A Unique Postganglionic Cell in the Praesoma of the Genus *Neoechinorhynchus* (Acanthocephala)

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**ABSTRACT:** A characteristic ganglionic cell between the posterior end of the proboscis receptacle and the posterior end of the cerebral ganglion was found in 6 of the 8 species studied in the family Neoechinorhynchidae and is described herein. This cell was observed only in members of the genus *Neoechinorhynchus*. It was not found in *Paulisentis fractus* Van Cleave and Bangham, 1948, or *Octospinifer macilentus*, Van Cleave, 1919, 2 other species of Neoechinorhynchidae, and neither was it found in representatives of the classes Palaeacanthocephala and Archiacanthocephala. This postganglionic cell is characterized by the presence of large granules in the cytoplasm and 2 elongated extensions that extend anteriorly to become associated with the nerve fibers of the cerebral ganglion. The function of this cell has not been determined. Photomicrographs of this cell showing its cytoplasmic granules, its location, and its lateral extensions are presented.

**KEY WORDS:** acanthocephalan nervous system, *Neoechinorhynchus* chrysemysidis, *N. cylindrus*, *N. emydis*, *N. emyditoides*, *N. magnapapillatus*, *N. pseudemydis*, *Octospinifer macilentus*, *Paulisentis fractus*.

The literature contains little information concerning the individual cells in the cerebral ganglia in species of the class Eoacanthocephala, especially the genus *Neoechinorhynchus*. There are descriptions concerning the numbers of cells in the cerebral ganglion, but few describe their functions and the nerves extending from them. Crompton (1963) described cholinesterase activity in the cells of the cerebral ganglion of *Polyommatus minutus* (Goeze, 1782). Dunagan and Miller (1975, 1981) enumerated the cells and reconstructed the cerebral ganglion in *Moniliformis moniliformis* (Bremer in Rudolphi, 1819) and *Oligacanthorhynchus tortuosa*. Dunagan and Miller (1975) in a review found that most descriptions are of members of the classes Archiacanthocephala and Palaeacanthocephala. Bone (1976), Budziakowski and Mettrick (1983), and Budziakowski et al. (1983, 1984) described the ultrastructure and possible neurosecretory activity of the cells in the cerebral ganglion of *M. moniliformis*. Golubev and Sal'nikov (1979) described the ultrastructure of the cerebral ganglion in *Echinorhynchus gadi* Zoega in Müller, 1776. During an extensive study on the morphology of the nervous system in the praesoma of 9 species of Acanthocephala, Gee (1969) observed a uniquely different cell on the posterior end of the cerebral ganglion of *Neoechinorhynchus cylindrus* (Van Cleave, 1913) and *Neoechinorhynchus emydis* (Leidy, 1851).

Since its original discovery in these 2 species, it has been observed in 4 additional species belonging to the genus *Neoechinorhynchus*. At the present time, it appears that this cell may be characteristic for only the genus *Neoechinorhynchus*. Because it may be of taxonomic, evolutionary, or physiological importance, it is described in this paper.

**Materials and Methods**

Eight species from the family Neoechinorhynchidae were studied. These species and their hosts are: (1) *Neoechinorhynchus* chrysemysidis Cable and Hopp, 1954; hosts: *Chrysemys picta picta*, *Pseudemys scripta scripta*; (2) *N. cylindrus*; hosts: *Micropterus salmoides*, *Ambloplites rupestris*; (3) *N. emydis*; host: *C. picta picta*; (4) *Neoechinorhynchus* emyditoides Fisher, 1960; hosts: *P. scripta scripta*, *P. scripta elegans*; (5) *Neoechinorhynchus magnapapillatus* Johnson, 1969; host: *P. scripta scripta*; (6) *Neoechinorhynchus pseudemydis* Cable and Hopp, 1954; hosts: *P. scripta scripta*, *P. scripta elegans*; (7) *Octospinifer macilentus* Van Cleave, 1919; host: *Caioptosum commersoni commersoni*; and (8) *Paulisentis fractus* Van Cleave and Bangham, 1948; host: *Semotilus atromaculatus atromaculatus*.

Adult specimens were collected alive from their hosts and fixed according to the following method: (1) Worms collected from the intestine of the host were placed in tap water and refrigerated overnight to evert the proboscis. (2) Worms were fixed in warm, 50–60°C, AFA or 10% formalin for 24–48 hr. During fixation, the body wall was punctured with fine needles to facilitate flow of fixative into the pseudocoel. (3) AFA-fixed specimens were washed in several changes of 70% isopropanol. Worms fixed in 10% formalin were washed in tap water for 8–12 hr and stored in 5% formalin to prevent excessive hardening of tissues. (4) Fixed worms were infiltrated with paraffin according to the isopropanol method of Doxtader (1948). Transverse and sagittal sections were cut from 4 to 6 μm in thickness. (5) Sections were stained progressively in 10% Ehrlich's acid-arahatoxylin according to Gruyer (1936). *Neoechinorhynchus* from turtles were identified based on the shape of the posterior end of females and size and shape of eggs. Because there are no known reliable
taxonomic characters to distinguish males of the various species of the genus *Neoechinorhynchus* from turtles, females were used as study specimens. Males were included to compare possible differences between male and female prae soma structure. Both sexes of *N. cylindratus* from fish were studied.

Measurements based on 30 specimens of each species were determined with an ocular micrometer.

