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ATTENTION-DEFICIT HYPERACTIVITY DISORDER: CLINICAL AND ELECTROENCEPHALOGRAPHIC PROFILE.

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ABSTRACT

BACKGROUND. Attention deficit hyperactivity disorder (ADHD) is the main neuropsychiatric disorder of childhood years. Abnormal graphoelements have been described in electroencephalography (EEG).

OBJECTIVE. To describe clinical characteristics and electroencephalographic alterations in children with ADHD with and without epilepsy during July to December 2018.

METHODS. Observational, cross-sectional, and descriptive study. Age, gender, family history, hypoxia, learning achievement, neurological comorbidities, drug treatment, ADHD type and alterations in EEG were identified. Data was captured in Excel. Independent variables were electroencephalographic alterations and dependent variables were patients with ADHD with and without epilepsy.

RESULTS. In n= 41 patients, mean age of 9.1 years, male predominance (92%); 12% with a history of ADHD in parents, 46% with mild perinatal asphyxia, while learning achievement was found to be low in 61%. Comorbidities: epilepsy is found in 17%, language disorders 32%, learning disorders 19%, oppositional defiant disorder 15%, night terrors 5%, anxiety 2% and migraine 10%. Treatment: methylphenidate 58%. ADHD type: inattentive 29%, hyperactive 2%, mixed 68%. Abnormal graphoelements 56%: focal paroxysms 34%, generalized paroxysms 10%, slow waves 5%, and excess theta-delta activity 7%.

CONCLUSIONS. In children with ADHD without epilepsy, an excess theta-delta activity and focal sharp waves were observed; in those with ADHD with epilepsy, focal sharp waves and generalized paroxysms were found. Follow-up studies that analyze the association between ADHD and electroencephalographic alterations are still necessary.

KEYWORDS : Attention deficit disorder and hyperactivity, epilepsy, electroencephalography.

BACKGROUND

The attention-deficit hyperactivity disorder (ADHD) is the main neuropsychiatric disorder of childhood years. In the meta-analysis carried out by Willkut[1] 86 studies were included with a 5.9% prevalence in children, 7.1% in adolescents and 5% in young adults. It represents between the 20 and 40% of the pedopsychiatrists appointments[2], with a male predominance.[3] The ADHD is characterized by a decrease in attention capacity, hyperactivity, and impulsivity, being divided in 3 subtypes: combined, hyperactive or impulsive, and inattentive. Diagnosis is based on clinical history and observation, and it is supported by neurophysiological data; there are currently no biological indicators nor pathognomonic psychological indicators.

The *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (DSM-V)-TDAH[5] is the most used manual to detect ADHD in children.

In ADHD, abnormal graphoelements have been described in electroencephalography (EEG)[5-10], hence why we consider it necessary to inform what is observed in the EEG in child population with ADHD in our environment.

Lubar's study[11] evaluated 109 volunteers with this disorder by QEEG, concluding that the reference point to diagnose ADHD is the alteration of the theta band (with excessive activity) and of the beta band (with less activity), without a mention of the alpha band.

He refers to asymmetry in the background rhythm of the alpha activity, fast rhythms in the beta frequency, and slow activity of frontal predominance. Epileptiform activity presence is reported up to 10% in the frontal and focalized regions; on the other hand, comorbidities associated to ADHD also show fast generalized rhythms.[12]

OBJECTIVE

To describe clinical characteristics and electro-encephalographic alterations in children with ADHD with and without epilepsy during July to December 2018, who attended pediatric neurology outpatient appointments, to determine whether EEG is important in the ADHD features.

MATERIAL AND METHODS

An observational, cross-sectional, and descriptive study was carried out among the population between 5 years and 14 years of age with ADHD diagnosis who attended outpatient appointments in our institute, during a period of 6 months, with n = 41 patients who fulfilled certain inclusion and exclusion criteria. The inclusion criteria were patients with an ADHD diagnosis, by means of DSM-V, and carried out by a pedopsychiatrist. Exclusion criteria were patients with information of less than 80%.

