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Morphological details of Central Nervous System of Freshwater Pulmonate snail *Indoplanorbis exustus*

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ABSTRACT
The last four decades have seen a massive assault on the function, development and plasticity of the nervous system. The ability to combine morphological and physiological identification of neurons in a range of vertebrate and invertebrate phyla is enabling neurobiologists to glimpse into the relationship of structures and function at the level of single neurons. In the final analysis, each phylum will have a special place in contributing to our understanding of the nervous system. The contribution of the molluscs will rank highly among those animals whose identified neurons have facilitated a range of inquiries varying from the gating of ionic currents to the cellular basis of synaptic plasticity.
Key word: *Nervous system, Indoplanorbis exustus, Morphological study*

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INTRODUCTION

The CNS of pulmonate molluscs is highly suitable for a wide range of neurological studies, due in part to their relatively simple and consistent neuronal organization. Detail morphology of certain ganglia is available for a few molluscs such as *Lymnaea, Aplysia* and *Helix*. The nervous system of various molluscs has been described by a number of workers. A fundamental question of behavioral neuroscience is how neural systems are controlled and modulated. Pulmonate snails have an extensive neuroendocrine system whose neurosecretory cell bodies lie mainly in the central nervous system (CNS) [1]. The anatomy of CNS of *L. stagnalis* and the locations of the neurosecretory cell types and their neurohemal areas [2], [3], [4, 5] & [6] had described in detail the anatomy and mapping of CNS and identified at least 8-10 different NCSs in *Laevicaulis alte*. Morphological descriptions of CNS of *I. exustus* are needed not only for comparative and systematic studies but also to provide a basis for further work in neural anatomy and development, neuroendocrinology, and the involvement of CNS in the regulation of physiological and behavior. The purpose of this study is to provide an anatomical description of CNS.

MATERIALS AND METHOD

In order to study, morphological features of the central nervous system of *Indoplanorbis exustus*, all intact central ganglia were dissected out from the snail body. The freshly dissected central ganglia were taken over slide with a drop of ringer's solution. Morphological features were noted down observing under dissecting microscope. *Indoplanorbis exustus* measuring 12-14mm shell length were selected for tracing nerves ramified from major ganglia. The CNS and nerves given out from each ganglion were traced out under the dissecting microscope.

RESULT

The CNS of *I. exustus* is made up of compact mass of central ganglia in the form of circum-oesophageal ring. The circum-oesophageal ring of the snail *I. exustus* consists of 11 ganglia. It consists of paired cerebral, buccal, pedal, pleural and parietal ganglia and a single visceral ganglion. The whole mass of central ganglia are divided into two distinct halves. Dorsally, supra-oesophageal ring constitutes two cerebral and two buccal ganglia and ventral half called as sub-oesophageal ring which is composed of paired pedal, pleural, parietal and single visceral ganglia. All paired and unpaired ganglia are fused to form the infra-oesophageal nerve ring.

1) Cerebral ganglia: There are two cerebral ganglia. These are reddish in color and are situated at anterior side of the oesophagus and posterodorsal surface of buccal mass. The cerebral ganglia are separated medially by a long, heavy cerebral commissure which passes above the oesophagus. This is the only commissure which passes dorsal to the oesophagus and completes the oesophageal nerve ring on the dorsal. Each ganglion is circular in shaped. These ganglia connected behind with the buccal mass. These ganglia are connected behind with the buccal, pleural, parietal and pedal ganglia by cerebro-buccal, cerebro -pleural, cerebro-periatal and cerebro-pedal connectives respectively. Nerves arising from the anterior boarder of the cerebral ganglia innervate the principle sensory structures of head. The cerebral nerves are mixed, containing axons.

2) Buccal ganglia: These are very small ganglia. A pair of buccal ganglia is located in the posterior boarder of buccal mass. These are somewhat embedded in the buccal mass on the ventro-lateral side. These are somewhat rounded in shape and are connected each other by a small buccal commissure. The cerebro- buccal connectives originate from the anterolateral side of each ganglion and connect them with the cerebral ganglia. Three nerves are given off from each buccal ganglion and are supplied to buccal mass. Buccal ganglia provide both sensory and motor innervations of buccal mass. Pair of nerves arises from the buccal ganglia and pass posteriorly to the radula sac.

3) Pedal ganglia: These ganglia are situated in the foot muscle. These are well developed ganglia and are connected with cerebral ganglia and pleural ganglia by cerebro-pedal and pleuro-pedal commissures. Three anterior pedal nerves and one latero-dorsal nerve arise from each pedal ganglion. Generally the pedal ganglia supply nerves to the anterior, middle and posterior regions of the foot. They also innervate the body wall above the edge of the foot and the genitalia on the right side of the body. The right ganglion is consequently often larger than the left.

4) Pleural ganglia: These ganglia are situated ventrolateral to the cerebrals and one on either side of oesophagus. These are paired pleural ganglia consisting of right and left pleural ganglia. Both the pleural ganglia are same in size and are rounded bodies. These are connected with pedal ganglia by pedo-pleural connectives. The pleural ganglia differ from other ganglia in lacking a commissure and lack nerves entirely.

