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Karim Okasha

Neuropsychiatry department, Police Academy Hospital, Egypt, dr.okasha@hotmail.com

Mahmoud Hamouda

Psychiatry department, Al Al-Azhar University, Cairo, Egypt., dosamo11729@gmail.com

ismail sadek

department of psychiatry, faculty of medicine, Al-Azhar university, Cairo, Egypt, ismsadek77@gmail.com

Mohammed hamouda

Lecturer of psychiatry Al-Azhar university, mohamad_hamouda@yahoo.com

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Study of EEG Changes Among Sample Of Egyptian Children With Attention Deficit Hyperactivity Disorder

Karim H. Okasha^{1,*}MBBCh; Mahmoud A. Hamouda²MD; Ismail M. Sadek²MD; Mohammed M. Hamouda²MD

*Corresponding Author:

Karim Okasha
dr.okasha@hotmail.com

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¹Resident in Psychiatry Department, Police Academy Hospital, Cairo, Egypt.

²Psychiatry Department, Faculty of Medicine, Al-Azhar University, Cairo, Egypt.

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ABSTRACT

Background: Attention Deficit Hyperactivity Disorder (ADHD) is a mental Neuro-developmental type, Up to 5% of primary school-age children have ADHD, characterized by Inattention, Hyperactivity, and Impulsivity, Relation between Encephalography (EEG) and (ADHD) is ambiguous, Guidelines recommend that (EEG) indicated only in the clinical suggestions of seizure disorder or a presence of focal signs.

Aim of The Work: To Study the prevalence of presence of changes in EEG recording of children diagnosed with different type of ADHD between (ADHD) children and their (EEG) changes, Further study of the Efficacy of Atomoxetine\Antipsychotic and Antiepileptic on ADHD children.

Patient and Methods: 60 Egyptian child (age 6-18) diagnosed with ADHD with No previous history of seizures. They have been attending to Police Academy Hospital, Neuropsychiatry clinic for treatment and fulfilling the criteria for (ADHD) according to (DSM-IV), All patient was assessed with Conner's scale for (ADHD) and (EEG) was applied for 60 children. Follow up study was conducted from September 2018 to January 2021, included, Follow up assessment for 18 months from January 2019 to June 2020 of all children with their treatment of all types of (ADHD) using Atomoxetine, Atomoxetine/Antipsychotic combination, and Antiepileptic.

Results: Out of 60 (ADHD) children, only 6 children (10%) (1 patient with Hyperactivity type, 2 patients with inattention type and 3 patients with combined type) showed (EEG) Abnormalities, Antiepileptic was given for all the (6) patient regardless their ADHD type, weak (improvement on (1 out of 6) with only (16.7%

Atomoxetine only was given to (27) child and showed a modest efficacy on (12 out of 27) patient with (44.4%) for all ADHD children regardless their type, While it showed a noticeable improvement on ADHD (inattention type on (4 out of 4) with (100%

Atomoxetine\Antipsychotic combination was given to (27) child and showed a superior efficacy on (24 out of 27) patient with (88.9%) for all ADHD children regardless their type, While it showed a noticeable improvement on ADHD hyperactivity type on (9 out of 9) with (100%).

Conclusion: There was a weak correlation of EEG changes and diagnosis of ADHD in children, beside that there was a weak role of Antiepileptic compared to other drugs.

Keywords: ADHD; EEG; Non-epileptic; Antiepileptic.

