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Avermectin resistance in *Cooperia pectinata* in cattle in Argentina

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ANTHELMINTIC resistance of nematode parasites of sheep is widespread and represents a significant threat to the sheep industry in many countries of the world, including Argentina (Waller and others 1995, Eddi and others 1996, Romero and others 1998). However, anthelmintic resistance of cattle nematodes is less widely reported. Most field cases reported in cattle come from New Zealand (McKenna 1991, Jackson and others 1995, Vermunt and others 1995, Hosking and others 1996) although the first case from the northern hemisphere was recently reported in the UK (Stafford and Coles 1999). Benzimidazole anthelmintics are involved in most of these findings although resistance to ivermectin has also been reported (McKenna 1996, Stafford and Coles 1999). This short communication describes the occurrence of anthelmintic resistance in bovine nematodes in Argentina.

In April 2000, 80 Hereford calves with histories of illthrift and persistant faecal worm egg counts after ivermectin treatment were purchased from a beef farm. The calves were moved to facilities near the Instituto Nacional Tecnologia Agropecuaria (INTA) Rafaela Experimental Station. Seventy-two animals were selected for a controlled trial of faecal egg count reduction (FECR) on the basis that they had a nematode eggs per gram (epg) of faeces count greater than 150. The animals were isolated in an outdoor pen and fed on concentrate and lucerne hay with water freely available. On the day before commencement of the study (day −1), the calves were divided into six groups of 12 animals (groups 1 to 6) on the basis of the epg count. The counts were performed as described by Roberts and O'Sullivan (1949). The epg count of these groups ranged from 228 to 256 (P=0·832; Kruskal Wallis test). On day 0, the calves were individually weighed and those in groups 1 to 5 were injected subcutaneously as follows: group 1 with 200 µg/kg ivermectin 1 per cent (Ivomec; MSD AGVET); group 2 with 630 µg/kg ivermectin 3·15 per cent (Ivomec Gold; Merial); group 3 with 630 µg/kg of a generic ivermectin 3·15 per cent (Vermectin Premium; Over SRL); group 4 with 200 µg/kg doramectin 1 per cent (Dectomax; Pfizer); and group 5 with 200 µg/kg moxidectin 1 per cent (Cydectin; Fort Dodge). The animals in group 6 were left untreated to act as controls.

TABLE 1: Mean faecal nematode eggs per gram (epg) count in calves before (day −1) and after treatment (day 12) with injectable macrocyclic lactones

Group	Macrocyclic lactone dose	Number of calves	epg Day −1	epg Day 12	FECR (%)*
1	Ivermectin 1 per cent 200 µg/kg	12	247	224	40
2	Ivermectin A 3·15 per cent 630 µg/kg	12	256	136	65
3	Ivermectin B 3·15 per cent 630 µg/kg	12	228	201	49
4	Doramectin 1 per cent 200 µg/kg	12	245	105	73
5	Moxidectin 1 per cent 200 µg/kg	12	238	42	89
6	Controls	12	248	393	-

* Percentage calculated according to Coles and others (1992)
FECR Faecal egg count reduction

On day 12 of the study, faecal egg counts were determined in all 72 calves. For each treatment group the FECR was compared with that for control group and percentages calculated according to Coles and others (1992). The FECRs were lower than 75 per cent in groups 1 to 4 and 89 per cent in group 5 (Table 1). *Cooperia* was the only Trichostrongyloidae genus identified from pooled pre- and post-treatment faecal cultures used to extract infective larvae. *Cooperia* larvae obtained by Baermannised post-treatment cultures were used to infect two worm-free Holstein calves for species identification. Each calf was orally inoculated with approximately 14,000 larvae and treated with 200 µg/kg ivermectin 1 per cent at patency. Eight days later the calves were euthanased and the gastrointestinal tracts removed for nematode recovery. The species present was *Cooperia pectinata*.

Thirty-five days after the macrocyclic lactone treatments, half of the calves were weighed and assigned into three new groups of 12 animals on the basis of epg counts. One group was treated with injectable levamisole (7·5 mg/kg), the second group with oral oxfendazole (5 mg/kg) and the third group was kept as an untreated control. Twelve days later, no eggs were observed in the faeces of the levamisole- and oxfendazole-treated animals.

