Actividad cerebral en estudiantes de medicina del 10° ciclo

Brain activity in medical students, 10° cycle

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Resumen

El electroencefalograma es el estudio no invasivo de la corteza cerebral que registra la actividad neuronal. El ritmo cerebral del rango delta es normal durante el sueño profundo, la infancia y en enfermedades orgánicas cerebrales causales de disejecución cognitiva.

La corteza cerebral está encargada de las funciones intelectuales y es el lóbulo frontal al que se considera fundamental en habilidades cognitivas y específicamente a la corteza prefrontal para la implementación de las conductas motivadas.

El aprendizaje es una función mental, cuya habilidad depende la adquisición del conocimiento, hábitos y comportamientos necesarios para el desarrollo social y educativo.

Los esfuerzos educativos centrados en el diseño curricular, no han considerado la interacción entre la función cerebral y el proceso educativo.

Es un diseño observacional, muestra no probabilística, por conveniencia en 39 participantes voluntarios, análisis descriptivo cuantitativo. Se empleó electroencefalógrafo Neuron Spectrum. En los resultados destaca la presencia de actividad delta generalizada, de mayor porcentaje y amplitud en áreas prefrontales, de predominio izquierdo.

Es pertinente ampliar los estudios de este tipo para considerar si la presencia de actividad delta en adultos jóvenes es normal o revalorar su correlación con disejecuciones cognitivas.

Palabras clave: electroencefalografía, aprendizaje, Lóbulo Frontal.

Abstract

The electroencephalogram is the non-invasive study of the cerebral cortex that records the neuronal activity. The cerebral rhythm of the delta range is normal during deep sleep, childhood and during organic brain diseases that causes the Dysexecutive syndrome (DES).

The cerebral cortex is responsible for the intellectual functions and is the frontal lobe that is considered fundamental in cognitive skills, and specifically to the prefrontal cortex for the implementation of motivated behaviors.

Learning is a mental function, whose ability depends on the acquisition of knowledge, habits, and behaviors needed for social and educational development.

The educational efforts focused on curriculum design, have not considered the interaction between brain function and the educational process.

It is an observational design, a non-probabilistic sample, for convenience in voluntary participants 39, quantitative descriptive analysis. We used Electroencephalograph Neuron Spectrum. The results emphasizes the presence of generalized delta activity, higher rate and amplitude in prefrontal areas, of left dominance.

It is appropriate to extend such studies to see if the presence of delta in young adults activity is normal or reassess its correlation with Dysexecutive syndrome.

Key Words: electroencephalography, learning, Frontal lobe.

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Introduction

The one who suffers from difficulties to learn concurrent with any neurological or psychiatric disorder usually resort to the services of health care, but those who in their difficulties to learn has no concurrence of neurological disorders should consider, that in addition to educational and psychological services the provision of health services for optimal care and handling of the problems of learning, in order to rule out any neurological disorder that could be involved in the genesis of the learning difficulties.

The ability to learn is a skill essential for the education, and the brain is the organ responsible for the learning processes.

Content It is electrophysiologically feasible to identify whether the brain activity is normal or abnormal. A healthy brain has a better chance to learn, even more so if you present that mental functions such as intelligence, thought, language, attention, memory and executive functions are involved in learning. The organizational structure that supports and regulates these functions is the central nervous system, which is comprised of dynamic structures capable of modifying themselves with regard to their functioning throughout the life, for this reason chances of neurofunctional adaptation for new learning, capacity which is known as neuroplasticity or brain plasticity (Portellano, 2005) (Gómez, 1992).

Learning is a process by which organisms modify their behavior to adapt to the variations and unpredictable environmental conditions surrounding this change in the nervous system results from the sensory experience that creates lasting changes in behavior. (Morgado, Psychobiology of learning and memory. 2005) (Flores Lazarus, 2008)

The neuronal plasticity is directly related to the number, quality and strength of interneuronal connections, which is the basis of physical or organic mental functions such as learning and memory support. (Morgado, 2005)

The frontal lobes are the structures of the cerebral cortex located ahead of the central sulcus and above the lateral fissure in each cerebral hemisphere. (Munoz Gamboa, 2002). The frontal lobe coordinates and monitors the activity of the brain, in addition to program, develop, sequence, execute and regulate cognitive processes; specifically is the prefrontal area to which he is responsible for the processes of sustained and selective attention necessary for learning. (Portellano, 2005) (MA Rebollo, 2006)

