Analysis of background EEG activity in patients with juvenile myoclonic epilepsy

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Summary

Purpose: To analyze background EEG activity of patients with juvenile myoclonic epilepsy (JME) with and without antiepileptic drugs.

Methods: We studied the background EEG activity in 18 patients with JME. The qEEG analysis included absolute power (AP), relative power (RP) and mean frequency (MF) of delta, theta, alpha and beta bands. The Z scores were calculated by comparison with population parameters based on the age-dependent regression function. Seven patients were unmedicated (UM) and eleven medicated (M).

Results: The UM group presented 69 (4.32%) abnormal Z scores and 227 (9.05%) in the M group ($P < 0.001$). In the UM group, AP delta abnormal Z scores were identified in frontotemporal and occipital leads. In AP alpha and beta bands an increase in Z scores was encountered in frontoparietal leads in three patients. In addition, in three patients, the AP theta Z scores were below -1.96 and distributed in all regions. In the M group, AP beta Z scores were above 1.96 in frontoparietal leads in 7 of 11 patients. The AP delta increased above 1.96 in frontotemporal and occipital leads in 6 patients of 11. The AP alpha showed an abnormal decrease in Z scores in 5 of 11 patients, whereas other 5 patients presented normal scores. The AP theta presented 7 normal Z scores out of 11; this band exhibited the lowest number of abnormalities of the 4.

Conclusion: Patients with JME have an increase in AP delta, alpha and beta bands, which is more evident in frontoparietal regions.

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Introduction

Idiopathic generalized epilepsy (IGE) has been recognized as a broad neurobiological continuum with similar genetic background, age of onset and electroencephalographic characteristics.[1] Juvenile myoclonic epilepsy (JME) is the prototype of IGE together with childhood absences, juvenile absences and grand mal on awakening. JME appears in puberty; it is characterized by myoclonic jerks in the morning, tonic-clonic seizures (TCS), and less frequently, absence seizures.[2] Generalized spike—wave (SWC) and polyspike—wave complexes (PSWC) with normal background EEG activity comprise the typical EEG pattern shown in JME.[3] In patients with JME, anatomophatological examinations, functional evaluation of visual working memory tasks with PET, MRI voxel-based morphometric analysis and magnetic resonance spectroscopy (MRS) studies have detected prefrontal alterations.[4—7]

Some articles on the analysis of paroxysmal activity in JME and other types of IGE have been published; frontocentral accentuation of spikes, polyspikes and electrical sources in frontal regions have been reported.[8—11] In contrast, background activity has been scarcely studied. In most cases, visual analysis of background EEG activity has been described as normal, except for some degrees of intermittent theta activity in patients with poor seizure control or in cases with polytherapy antiepileptic drugs (AED).[2]

Quantitative EEG (qEEG) analysis is a useful tool to evaluate background EEG activity.[12] When different variables of qEEG analysis are compared with those in a normal population of the same age, Z scores are obtained which improve the precision of the results. This last tool has been named EEG neurometric analysis and it has provided interesting results in the study of many diseases.[13—15] Some studies on background EEG activity with qEEG have been carried out in IGE and focal epilepsies, but not specifically in JME.[16—20] The analysis of different syndromes in the same group can produce confusing results in the study of alterations of background EEG. Therefore, our aim in this work is to apply qEEG and neurometric analysis to study background EEG activity in patients with JME.

Methods

Patient population

Eighteen patients with JME, thirteen females and five males, were studied. Mean age was 20.4 ± 9.4 years, with an age range between 10 and 46 years.

After giving their informed consent, all patients underwent clinical neurological examinations and EEG recordings.

The onset of epilepsy had a mean age of 13 years; all patients presented myoclonic and TCS. Both types of seizures were always present in the first hour after awakening. The patients had normal neurological examinations and characteristic paroxysmal generalized activity with PSWC in EEG recordings. Eleven patients were under standard antiepileptic drug treatment (M group) and seven were without antiepileptic drugs (UM group) at the moment of the study. Specifically from the eleven medicated patients, four were under treatment with valproate (VA), three with carbamazepine (CBZ), two with phenytoin (PHT), one with lamotrigine (LA) and one with oxcarbazepine (OXC). The seizure frequency (TCS) per year was of 1.2 in the UM group and 1.3 in the M group. No patient had TCS 1 week before the EEG register. The diagnostic of JME was established only in three patients prior to being admitted in the study. Therefore, almost all patients had no specific AED for JME nor were under any other AED treatment.

EEG analysis

Twenty minutes of EEG recording with patient awake, eyes closed were obtained in a quiet room using the Medicid-03 M system. Amplifier characteristics were: 10,000 dB gain, low cut filters at 0.05 Hz and high filters at 70 Hz. Nineteen referential leads of the International 10/20 System were recorded using linked earlobes as reference. The impedance was under $5 \, \mathrm{K}\,\Omega$ in all electrodes. The sampling frequency was 200 Hz. All EEG recordings were analyzed by two neurophysiologists (TH and ES-R), who agreed in the diagnosis of paroxysmal activity with PSWC or SWC in all cases.

The analysis of background EEG activity was carried out with the fast Fourier transform. Twenty-four artifact and paroxysmal free segments, 2.56 s each, were selected in blind form by the principal author (ES-R). Only EEG segments in which the patient was awake were analyzed (presence of alpha activity, no segments with decreased alpha activity, increased theta activity, nor vertex sharp waves).

The absolute power (AP), relative power (RP) and mean frequency (MF) of delta (0.5—3.5 Hz), theta (3.6—7.5 Hz), alpha (7.6—12.5 Hz) and beta (12.6—19 Hz) bands were obtained. The subtraction of the global scale factor (GSF) was applied to AP in all bands to decrease non-physiological variability; this procedure is known to improve diagnostic precision.[21]