Journal of Neurophysiology 2015 vol.113 N9, pages 3386-3396

Electrophysiological biomarkers of neuromodulatory strategies to recover motor function after spinal cord injury

Gad P., Roy R., Choe J., Creagmile J., Zhong H., Gerasimenko Y., Reggie Edgerton V.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© 2015 the American Physiological Society. The spinal cord contains the circuitry to control posture and locomotion after complete paralysis, and this circuitry can be enabled with epidural stimulation [electrical enabling motor control (eEmc)] and/or administration of pharmacological agents [pharmacological enabling motor control (fEmc)] when combined with motor training. We hypothesized that the characteristics of the spinally evoked potentials after chronic administration of both strychnine and quipazine under the influence of eEmc during standing and stepping can be used as biomarkers to predict successful motor performance. To test this hypothesis we trained rats to step bipedally for 7 wk after paralysis and characterized the motor potentials evoked in the soleus and tibialis anterior (TA) muscles with the rats in a non-weigh--bearing position, standing and stepping. The middle responses (MRs) to spinally evoked stimuli were suppressed with either or both drugs when the rat was suspended, whereas the addition of either or both drugs resulted in an overall activation of the extensor muscles during stepping and/or standing and reduced the drag duration and cocontraction between the TA and soleus muscles during stepping. The administration of quipazine and strychnine in concert with eEmc and step training after injury resulted in largeramplitude evoked potentials [MRs and late responses (LRs)] in flexors and extensors, with the LRs consisting of a more normal bursting pattern, i.e., randomly generated action potentials within the bursts. This pattern was linked to more successful standing and stepping. Thus it appears that selected features of the patterns of potentials evoked in specific muscles with stimulation can serve as effective biomarkers and predictors of motor performance.

http://dx.doi.org/10.1152/jn.00918.2014

Keywords

Epidural stimulation, Evoked potentials, Quipazine, Spinal cord injury, Strychnine