Structure and Evolution of the nervous system in Annelida

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Members of the taxon Annelida, the segmented worms, can be found in all marine, limnetic, and terrestrial habitats and as a consequence Annelida constitutes a group of extraordinarily high diversity, among the invertebrates, only comparable to molluscs or arthropods. Recent phylogenomic studies provide a new picture of annelid phylogeny: besides a basal grade comprising taxa such as Chaetopteridae, Oweniidae, and Magelonidae, the vast majority form a clade Pleistoannelida with Errantia and Sedentaria as the highest ranked sister groups; Clitellata is an in-group within Sedentaria and taxa formerly regarded as separate phyla are in-groups as well: Sipuncula, Myzostoma, Echiura and Pogonophora. Among annelids the polychaetes display by far the greatest structural variation and degree of complexity which includes the nervous and sensory system. Especially the errant forms possess rather advanced nervous and sensory systems. This complexity is correlated to their highly developed sensory structures, including isolated or clustered sensory cells, up to various complex sensory organs. The annelid nervous system is usually described as rope-ladder-like ventral nervous system connected to the dorsal brain via double connectives. The ventral cord is generally seen as a chain of paired segmental ganglia connected by commissures and connectives but does such a structure really exist in nature and how did the brain and the nervous system in the last common ancestor look like? A lot of new information has been gathered which will be reviewed in the present contribution focusing on structure and evolution of the brain and the ventral nerve cord in polychaetes.