Evoked Potentials in Multiple Sclerosis

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KEYWORDS

• Evoked potentials • Visual evoked potentials • Somatosensory evoked potentials
• Brain stem evoked responses

KEY POINTS

- Evoked potentials still may be valuable in the diagnosis of and management of multiple schlerosis (MS).
- Evoked potentials provide a means of evaluating the type of neurologic abnormality: demyelination produces conduction slowing, whereas axonal degeneration causes attenuation of the potential amplitude.
- Evoked potentials are noninvasive and can be used to monitor changes in the central nervous system of a patient with MS.
- Evoked potentials are useful in identifying superimposed mechanical pathology (eg, cord stenosis) in MS patients.

INTRODUCTION

Multiple sclerosis (MS) is a demyelinating disease of the central nervous system (CNS), associated with neural degeneration. The diagnosis is based on the clinical history, physical examination, laboratory findings, imaging of the CNS (magnetic resonance imaging [MRI] and other neuroimaging techniques), spinal fluid analysis, and selected additional laboratory tests to eliminate other diseases. The diagnosis is confirmed when disease has been confirmed in at least 2 different locations of the CNS, occurring at 2 or more points in time, for which there is no alternative disease diagnosed. It can initially manifest itself in several distinct patterns: relapses followed by remissions (relapsing remitting or RR MS), progressive degeneration from onset (primary progressive or PP MS), and a progressive course with superimposed episodes of relapses and remissions (progressive relapsing MS). The fourth clinical type—second progressive MS—evolves from RR MS over time as the disease progresses.

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There are 3 types of evoked potentials (EPs) used in MS diagnosis and management: (1) visual evoked potentials (VEPs), which assess neural conduction in the optic pathways. VEPs are most typically triggered by observing an illuminated, alternating checkerboard pattern of black and white squares (pattern reversal VEPs) or a flashing light. Recordings are made over the visual cortex. Prolongation of the latency indicates disease in that neural pathway; (2) somatosensory evoked potentials (SEPs) involve peripheral stimulation of the large 1 A afferent fibers in various mixed nerves in the extremities, with the ascending potentials measured at various points along the peripheral nerves, spinal cord, brainstem, and somatosensory cortex; (3) brainstem auditory evoked responses (BAERs), triggered by auditory clicks and recorded over the cortex. (Motor evoked potentials will not be covered in this review, as they are currently not Food and Drug Administration approved for clinical practice in the United States.)

EPs represent a valuable adjunct to the diagnosis and management of MS because they measure physiology in the CNS. Indeed, it is the abnormal physiology of neural pathways caused by the inflammation and degeneration caused by MS that produces the motor weakness and sensory symptoms. Consequently, EPs are the only laboratory tools that directly measure the abnormal physiology resulting from the disease; all other tests are inferences of diseased pathways.

USE OF EPS IN MANAGEMENT OF MS

Classically, the value of EPs is the identification of an additional region of the CNS that may be clinically "silent"—that is, not associated with clinical symptoms, which may provide the additional information necessary to satisfy the dissemination in space criterion required for a confirmed diagnosis of MS. Used for this purpose, the most sensitive of the several EPs is the VEP.[1] Classically, the second most sensitive EP is the SEP, followed by the BAER. However, early studies evaluated only upper limb SEPs; they did not measure SEPs from the lower limbs. Subsequent research has demonstrated that with lower limb SEP testing (most commonly tibial nerve SEP), the sensitivity of SEPs may actually exceed VEP testing.[2] The reason is that a tibial SEP evaluates the ascending afferent pathways through the entire length of the spinal cord, brainstem, and brain. As more neural tissue is traversed, there is a greater probability that areas of disease will be encountered.

STEPS TO IDENTIFY ADDITIONAL SITES OF DISEASE

Unlike a traumatically produced disease, MS does not suddenly appear in its fully manifested state. There is no single point in time whereby a completely healthy individual suddenly has MS. Rather, it occurs over time—often many years. The diagnosis of MS requires satisfaction of the criteria of CNS disease "disseminated in *time* and space." Thus, by definition, MS is not a disease of sudden onset.

Pathologically, RR MS starts in some portion of the CNS, producing symptoms that typically subside in weeks (remission). Somewhat later, another symptom might occur in a similar manner, or the initial symptom may return (exacerbation). By the time of diagnosis (sufficient symptomatology and pathology to produce the criteria of dissemination in time and space) many years may have transpired. It is not uncommon to see patients with moderately extensive brain and spinal cord disease at the time of definite diagnosis of MS.

It is now clear that it is extremely important to diagnose RR MS as early as possible, as it is well established that treatment of RR MS in the earliest stages offers the best opportunity to control the disease,[3] whichis the classic role of VEPs and SEPs in the