With respect to the collection of data, a direct interview was carried out with the patients recording age, gender, family history, mild perinatal asphyxia (Sarnat classification grade I)[13], learning achievements measured by grade point average (low<8), neurological comorbidities, as well as drug treatment.

The EEG was performed in patients at the Pediatric Clinic Neurophysiology service, with a duration of half an hour, velocity of 30 mm/s, in vigil and in physiological sleep.

The electroencephalographic tracing was recorded as either normal or abnormal. For the latter, the observed abnormal graphoelement was specified and its location.

The EEG was considered normal when the study had an adequate integration of the stages of sleep in accordance with age, with symmetry and synchrony, without abnormal

graphoelements. The abnormal EEG (with immaturity data) were those that presented a baseline rhythm not in accordance with the patient's age, with poor background rhythm structuring, or that did not integrate an age-appropriate rhythm in sleep. The abnormal EEG (with epileptiform activity) were the tracings with a focal or generalized activity of the spikes, sharp waves, spike-wave complexes, polyspikes or wave polyspike.

Subsequently, a database was prepared using the Excel versión 2013 program to capture information. Descriptive statistics, measures of central tendency and dispersión were used for quantitative variables, frequencies and proportions for categorical variables, using the SPSS program.

RESULTS

N = 41 patients were included with EEG results from a period extending from July to December 2018, of ages between 5 years to 14 years. The mean age of the studied population is 9.1 years, DE±2.6. The male gender is predominant with 92%.

With respect to hereditary-family records, 12% which is equivalent to 5 patients reported ADHD in their parents.

As for perinatal precedents, mild asphyxia reached 46%, equivalent to 19 patients of the total studied population.

With respect to learning achievement, 25 patients presented low performance (61%) and 16 patients had high performance (39%), with a predominance of low performance in the group with ADHD without epilepsy (80%).

Regarding comorbidities, epilepsy was found in 7 patients (17%), language disorder in 13 patients (32%), learning disorder in 8 patients (19%), oppositional defiant disorder in 6 patients (15%), migraine in 4 patients (10%), night terrors in 2 patients (5%), and anxiety disorder in 1 patient (2%). In children with ADHD without epilepsy, the language disorder was predominant (32%); while for children with ADHD with epilepsy, learning disorder and oppositional defiant disorder (29%) are added.

The drug treatment used was methylphenidate in 24 patients (58%), which was predominant in the group with ADHD with epilepsy (75%), magnesium valproate in 19 patients (46%), risperidone in 5 patients (12%), oxcarbazepine in 3 patients (7%), sertraline in 3 patients (7%), imipramine in 2 patients (4%), levetiracetam in 1 patient (2%), and atomoxetine in 1 patient (2%).

The ADHD types were mixed in 28 patients (68%), inattentive in 12 patients (29%), and hyperactive in 1 patient (2%). In children with ADHD without epilepsy, the mixed type (76%) was predominant and in children with ADHD with epilepsy the inattentive type (71%) prevailed (Chart 1).

Chart 1. Clinical And Electroencephalographic Alterations In Children With ADHD Without And With Epilepsy.

	ADHD type n= 41	Perinatal asphyxia	Low learning achievement	Language disorder	Learning disorder	Oppositional defiant disorder	Methylpheni-date	Abnormal EEG
Inattentive without epilepsy	7	3	5	0	0	0	2	5
Hyperactive without epilepsy	1	1	0	1	0	1	0	0
Mixed without epilepsy	26	12	15	10	6	3	16	12
Inattentive with epilepsy	5	1	1	1	1	0	2	2
Hyperactive with epilepsy	0	0	0	0	0	0	0	0
Mixed with epilepsy	2	2	4	1	1	2	4	4
ADHD without epilepsy total	34	16	20	11	6	4	18	17
ADHD with epilepsy total	7	3	5	2	2	2	6	6

The total of EEG within normal limits was 18 normal ones (44%) and 23 abnormal ones (56%). From the group of children with ADHD without epilepsy, 50% had abnormal EEG. As for children with ADHD with epilepsy, 86% showed abnormal EEG (Chart 1).

