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Anatomical organization of locomotor command systems in the lamprey brain

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In vertebrates, command systems in the brain activate central pattern generators (CPGs) in the spinal cord to generate the basic pattern of locomotor activity, such as swimming or walking. Reticulospinal (RS) neurons in reticular nuclei are the neural output elements of the command system that activate the spinal CPGs. In the lamprey, a lower vertebrate, several brain areas are part of the locomotor command system: rostromedial rhombencephalon (RLR); dorsolateral mesencephalon (DLM); ventromedial diencephalon (VMD); and reticular nuclei. Neurons in the RLR project to the DLM and VMD, which then activate RS neurons (Paggett et al., 2004). Also, RS neurons receive inputs from second order sensory neurons in the lateral rhombencephalon as well as ascending inputs from spinal neurons. The purpose of the current project is to provide anatomical evidence for the above proposed pathways in the locomotor command system and potentially to identify new brain command areas that were previously unrecognized. Biocytin was applied to reticular nuclei using several methods so that the tracer would be picked up by input axons and retrogradely transported to the cell bodies of neurons with inputs to RS neurons. Biocytin was applied via pressure ejection both with and without NMDA (N-methyl D-aspartate), as well as via direct application of crystalline biocytin. These procedures resulted in labeling of neurons in several areas of the brain. First, neurons were labeled in the lateral rhombencephalon, and these cells probably correspond to second order trigeminal sensory neurons. Second, occasionally some neurons were labeled in the spinal cord. Third, neurons were labeled in the mesencephalon and diencephalon, in the vicinity of the DLM and VMD, respectively. Further research is needed to determine the functional identity of the labeled neurons in the mesencephalon and diencephalon. The DLM and VMD will be stimulated to initiate coordinated swimming activity, and these stimulation sites will be marked with Alcian Blue. Subsequently, biocytin will be applied to reticular nuclei to determine if retrogradely labeled neurons are within the DLM and VMD sites. A better understanding of the brain locomotor command system in the lamprey may provide insights into the organization and operation of similar brain systems in higher vertebrates, including humans.