The results of the present study are the first confirmation of anthelmintic-resistant nematodes in cattle in Argentina. There has been a large increase in sales of macrocyclic lactones in Argentina over the past decade, both for endo- and ectoparasite control, and this is likely to be the major reason for the development of anthelmintic-resistant nematodes (Argentinian Board of Veterinary Pharmaceutical Products, Argentinian Association of Veterinary Parasitology, personal communication). There is no detailed record of anthelmintic use on the study farm but injectable ivermectin has been used for a long time. Since *Cooperia* is the dose-limiting species for the avermectins (Benz and others 1989, Goudie and others 1993), resistance would be expected to develop first in this species. It is important to determine the prevalence of anthelmintic resistance in Argentina and other countries, and to establish what needs to be done to slow the development and spread of resistance.

From a knowledge of the pharmacology of the macrocyclic lactones (Conder and others 1993) it would be expected that there would be side resistance between ivermectin and doramectin and cross resistance with milbemycin. It is known that ivermectin can temporarily sterilise nematodes in sheep (Jackson 1993). Thus, the higher reduction of egg counts with moxidectin may possibly be due to the persistence of the drug rather than a greater reduction in worm numbers. This requires further investigation.

It appears that anthelmintic resistance in bovine nematodes is in its early stages in several parts of the world including New Zealand, the UK and Argentina. Rather than ignore the development of resistance, as largely happened with nematodes of sheep, it is to be hoped that serious attempts will be made to try to prevent its rapid spread and development in cattle.

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Prenatal infection with a hydatid cyst in a camel (*Camelus dromedarius*)

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THE larval (hydatid cyst) stage of the carnivore tapeworm, *Echinococcus granulosus* can develop in several mammalian intermediate hosts causing hydatidosis (cystic echinococcosis). This parasite has a widespread global distribution and has a high level of endemicity in areas within the range of the dromedary (*Camelus dromedarius*). In these areas, dromedaries seem to be the intermediate hosts of preference. The rate of infection in camels has been reported to range from 17 per cent to 80 per cent (Afshar and others 1971, Dada 1978, Al-Abbassy and others 1980, Euzeby 1982, Pangui and Ould 1991, Rahman and others 1992). In comparison, the prevalence of infection in sheep ranges from 1·3 per cent to 20 per cent (Babero and others 1963, Pandey and others 1986, Rahman and others 1992). However, the common assumption is that *E granulosus* has a domestic dog-sheep life cycle in these areas and that the dromedary contributes little, if at all, to the maintenance of the life cycle. This is due to the high frequency of sterile cysts isolated from infected camels (ElBihari 1985). Intermediate hosts become infected by *E granulosus* postnatally by the ingestion of food and water contaminated with *E granulosus* eggs from faeces of the final carnivore host. Once established, the hydatid cyst develops slowly over several months, can commonly reach 5 to 10 cm in diameter and is typically unilocular (Soulsby 1982). Cystic echinococcosis does not display specific definitive clinical symptoms in domestic animals, even in cases where multiple cysts occur in the liver and lungs. This short communication describes the occurrence of prenatally acquired atypical cystic echinococcosis in a newborn dromedary.

FIG 1: Subcutaneous polylobulated cyst occupying the lateral thoracoabdominal region of a female dromedary

A four-week-old female camel was admitted to the Veterinary Teaching Hospital of King Faisal University, Al-Ahsa, Saudi Arabia. The owner stated that the camel had been born with a large vesicle on its back. On clinical examination the lesion was found to occupy the left lateral thoracoabdominal region, from the scapulohumeral region of the left flank (Fig 1). The vesicle was soft, compressible, clearly lobulated and covered with intact skin. Aspiration revealed a clear transparent fluid. The camel was otherwise clinically normal. The animal was prepared for surgery and anaesthetised intramuscularly with a mixture of 0·1 mg/kg bodyweight xylazine (Seton, 2 per cent; Laboratorios Caliers) and 2 mg/kg bodyweight ketamine hydrochloride (Ketamidor 10 per cent; Richter Pharma) (Ramadan 1994). An incision was made in the skin around the base of the cyst, which was then carefully dissected out from the underlying subcutaneous tissues. Wound closure was routine, and the skin was closed with interrupted mattress sutures. The camel recovered soon after the operation and the owner was advised to remove the stitches after 14 days.

The excised cyst (Fig 2) weighed 1750 g and contained 2·5 litres of fluid. The interior of the lesion appeared polyloculated and was surrounded by reactive tissue which was fibrous, thick and very firm (Fig 3). Microscopic examination of the cyst revealed the presence of laminated cuticle membrane that was devoid of germinal elements. The cyst fluid was centrifuged and examination of the sediment did not reveal any protoscolices. The cyst was identified as a sterile hydatid cyst (acephalocyst).

The occurrence of such a cyst in a four-week-old camel seems to indicate a prenatal acquisition of hydatidosis. It is