Ultrastructure of the excretory system
of *Trilocularia acanthiaevulgaris* (Cestoda, Tetraphyllidea)

J.S. McCullough* and I. Fairweather

The School of Biology and Biochemistry, The Queen’s University, Belfast, BT7 1NN, Northern Ireland

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**Abstract.** The fine structure of the excretory system in the juvenile (plerocercoid-like) form of *Trilocularia acanthiaevulgaris* is described. The flame cell bears a bunch of 50–70 cilia, which are anchored in the cytoplasm by means of basal bodies possessing striated rootlets. All the cilia in the “flame” are aligned in the same direction. The flame and duct cells are connected by interdigitating ribs of cytoplasm separated by a fibrous sheet. Both internal and external leptotriches are also present. The lumen of the excretory ducts is intracellular in origin. The apical surface of the cytoplasm lining the duct is convoluted and its surface area is further amplified by means of microvilli. The fine structure of the excretory system in this primitive tapeworm is compared with that described for other parasitic and free-living flatworms.

The few ultrastructural studies that have been carried out on the excretory system of cestodes have been confined to the Cyclophyllidea and Pseudophyllidea (Bonsdorff and Telkka 1966; Howells 1969; Lumsden and Hildreth 1983; Lumsden and Specian 1980; Swiderski et al. 1975). Little is known about the physiology of the system, the presumption being that it is largely excretory in nature and plays little role in osmoregulation (see review by Lumsden and Hildreth 1983). To date, no detailed study of the fine structure of the excretory system in the primitive Tetraphyllidea has been carried out, and the present investigation on *Trilocularia acanthiaevulgaris* seeks to fill this gap. The distribution of the main excretory vessels in this species has been described by Rees (1953). There are two pairs of lateral, longitudinal collecting ducts, one ventral and the other dorsal, and they form a looped arrangement within the scolex. At the posterior end of the juvenile (plerocercoid-like) form examined, the ventral vessels join to form an excretory bladder that opens to the exterior via a terminal pore (Rees 1953).

**Materials and methods**

*Trilocularia acanthiaevulgaris* juvenile worms were recovered from the stomach of the spiny dogfish, *Squalus acanthias*. They were immediately fixed overnight at 4°C in 4% (w/v) glutaraldehyde in 0.05 M sodium cacodylate buffer (pH 7.2) containing 3% (w/v) sucrose and 0.5 mM calcium chloride. Following fixation, specimens were processed for transmission electron microscopy as described by McCullough and Fairweather (1984). Ultrathin sections were examined using a Jeol 100 CX transmission electron microscope operated at 80 kV.

**Results and discussion**

The excretory system of *Trilocularia acanthiaevulgaris* comprises two major components, the flame cell and the excretory duct. The spindle-shaped flame cell has a large, terminal nucleus, surrounded by scant cytoplasm containing some mitochondria and numerous free ribosomes. A bunch of between 50 and 70 cilia (the “flame”), which are anchored in the cytoplasm, project into a lumen (Fig. 1). A cytoplasmic collar extends out from the flame cell around the basal region of the flame and connects to the walls of an excretory duct via a junctional complex of the zonula adhaerens type (Fig. 1). The flame and duct cells are further joined by the interdigitation of ribs of cytoplasm, which are connected to each other by a fibrous sheet. The ribs occurring internally to the sheet originate from the flame cell and those occurring externally arise from the duct cell (Fig. 2). Ultrafiltration across the fibrous sheet is believed to occur in the spaces between the ribs. No pores were observed in these sites, as has been described by Howells (1969) and Swiderski et al. (1975), although their existence has been doubted by other authors, including Lumsden and Hildreth (1983). Many microvillus-like projections, known as internal leptotriches, ex-
Fig. 1. Transmission electron micrograph (TEM) of a flame cell showing the large terminal nucleus (N) and “flame” (F) of cilia. Each cilium has a long basal body (B) and striated rootlet (R). The flame cell and adjoining duct wall (D) are connected by a zonula adhaerens junctional complex (arrow). Bar = 1 μm. Fig. 2. TEM of a cross section through the “flame” of a flame cell. Note the central cilia (C) with their typical 9 + 2 pattern of microtubules. Bounding the “flame” are internal ribs (ir) of flame cell origin and external ribs (er) of duct cell origin. Ribs are interconnected by a fibrous sheet (fs). Internal leptotriches (IL) arising from the flame cell occur between the cilia and ribs. In the interstitial material outside the ribs are a number of external leptotriches (EL) of duct cell origin. Bar = 0.5 μm. Fig. 3. TEM of an excretory duct cell showing the nucleus (N) and duct lumen (L). The highly convoluted cytoplasm of the periphery contains many mitochondria (m). Bar = 2.5 μm. Fig. 4. TEM of the lumen (L) and surrounding cytoplasm of an excretory duct cell. The luminal surface is expanded into numerous microvilli (small arrows) and the cytoplasm just below contains many vesicles (v), some of which possess granules of electron-dense material. The basal plasma membrane is thrown into a number of deep infoldings (large arrows), with which mitochondria (m) are associated. Bar = 1 μm.