The most frequent abnormal graphoelements were focal sharp waves (34%), generalized paroxysms (10%), medium voltage slow waves (5%), and excess theta-delta activity (7%).

In children with ADHD without epilepsy, the most frequent abnormal graphoelements were excess theta-delta activity (9%) (Figure 1) and focal sharp waves (29%). In children with ADHD with epilepsy, the most frequent abnormal graphoelements were focal (57%) (Figure 2) and generalized paroxysms (29%).

The most frequent location of abnormalities was found in the right temporal lobe (43%), followed by the left temporal lobe (21%), the left frontal lobe (14%), the left parietal lobe (14%), and the right frontal lobe (7%). In children with ADHD without epilepsy, the most frequent location was the temporal lobe (14%), followed by the frontal lobe (9%). In children with ADHD with epilepsy, the most frequent location was the temporal lobe (57%).

DISCUSSION

The most frequent reported alterations in the conventional EEG analysis of patients with ADHD without epilepsy are the increase in slow activity in the frontal regions and the increase in paroxysmal activity with respect to healthy controls.[14]

In the present study, the most frequent abnormal

graphoelements in children with ADHD without epilepsy were excess theta-delta activity. Meanwhile, in children with ADHD with epilepsy, focal and generalized paroxysms were found.

The most frequent location of electroencephalographic abnormalities in patients with ADHD with and without epilepsy was the temporal lobe, followed by the frontal lobe, which agrees with literature and could be related to a transient cognitive impairment, which are more evident with a higher latency of response or with a higher number of errors during the fulfillment of different tasks.[14]

In children with ADHD without epilepsy, the mixed type prevailed, while in children with ADHD with epilepsy, the inattentive type was predominant, in agreement with Harvey et al.[15]

The comparison between children with ADHD that present epilepsy with electroencephalographic alterations is important due to the existence of a two-way relationship between ADHD and epilepsy. The ADHD, particularly the inattentive type, increases the risk of epilepsy, while epilepsy increases the risk of ADHD.

In Mexico, the studies that evaluate this relationship are scarce, raising the importance to analyze it because when there is comorbidity between ADHD and epilepsy, carrying out the EEG is more relevant to differentiate the inattention of epileptic cause from that of non-epileptic cause.[16]

With respect to children with ADHD without epilepsy, we consider the alterations in the EEG to be unspecific and do not necessarily constitute focus of epilepsy, since many patients with these findings never presented seizures. Additional studies are required to evaluate the clinical expression of the electroencephalographic alterations in children with ADHD without epilepsy.

It is considered that the EEG should not be used routinely, although in this study electroencephalographic abnormalities were found in patients with comorbidities, further studies are needed to assess whether there is a real association.

CONCLUSIONS

In children with ADHD with and without epilepsy, electroencephalographic alterations were found. Follow-up studies that analyze the association between ADHD and EEG alterations are still necessary, especially its clinical impact, clinical evolution, and response to treatment.

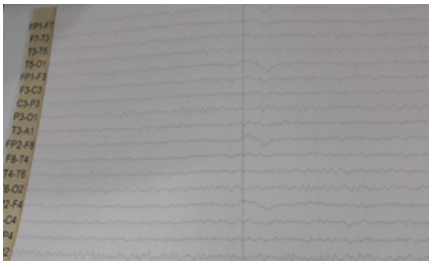

Figure 1. EEG in ADHD without epilepsy, excess theta-delta activity.

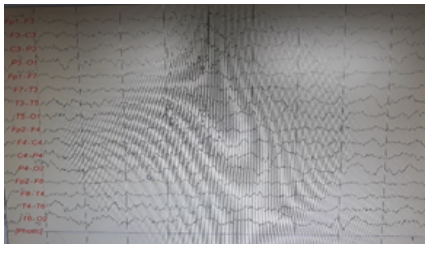

Figure 2. EEG in ADHD with epilepsy, focal sharp waves.

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