More complex functions of the human, including executive functions (EF) are mainly supported by the prefrontal cortex, and participate in the control, regulation and efficient planning of human behavior, also allow subjects successfully engage in behaviors independent, productive and useful for themselves; defined as a process or series of processes whose main objective is to facilitate adaptation to new situations, operates through modulation or control of more basic cognitive skills; these skills or routines are projecting processes learned through practice and repetition and include motor and cognitive skills, such as reading, memory and language. (Munoz Gamboa, 2002)

Attention is the device that allows you to choose, based on the particular interest or motivation, adequate information for further processing by the nervous system, so this device is essential for any mental activity. (Portellano, 2005) (MA Rebollo, 2006) (Munoz Gamboa, 2002)

Physiologically the left brain controls verbal behavior, including the ability to communicate through oral or written language skills through reading, writing, speaking

and understanding verbal material. The right hemisphere is responsible for implementing automatic functions, in addition to directing the three-dimensional orientation and problem solving which involved spatial reasoning. (Portellano, 2005) (MA Rebollo, 2006) (Flores Lazarus, 2008)

There are also important differences between the operation of the left prefrontal cortex (PFC) and CPF right. The CPF left, is more related to the processes of sequential planning, mental flexibility, verbal fluency, working memory (verbal information), memory strategies (verbal material), semantic memory encoding and inverse sequences; and in the establishment and consolidation of routines or patterns of action that are frequently used. The CPF right is more related to the construction and design of objects and figures, working memory for visual material, the appreciation of humor, episodic memory, behavior and social cognition, as well as in the detection and processing of information and new situations. It is more related to subjective and adaptive decisions that are not logical, they are relative to the time and place of a particular subject; conditions are unclear or space where they develop are fully known. (Munoz Gamboa, 2002)

Activation processes, localization, regulation of alertness and determining the relevance of the stimulus are powers of the cerebral cortex and the parietal lobes are in addition to the frontal lobes, which are more relevant in this process. This is because the parietal lobe is responsible for preparing the necessary sensory maps for the control of attention in the prefrontal area acts as an integrating center of activity of the cerebral cortex; develops many skills related to attention control as attentional regulation of activities that require a particular planning, control of sustained attention, focused attention control and control of eye movements through visual fields. (Portellano, 2005) (Flores Lazarus, 2008)

The deficit in the nervous system may be causal factor fault for the processing of cognitive and behavioral skills, may be evidenced by trouble learning, particularly due to memory disorders, attention deficit flaws in the ability to understand, and behavioral disturbances that are related to dysfunctional cerebral electrophysiological activity. The electroencephalogram (EEG) is a recording of cortical electrical activity that shows the

characteristics of the electrophysiological brain activity and is part of the diagnostic evaluation of all persons with suspected central nervous system dysfunction. It is important to add that this type of instrumented evaluation of brain activity only complements clinical examination, and must avoid overvaluation of the electroencephalographic data regardless of the clinical situation. (Ysunza, 2007) (Díaz C, 2006)

The quality of neurological functioning is critical to the efficiency of mental functions, both neurocognitive and neurobehavioral, which is supported by the concept of Collins, who considers the origin of learning disabilities in some form of neurobiological abnormality. (Collins, 2003)

Technological advances in neuroscience have been substantial in recent years and made available to clinicians and scientists a great set of tools to detect brain activity as a correlate of behavior and "higher" cognitive activities. One technique of Time and has better time resolution to measure the cognitive activity in real time is the Electroencephalogram (EEG), whereby it is possible to quantify neuronal electrical activity in milliseconds. (Hernández Cervantes, 2010)

The cerebral cortex is the anatomical-functional of the most important intellectuals of the individual functions or higher seat. The bark contains the main neuronal bodies bearing motor, sensory-motor, auditory and / or visual functions, as well as memory, language, abstract reasoning or gestural activities. (Corral-Fernández, 2007) (Diaz, 2008)

The EEG is a neurophysiological examination by electrodes on the scalp that is based on the registration of bioelectrical activity at the surface of the cerebral cortex at baseline sleep, waking or sleeping, and during various activations (usually hyperpnea and intermittent) light stimulation. The approximate total duration of an EEG is 15-25 minutes. (Diaz, 2008) (Figueredo-Rodríguez, 2009)

The EEG is practiced in a small percentage of non-epileptic persons, usually afflicted with neurological symptoms that suggests that a hypothetical functional alteration of the brain, which can be described as minimal or no importance, so it is difficult to know precisely how many individuals with alterations EEG are free of any clinical manifestation dysfunctional cognitive or behavioral if they are not practiced this type of evaluation. (Casas, 2002)

