

EMG SIGNAL ANALYSIS OF THE LOCOMOTORY ACTIVITY EVOKED BY EPIDURAL SPINAL CORD STIMULATION.

Scherbakova N¹, Bogacheva I¹, Kucher V¹, Musienko P¹, Gerasimenko Y¹

Pavlov Institute Physiology of the Russian Academy of Science, St.Petersburg, Russia (1)

The recent experimental researches evidence that the spinal cord (SC) of mammals, including human, contains a network of interneurons acting as generator of stepping movements – central pattern generator (CPG). Such network produces coordinated rhythmical patterns activity, providing the locomotion. For this purposes we analysed the electromyographic activity (EMG) of the leg muscles in response to electrical epidural stimulation of the spinal cord dorsal surface in the decerebrated cat. We used the frequencies of stimulation in range from 1 to 20 Hz with the current amplitude twice exceeded the threshold amplitude for reflectory responses of leg muscles. It was found that the optimal stimulus frequency for eliciting locomotor activity was 5Hz. Methods of EMG analysis with Hilbert transformation was performed for calculation of the EMG envelope so far as just the EMG envelope describes the muscles efforts. Then autocorrelation functions (ACF) were calculated for EMG envelopes for cases with stimulation of different frequencies. The shape of ACF for EMG of m. tibialis ant. (TA) and m. gastrocnemius (GM) to L4 stimulation with 5Hz are different from the shape of ACF calculated for activity of these muscles to stimulation of other frequencies. In particular the marked ACF peaks correspond exactly to the frequency of stimulation in cases of non-optimal frequencies, while in case of 5Hz stimulation these peaks are insignificant relatively whole ACF and new peaks appear at frequency about 1 Hz. Cross-correlation analysis of the relation between EMG and stimulus signals reveals the marked weakening of the relation of the EMG activity patterns with stimulus impulse successions for 5Hz stimulation only. The results of our investigations allow us to speculate about the mechanisms of initiation the CPG and locomotion triggering. It is possible that the CPG works in regimen of taking the phase under non-optimal stimulus frequencies (with response on each stimulus impulse). But under certain optimal stimulus frequency the CPG turns into the regimen of its own fluctuations and produces the rhythmic locomotor pattern. The experimental data shows that the generation of locomotor activity continues after the cessation of the stimulation with the same properties of the bursting activity.

Supported by RGNF grant № 03-06-00315.