5) Parietal ganglia: These ganglia lie just near the pleural ganglia and are attached to visceral ganglia. Right parietal ganglion is larger in size as compared to left parietal ganglion. Right parietal ganglion gives off two nerves which are supplied to the pallial region. They are somewhat triangular in shape and are connected with visceral connective.

6) Visceral ganglion: It is a single ganglion which is formed by union of two small masses. Visceral ganglion is comparatively moderate in size. It lies near the base of the visceral mass. It is attached to the parietal ganglia by its either side. Two nerves give off from the visceral ganglion, and supplying to the visceral parts.

DISCUSSION

In pulmonates, nervous system has several advantages, such as giant size of neurons compared to the rest of the animal kingdom, simplicity of structure and complexity of function and easy availability. Detailed maps of the neurosecretory system are available for only two species of basommatophoran snail *L. stagnalis* [2] and *Bulinus trancatus* [7].

The central nervous system of *I. exustus* is made up of compact mass of central ganglia in the form of circum-oesophageal ring. The circum-oesophageal ring is composed of five paired and one unpaired ganglion. Buccal, cerebral, pedal, pleural and parietal ganglia are paired and visceral ganglion is single one. The whole masses of central ganglia are divided into two distinct halves. Dorsal supra-oesophageal ring and ventral sub-oesophageal ring.

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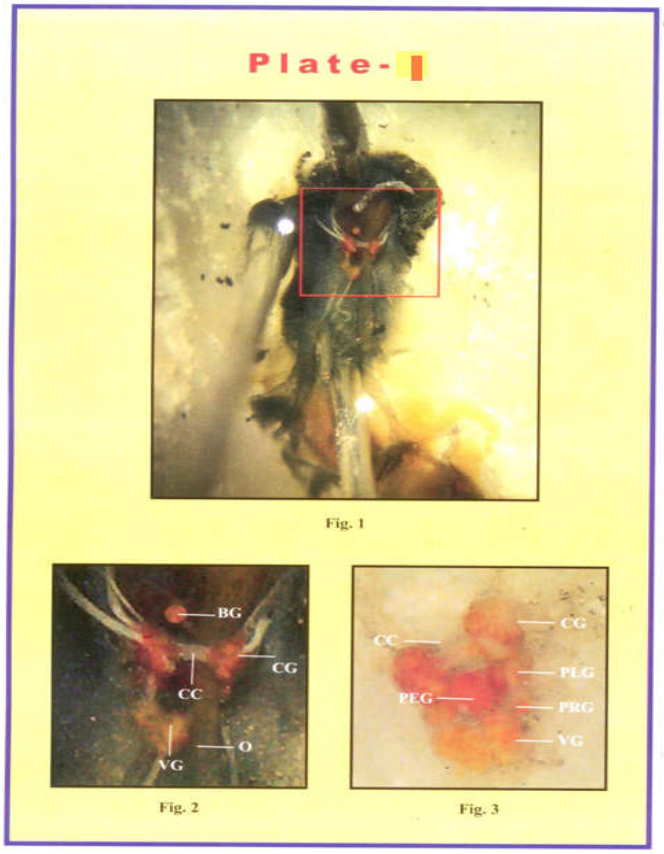

Plate - I Micrograph showing the position of ganglia in nervous system of *I. exustus*
Fig. 1 – Showing position of ganglia in nerve ring.
Fig. 2 – Showing ganglia and their nerves.
Fig. 3 – The whole mount of nerve ring.

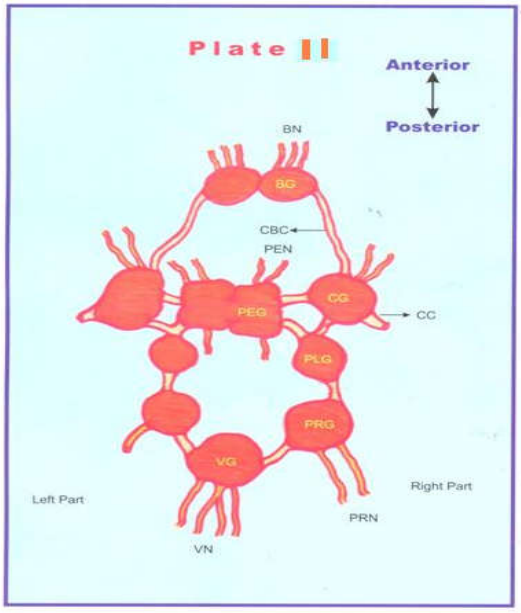

Plate - II Diagrammatic representation of Central Nervous System, showing positions of different ganglia.
BG – Buccal ganglia; BN – Buccal nerve; CC – Cerebral commissure; CG – Cerebral ganglia; PEG – Pedal ganglia; PEN – Pedal nerve; PLG – Pleural ganglia; PRG – Parietal ganglia; PRN – Parietal nerve; VG – Visceral ganglia; VN – Visceral nerve

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