

RESEARCH NOTE

SURGICAL TRANSFER OF THE CYSTICERCIC OF *TAENIA HYDATIGENA*

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ABSTRACT

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Unattached immature cysticerci of *Taenia hydatigena* were transferred surgically to the peritoneal cavities of 4 sheep. Mature infective cysticerci were recovered from the recipient sheep 3 and 5, 8 months later. A fully developed live cysticercus was present in the muscle layers surrounding the scar of the laparotomy site in 2 of the animals.

Résumé

TRANSPLANTATION CHIRURGICALE DES CYSTICERQUES DE *TAENIA HYDATIGENA*

On a transplanté chirurgicalement des cysticercues libres immatures de *Taenia hydatigena* dans les cavités péritonéales de 4 moutons. Les animaux récepteurs ont rendu des cysticercues mûrs et infectieux 3, 5 et 8 mois plus tard. Un cysticercue vivant et complètement développé a été retrouvé chez deux de ces moutons au milieu des couches musculaires entourant la cicatrice laissée par la laparotomie.

INTRODUCTION

The experimental infestation of the intermediate hosts with the larval stages of *Taenia* spp. is not always satisfactory, since the infestation may not become established either because of the resistance of the intermediate host or the lack of viability or infectivity of the eggs. Hürchner, Langnes & Oguz (1976) infested 25 pigs with 2 000 ova of *Taenia hydatigena*, but cysticerci developed in only 5 of them. When these authors infested pigs with 5 000 eggs of this parasite, all 35 pigs became infested. If the hosts are fully susceptible, too many parasites may develop and lead to the death of the host. Hürchner *et al.* (1976) also infested 30 rabbits each with 1 500 eggs of *Taenia pisiformis* and 3 of the animals died of acute cysticercosis. Moreover, with some species, such as *Taenia multiceps*, it is difficult to simulate experimentally the light infestations which normally occur under field conditions.

In sheep, light infestations with cysticerci of *Taenia hydatigena* cause slight pathogenic changes. In severe infestations, however, the larvae migrating through the liver to the abdominal cavity cause hepatitis cysticercosa which can result in the death of the host.

This paper reports on the surgical transference of immature cysticerci from sheep with hepatitis cysticercosa into other sheep where they developed into mature infective cysticerci.

MATERIALS AND METHODS

Seven Karakul rams, 6-7 months old, were each infested with approximately 13 000 *T. hydatigena* ova recovered from segments taken from an experimentally infested dog. The viability of the eggs was assessed by a modification of the technique described by Silverman (1954): the artificial gastric juice consisted of 1% trypsin*, 1% bile salts** and 1% sodium bicarbonate at pH 7.2-7.4. From the 14th day all the animals developed anorexia, became weak, and eventually were unable to stand. At autopsy from the

16th-20th day they all had extensive hepatitis cysticercosa. Unattached immature cysticerci removed from the peritoneal cavity of Sheep D1 after it was killed on Day 18, were transferred to the peritoneal cavities of 2 cestode-free sheep (R1 and R2), and from Sheep D2, killed on Day 20, to Sheep R3 and R4.

These operations were performed as follows: The donor sheep were killed by exsanguination and immediately autopsied. The required numbers of cysticerci were collected aseptically and mixed with about 500 ml physiological saline solution. The cysticerci from Sheep D1 were maintained at room temperature while those from Sheep D2 were maintained at 37 °C.

Thirty minutes before the operation, each recipient sheep received an intramuscular injection of a tranquilizer*. The left or right paralumbar fossa was prepared for surgery and the site of the incision infused with a procaine hydrochloride solution**. Using aseptic surgical techniques, an incision about 40 mm long was made through the abdominal wall to expose the peritoneal cavity. The solution containing the cysticerci was run into the peritoneal cavity through a funnel to which a length of rubber tubing was attached. The free end of the tube was placed deep into the peritoneal cavity, its position being changed periodically to facilitate the flow of the suspension. The abdominal wound was thereafter sutured.

The interval between collection of the cysticerci and their insertion into the recipient animals was approximately 60 and 90 min in the case of Sheep R1 and R2, and 45 and 60 min in R3 and R4, respectively.

