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Descending Inputs to the Spinal Cord Networks

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Stimulation of the Mesencephalic Locomotor Region (MLR) gives rise to locomotion via relays in the pons and medulla. A number of pathways are implicated in the initiation of locomotion, including glutamatergic, noradrenergic, dopaminergic, and serotonergic (5-HT). Evidence will be presented relating to glutamatergic and serotonergic pathways from the brainstem to cells of the spinal locomotor central pattern generator (CPG) for locomotion.

Glutamate antagonists block MLR induced and spontaneous locomotion, and glutamatergic agonists induce locomotion in spinal animals. MLR stimulation produces short latency PSPs in spinal motoneurons and locomotor interneurons. 5-HT inputs to the spinal cord originate in the brainstem, and agonists of 5-HT facilitate or induce locomotion in spinal animals. Stimulation of a discrete region of the rat brainstem containing spinally-projecting 5-HT neurons induces locomotion in the isolated neonatal rat brainstem-spinal cord preparation. This region has been termed the Parapyramidal Region (PPR), and constitutes the first anatomically discrete group of neurons demonstrated to be involved in the initiation of locomotion. Neurons in the PPR are activated during treadmill locomotion in adult rats. Locomotion evoked from the PPR is blocked by 5-HT antagonists, including those to 5-HT7 and 5-HT2 receptors. 5-HT7 antagonists block locomotion in cat, rat and mouse preparations, but have little effect in mice lacking 5-HT7 receptors. 5-HT induced activity in 5-HT7 knockout mice is rhythmic, but coordination among flexor and extensor motor nuclei and left and right sides of the spinal cord is disrupted. In the adult wildtype mouse, 5-HT7 antagonists impair locomotion, producing patterns of activity resembling those induced by 5-HT in 5-HT7 knockout mice. 5-HT7 antagonists have a much reduced effect on locomotion in most of the adult 5-HT7 knockout mice tested.

We conclude that the PPR is the source of descending 5-HT neurons that activate the CPG via 5-HT7 and 5-HT2 receptors, and that 5-HT receptor activation is important for normal locomotion in adult rodents.

Chau, C., Giroux, N., Barbeau, H., Jordan, L., and Rossignol, S. Effects of intrathecal glutamatergic drugs on locomotion I. NMDA in short-term spinal cats. J Neurophysiol 88: 3032-45, 2002.

Douglas, J. R., Noga, B. R., Dai, X., and Jordan, L. M. The effects of intrathecal administration of excitatory amino-acid agonists and antagonists on the initiation of locomotion in the adult cat. J Neurosci 13: 990-1000, 1993.

Liu, J. and Jordan, L. M. Stimulation of the parapyramidal region of the neonatal rat brain stem produces locomotor-like activity involving spinal 5-HT7 and 5-HT2A receptors. J Neurophysiol 94: 1392-404, 2005.

Liu J, McVagh JR, Hedlund PB, and Jordan LM 5-HT-induced locomotor-like activity is defective in 5-HT7 receptor knock-out mice. Program No. 516.6. *2005 Abstract Viewer/Itinerary Planner.* Washington, DC: Society for Neuroscience 2005.