Onderstepoort J. vet. Res., 55, 187–189 (1988)

RESEARCH COMMUNICATION

NOTES ON THE OCCURRENCE OF TUBERCULAR SPINES IN *SCHISTOSOMA MARGREBOWIEI* AND *SCHISTOSOMA MATTHEEI*

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ABSTRACT

KRUGER, F. J., HAMILTON-ATTWELL, V. L., TIEDT, L., VISSER, P. S. & JOUBERT, P. H., 1988. Notes on the occurrence of tubercular spines in *Schistosoma margrebowiei* and *Schistosoma mattheei*. *Onderstepoort Journal of Veterinary Research*, 55, 187–189 (1988).

Scanning electron microscopical (SEM) studies on the tegument of the bovid schistosomes, *Schistosoma margrebowiei* and *Schistosoma mattheei* have yielded conflicting results; certain authors observed the tubercles on the tegument of these species to be spined, while others reported that they are spineless. The present study indicates that the protrusion of tubercular spines is subject to phenotypic plasticity regulated by external factors such as the identiy of the host species and whether or not the schistosome is paired.

INTRODUCTION

Ogbe (1982) described the tegument of *Schistosoma margrebowiei* for the first time using laboratory maintained material obtained from the Experimental Taxonony Unit of the British Museum. He found the tubercles on the tegument of the male of this species to be devoid of spines. In contrast, Evers, Jackson, Dettman & Sapsford (1983) found the isolate of the parasite maintained at Nelspruit, to exhibit numerous short tubercular spines. Probert & Awad (1987) studied laboratory maintained material originating from Zambia and noticed both spined and spineless tubercles on the dorsal and dorsolateral surfaces of mature male worms *in copula*, while unpaired males lacked tubercular spines. From this observation they deduced that copulation is a prerequisite for the development of tubercular spines and suggested that, in this species, spinulation of the tubercles should be regarded as an unreliable taxonomic character.

Descriptions of the tegument of *Schistosoma mattheei* are equally conflicting. Tulloch, Kuntz, Davidson & Huang (1977) studied *S. mattheei* from South Africa and found the tubercles on the male tegument of this species to be devoid of tegumental spines, a finding confirmed by the observations of Hockley & Mclaren (1977). However, Hamilton-Attwell & Van Eeden (1981) observed that certain specimens from a laboratory population of the parasite maintained in sheep at the Veterinary Research Institute at Onderstepoort possessed spines. Kruger, Hamilton-Attwell & Schutte (1986) more recently compared laboratory populations of the parasite isolated from 3 localities where it occurs sympatrically and 2 localities where it occurs allopatrically to *Schistosoma haematobium*, with which it hybridizes in nature (Pitchford, 1961; Wright & Ross, 1980). They observed certain specimens from the sympatric populations to be spined and postulated that the spines might be a characteristic inherited from *S. haematobium*. In order to ascertain whether other allopatric populations of *S. mattheei* are also spineless, Joubert, Hamilton-Attwell & Kruger (1987) isolated another colony of this parasite from the South-western Transvaal, where *S. haematobium* does not occur at all, and found the males to be spineless.

EXPERIMENTAL OBSERVATIONS

In this communication we report on a number of observations pertaining to the expression of tubercular spines in *S. margrebowiei* and *S. mattheei*. As these observations were made during projects of which the aims were diverse, the recordings and the implications thereof may best be reported in chronological order:

1. A large number of *S. mattheei* pairs were dissected from cattle originating from 4 farms in the Eastern Transvaal. Thirty males from each sample were examined by means of SEM. The percentage of spined males varied between 30 % and 80 % within the 4 populations. In order to ascertain whether spineless males contain unprotruded spines beneath the tegument, transmission electron microscopy (TEM) was performed on a number of specimens. Of these, certain males were observed to contain primordial spines originating from the basal membrane (Fig. 1).

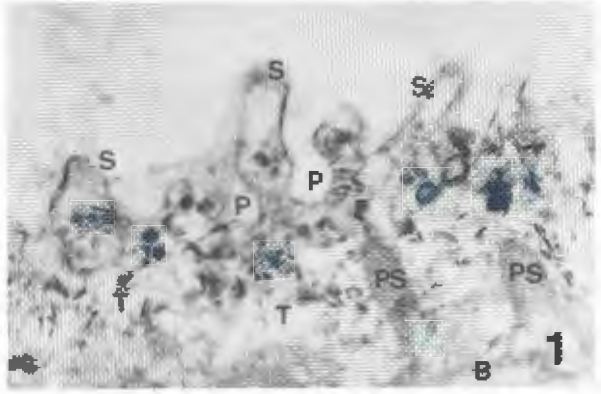

FIG. 1 Transmission electron micrograph of a section through the tegument of a tubercle of a spineless, paired *Schistosoma mattheei* male dissected from cattle demonstrating primordial spines: × 21000 (B=basal membrane: P=surface pits: PS=primordial spines: S=surface membrane: T=tegument containing elongated and membraneous bodies)

Whether the primordial spines in these *S. mattheei* males were the result of recent pairing, or whether the protrusion of spines was inhibited in some way, is not known. The observation nevertheless indicates that, as in the case of *S. margrebowiei* (Probert & Awad, 1987), care should be taken in the use of tubercular spines as a taxonomic character. The deductions made by Kruger *et al.* (1986) which are based on the occurrence of tubercular spines, should therefore be interpreted with this observation in mind.

