

Brain Motor Control Assessment - A Neurophysiological Assessment of Motor Control

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The Brain Motor Control Assessment (BMCA) is a method for characterizing impaired motor control that covers the spectrum from paralysis to recovery. Based on the work of Milan R. Dimitrijevic, MD, PhD, the BMCA employs electromyographic recording to document central nervous system motor output in response to a protocol of specific volitional and reflex motor tasks. Thus, the BMCA produces a quantitative profile of motor control in persons with neurological disorders. The BMCA has been most used in spinal cord injury (SCI) where it provided evidence that many persons who were clinically judged to be completely paralyzed were actually “Discomplete,” retaining the ability to modify reflex excitability without clinically evident voluntary movement. This evidence of neurophysiological or ‘sub-clinical’ incompleteness was shown to be valuable in the selection of intervention modalities and the evaluation of treatments for spasticity. More recently, the BMCA method has been used to monitor the return of motor control during the acute phase of recovery, augmenting the clinical evaluation by documenting the return of voluntary activation of paralyzed muscles, the development of coactivation and spasticity, and the reintegration of disrupted motor control.

The method relies on high-quality electrophysiological recording and the careful presentation of the motor tasks from protocols designed to evaluate control of neck and shoulder, trunk, upper limb, and/or lower-limb muscles in the supine position. All recordings begin with calibration and electrode test segments that verify the quality of the recorded signals and the appropriateness of the connections. The observation of motor control begins with five minutes of relaxation, followed by general activation tasks, “reinforcement maneuvers” such as deep breath, neck flexion, and Jendrassik or shoulder shrug that can activate muscles distal to a spinal cord lesion or trigger spastic activation in other disorders. All maneuvers are marked in the recorded data, and those requiring a volitional component are cued by an audible tone with an accompanying event marking. Maneuvers are repeated at least three times at a pace that allows relaxation to be reached between each attempt and provides a preset time window for quantification. Next, specific voluntary motor tasks are attempted to document paralysis or quantify disrupted motor control from the multi-muscle patterns recorded. Responses to passive stretch, tendon taps, strong vibration, and are then recorded to assess reflex excitability. Finally, withdrawal from plantar stimulation in the lower-limb protocol is recorded first without and then with volitional suppression to evaluate volitional control of inhibitory spinal motor circuitry. All aspects of the BMCA protocol are quantifiable including the degree of responsiveness to reinforcement and reflex activation. Voluntary movement control is quantified in the form of an index that is calculated from the multi-muscle EMG patterns and indicates how different those patterns are from the patterns recorded from neurologically intact control subjects. As an extension of this core protocol, additional motor tasks such as sitting, standing and stepping may be evaluated.

The BMCA offers a stable standard measure for use in multi-center research studies. Finally, in clinical application, it offers objective criteria for the selection of intervention strategies and the quantification of treatment effects in persons with disorders that impact motor control.

References:

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