INTRODUCTION

Attention deficit hyperactivity disorder is a common developmental condition of inattention that might be accompanied by hyperactivity or not.¹

ADHD is characterized by difficulty paying attention, excessive activity, and behavior regardless of the consequences which are not appropriate for a person's age.²

Diagnosis of ADHD using EEG is an ongoing area of investigation in the United States, the Food and Drug Administration has approved the use of EEG to only evaluate the morbidity of ADHD.³

A wide agreement that ADHD occurs as a result of dysfunction in the central nervous system, but the mechanism are still not well known, EEG is used to

describe as well as to quantify the neurophysiology of ADHD, also clinically the assessment, diagnosis, and treatment of ADHD.⁴

The EEG common features related with ADHD is the elevation of slow waves Theta and/or decreased power of fast waves Beta, mostly noticed on the fronto-central electrodes, which are sometimes combined and quantified by the theta/beta ratio TBR.⁵

Not less than five recent studies failed to duplicate theta/beta ratio TBR differences in ADHD versus Non-ADHD between groups of children and adults, as well as cross-sectional across age.⁶

In a study of 101 children, only 62 were diagnosed with ADHD differentiating between children with and without ADHD based on theta/beta ratio TBR

reported an accuracy of 89.9-96.5% in theta/beta ratio predicting age but only 49.2-54.8% accuracy in predicting if the individual has ADHD or not. ⁷

Another study suggests the EEG theta/beta ratio is not definitive in differentiation between individuals with or without ADHD. ⁸

The slight success of EEG in the diagnosis of ADHD is predictable when considering the variability in etiology, symptoms, and treatment results of ADHD. ⁹

Impressively, neither medications responses nor side effects were speculated by ADHD subtype, studies revealed that the advantage of EEG as a predictor of results outcome rather than as a diagnostic tool. ¹⁰

This study designed to assess the presence of EEG changes in children diagnosed with ADHD in order to evaluate role of Antiepileptics compared to Atomoxetine and Antipsychotics.

PATIENTS AND METHODS

Study design

This follow-up study was conducted on 60 Non-epileptic ADHD children aged (6-18) years old attending for treatment to Neuropsychiatry clinic of Police Academy Hospital at Cairo, Egypt from September 2018 to January 2021. The Ethical committee of Al-Azhar Faculty Of Medicine approved this study.

All children were clinically interviewed semi structurally and were excluded from any other neuropsychiatric or medical disorder, After explaining Aim of our study and verbal consent was obtained.

Procedures

All study children have been diagnosed with ADHD according to the DSM IV criteria SCID, Conner's scale for ADHD was applied for all the study's children.

EEG was obtained for all the children in the study before given treatment and after stabilization of the medications.

Applying medical treatment for all the children and follow up their improvement who categorized into 3 groups, the first group consists of 27 newly diagnosed children with ADHD with no EEG abnormalities and were given Atomoxetine only regardless of the ADHD type.

While the second group consists of 27 newly diagnosed children with ADHD with no EEG abnormalities and were given a combination of Atomoxetine and Antipsychotic regardless of the ADHD type.

The third group consists of 6 newly diagnosed children with ADHD who have EEG abnormalities and were given only Antiepileptic regardless of ADHD type.

Statistical analysis

We used SPSS version 20.0. qualitative data were described using numbers and percent, the significance of the obtained results was judged at the 5% level.

RESULTS

The Study applied to 60 child diagnosed with ADHD, 70% of them was less than 8 years old, 71.7% are males and 28.3% are females, 53.3% live in rural areas.

ADHD combined type was predominance type according to the study statistical with 56.7%, ADHD predominance Co-morbid disorder was oppositional defiant disorder ODD.

The Study shows a high statistical significance between ADHD combined type and their educational level (P value<0.001) table 1.

	Hyperactivity and Attention deficit						χ^2	p
	Hyperactivity (n = 18)		Attention deficit (n = 8)		Both on same degree (n = 34)			
	No.	%	No.	%	No.	%		
Age (years)								
From 13 to 18 years	0	0.0	0	0.0	6	17.6	6.658	MC p=0.117
From 8 to 13 years	2	11.1	3	37.5	7	20.6		
Less than 8 years	16	88.9	5	62.5	21	61.8		
Gender							2.062	0.357
Female	3	16.7	2	25.0	12	35.3		
Male	15	83.3	6	75.0	22	64.7		
Residence							23.957*	MC p<0.001*
Urban	13	72.2	8	100.0	7	20.6		
Rural	5	27.8	0	0.0	27	79.4		
Education							56.221*	MC p<0.001*
Above average	10	55.6	0	0.0	0	0.0		
Average	3	16.7	8	100.0	1	2.9		
Below average	5	27.8	0	0.0	33	97.1		

Table 1: Relation between Attention deficit and Hyperactivity and demographic data.