Sheep R1 and R2 were killed 95 and 176 days and Sheep R3 and R4 93 and 175 days respectively after transference of the cysticerci. Some of the cysticerci from Sheep R2, R3 and R4 were fed to 3 cestode-free dogs to test their infectivity. A faecal specimen from the dog infested with cysticerci from Sheep R3 was examined for *Taenia* sp. eggs on Day 88 post-infestation; faecal specimens from the other 2 dogs were examined daily from Day 30 until they became positive.

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* Merck

** Difco Bile Salts No. 3

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* Acetylpromazine V, Boots at 0.1 mg/kg body mass

** 2% Planocaine V, Maybaker

RESULTS

The numbers of cysticerci transferred to the recipient sheep and the number subsequently recovered are summarized in Table 1.

TABLE 1 Number of cysticerci recovered after surgical transfer

Sheep		Number of cysticerci				Cal- cified
Donor	Recipient	Trans- ferred	Recovered		Viable	
			Total	%		
D1.....	R1.....	100	7	7	7	0
	R2.....	85	38	45	14	24
D2.....	R3.....	78	61	78	58	3
	R4.....	100	76	76	71	5

Comparatively few of the cysticerci from Sheep D1 developed in the recipient sheep and the majority of those in Sheep R2 were calcified. The majority of the cysticerci from Sheep D2 became established in the recipients and only a few calcified.

A fully developed live cysticercus was present in the muscle layers surrounding the scar of the laparotomy site in both Sheep R2 and R4.

Faecal specimens from the dogs fed cysticerci from Sheep R2 and R4 were first positive for *Taenia* eggs on Day 49. A similar specimen from the dog infested with material from Sheep R3 contained *Taenia* eggs when examined on Day 88.

DISCUSSION

When the eggs were tested before infestation of the donor sheep, only 5% were apparently viable. Each sheep was therefore dosed with approximately 13 000 eggs, i.e., an estimated 650 viable eggs. When the animals showed signs of hepatitis cysticercosa, another *in vitro* test was carried out on the remaining eggs, using a fresh batch of bile salts in place of the old one which had been in use for over 5 years. In the 2nd test more than 99% of the ova hatched and it was clear that the animals had been dosed with far too many viable ova.

Our experience has shown that goats sometimes recover from severe infestations if they are able to survive the migratory phase through the liver, i.e., 14–21 days after infestation. In the present trial it became obvious that the sheep would die and they were therefore slaughtered from 16–20 days after infestation.

Comparatively few of the cysticerci from Sheep D1 became established in the recipient sheep. The majority were calcified, possibly because of a decrease in their temperature during transference. However, the majority of the cysticerci from Sheep D2, which were maintained at 37 °C during transference, developed into mature cysticerci. A drop in temperature may therefore have played a role in the number of cysticerci that survived transference and their subsequent development.

Cestodes with polycephalic larvae are commonly passaged in the laboratory from one intermediate host to another by intraperitoneal inoculation, e.g., *Taenia mustelae* (Freeman, 1956), *Taenia crassiceps* (Freeman, 1962) and *Echinococcus granulosus* (Pennoit-De Co-

man, De Rycke & Outryve, 1974). In this instance surgery was used as the cysticerci were so large that it was felt that inoculation would injure them. Animals infested by such transference have also been used to test the efficacy of anthelmintics against the larval stages of cestodes such as *T. crassiceps* (Campbell, McCracken & Blair, 1975), *E. granulosus* (Heath, Christie & Chevis, 1975), *Echinococcus multilocularis* (Campbell *et al.*, 1975) and *Mesocestoides corti* (Heath *et al.*, 1975).

Surgical transference of the cysticerci of *T. hydatigena* can be used to infest animals with the small numbers of parasites normally found in natural infestations. Animals infested in this way would be suitable for investigating the effect of various anthelmintics on the cysticerci of *T. hydatigena* with the certain knowledge that no liver damage resulting from the migration of parasites was present. The use of this technique should also make it possible to infest animals with very large numbers of cysticerci without the risk of their dying from hepatitis cysticercosa.

Intra-abdominal pressure resulted in cysticerci being deposited in the musculature at the site of the incision of 2 of the sheep. This is the first recorded instance of these cysticerci maturing in the musculature. Other more easily accessible sites, e.g., subcutis, might be equally favourable for their development.

After the completion of the transference described here, a mature cysticercus of this species was incidentally found in the abdominal musculature of a naturally infested sheep in a subsequent unrelated experiment. The parasite occurred immediately beneath the peritoneum but the local tissue reaction of the host to its presence was minimal.

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