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Electrophysiological evaluation of psychogenic movement disorders

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ABSTRACT

Psychogenic movement disorders (PMD) include a group of neurological symptoms which cannot be explained by any organic syndrome. The diagnosis of PMD is challenging for both neurologist and psychiatrist. Electrophysiological examination is a useful tool to evaluate and support a diagnosis PMD. It includes a set of tests which are chosen appropriate to the clinical setting that provides objective criteria for the diagnosis of PMD. The various tests available include accelerometry, surface electromyography, electroencephalography, jerk locked back averaging and pre-movement potentials, somatosensory evoked potentials, transcranial magnetic stimulation (TMS) etc. Electrophysiologically psychogenic tremors display features of variability, entrainability, coactivation, distractibility and increase in the amplitude and frequency on mass loading. Movement related cortical potentials such as Bereitschaft-spotential is seen in psychogenic myoclonus. Presence of triphasic contraction of muscles and absence of co-contraction suggests psychogenic myoclonus. Latency of C-reflex is longer in psychogenic myoclonus as compared to organic myoclonus. The role of TMS to differentiate psychogenic from organic dystonia is still not clear. In conclusion, electrophysiological tests are most useful for tremor, followed by jerks and least for dystonia. In patients with long-standing PMD or those with mixed pathology, electrophysiological tests may not be very useful.

1. Introduction

Psychogenic movement disorders (PMD) include a group of neurological symptoms which cannot be explained by any organic disorder and have an underlying psychological or psychiatric basis in majority of the patients [1]. The most common psychogenic movement disorders seen in specialist clinic are tremor, myoclonus and dystonia [2]. The clinical features which point to a diagnosis of PMD include abrupt onset, deliberate slowness of movements, bizarre or difficult to classify movements, changing characteristics of movements, presence of multiple movement disorders, excessive startle response, paroxysmal movement disorders, motor manifestations incongruous with the organic pathology and functional disability out of proportion to examination findings. These abnormal movements are variable, distractible, changing to suggestions and can be entrained [3]. The diagnosis of PMD is challenging for both the neurologist and psychiatrist. Electrophysiological examination is a useful tool to evaluate and support a diagnosis PMD. It includes a set of tests which are chosen appropriate to the clinical setting that provides objective criteria for the diagnosis of PMD [4] [Table 1]. The clinical classification of Fahn and Williams is most widely used for the diagnosis of PMD [5]. The diagnostic criteria were revised and electrophysiological criteria were included to increase the diagnostic accuracy [2].

The present review focuses on the electrophysiological methods and its role in the diagnosis of PMD.

2. Psychogenic tremor

Psychogenic tremor is often highly variable both in frequency and amplitude [6]. It tends to be present at rest, posture and during action. It can be difficult to distinguish from organic tremors such as exaggerated physiological tremors, essential tremors, parkinsonian tremors and dystonic tremors. Surface electromyography (EMG) from different muscles and accelerometry are useful electrophysiological tests to differentiate psychogenic from organic tremors. Among the two, accelerometry is best method to record frequency and amplitude [7]. EMG also provides useful clue about the duration and pattern of the EMG bursts.

2.1. Protocol for electrophysiological evaluation of psychogenic tremors

Tremor recording includes multi-channel surface EMG and

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Table 1
Electrophysiological tools in the evaluation of psychogenic movement disorder (PMD).

Type of PMD	Electrophysiological tool	Parameters evaluated
Psychogenic tremor	Multichannel surface electromyography (EMG) with accelerometry	Frequency, duration and pattern of EMG bursts, variability, distractibility, entrainability, effect with mass loading, co-activation sign, coherence analysis
Psychogenic myoclonus	Multichannel surface EMG	Frequency, duration and pattern of EMG bursts, progression of EMG activity, reflex latency
	Jerk-locked-back averaging	Bereitschaftspotential
	Electroencephalography	Cortical potentials
	Somatosensory evoked potentials	Giant potentials, sensory attenuation
	Long loop reflexes	C-reflex latency
Psychogenic dystonia	Multichannel surface EMG	EMG pattern, co-contraction phenomenon
	Transcranial magnetic stimulation	Short interval intracortical inhibition, long interval intracortical inhibition, cortical silent period

accelerometer for recording the movement, frequency and amplitude of the tremor. Accelerometers are lightweight materials that do not interfere with the movements and are connected to the computer interface for accurate characterization of the tremors [8].

