Distribution and Fine Structure of Tegumental Receptors in
Onchocleidus cyanellus (Monogenea: Ancyrocephalinae)

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ABSTRACT: Scanning and transmission electron microscopy were utilized to determine the distribution and fine structure of uniciliate receptors of Onchocleidus cyanellus Mizelle, 1938. Receptors occur dorsally, ventrally, and laterally on the body surface. Most are distributed in the anterior region of the worm. Each receptor consists of a nerve bulb attached to the surrounding tegument by septate desmosomes. The bulb, which extends into the parenchyma, possesses a cilium with a 9+2 microtubular arrangement. The cilium arises from a closed-end basal body lacking a ciliary rootlet system.

Tegumental receptor fine structure has been examined in many major taxa of parasitic platyhelminths (Halton and Morris, 1969; Lyons, 1969, 1972, 1973a, b; Rohde, 1972; Webb and Davey, 1974; Richards and Arme, 1982). These receptors may be divided into two broad categories, ciliated and nonciliated. Lyons (1973a) has reported that both types are found in the Monogenea.

The present study focuses on the distribution and fine structure of uniciliate receptors of adult Onchocleidus cyanellus Mizelle, 1938 utilizing scanning electron microscopy (SEM) and transmission electron microscopy (TEM).

Materials and Methods

SEM
Specimens of Onchocleidus cyanellus were collected from the gills of 20 freshly killed Lepomis cyanellus Rafinesque. The worms were fixed for 4 hr in 4% glutaraldehyde in 0.05 M sodium cacodylate buffer (pH 7.2), washed twice for 2 hr each time in changes of the above buffer, dehydrated in a graded alcohol series, placed in 100% acetone, critical point dried with liquid CO2, and coated with 200 Å of Au/Pd. Eighty specimens were then examined with a Hitachi S-500 scanning electron microscope to determine the receptor distribution.

TEM
Specimens of O. cyanellus were fixed and washed as for SEM, but were then post-fixed for 1.5 hr in 1% osmium tetroxide in the above buffer, rinsed in that buffer, dehydrated in a graded alcohol series, and embedded in LR White medium grade acrylic resin. Ultrathin sections were stained with aqueous uranyl acetate followed by lead citrate and examined with a JEOL JEM 100CX transmission electron microscope. Six representative sections were selected for diagrammatic reconstruction.

Results

SEM—Receptor distribution

Uniciliate receptors are arranged bilaterally in dorsal, ventral, and lateral tegumentary tracts (Figs. 1–9). Each dorsal tract consists of 23 receptors, beginning at the anterior extremity of the worm and extending posteriorly ½ its length (Figs. 1, 4–6). In that tract, 10 receptors are in pairs and 13 occur singly.

Each ventral tract has 11 receptors that begin near the anterior extremity and extend to the level of the vaginal opening. Six are ventrolateral and five are medial (Figs. 2, 7, 9).
Figures 4-9. *Oncholeidus cyanellus*: scanning electron micrographs of adult. 4. In situ dorsolateral view showing portions of the dorsal (D) and lateral (L) ciliated receptor tracts. EP = excretory pore, VO = vaginal opening. Bar = 14 μm. 5. En face view showing the point where the dorsal, ventral, and lateral tracts diverge (arrow). D = dorsal surface. Bar = 6.5 μm. 6. Anterodorsal view showing increasing distance between dorsal receptor tracts (D) from anterior to posterior. Also, portions of the lateral receptor tracts (L) are visible. Bar =
Twenty-seven receptors are positioned on each side of the body from the anterior extremity to near the haptor (Figs. 3–9).

The dorsal surface of the haptor bears six receptors that are associated with larval hook pairs 4, 5, and 6. None is associated with the two pairs of hamuli nor the ventral surface of the haptor (Figs. 1–3, 8).

**TEM—Receptor fine structure**

A cilium exhibiting a 9 + 2 microtubular arrangement projects from a receptor nerve bulb that has an apical diameter of 0.46–0.56 μm lying 0.3–0.37 μm below the surface of the tegument. Distally, the bulb is attached to the adjacent tegument by septate desmosomes (Figs. 10–12).

Two electron-dense nerve collars encircle the nerve bulb. The distal one lies adjacent to the septate desmosomes and is separated from the second, more proximal collar, by a distance of approximately 0.11 μm. Within each nerve bulb is an electron-dense basal plate approximately 0.04 μm in thickness. Microtubules of the cilium extend to the basal plate, which is connected to a closed-end basal body, 0.50–0.56 μm long. Transitional fibers extend from the basal body to the distal nerve collar. The nerve bulb extends into the parenchyma as a process presumed to be continuous with the soma of a neuron (Figs. 10, 12–14). No striated rootlets nor mitochondria were observed.