2. Careful examination of the spineless laboratory strain of *S. mattheei* originally studied by Tulloch *et al.* (1977), revealed that the dorsal and dorso-lateral tegument of all paired adult males was indeed spineless.

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Received 9 May 1988—Editor

FIG. 2 Scanning electron micrograph of an adult, paired *Schistosoma mattheei* male from a laboratory population demonstrating spined tubercles on the outer gynaecophoric fold and aspinous tubercles on the inner gynaecophoric fold (IG=inner gynaecophoric fold: OG=outer gynaecophoric fold)

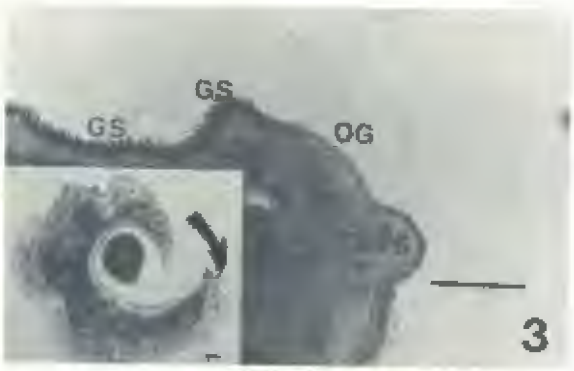

FIG. 3 Optical micrograph of a cross section through a male similar to the one in Fig. 2 demonstrating the location of the spined tubercles on the outer gynaecophoric fold: Bar=20 μm (arrow on insert=location of spined tubercles: GS=spines of the gynaecophoric canal: OG=outer gynaecophoric fold: TS=tubercle with short spines)

FIG. 4 Scanning electron micrograph of the aspinous dorsal tegument of *Schistosoma margrebowiei* dissected from lechwe

However, in certain specimens the tubercles on the outer gynaecophoric fold bore a small number of spines (Fig. 2 & 3).

These spines probably play a role in the clasping act during copulation. The spines within the gynaecophoric canal ensure efficient male/female contact; it is possible that the tubercular spines might promote efficient interlocking of the two gynaecophoric folds. The presence of tubercular spines on only this particular region of the tegument, would therefore seem to be genetically fixed in this isolate.

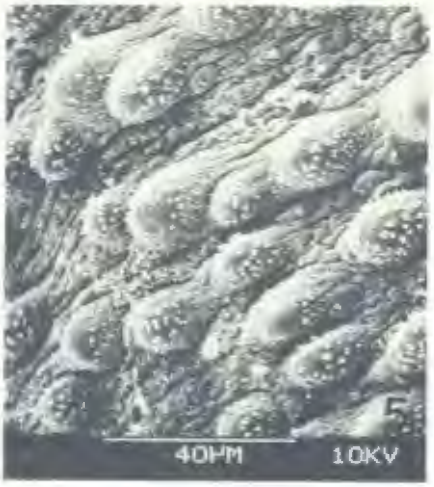

FIG. 5 Scanning electron micrograph of the spined dorsal tegument of *Schistosoma margrebowiei* from a laboratory population maintained in *Saccostomus campestris*

3. Thirty-five *S. margrebowiei* pairs were dissected from two lechwe (*Kobus leche*) in the Eastern Caprivi. Scanning electron microscopy revealed all of them to be spineless (Fig. 4). These schistosomes were compared with a laboratory population of the parasite isolated from the same area and maintained in *Saccostomus campestris*. The males of this population were all spined (Fig. 5).

DISCUSSION

Senft, Gibler & Knopf (1978) observed that the tubercles of *S. mansoni* males are aspinous in non-permissive hosts, but spined in permissive hosts which indicates that non-permissive hosts are capable of retarding schistosome maturation and consequently inhibit the protrusion of tubercular spines through the tegument. In view of this, one would expect the probability of finding spined specimens from a natural host to be greater than from a laboratory host, which although permissive, is an unnatural host. The occurrence of only aspinous specimens from lechwe is therefore an unexpected but interesting phenomenon. It is unlikely that this represented a recent infection since all the schistosomes from the both lechwe (one was considerably older than the other) were of adult size.

Information as to the function of tubercular spines may provide insight into the reasons for their presence or absence. Hockley (1970) found the spines on the dorsal tubercles of *in sito* adult *S. mansoni* males to be deeply embedded in the endothelial cells of the host's blood vessels. Since he observed the base of the spines to be associated with longitudinal and transverse muscle fibres, Hockley (1973) postulated that they are movable within the tegumental matrix. In this way they allow the worm to change its position within the blood vessel without causing extensive damage to the endothelial cells. Probert & Awad (1987) on the other hand ascribed the appearence of tubercular spines, which occur in *S. margrebowiei* only after copulation, to "an adaptive feature to enable the male worm to obtain purchase in the blood vessels when the additional weight of the female occurs at copulation." In our opinion, factors which could influence the protrusion of tubercular spines and which could be worth investigating are: the diameter of the vessel in which the schistosome pair resides, the parasite density level and the immunological response of the wild, domestic or laboratory host to the infection.

ACKNOWLEDGEMENTS

We would like to thank the Namibian Department of Nature Conservation for the 2 lechwe, Prof. C. H. J. Schutte and Dr S. J. Pretorius for their valuable advice and criticism in the preparation of the manuscript and the South African Medical Research Council for permission to publish this paper.

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