**Results**

In *Neoechinorhynchus cylindratus, N. chrysemysidis, N. emydids, N. emydidoïdes, N. magnapatulatus,* and *N. pseudemydis* there is a large postganglionic cell (PGC) located between the posterior end of the cerebral ganglion (CG) and the musculature of the posterior end of the proboscis receptacle (PR) which appears to be different from other cerebral ganglion nerve cells (Fig. 5). In *N. chrysemysidis, N. emydids, N. emydidoïdes, N. magnapatulatus,* and *N. pseudemydis* this cell measures 20–30 µm wide and 15–18 µm long (N = 150). In *N. cylindratus* it is 12–23 µm wide and 12–18 µm long (N = 30). Differences in size appear to be due to sizes of worms studied. The cytoplasm of this ganglion cell contains numerous dark-staining granules located around the inner surface of the cell membrane (Figs. 1, 2, 5; PGC). The nucleus contains a large dark-staining nucleolus. The cytoplasm appears as light-staining granulated material when compared to the compact dark gray-staining cytoplasm of other cells in the cerebral ganglion. In some specimens a large clear area, possibly an empty vesicle, was observed in the cytoplasm. Two elongated lateral processes (LPGC) of the cell extend anteriorly along the lateral surface of the cerebral ganglion to the point where the retinacular nerves leave the cerebral ganglion (Figs. 2–4, 6; LPGC). At this point they appear to extend into the neuropile of the cerebral ganglion where they become indistinguishable from other fibers in this region (Fig. 4; LPGC). This ganglion cell was not demonstrable in either *Paulisentis fractus* or *Octospinifer macilentus,* 2 other species of *Neoechinorhynchidae* studied.

**Discussion**

In their descriptions, based on light microscopy, of the cells in the cerebral ganglion of *M. moniliformis moniliformis* and *Oligacanthorhynchus tortuosa,* Dunagan and Miller (1975, 1981) do not mention a cell such as described in this investigation. Bone (1976), Golubev and Sal’nikov (1979), Budziakowski et al. (1984), and Budziakowski and Mettrick (1985), using transmission electron microscopy, described 5–6 possible cellular types within the cerebral ganglion of *M. moniliformis* and *E. gadi.* Their studies do not describe a granulated cell on the posterior surface of the cerebral ganglion. Harada (1931) described a tripolar postganglionic cell between the proboscis inverter muscles in the posterior region of the proboscis receptacle of *Bolbosoma turbinella* (Dies., 1851). This cell has nerve fibers originating from it that innervate the proboscis inverter muscles in the posterior region of the proboscis receptive. Gee (1969) observed a postganglionic cell, similar to the one described by Harada (1931), in *Echinorhynchus salmonis* Müller, 1784, *Leptorhynchoides thecatus* Linton, 1891, and an undescribed species of *Echinorhynchidae.*

In *Neoechinorhynchus cylindratus, N. chrysemysidis, N. emydids, N. emydidoïdes, N. magnapatulatus,* and *N. pseudemydis* this ganglion cell differs from the postganglionic cell in *E. salmonis, L. thecatus,* and *B. turbinella* by the absence of nerve fibers extending from it to terminate in the proboscis inverter muscles. It should be noted that in species of *Neoechinorhynchus* the cerebral ganglion is situated at the posterior end of the proboscis receptive. In *E. salmonis, L. thecatus,* and *B. turbinella* it is located in the midregion of the proboscis receptive. Gee (1969) did not observe a postganglionic cell in *Pomphorhynchus bulbocalli* (Linkins, 1919), a species of *Palaeacanthocephala* in which the cerebral ganglion is located at the posterior end of the proboscis receptive. If the ganglion cell in these species of *Neoechinorhynchus* proves to be homologous to the postganglionic cell in the *Palaeacanthocephala,* the posterior position of the cerebral ganglion may explain why there are no nerve fibers associated with the postganglionic cell in the *Palaeacanthocephala,* the posterior position of the cerebral ganglion that appear to innervate the inverter muscles of the proboscis in this area (Gee, 1969, 1987a).

The granules may contain neurotransmitter substances, may be neurosecretory, neurohormonal, or may have another function. Crompton (1963) demonstrated cholinesterase activity in cells of the cerebral ganglion of *Polymorphus minutus.* Bone (1976), Budziakowski et al. (1983, 1984), and Budziakowski and Mettrick (1985) have described vesicles and granules that appear to contain biogenic amines in the cerebral gan-
Figures 1–6. 1–4. Transverse sections of posterior region of proboscis receptacle (PR) and cerebral ganglion (CG) of Neoechinorhynchus cylindratus illustrating postganglionic cell (PGC) and lateral extensions of postgan-
ganglion of *M. moniliformis*. Granules were widely distributed in all cells that they observed in the cerebral ganglion. I have studied *M. moniliformis* and *Macracanthorhynchus hirudinaceus* Pallas, 1781, using light microscopy, and observed small granules in various cells in the cerebral ganglion. I could not find an isolated cell containing granules as distinctive as described in this report in either of these Archiacanthocephala or in *E. salmonis, L. thecatus*, and *Pomphorhynchus bulbocelli*, species of Palaeacanthocephala.

This postganglionic cell should not be confused with the Stützzelle (support cell). In these species of *Neoechinorhynchus* the Stützzelle is a binucleate structure located on the inner surface of the dorsal wall of the proboscis receptacle between the anterior end of the cerebral ganglion and the neck region (Gee, 1969, 1987a, b).

At present, it appears that this postganglionic cell is unique to the genus *Neoechinorhynchus*. Further studies on other members of the *Eoacanthocephala* are needed to establish whether this is truly a characteristic cell found only in the genus *Neoechinorhynchus* and to elucidate the function of this cell type.

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**Literature Cited**