In people with learning EEG may be useful to identify a possible electrophysiological brain dysfunction such as children for whom excessive slow activity, below 8 Hz (particularly 3-4 Hz) on the parietal and occipital areas has been identified as a common sign in learning disorders, using analysis of brain activity using quantitative electroencephalography. (Lubar, 1985)

In secondary learning disorders Attention Deficit Disorder (ADD) the EEG provides a direct measure of brain function, so it is considered an appropriate tool for assessing the condition. The most frequently referred electroencephalogram abnormality of these patients is slowly increased activity. (Ricardo, 2004)

Josefina Ricardo Garcell mentions that many children and adolescents with ADHD become adults with symptoms characteristic of this condition and in cases clinically diagnosed during childhood disorder persists into adulthood in 30-50%. For this reason, every effort is made to assess attention disorders should not be rejected by misuse, ignorance, stiffness or professional impatience. (Ricardo, Contributions and conventional EEG frequency analysis for the study of attention deficit disorder. Part., 2004)

Approximately 50% of patients with subclinical epileptic discharges, present transitory cognitive impairment (TCT), directly related phenomenon with the appearance of paroxysmal EEG activity and disruption of mental processing of information. Has considered a possible relationship between the location of paroxysmal activity and the type of tasks that are affected, for example, when the paroxysmal activity is predominantly in the right hemisphere executive tasks type nonverbal (eg memory

visuospatial) are the most affected, or when the prevalence of paroxysmal activity in the left hemisphere is verbal type tasks reveal a disruption in execution. (Morgade, 2006)

Neuroanatomical and neurophysiological findings relate to the involvement of the frontal lobes and especially the prefrontal cortex and the cognitive and behavioral processes in subjects with attention deficit disorder and hiperquinecia in whom neurophysiologically has detected an increase in slow activity in a high percentage of subjects and increased incidence of epileptiform activity. (Wood, 2007)

The techniques of functional neuroimaging and neurophysiological prove increasingly useful in the clinical setting. Quantification of psychophysiological variables is a key to model rehabilitation after serve to increase or decrease certain related normal and abnormal brain activity parameters tool. In this context quantitative electroencephalography (quantitative EEG, QEEG), neurophysiological noninvasive technique that processes the electrical signal from the conventional EEG and quantifies the relative contribution of each frequency in the cerebral functioning of an individual emerges. (Almeida, 2005) (Damas-López J., 2005) (Figueredo-Rodríguez, 2009)

Learning is involved in organizing neural networks. The spikes recorded in the EEG during sleep are an important reflection of the efficiency of the cortico-subcortical connectivity and apparently are linked to skills related to cognition and memory. (Schabus, 2006)

Each time, a greater number of researchers are taking advantage of the potential of electrophysiology to discern the best treatment and thus guide the stimulation of brain Neuroplastic positive changes by enabling or recovery of cognitive and behavioral functions. (Boyd LA, 2007)

The main cognitive functions including attention, memory, language skills, visuospatial abilities and frontal executive functions, all involved in the learning process. The difficulty of learning (DA) is a chronic condition presumed neurological origin that selectively interferes with the development, integration and / or demonstration of verbal and nonverbal skills, and epileptic children do not get the same academic results than those

considered control groups developing different types of DA, different from that observed in the general population. (Mulas F, 2006) (Aguilar L, 2006)

In Mexico it is considered that epilepsy is a public health problem. The electroencephalogram is the complementary test that contributes specifically to the diagnosis of epilepsy, because it can show changes that have a very high correlation with the clinical presentation of this syndrome. (Ortega Loubon, 2010)

Children with epilepsy often have DA: indifference of the class, below average results, disorders associated behavior, distractibility, poor concentration and sleepiness, arrest or regression in development, learning difficulties or a marked fluctuation in the skills cognitive; However, many children with adequate control of their crisis, no problems learning or behavior; is necessary to consider that adequate seizure control itself not only ensures free stay disatencionales symptoms, learning or language that may occur in up to half of children with epilepsy, and that certainly fare worse while there are crises or EEG changes. (Mulas F, 2006) (Aguilar L, 2006)

It is suggested that the effect of paroxysmal epileptiform activity on cognitive mechanisms can be accumulated over time if the overall seizure frequency is high, or if the crisis is prolonged or there are frequent electroencephalographic discharges. In these cases the acquisition of information during the learning process can be blocked with progressively devastating effects on the most stable aspects of cognitive, such as intelligence and school progress function. (Domizio S, 2008)

Problem

As the brain activity underlying the main element for learning processes is deemed appropriate support in evaluating the characteristics of brain activity from the neurophysiological approach, using EEG to identify brain electrophysiological characteristics prevalent in the population university student, which in turn may allow meet the needs of specific educational services for college students, and applied this guidance will facilitate more efficient academic development. Conventionally this type of

evaluation is not taken into account, so that through this type of research may clarify the importance of formal and accessible to all university students, with the aim of reducing future learning difficulties.

