challenge by HC in the early grazing season can have such a devastating effect because sheep that have not had significant exposure to these other parasite species, and therefore lack competition in the abomasum, may provide better conditions in the abomasum for a rapid population increase.

Treatments

In addition to the broad-spectrum wormers, closantel, a narrow spectrum product is also effective against *H. contortus* and is the product of choice where this is the target predominant parasite. This is particularly important with regard to ewes where we are trying to minimise unnecessary treatment of other worm species (see Chapter 2. SCOPS Principles, 2.5 Select Right Product).

The use of closantel on farms where it is also used for liver fluke control needs to balanced and based on the presence of fluke at the same time as the HC treatment, and the degree to which closantel is used for fluke control on the farm. In areas where closantel is the mainstay of their fluke control programme (due to Triclabendazole (TCBZ) resistance, for example) it may not be the best choice. However, on other farms where it would only be used once during the winter, it would be a practical choice.

NB The toxic dose of closantel is only 4x recommended dose and treatment must not be repeated within 7 weeks or thereabouts.

It should not be assumed that AR HC strains are present because many farms will still find that one or more of the three older groups will very likely still be effective. A review of their historical use of these (for example if they have heavily used 3-ML for scab control will increase the risk of AR to this group) is a useful starting point. In most cases the use of a group 4 or 5 product is not justified unless HC specific AR to the other groups has been confirmed and closantel is not appropriate.

In cases of sub-acute/chronic disease, targeted treatment of clinically affected animals, using the markers above (eg FAMACHA®), avoids blanket use and maintains *in refugia (link to this in technical manual).* This is important because AR is a major issue with *H.contortus* worldwide and as the UK deals with a higher prevalence we must reduce selection pressure on anthelmintics as much as possible.

Weighing adult sheep to make sure the dose rate is correct is vital. Breed averages are often very misleading, making underdosing a significant risk. Each flock should weigh at least a sample of ewes to ascertain the heaviest weight for ewes and be prepared to split them if there is a wide range (see Chapter 2. SCOPS Principles, 2.1 Administer Effectively*). NB Overdosing of closantel is to be avoided.*

Post-Drench Testing combined with speciation of survivors is essential when dealing with HC so that the classes of anthelmintic that remain effective can be recorded. It is not acceptable to make assumptions and use the newer classes (Group 4 – monepantel; Group 5- derquantel/abamectin)

Vaccination

There are currently no vaccines against Haemonchus licensed in the UK. A commercially available vaccine** initially developed at Moredun is licensed in parts of Australia and South Africa. It induces high serum antibody levels to 'hidden' gut antigens of Haemonchus and manufacture of the vaccine involves harvesting extracts of the parasite's gut. Vaccination results in a reduction in egg shedding and disease in lambs, yearlings and ewes.

This vaccine is being used successfully to help in the control of *H.contortus* in parts of Australia and, South Africa and is being used by some practitioners under a special import certificate (SIC) via the Veterinary Medicine Directorate (VMD) in the UK. This can only be done through a vet. Sheep require three priming doses of vaccine, followed by boosters every six weeks to six months depending on level of challenge.

***(BarbervaxÔ) is commercially available in some countries but is not currently authorised in the UK. The use of the vaccine has not yet been evaluated in control programmes for commercial flocks in the UK.*

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