SYSTEMIC RESPONSES TO CHALLENGE INFECTION WITH HAEMONCHUS CONTORTUS IN IMMUNE MERINO SHEEP

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ABSTRACT


Some systemic responses to single-dose infection with 10,000 Haemonchus contortus infective larvae were examined in sheep already shown to have protective immunity against the parasite. The major haematological finding was a neutrophil leukocytosis that occurred after the infections became patent but not during the pre-patent period. There was no definitive eosinophilia and no discernible change in the erythrocyte parameters. Systemic hyperthermia was not conclusively evident during the pre-patent period. Enzyme-linked-immunosorbent assays (ELISA) were used to measure the secondary anti-helminth antibody response in serum during the pre-patent period when the establishment of patent infection is resisted. These ELISAs employed preparations from adult worms to represent the parasitic stages of the worm, preparations from infective larvae to represent the pre-parasitic stages of the worm, and exsheathing fluid, which is the soluble material obtained when Haemonchus contortus larvae undergo ecdysis and transform from the pre-parasitic to the parasitic phase. Antibody responses to the three preparations differed qualitatively, indicating the presence of three different but perhaps overlapping sets of antigens. The three peaks in antibody against exsheathing fluid may reflect the pulses of antigen delivered to sheep as the parasite undergoes its three moults within the host.

Keywords: antibody, antigen, ELISA, Haemonchus contortus, immune response

Abbreviations: ELISA, enzyme-linked immunosorbent assay
EDTA, ethylene diamine tetraacetate

INTRODUCTION

Low worm burdens in immune sheep infected with the abomasal nematode parasite Haemonchus contortus are the net result of a variety of host-protective responses. These include the self-cure reaction, which dislodges resident worms through a localized immediate hypersensitivity reaction triggered by incoming larvae (Stewart, 1955), and two separate responses that prevent the effective establishment of infection by incoming larvae. The first is termed immune exclusion (Miller et al., 1983). It acts within 48 hours of infection and is dose-dependent (Jackson et al., 1988). This first response is elicited only by high doses of larvae (1,000,000 and 100,000) and does not appear after infection with 10,000 larvae. The second response is perhaps the more usual one under grazing conditions in Australia. It has been described as refractoriness to reinfection. It acts between 4 and 7 days after challenge infection in
sheep made immune by previous exposure to the parasite and is observed with
challenge doses of infective larvae of 10,000 or less (Adams, 1982).

Information on the mechanisms underlying each form of anti-helminth immunity
may help in understanding how environmental factors interfere with protection and
hence how integrated control programmes may be engineered. It may also aid
research into vaccines against helminth parasites by suggesting in vitro and in vivo
tests for discriminating those worm antigens which might induce protective immunity.
The mechanisms ultimately involved in protective immunity against Haemonchus
contortus can be predicted to operate at the interface between host and parasite, that
is in the abomasum, and at a time corresponding to damage to parasites. They are
likely to be controlled and integrated by the general immune system and will thus be
linked to responses which appear systemically.

Descriptions of the local and systemic reactions that accompany parasite infection
will help in the identification of mechanisms of protective immunity. For this reason,
the present paper reports on the systemic reactions to single-dose challenge infection
with Haemonchus contortus in sheep already known to have acquired immunity by
their response to previous infections (Adams and Beh, 1981). This experimental
system uses relatively low doses of infective larvae and focuses upon that form of
immunity expressed as refractoriness to reinfection. Systemic changes were sought in
body temperature, haematology and serum antibody to soluble antigens from infective
larvae and adult worms and to substances released when infective larvae undergo
ecdysis in vitro.

MATERIALS AND METHODS

Experimental animals

Adult Merino wethers exposed to a series of infections with 10,000 H. contortus
infective larvae were used. Protective immunity was recognized in these animals by
lower faecal egg counts in infections subsequent to the primary infection, as shown in
Figure 1 for the first experiment. During the experiments, the sheep were housed on
slatted wooden flooring in group pens and were fed a pelleted ration based on lucerne
hay and wheat supplemented with 2% w/w coarse salt to control urolithiasis.

Parasitology

H. contortus infective larvae of the McMaster strain were obtained from cultures of
faeces from sheep harbouring pure infections. Larvae for the challenge infection were
injected transabdominally into the rumen of immune sheep (Adams, 1982) to avoid
experimental variation associated with the operation of the ruminal groove reflex
when larvae are given by mouth. Oxfendazole (Systamex, Coopers Animal Health,
Silverwater, New South Wales, Australia) was used at 9 mg/kg live weight to remove
residual worms from previous infections in the second experiment. Faecal egg counts
were made by the modified McMaster method (Whitlock, 1948).