**Discussion**

**SEM—Receptor distribution**

Although numerous studies of the surface topography of various adult Monogenea exist, few have concentrated on the overall distributional patterns of ciliated receptors. Harris (1983) used silver stain and SEM in observing uniciliate receptors in four transverse bands on adult *Oogyracytis farlowellae* Harris, 1983. Additional clusters occurred around the cephalic lobes, mouth, genital apertures, and haptor. Harris' figures showed that the receptors were elevated forms similar to ciliated papillae and that the majority occurred in the dorsoanterior region of the worm. In addition, five ciliated receptors shown on the ventral surface of the haptor of *O. farlowellae* clearly indicate a distributional pattern different from that of *O. cyanellus*.

The topography of the ventral surface of the monogenean haptor is variable from species to species. Cone and Beverley-Burton (1981) reported that ciliated receptors and papillae were absent from that surface of the haptor of *Benedenia* sp. On the other hand, Halton (1979) observed numerous elevated rosette- and dome-shaped structures on the ventral surface of the haptor of *Diclidophora merlangi* (Nordmann, 1832). He did not mention uniciliate receptors as being there although he did observe them on other areas of the body without discussing their

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Figure 10. *Onchocleidus cyanellus*: diagram of a tegumental receptor. B = basal body, BP = basal plate, C = cilium, Des = septate desmosome, DC = distal nerve collar, N = nerve bulb, P = parenchyma, PC = proximal nerve collar, T = tegument, TF = transitional fiber.
overall distributional pattern. Similarly, Lyons (1973b) reported numerous papillae on the ventral surface of the haptor of *Entobdella soleae* (van Beneden et Hesse, 1863) but gave no indication that uniciliate receptors were present. In the case of *O. cyanellus*, it more nearly resembles *Benedenia* sp. in that it lacks ciliated receptors and papillae on the ventral surface of the haptor.

**TEM—Receptor fine structure**

As revealed by TEM, the fine structure of tegumental receptors in *O. cyanellus* is markedly similar to that described by Lyons (1969) for another monogenean, *Gyrodactylus* sp. Common to those receptors in both species are nerve collars, septate desmosomes, transitional fibers, and absence of ciliary rootlets.

Richards and Arno (1982) stated that the function of dense nerve collars in platyhelminth receptors is unclear, but their relationship to septate desmosomes suggests their function to be one of maintaining the shape of the distal region of the receptor during contraction or relaxation of the worm. Lyons (1973a) proposed that a thickened nerve collar is highly specialized and may, if not deformable, play a part in constraining cytoplasm affected by the shear force produced at the base of the cilium during, perhaps, mechanoreception. Webb and Davey (1974) further suggested that both nerve collars and rootlets are probably involved in support of the cilium, and the longer or more massive the cilium the greater is the degree of development of either the collar or rootlet system, or both. In *O. cyanellus*, as in *Gyrodactylus* sp., ciliary rootlets are lacking, therefore, the dense nerve collars would be the primary structures involved with constraint of the cytoplasm and ciliary support. In addition, the supportive function may be augmented by transitional fibers that interconnect the distal nerve collar and basal body.

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Figures 11-14. *Onchocleidus cyanellus*: transmission electron micrographs of uniciliate receptors. 11. Cross section of a receptor cilium showing a 9+2 microtubular arrangement. Bar = 0.2 μm. 12. Longitudinal section. B = basal body, BP = basal plate, Des = septate desmosomes, DC = distal nerve collar, PC = proximal nerve collar, T = tegument. Bar = 0.2 μm. 13. Longitudinal section showing transitional fiber (TF) in the nerve bulb (NB). Bar = 0.2 μm. 14. Longitudinal section showing a continuation of the receptor (arrowhead) below the level of the tegument (T). Bar = 0.4 μm.
Literature Cited


XVIIIth International Symposium of the European Society of Nematologists

The next International Symposium of the ESN, co-organized under the patronage of INRA and ORSTOM, will be held at the Conference Centre of Antibes, France, September 7–12, 1986.

It is planned to have four days of presented papers and colloquia. One or more special poster sessions with subsequent discussion meetings will be organized.

Official languages will be English and French.

A full day excursion, and a spouses’ program are planned. A post-congress three-day tour of areas of interest in the south of France will be arranged.

For any further enquiries, please contact the President of the ESN: M. Ritter, INRA, Station de Recherche sur les Nématodes, B.P. 78, 06602 Antibes, France.