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Funding Source: Missouri Academy at Northwest Missouri State University

Axonal regeneration following spinal cord hemi-transection in larval lamprey

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In higher vertebrates, including humans, axonal regeneration following spinal cord injury (SCI) is very limited and there is little behavioral recovery. In contrast, lower vertebrates, such as lamprey, fish, and certain amphibians, display robust axonal regeneration and dramatic behavioral recovery after a complete spinal cord transection. In the lamprey, we have examined the properties of left and right descending brain neurons at various recovery times following spinal cord hemi-transection (HT). However, it is not known if axonal regeneration following spinal HTs is similar to that following a complete spinal cord transection. For example, uninjured axons on one side of the cord might influence regeneration of injured axons on the opposite side. In the present project, animals received a HT of the right side of the upper spinal cord and were allowed to recovery for 1, 2, 4, 8, 12 and 16 weeks. After recovery, an anatomical tracer (HRP) was applied 10 mm below the HTs to retrogradely label descending brain neurons. For all cell groups containing descending brain neurons, there was a gradual increase in the numbers of injured neurons that regenerated their axons for at least 10 mm below the lesion with increasing recovery time. At the longer recovery times, the numbers of labeled descending brain neurons in certain cell groups were not significantly different than those in control animals, indicative of significant axonal regeneration. In other cell groups, regeneration had not restored the normal numbers of projections to the spinal cord. These results appear to be similar to those following complete spinal cord transections, in which descending neurons in different cell groups in the brain display different capacities for axonal regeneration. Therefore, the results of the present study suggest that the rate and extent of axonal regeneration is similar following spinal HTs and complete spinal transections.