Methodology and procedures

A nonrandom sample, for convenience, by inviting students from the 10th cycle of the degree in Medicine, Faculty of Medicine and Nutrition Durango Campus of the Universidad Juarez del Estado de Durango, during the second half of 2013. They turned evaluated voluntarily, after signing the informed consent, 39 students, who were instructed to on the electroencephalogram begin waking from 04:00 am. Through the international 10-20 system 19 electrodes were placed to record brain activity using two of them as reference electrodes (A1 and A2) for each respective cranium and one ground electrode, thus obtaining a record 16 monopolar electrodes for which a digital EEG Spectrum Neuron, which has software to analyze frequencies and amplitudes using the fast Fourier transform, so the results discussed herein were obtained was used.

A electroencephalographic measurements taken over a span of five minutes, resting with eyes closed, divided into periods of five seconds, they analyzed the free spectral power of artifacts, and divided into the following bands: Delta: 0.5- <4 Hz, Theta: 4- <8 Hz, Alfa 8- <13Hz, lower Beta (BL): 13- <20 Hz and High Beta (BH): 20-35Hz. The spectral absolute power of each frequency band, defined as the frequency spectrum showing the highest power, was used for quantitative analysis.

The data were processed by averaging each variable under study by Excel 2007 Microsoft Office program.

The total number of variables analyzed was 130, of which two were signalíticas for gender and age and the remaining 128 Variable simple, 16 corresponded to the complex variable Average Average Frequency 16 Frequency Middle Parent, 16 the Average Total Extent and 80 to the average of the percentages in different frequency bands Delta, Theta, Alpha, Beta and Beta Slow Alta (16 variables for each frequency band).

Results

The group of 39 participants was comprised of 12 men and 27 women. The mean age was 23.9 years.

The MEDIA FREQUENCY Average of absolute power observed in each of the 16 registration areas showed the following data: 1) Activity Theta Band in FP1, FP2, F3, F7 and F8; and 2) activity of alpha band F4, C3, C4, T3, T4, P3, P4, T5, T6, O1, and O2.

The Middle of the dominant frequency of absolute power recorded in each of the studied areas shown in the Delta range in areas with 1.74 Hz FP1, FP2 with 1.79 Hz to 3.58 Hz and F7; Theta range in the following areas were observed: F3, F4, C3, C4, P3, F8, T3, T4, T5 and T6; Alpha in the range observed only in areas P4 8.39 Hz, 9.05 Hz O1 to O2 and 10.0 Hz; not observed in any area the frequency domain Slow or Beta Beta Alta.

The Average TOTAL RANGE of absolute power showed the highest voltages in the prefrontal areas with 214 □V2 in FP1 and FP2 229.4 □V2 in, followed by O1 and O2 with 176.3 to 191.9 □V2 □V2.

The Average percentages of electroencephalographic activity in different frequency bands showed the highest values in the following areas: 1) The DELTA band FP1 with 38.02% and FP2 with 37.65% (In all other areas recorded was shown some percentage of activity Delta, the junior was 13.95% in O2 and 14.68% in O1, and values higher than those reported in the latter two areas in other registration points, but lower than those observed in FP1 and FP2); 2) in the ALFA band with 34.4% O2, O1 with 33.47%, 30.11% and P4 to P3 with 30.02%; in the band BETA SLOW to 24.82% O2 and O1 with 24.53%; in the band HIGH BETA T4 and T3 with 23.48% with 22.52%; and finally the band THETA C3 with 17.88% and 17.46% F3.

Discussion and conclusion

From the results obtained in the Medium Frequency behavior records in different areas did not show any relevant data.

In the results of the dominant frequency striking presence domain of Delta band FP1 and FP2 in areas and that the amplitude of absolute power is just larger in those areas. Whereas the participants in the study were asked about any neurological history and that there was

some positive fact about the question of the presence of the percentages of Delta activity referred arises, so it is necessary to consider whether this form analyzing digital electroencephalogram opens neurophysiological parameters to be considered as normal in the general population and therefore necessitates the realization of broader studies to define these conditions.