High statistical significance was found between Co-morbid disorders and male ADHD children ($P < 0.005$) table 2, and age less than 8 years old ($P = 0.026$) table 2.

	Comorbid disorder						χ^2	p
	No (n = 10)		conducted (n = 20)		ODD (n = 30)			
	No.	%	No.	%	No.	%		
Age (years)								
From 13 to 18 years	0	0.0	0	0.0	6	20.0	9.979*	MC p= 0.026*
From 8 to 13 years	0	0.0	4	20.0	8	26.7		
Less than 8 years	10	100.0	16	80.0	16	53.3		
Gender								
Female	0	0.0	3	15.0	14	46.7	10.670*	0.005*
Male	10	100.0	17	85.0	16	53.3		
Residence								
Urban	6	60.0	11	55.0	11	36.7	2.472	0.290
Rural	4	40.0	9	45.0	19	63.3		
Education								
Above average	5	50.0	4	20.0	1	3.3	12.173*	MC p= 0.009*
Average	0	0.0	5	25.0	7	23.3		
Below average	5	50.0	11	55.0	22	73.3		

Table 2 : Relation between co morbid disorder and demographic data.

EEG abnormalities in the Non-epileptic ADHD children of the study were only 10%, with no statistical relationship between them. table 3

While it was obvious according to the study the strong relation between the ADHD children regardless of their types and the Co-morbid disorders with them ($P < 0.007$) table 3.

	Hyperactivity and Attention deficit						χ^2	MC p
	Hyperactivity (n = 18)		Attention deficit (n = 8)		Both on same degree(n = 34)			
	No.	%	No.	%	No.	%		
EEG								
Changes	1	5.6	2	25.0	3	8.8	2.357	0.307
Normal	17	94.4	6	75.0	31	91.2		
Co morbid disorder								
No	5	27.8	0	0.0	5	14.7	13.003*	0.007*
Conducted	10	55.6	3	37.5	7	20.6		
ODD	3	16.7	5	62.5	22	64.7		

Table 3 : Relation between Attention deficit and Hyperactivity with EEG and co morbid disorder

Study analysis showed a highly statistical significance for ADHD children regardless of their type with their improvement on treatment. ($P < 0.001$) table 4.

As well as the study showed a highly statistical relation between ADHD hyperactivity type children's improvement when given Atomoxetine\Antipsychotic combination. ($P = 0.001$) table 4.

In addition, there was a highly statistical relation between the ADHD combined type children improvement when given Atomoxetine\Antipsychotic combination. ($P = 0.010$) table 4.

Hyperactivity and Attention deficit	Atomoxetine		Anti-psychotic + Atomoxetine		Anti-epileptic		χ^2	MC p
	No.	%	No.	%	No.	%		
Overall	12/27	44.4	24/27	88.9	1/6	16.7	17.417*	<0.001*
Hyperactivity	2/9	22.2	9/9	100.0	1/2	50.0	12.021	0.001*
Attention deficit	4/4	100.0	3/4	75.0	0/2	0.0	5.085	0.135
Both on same degree	6/14	42.9	12/14	85.7	0/2	0.0	8.123*	0.010*

Table 4 : Comparison between Atomoxetine, Anti-psychotic + Atomoxetine and Anti-epileptic according to Attention deficit and Hyperactivity.

DISCUSSION

In this study we demonstrate whether Non-epileptic ADHD children are related to any abnormalities of their EEG or not, also we made a follow-up study according to the treatment of all types of ADHD by using Atomoxetine, Atomoxetine\Antipsychotic combination, and Antiepileptic.

