ULTRASTRUCTURE OF THE TEGUMENT OF EURYTREMA PANCREATICUM CERCARiae

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Abstract. The distal cytoplasm of tegument of E. pancreaticum cercaria contains numerous rod-shaped, electron-dense granules, single mitochondria and four types of sensory receptors. The tegument in the oral sucker projects into short, thick microvilli. The ducts of penetration and cystogenic gland cells with a large number of longitudinally arranged peripheral microtubules open in the region of stylist pocket. Secretory granules of penetration gland cells are electron-dense, those of cystogenic gland cells are electron-lucent. The scanning electron microscopy and transmission electron microscopy of sensory receptors are correlated.

This paper is a part of complex investigations of the adaptation of larval trematodes to terrestrial conditions. It was preceded by ultrastructural studies of sporocyst wall of *Eurtyrema pancreaticum* (Nesterenko 1978, Nesterenko et al. 1980a, b, Ždářská 1979, 1982, Ždářská et al. 1978), which is a trematode of economic importance.

MATERIAL AND METHODS

Cercariae of *E. pancreaticum* were obtained from naturally infected smalls *Brehmiiella landzi* collected in the pastureland in the vicinity of Alma-Ata. The methods used for the fixation, embedding and contrasting were described in a previous paper (Ždářská et al. 1978).

RESULTS

The syncytial tegument of a fully developed cercaria is of an even structure on the whole body surface, with the exception of oral sucker. The tegument (Fig. 1) is finely folded and only in the oral sucker it projects into short, thick microvilli (Fig. 2). The tegument on the surface and at the base is limited by a trilaminar unit membrane. The basal plasmalemma follows the folds of the basal lamina. The distal cytoplasm contains, in addition to single mitochondria, a large number of rod-shaped, dense granules oriented mostly upright to tegument surface (Fig. 1; Plate I, Fig. 1). Under the basal lamina is a thin fibrous layer and under it a layer of circular and longitudinal muscles (Figs. 1, 2; Plate I, Fig. 1; Plate III, Fig. 2). The subtegmental cells open into the tegument through their thin cytoplasmic processes and produce dense, rod-shaped granules surrounded by a trilaminar unit membrane. The tail tegument (Plate I, Figs. 1, 2) is of the same structure as the body tegument. The body tegument, particularly around the oral sucker, contains numerous sensory receptors of two types with and without a cillum (Fig. 2; Plate II, Figs. 1, 2; Plate III, Figs. 1, 2; Plate IV, Fig. 1). The ciliated sensory receptors possess either one or two cilia each. The terminal cillum has a basal body (Plate II, Fig. 1; Plate IV, Fig. 1) and a striated rootlet may be present (Plate II, Fig. 2; Plate III, Fig. 1) or absent (Plate II, Fig. 1). The ciliary rootlet is embedded in a bulbous area containing single small vesicles and microtubules. The cillum and the bulb, which are connected
with the nerve below the basal lamina, penetrate into the tegument. The bulb is limited by unit membrane and attached to the plasmalemma of tegument by a terminal circular septate desmosome. The apical part of the bulb is strengthened by a dense mass. A fold of the distal cytoplasma of the tegument covers the whole bulb (Plate II, Fig. 1). This ciliated sensory receptor morphologically corresponds to the so-called sensory receptor with finger-like process. The papilla forming a base of the finger-like process is not smooth, but it is covered with short processes (Plate IV, Fig. 1).

The ciliated sensory receptors (Plate III, Fig. 2) are bulbous widenings of the nerve, which do not communicate with the surface of tegument. They contain a large number of vesicles, microtubules, single mitochondria and dense mass situated at the periphery. The nerve penetrates through the muscle and fibrous layer and through basal lamina into the tegument where it widens and is joined to the plasmalemma of tegument through a lateral circular septate desmosome. The lateral part of the bulb is strengthened by a dense collar.

Both penetration and cystogenic gland cells open on the tegument surface in the stylet pocket. Their ducts are surrounded by basal lamina and under the plasmalemma they possess a large number of longitudinally arranged microtubules (Plate IV, Fig. 3). The secretion of penetration gland cells forms irregular dense granules (Plate IV, Fig. 3). The secretion of cystogenic gland cells forms large electron-lucent granules with a fine granular structure (Plate IV, Fig. 2). The granules are mostly situated in cell bodies, whereas most of the ducts of cystogenic cells are empty. Only in some of the ducts is a small amount of the secretion (Plate IV, Fig. 3).

Fig. 2. Tegument of oral sucker (below) with transverse sections through microvilli (above) and a sensory receptor (left); the unit membrane of which is connected with plasmalemma of tegument through septate desmosome (G, Os, UA, Pb). (× 18 400).

DISCUSSION

The structure of the tegument of E. pancreatica cercaria is almost identical with that of D. lancea cercaria (Nesterenko et al. 1961). Both species are members of the family Dicrocoeliidae and the electron-microscopical studies of their tegument revealed characteristic rod-shaped, dense granules and sensory receptors in their distal cytoplasm. The sensory receptors of larvae of the family Dicrocoeliidae have been studied only by scanning electron microscopy (SEM) (Zdarska 1977, 1982), but not yet by transmission electron microscopy (TEM). The four types of sensory receptors in E. pancreatica cercaria observed in TEM correlate to the two types described by Zdarska (1982) in SEM. The SEM observations revealed papillae with finger-like process and papillae without this process, whereas in the transmission electron microscope it was visible that the papillae with finger-like process consist of one or two short cilia with striated rootlet covered with a tegument fold along its whole length. This tegument fold, which has a form of cylinder, represents the so-called finger-like process. The papilla, on the surface of which this finger-like process is situated, is not smooth, but it is covered with short, spherical processes well visible in both SEM and TEM. The inner structure of this type of sensory receptors conforms to the ciliated sensory receptors described by Dixon and Mercer (1965), Matrion — Gondran (1971), Erasmus (1972), Lyons (1972), Kie (1973), Bennett (1973), Edwards et al. (1977), Fujino et al. (1979), Allison (1980), Hoole and Mitchell (1981), Zdarska and Sobolev (1982) and Zdarska (1983).