Therefore, within the educational environment and taking into account that the prefrontal area to which he is responsible for the process of sustained and selective attention (Portellano, 2005) (Rebollo MA, 2006) and in people with disorders Learning the EEG may be useful in identifying a possible electrophysiological brain dysfunction (Lubar, 1985), as neuroanatomical and neurophysiological findings relate involvement of the frontal lobes and especially the prefrontal cortex and the cognitive and behavioral processes in subjects with disorder Attention Deficit hiperquinecia, and who neurophysiologically has detected an increase of slow activity and increased incidence of epileptiform activity (Wood, 2007), it is relevant to consider that the presence of delta activity in the studied sample may have some influence in cognitive functions for further studies.

Bibliography

Aguilar L, M. R. (2006). Cognitive impairment in epilepsy. Mex Neuroci , 218-224.

Ahmed Osama, A. A.-H. (2013). Peak power Frequency Changes in Patients with Migraine .

Almeida, L. (2005). Functional anatomy in disorder attention deficit hyperactivity disorder. Alterations Mental health , 1-12.

Boyd LA, V. E. (2007). Answering the call: the influence of neuroimaging and electrophysiological evidence on rehabilitation. Phys Ther , 684-703.

Casas, C. (2002). Transient cognitive impairment by subclinical paroxysmal EEG activity. Neurol , 21-29.

Collins, D. (2003). Learning-disabled brains: A review of the literature. J Clin Exp Neuropsychology , 1011-1034.

Corral-Fernández, E. (2007). BASICS OF EEG AND EPILEPSY IN ADULTS N INTERNAL MEDICINE.

Damas-López J., M.-R. J. (2005). Neurophysiological pattern of mental retardation: A case study with quantitative electroencephalography. Spanish Neuropsychology , 135-149.

Díaz C, D. A. (2006). Value of the electroencephalogram in neonatal. Mex Neuroci , 338-339.

Díaz, P. (2008). Implications of techniques for measuring brain activity in cognition: The time or space? XVII (1).

Domizio S, e. a. (2008). Epileptic EEG discharges and short non-convulsive crisis: Influence on cognitive and psychobehavioural functions in youths. Clin Invest Med , 31.

Figueredo-Rodríguez, P. D.-P.-R.-O.-C. (2009). The front Alfa activity in primary insomniacs with difficulty initiating sleep. 32 (1).

Flores Lázaro, J. C.-S. (2008). Neuropsychology of Frontal Lobes, Executive Functions and Human Behavior. 8 (1).

Gómez, C. E. (1992). Location neuro-cognitive processes. (52).

Hernández Cervantes, J. V. (2010). Electroencephalographic findings in refractory epilepsy at the National Medical Center November 20. 15 (1).

Lubar, J. (1985). Spectral analyses of EEG differences between children with and without learning disabilities. J Learning Disabilities , 403-408.

Madera, H. (2007). Quantitative analysis of EEG to confirm frontal functional disorder in children with attention deficit disorder with hyperactivity. Gac Med Mex , 391-400.

Morgade, R. (2006). E valuation of the effects of paroxysmal activity on cognitive processing in non-epileptic with reading disorders children. Mex Neuroci , 536-544.

Morgado, I. (2005). Psicobiología del aprendizaje y la memoria. Cuadernos de la Información y Comunicación , 221-233.

Morgado, I. (2005). Psicobiología del aprendizaje y la memoria; Fundamentos y avances recientes. Neurol , 289-297.

Mulas F, H. S.-M. (2006). Dificultades del aprendizaje en los niños epilépticos. Neurol , 157-162.

Muñoz Gamboa, C. J. (2002). Potenciales evocados II: potenciales exógenos. XXIII (1).

Ortega Loubon, C. C. (2010). Neurofisiología del aprendizaje y la memoria. Plasticidad Neuronal. 6 (1:2).

Portellano, J. (2005). Como desarrollar la inteligencia: entrenamiento neuropsicológico de la atención y las funciones ejecutivas. España: Mc Graw Hill.

Rebollo MA, M. S. (2006). Atención y funciones ejecutivas. Neurol , s3-s7.

Ricardo, J. (2004). Aportes del electroencefalograma convencional y el análisis de frecuencias para el estudio del Trastorno por déficit de atención. Primera parte. Salud Mental , 22-27.

Ricardo, J. (2004). Aportes del electroencefalograma convencional y el análisis de frecuencias para el estudio del Trastorno por déficit de atención. Segunda parte. Salud Mental , 7-14.

Rodriguez Reyes, R. T. (2006). FUNCIONES CEREBRALES SUPERIORES, SEMIOLOGIA Y CLINICA. 7 (2).

Schabus, M. (2006). Sleep spindles and general learning abilities. European J Neuroscience , 1738-1746.

Ysunza, A. (2007). Electrodiagnóstico. A Med G , 73-80.