The patient is made to sit in a chair comfortably and is explained about the nature of the procedure. The muscles to be analyzed are determined by careful observation of the patient for the site or sites of tremor or abnormal movement and also by palpation of the affected muscles. The surface electrodes are placed over the involved muscles, both the agonist and antagonist in a tendon-belly fashion. Accelerometer is strapped over the body part which shows the maximum movement. Muscle activity is also recorded from the unaffected side (one channel may be sufficient) to record the normal movement which the patient is asked to perform to observe its effect on the tremulous side.

Tremor is recorded at rest, while maintaining posture such as outstretched hands, hands held in front of the chest with elbows flexed and arm abducted, during finger–nose test and on doing specific tasks that is known to increase the tremors [1].

The following observations are documented during tremor recording: tremor frequency at rest and in different postures or with special maneuvers, amplitude, pattern of EMG bursts, duration of EMG bursts, variability, distractibility, entrainability, co-activation and effect on frequency and amplitude with weight loading. The EMG and accelerometric data are analyzed using fast Fourier transformation and coherence analysis.

The electrophysiological findings in psychogenic tremors include the following:

2.1.1. Tremor frequency

The frequency may help to differentiate between organic and psychogenic tremors. Tremor is usually classified based on frequency into low (<4 Hz), medium (4–7 Hz) and high (>7 Hz) frequency. Tremors with frequency >11 and <6 are usually organic, whereas psychogenic tremors are usually between 6 and 11 Hz [2,9].

2.1.2. Pattern of EMG bursts

In a tremorogram, the EMG bursts from the agonist and antagonist muscles may be either synchronous or alternating. Either pattern may be seen in various types of organic tremors. Psychogenic tremors more often tend to have alternate EMG bursts, which are often irregular [1].

2.1.3. Duration of EMG bursts

Short duration (<70 ms) EMG bursts are characteristic of organic tremors. In psychogenic tremors the burst duration has been variably reported to be >50–80 ms [2,4]. However, EMG recorded from larger muscles in organic tremors can have longer duration of bursts. Also variability in the duration is also a feature of psychogenic tremors, while in organic tremors the duration of EMG burst is almost fixed [1].

2.2. Variability

Variability may be observed in the amplitude, frequency and distribution or pattern of the tremors [6]. The frequency of organic tremor does not vary more than 0.5–1.0 Hz, whereas in psychogenic tremor a large variation in frequency may be seen, spontaneously or on distraction [6]. Variability in the distribution or pattern of tremors may be exemplified by change from flexion–extension of wrist to alternate supination and pronation.

2.3. Distractibility

Distractibility is the modulation or change in the frequency and pattern of tremor induced by diverting the patients attention and asking the patient to perform a simple mental task such as counting the names of the months in reverse order, serial 7 subtraction or by movement of other body part. A complete cessation of the tremor, change in the frequency or amplitude of tremor, irregular EMG bursts, and change in the axis of movement (e.g. flexion–extension to pronation–supination) may be noted [3].

2.3.1. Frequency dissociation

Patients with psychogenic tremor have difficulty in maintaining two or more different tremor frequencies in different body parts [10]. However in organic tremors, there is simultaneous occurrence of tremors in different muscle groups of different frequencies. This frequency dissociation is a feature of organic tremor; however its absence does not rule out organic etiology [7].

2.3.2. Entrainability

Entrainability is considered as a characteristic feature of psychogenic tremor [2]. It is usually assessed by asking the patient to perform voluntary finger tapping or flexion–extension of wrist or fingers with the uninvolved hand and documenting the modulation of the frequency of the tremor of the "affected" hand. When entrainability is present, the frequency of the tremor of the "affected" hand will have the same frequency of the slow or fast movements done with the "healthy" hand. Organic tremors cannot be entrained and have a fixed frequency that does not vary [7,11].

2.3.3. Effect with mass loading

This is tested by attaching a load to the tremulous hand and to observe for any change in the frequency and amplitude of tremor [6,12]. In 70% of patients with psychogenic tremors there is an increase in the tremor amplitude and frequency with weight loading

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