STICHOSOME ULTRASTRUCTURE OF THE FISH NEMATODE Capillaria pterophylli Heinze, 1933

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Summary:
The stichosome (posterior glandular esophagus) of Capillaria pterophylli Heinze, 1933 consists of large gland cells (stichocytes) and luminal epithelium with cuticular lining. Both structures are enclosed in a reticulum of muscle cells. The stichocyte cytoplasm contains small cisternae of rough endoplasmic reticulum, Golgi complexes, one kind of electron dense secretory granules, mitochondria and a branching system of intracellular collecting ducts without filament bundles around them.

KEY WORDS: Nematoda, Capillaria pterophylli, ultrastructure, stichosome.

The present paper, describing the ultrastructure of the stichosome of Capillaria pterophylli Heinze, 1933, completes our studies on the ultrastructure of this nematode (Zd'arska & Nebesárová 1999, 2000). The esophagus of the superfamily Trichinelloidea Ward, 1907 (1879) consists of two distinct parts, the anterior muscular part and posterior glandular part termed the stichosome. The stichosome is an exocrine organ. The main component of the stichosome are large glandular cells, the stichocytes. Stichosome ultrastructure has been studied earlier in the family Trichuridae by Sheffield (1963) in Trichuris muris (Owen, 1835) and T. vulpis Froelich, 1789; in the family Capillariidae by Bruce (1970), Despommier (1974), Despommier & Müller (1976) and Takahashi et al. (1992) in Trichinella spiralis (Schrank, 1788); in the family Capillaridae by Wright (1972) in Capillaria hepatica Bancroft, 1893, 1933 and by McDarby et al. (1987) in Capillaria catostomi (Pearse, 1924). From the family Cystocephalidae only histological data are available of two species of Dioctoittittus Chabaud & Le Van Hoa, 1960 (Bain & Ghadirian, 1967).

In the recently accepted conception of Moravec (1982, 1987) of a new systematic arrangement of nematodes of the family Capillariidae, Capillaria hepatica (Bancroft, 1893) does not belong to the genus Capillaria s.s., but to the genus Calodium Dujardin, 1845, and Capillaria catostomi (Pearse, 1924) to the genus Pseudocapillaria Freitas, 1959. Therefore, in the new systematic arrangement, our study represents the first description of the stichosome ultrastructure in the genus Capillaria s.s.

MATERIALS AND METHODS

Female and male specimens of C. pterophylli Heinze, 1933 collected from the intestine of an angel fish Pterophyllum scalare (Lichtenstein, 1823) were rinsed in saline, fixed in 3 % glutaraldehyde in 0.1 M phosphate buffer (pH 7.2) at 4°C for two hours, postfixed in 1 % OsO4 at 4°C for two hours, dehydrated in an ethanol series and embedded in Durcupan via acetone. A series of ultrathin sections of the whole stichosome (from the first stichocyte to the last one encircled by two pseudocoelomocytes) were cut using a Reichert Jung Ultracut E ultramicrotome, double-stained with uranyl acetate and lead citrate and viewed in a transmission electron microscope JEOL 1010 operated at 80 kV. Semi-thin sections were stained in toluidine blue.
Figs 1-4. – Stichocyte of *C. pterophylli*. Fig. 1. Oblique TEM section through the body of *C. pterophylli* in the region of the stichosome. The stichosome fills the entire pseudocoelom. The stichocyte (ST) surrounds the lumen (L) of the esophagus. NU: nucleus, N: nucleolus, S: dense secretory granules, D: collecting ducts, BB: bacillary band gland cells, arrow: pore of BB, C: cuticle, scale bar = 5 µm. Fig. 2. Detail of Fig. 1. NU: nucleus, N: nucleolus, S: secretory granules, D: collecting ducts, CI: small cisternae of rough endoplasmic reticulum, scale bar = 1 µm. Fig. 3. Detail of Fig. 2 (bottom right). Collecting ducts (D) contain electron dense secretory material (arrows). S: secretory granules, scale bar = 200 nm. Fig. 4. Lumen of the esophagus lined by a thin cuticle (arrows) connected with a thin epithelial layer. D: collecting ducts, S: secretory granules, scale bar = 1 µm.
RESULTS

The stichosome of *C. pterophylli* consists of a single row of large gland cells, the stichocytes (Fig. 1) and an esophagus with cuticular lining (Figs 1, 4). The whole surface of the stichocytes adheres to a thin basal lamina. Over this basal lamina the stichosome surface through the whole length covers a meshwork (fenestrated layer) of muscle cells (Figs 5, 6). The dimensions of the lobes on the surface of the stichocyte (Fig. 1) depend on the contraction or dilatation of the peristichocytal muscle bands. The muscle cells, localized external to the stichocyte basal lamina contain myofilaments (Fig. 5) and are connected with the basal lamina by hemidesmosomes (Fig. 6).