The third and fourth type of sensory receptors detected in TEM are papillae without finger-like processes formed by a tegument elevation under which is one or
more sensory receptors without cilium, so-called "récepteur en massue" (Matricon-Gondran 1971) formed by a bulbous extension of the nerve fibre filled with clear vesicles and microtubules. The sensory receptors of the fourth type, i.e. papillae with a greater number of acilliated bulbous extension, are partly similar to the type of sensory sucker papillae in Entodella soleae (Monogenea) (Lyons 1973).

The ducts of both penetration and cystogenic gland cells opening on the tegumental surface in the region of stylet pocket are provided with a large number of longitudinally arranged microtubules, similar to that described by several authors in cercariae of other families (Krupa et al. 1968, Kemp 1970, Robson and Erasmus 1970, Koe 1971, Morris 1971, Ebrahizadeh and Kraft 1971, Dorsey 1974, 1978, Tongu et al. 1985).

The proximal parts of ducts of penetration gland cells of E. pancreaticum cercariae obtained from sporocysts released into the outer environment are filled with a secretion, whereas the proximal parts of ducts of cystogenic cells are mostly empty. Only small granules contain a small amount of secretion arising from the fusion of individual granules of the electron-lucent (mucous) substance. A similar fusion of individual mucoprotein granules was described by Mercer and Dixon (1966) in the cystogenic gland cells of cercaria of Fasciola hepatica. Also the proximal parts of ducts of penetration gland cells contain fused materials and not single granules like in the distal part of ducts and in cell bodies. This was observed also by Tongu et al. (1975) in the ducts of penetration gland cells of cercariae of the genus Metagonimus.

The ultrastructural studies of E. pancreaticum cercaria indicate that the penetration gland cells are fully prepared for the penetration already before the release of the sporocyst from the first intermediate host, whereas the shift of secretion of cystogenic gland cells into the ducts seems to be stimulated only in the second intermediate host.

УЛЬТРАСТРУКТУРА ТЕГУМЕНТА ЦЕРКАРИЯ ЕВРУГРЕМА PANCREATICUM

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Резюме. Дистальные цитоплазмы тегумента церкарий E. pancreaticum содержат многочисленные наночастицы, электронно-электронные грани, отдельные митохондрии и незначительные цитоплазматические пузырьки. Тегумент содержит большое количество жировых включений.

REFERENCEs


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Fig. 1. Longitudinal section through posterior part of cercarial body (left, at the top) and tail (right) surrounded by a fibrous mucoid substance more densely arranged in the fold between body and tail (G, Os, UAe, Pb). (× 4 000). Fig. 2. Detail of tail tegument of E. pentastriatus cercaria (G, Os, UAe, Pb). (× 18 400).

Fig. 1. Longitudinal section through papilla with finger-like process showing sensory receptor with two cilia. Plasmalemma of tegument is united with plasmalemma of receptor through septate desmosome. In front of it inside the receptor is the electron-dense substance (arrows) (G, Os, UAe, Pb). (× 55 200). Fig. 2. Oblique section through bulb of sensory receptor from the tegument of E. pentastriatus cercaria at level of striated rootlet. The plasmalemma of bulb is connected with plasmalemma of tegument through septate desmosome (arrows) (G, Os, UAe, Pb). (× 48 000).
Fig. 1. Longitudinal section through a bulb of sensory receptor with striated rootlet. Note septate desmosome (left) and nerve (right) penetrating lamina basilis and fibrous layer under the tegument (G, Os, UAc, Pb). (×41 400). Fig. 2. Group of three innervated sensory receptors from the region of oral sucker of E. necator cercaria. Nerve fibres (arrows) of these receptors with numerous microtubules run between the layer of transverse and longitudinal muscles of body and then penetrate through the layer of transverse muscles, fibrous layer, lamina basilis and basal plasmalemna into the tegument where they form bulbous widenings filled with clear vesicles. Opposite to the lateral dense collar of the bulb, the plasmalemna of receptors is connected with basal plasmalemna of tegument through septate desmosome. a — longitudinal, b — transverse section through innervated

Fig. 1. Oblique section through the base of papilla with finger-like process at level of basal body in which triplets of microtubules are distinctly visible (arrow) (G, Os, UAc, Pb). (×46 000). Fig. 2. Detail of granules in the body of cystogenic gland cell of E. necator cercaria (G, Os, UAc, Pb). (×15 000). Fig. 3. Horizontal section through subtegmental layer in the region of stylet pocket showing mostly empty ducts of cystogenic gland cells (a), from which only one is filled with electron-dense matrix (b) and duct of penetration gland cell (c) filled with electron-dense mass. Note microtubules running longitudinally in ducts of both cystogenic and penetration gland cells (G, Os, UAc, Pb). (×15 000).