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NEW DATA ON INNERVATION OF THE LOPHOPHORE AND TENTACLES IN BRACHIOPODS: COMPARATIVE ANALYSIS OF THE LOPHOPHORE INNERVATION IN THE LOPHOPHORATES

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Evolutionary relationships among members of the Lophophorata remain unclear. The phylum Brachiopoda is a monophyletic group, which is characterized by unique body plan. All brachiopods have the lophophore: a specialized part of the mesosome, which bears tentacles and provides several important functions. Among brachiopods, there are six main types of the lophophore organization, however peculiarities of the lophophore function are very similar among brachiopods. The lophophore is also known in phoronids and bryozoans, whose body plan is considerably different from that of brachiopods. In spite of this difference, phoronids, brachiopods, and bryozoans are traditionally regarded as the closest relatives, which form a united clade called Lophophorata. At the same time, modern molecular data revealed that Lophophorata does not exist. In order to resolve this contradiction, we have studied the innervation of the lophophore and tentacles in brachiopods of two different groups with two different types of the lophophore morphology and compared this data with innervation of the phoronid and bryozoans lophophore. The lophophores of inarticulate brachiopod Lingula anatina Lamarck, 1801 and articulate brachiopod Hemithyris psittacea (Gmelin, 1790) are studied by method of immunocytochemistry, laser confocal microscopy, and transmission electron microscopy. In two different brachiopods, the general morphology of the nervous system of the lophophore is similar. The lophophore contains three brachial nerves, which extend along each brachium of the lophophore: the main, accessory, and lower brachial nerves. All these nerves exhibit serotonin-like, FMRFamide-like, and α-tubulin-like immunoreactivity. All brachial nerves are located intraepidermally and have stratified structure. Thus, the uppermost layer is composed by epidermal cells, which form long thin basal projection attached to the basal lamina. The second layer is formed by perikarya of different types. The third layer is formed by nerve projections. In L. anatina, among the smaller neurites, there are one to three larger neurites, with diameters from 4 to 8 µm. The cytoplasm of these giant neurites is filled with numerous thick microtubules and small mitochondria. In both studied brachiopod species there are cross nerves, which extent in the connective tissue and connect the main and accessory brachial nerves. Cross nerves are often associated with envelope cells. Comparative analysis revealed the presence of many similar features in the organization of the lophophore nervous system in phoronids, brachiopods, and bryozoans. The main brachial nerve of brachiopods is similar to the dorsal ganglion of phoronsids and the cerebral ganglion of bryozoans. The accessory brachial nerve of brachiopods is similar to the dorsal ganglion of phoronids and the cerebral ganglion of bryozoans. All lophophorates have intertentacular neurite bundles, which innervate adjacent tentacles. The presence of similar nerve elements in the lophophore of phoronids, brachiopods, and bryozoans supports the homology of the lophophore and the monophyly of the lophophorates. All lophophorates have intertentacular neurite bundles, which innervate adjacent tentacles. The presence of similar nerve elements in the lophophore of phoronids, brachiopods, and bryozoans supports the homology of the lophophore and the monophyly of the lophophorates. In brachiopods, the latero-abfrontal zones of the inner tentacles and latero-frontal zones of the outer tentacles are homologous. Thus, the frontal zone is very wide in inner tentacles but narrow in outer tentacles. The collection of material was done with support from the Russian Foundation of Basic Research (#14-04-00238), the TEM and 3-D investigations were done with support from the Russian Scientific Fund (#14-04-262), and the processing of the report was supported by Grants of the President of Russia (#MD-5812.2015.4; # NSH-1801.2014.4).