Concentration of electron dense granules occur around the nucleus and collecting ducts (Figs 1, 2, 3, 4). There is a great size diversity in granules (Figs 2, 3). Smaller-sized granules could represent stages of granulogenesis. Mature granules measure 500 nm. Some of them are round, other of irregular shape. The stichocyte cytoplasm contains a high concentration of rough endoplasmic reticulum with abundant small cisternae (Fig. 2), Golgi systems, and mitochondria mainly concentrated at the periphery of the cell. Around the nucleus, among the dense secretory granules, there are aggregations of narrow collecting ducts containing small amount of electron dense material (Fig. 3). These collecting ducts, of irregular contour, pass through the cell to the esophagus (Figs 1, 4).

The esophagus (Fig. 4) comprises the cuticle and flattened epithelial cells connected by means of very fine desmosomes. No myofilaments were identified in this part of esophagus. The epithelial cells are separated from the stichocyte plasmalemma by a thin basal lamina. At some parts these epithelial cells are not detectable, mainly at the level of the last stichocyte, where small cytoplasmic evaginations of the stichocyte are connected directly to the cuticle by dense material. At the level of the last stichocyte, the stichosome is connected with the basal lamina of two pseudo-coelomocytes. At this level the esophagus, bordered by a cuticle, terminates, and continues as the intestinal lumen bordered by a microvillous zone of the enterocytes (see Žďárská & Nebesářová 1999 – Figs 1, 2, 3).

DISCUSSION

In cross sections of *C. pterophylli* one unicellular stichocyte surrounds the esophagus as in *Calodium hepaticum* (Wright, 1972), *Pseudocapillaria cato*...
stomi (Mc Darby et al., 1987), Trichuris species (Sheffield, 1963; Jenkins, 1970; Wright, 1972) and Trichinella spiralis (Khan, 1966; Bruce; 1970; Desponnier, 1974; Desponnier & Müller, 1976; Takahashi et al., 1990, 1992). The unicellular stichocytes of C. pterophylli, and the above mentioned species, differ from the voluminous syncytial stichocytes of the genus Diocto-wittus (Bain & Ghadirian, 1967; Moravec 2001).

The well developed peristichocytal muscle reticulum of the stichosome in C. pterophylli, as in Calodium hepaticum and Trichuris species (Wright, 1972) and Trichinella spiralis (Bruce, 1970; Desponnier, 1974; Takahashi et al., 1990) is important for the contractions that can be transmitted through the stichosome to the esophagus and from the esophagus to the intestine. Their function is probably to squeeze the content of the stichosome part of the esophagus into the intestine. The stichosome part of the esophagus in C. pterophylli comprises the cuticle and thin layer of epithelial cells connected with the stichocyte basal lamina. As in C. hepaticum (Wright, 1972) no myofilaments are present in the stichosome part of the esophagus of C. pterophylli.

Intracellular filament bundles localized around the collecting ducts in C. hepaticum (Wright, 1972) were not detected in the stichocytes of C. pterophylli. Electron-dense secretory granules observed in stichocytes of the anterior, middle and posterior part of the stichosome, which are concentrated around the stichocyte collecting ducts, probably desintegrate when entering into the ducts. In the collecting ducts of C. pterophylli some electron dense material is present and presumably is carried from the stichocyte into the esophagus. No granules were observed in the canalicular tree. We do not divide the mature electron-dense granules in C. pterophylli into two types. In our opinion coexistence of two types of granules (more or less rounded) in C. pterophylli represents two stages of granulogenesis which can result, as documented in T. spiralis (Takahashi, 1992), in a difference in antigenicity. The dense secretory granules probably contain some of the enzymes identified in Trichiurus muris by Nimmo-Smyth and Keeling (1960). In transportation of the stichocyte secretory product from the collecting ducts to the esophagus lumen, assist probably contractions of the peristichocytal muscle reticulum.

Our ultrastructural investigation of the stichosome of C. pterophylli has not confirmed a pore-like opening of the stichocytes to the esophagus as reported by Bruce (1970) and Takahashi et al. (1992) in Trichinella spiralis, Wright (1972) in Calodium hepaticum, and Bain & Ghadirian (1967) in Dioctolittus chabaudi and D. wittet. At the ultrastructural level in Trichuris species (Sheffield, 1963), Jenkins (1970) and Wright (1972) were unable to detect these pore-like openings too. Pore-like openings of stichocytes to the esophageal lumen undoubtedly occur in C. pterophylli as in C. hepaticum, T. spiralis and Dioctolittus spp. In C. pterophylli as in Trichuris spp, they have not yet been seen in electron microscopy because of the great sampling problem involved in locating this single, small structure in the large stichocytes.

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REFERENCES


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