This study was applied to 60 newly diagnosed ADHD who have no previous history of epilepsy.

Study results showed that the ADHD combined type was the predominance type with 56.7%, these findings were corresponding to Socanski study which revealed that the ADHD combined type was predominant in his study.¹¹

The Current study showed no statistically significant relation between ADHD children regarding their EEG results, as shown there was only 10% with EEG abnormalities, these findings were in agreement with Castaneda-Cabrero's study which found that EEG abnormalities were only in 40% of the ADHD study patients.¹²

In addition, current study results were in harmony to Silverstri's study which found the EEG abnormalities in non-epileptic ADHD was only 53% in his study group.¹³

According to the study, ODD was the predominant ADHD Co-morbid disorder with 50% and these findings consist with Steinhausen study who found that ODD is the most common Comorbidity with ADHD which occurring in 30-67% of youth with ADHD.¹⁴

Also, there was a highly statistical relation between ADHD children and their residency, as the study found that ADHD combined type was more common in rural areas with 79.4% rather than those lives in urban areas, these findings were in harmony with those reported by Willcutt EG who found that the ADHD combined type was 48% of total cases in his study lives in rural areas.¹⁵

The Current study also revealed that there was a highly statistically significant relation between Co-morbid disorders and ADHD children's age as it's more common in ADHD children less than 8 years old, these findings are corresponding to Masi's study which found out that more than 2/3 of ADHD children have a Co-morbid disorder is during early childhood.¹⁶

According to the treatment a Follow-up study was conducted and we found that in the first group of 27 patients who were given only Atomoxetine regardless of ADHD type, improvement was noticed in all patients with ADHD inattention variant 100%, only 22.2% improved from the ADHD hyperactivity variant and 42.9% improved from the ADHD combined variant. These findings suggest that Atomoxetine has a superior efficacy on ADHD inattention variant rather than ADHD hyperactivity variant. These findings were consistent with Vinutha and her colleague's study which revealed to the

superior efficacy of Atomoxetine is significant on inattention more than hyperactivity/impulsivity.¹⁷

While the second group of 27 patients in the current study were given a combination of Atomoxetine\Antipsychotic regardless of ADHD type, improvement was noticed in all patients with ADHD hyperactivity variants 100%, 75% improved from the ADHD inattention variant and 85.7% improved from the ADHD combined variant. These findings suggest that Antipsychotic is very effective in controlling ADHD different variants and has a superior efficacy on ADHD hyperactivity variant. These findings are in agreement with many studies which revealed the great efficacy of Antipsychotics on agitation, over activity, aggression, and impulsivity in all their study groups.^{18,19}

The third group 6 ADHD patients who showed EEG abnormalities and have NO previous history for epilepsy were given only Antiepileptic, improvement was very frustrating as there was NO noticeable improvement 16.7% in all ADHD regardless of the variant. These findings suggest that there is no relation between Non-epileptic ADHD and their EEG abnormalities, these findings are corresponding to other many studies which revealed that it's not recommended to prescribe Antiepileptic ADHD children with no seizures while stimulants appear to be more effective for the treatment of ADHD.²⁰

In addition to Pliszka S study which was consistent with the current study findings that there's no role for Antiepileptic as a treatment to ADHD children with no seizures history and should start a trial of a stimulant, if not effective then alternative stimulant used next and if stimulant is not effective or cause intolerable side effects should start with Non-stimulants.²¹

Upon the current study, Non-epileptic ADHD children with EEG abnormalities after being given Antiepileptic and repeat EEG still changes are the same, these findings suggest that EEG changes in Non-epileptic ADHD children are strongly related to epilepsy not to the ADHD itself. This is in harmony with K.osamu's study which found out that EEG changes in ADHD are strongly related to epilepsy and shouldn't be referred as ADHD.²²

CONCLUSION

There was a weak correlation of EEG changes and diagnosis of ADHD in children, beside that there was a weak role of Antiepileptic compared to other drugs.

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