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Characterization of the Spinal Locomotor Network in the Adult Zebrafish

Generation of vertebrate movement such as walking and swimming relies on neuronal networks in the spinal cord, known as central patterns generators (CPGs) that can function independently of input from the brain and sensory feedback. CPGs thus are valuable systems for the study of cellular interaction and neuronal function in relation to behaviour. Extensive studies of swimming behaviour in the lamprey and the *Xenopus* tadpoles have provided much of the understanding of CPG function and network organization in the vertebrate spinal cord. Recently, research has been expanded to new model systems, such as the locomotor GPG in the mammalian spinal cord of rodents and zebrafish larvae. The work presented here introduces the adult zebrafish as a model system for the study of spinal locomotor networks. Features of locomotor activity were studied in two preparations of the adult zebrafish. In the semi-intact preparation, application of NMDA was able to elicit locomotor activity in the spinalized preparation. In this preparation, dorsal roots are left intact and the effect of sensory feedback on the modulation of swimming can be studied. Characteristic features of swimming such as left/right alternation of muscle contraction on opposite sides of the body as well as a rostral to caudal propagation of muscle contraction could be revealed by recording EMG activity. An important aspect of the work presented here was the development of an in-vitro preparation of the adult zebrafish spinal cord. In the isolated spinal cord fictive locomotion could be induced by application of NMDA. By use of extracellular recordings from ventral roots, basic features of swimming could be characterized. Left/right alternation of ventral root activity was dependent on glycinergic transmission as synchronized activity was induced by a glycine receptor antagonist. In addition, different types of neurons could be distinguished based on their firing properties and presence of post-inhibitory rebound. Introduction of the adult zebrafish as a model system for the study of the spinal network now adds to the scope of experimental possibilities to elucidate the architecture and mechanisms of the function of the locomotor CPG in adult vertebrates.