Neuroanatomy of Chelicerata – current progress and future directions

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Within the last two decades, morphological investigations have regained considerable attention within the framework of evo-devo, especially concerning phylogenetic relationships of Arthropoda. Often contradicting results based on traditional external morphology and modern sequence information ask for independent data to evaluate these hypotheses and to supplement our knowledge of arthropod evolution. One promising approach, fuelled by the rapid methodological advancements of imaging techniques, deals with the anatomy and development of the nervous system. Research has been focussed on insect and crustacean species, whereas myriapods and chelicerates have largely been ignored. Information on these taxa is thus of particular interest to assess existing neuroanatomical data and identify apomorphic versus plesiomorphic characters as well as presumptive evolutionary transformations. In this talk, I will focus on two aspects, a) the morphology of individually identifiable neurons and b) the neuroanatomical features of chemosensory organs in Chelicerata. The distribution and projection patterns of individually identifiable neurons has gained considerable attention in the context of arthropod neurophylogeny. Especially serotonin- and histamine-immunoreactive neurons are well suited for phylogenetic comparisons because of small cell numbers and large amounts of data available for several arthropod taxa. Data on chelicerates are nonetheless extremely limited, but crucial for meaningful conclusions. Analyses of chemosensory processing in Chelicerata are scarce, not least since Chelicerata do not possess antennae, as do Mandibulata, but evolved dedicated chemosensory organs in several other body regions. The conspicuous pectines in scorpions as well as the raquet organs of camel spiders are prominent examples here. Comparisons of these two structures and with the antennae of Mandibulata show widespread similarities as well as conspicuous differences. Thus, a systematic comparative approach of neuroanatomical characters can reveal functional prerequisites for chemosensory systems on the one hand and taxon-specific adaptations on the other.

The presentation will provide insights into the evolutionary morphology of individually identifiable neurons and chemosensory organs in Chelicerata with detailed comparisons to Mandibulata, and it will address future directions in this field of research.