Splenium, the Most Common Structural Brain Abnormality among Iraqi Children Population Diagnosed with ADHD

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ABSTRACT

Objective: Globally, ADHD is a widespread neuropsychological condition. Inappropriate levels of inattention, hyperactivity, and Phenotypes of impulsivity describe the disorder. Various studies have been shown that a variety of brain sections is damaged in ADHD patients. This study aimed to evaluate the structural brain abnormalities among the Iraqi children population diagnosed with ADHD using MRI.

Methods: Ten male and five female with mean age = 10.3, SD=2.44 diagnosed with ADHD/ /Hyperactivity were included to our study. All of them underwent a brain MRI assessment.

Results: MRI evaluation was positive in 60% (9/15) patients and negative in 40% (6/15). Out of 15 participants, 8 participants show clinical symptoms of attention deficit disorder, 4 patients show symptoms of hyperactivity/ impulsivity, and 3 have combined type of the disease. Sub cortex, Selenium, Pineal Gland, cerebral, retro cerebellar Arachnoid, Frontal &Temporal Lobes, and Frontal Lobe were damaged regions in the brain structure. Splenium was the most common abnormality finding in patients. The outstanding point of our results was that no brain anomaly was reflected in the MRI findings for patients with hyperactivity.

Conclusion: Although our findings did not show abnormality in all patients with attention deficit, MRI can be considered as a pivot strategy in ADHD diagnosis.

Keywords: ADHD, Brain abnormalities, Iraq

INTRODUCTION

Attention deficit hyperactivity disorder (ADHD) is a neurodevelopmental disease with a heterogeneous pattern of common behavioural disorders that are becoming increasing in the world[1]. According to DSMV, the most common behavioural anomaly is characterized by pervasive and impairing signs of inattention, hyperactivity, and impulsivity[2]. Meta analytical results have been shown an estimation ranging from 5.9% to 7.1%, depending on the source of information for the diagnosis[2].

Prevalence rates for ADHD vary, depending on the patient sample, geography, and diagnostic criteria[1]. Patients with ADHD expose a weakness in executive function, self-control and self-regulation, inattention, and the lack of concentration[3]. In these patients, aggressive behaviour is a social impact that affects their academic level and social lives[4].

Neuroimaging techniques are increasingly being applied to the study of abnormalities in ADHD disorder[5]. Various functional MRI studies have shown that in children with ADHD, a number of brain parts are affected. These sub-regions include frontal and parietal cortexes, cerebellum, basal ganglia, hippocampus, and corpus callosum which are involved in the pathophysiology of the unique frontal-striatal-parietal cerebellar network of ADHD functional networks[6] (Figure 1).

It has also revealed that beyond the frontal-striatal-parietal cerebellar circuit, the patients also have pathophysiological abnormalities in the limbic network[7].

Our study aimed to evaluate the structural brain abnormalities among the Iraqi children population diagnosed with ADHD using the MRI method.

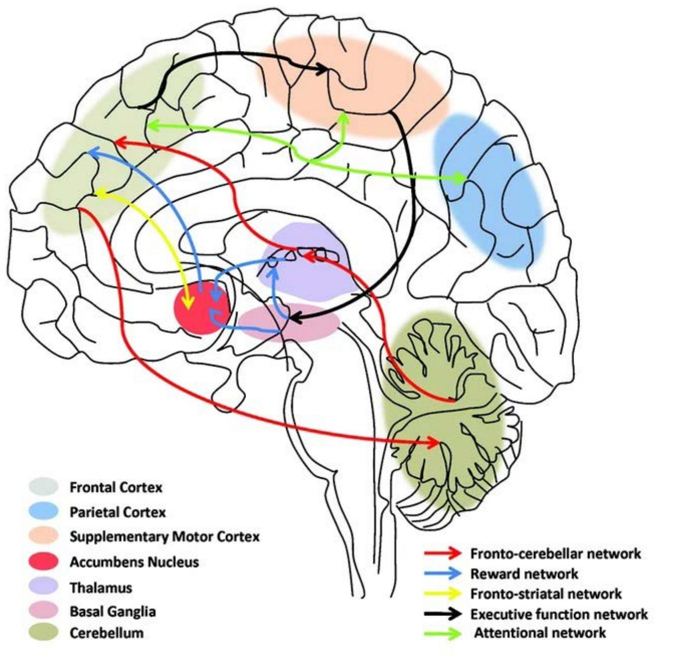

Figure 1: Schematic depiction of functional circuits involved in the ADHD pathophysiology. The attentional network (green), the fronto-striatal network (yellow), the network of executive functions (black), the fronto-cerebellar network (red), and the reward network (blue) are summarized here[17]

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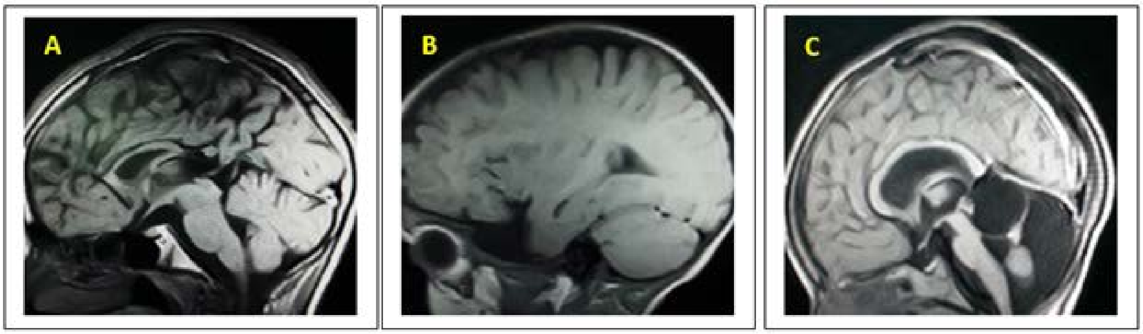

Figure 2: A schematic presentation of some MRI results of patients. Hypo plastic corpus callosum (A), reduction of the temporal lobe size (B), cerebral hypoplasia (C)

PATIENTS AND METHODS

Ten men and five females (15patients) were diagnosed with ADHD/ Attention Deficit Disorder (DSM-IV) with the mean age= 10.3 and SD= 2.44, referred to from the psychiatric in Baghdad (Iraq) included in the research. All patients had six or more symptoms in their documented clinical history. Patients participated in the current study with full agreement (obtained from parents) and research ethics. For diagnosis of possible structural brain abnormalities, as a non-invasive and sensitive procedure, all participants were scan by magnetic resonance imaging (MRI-magnetom Avanto model).

RESULTS

Data review found that out of 15 ADHD patients, 8 patients had clinical attention deficit symptoms, 4 patients had hyperactivity/impulsivity symptoms, and 3 had a mixed form of the disease. MRI data analysis showed that 60% (9 out of 15) of patients had a brain abnormality. The subcortex, Selenium, Pineal Gland, Retro cerebellar Arachnoid, Frontal & Temporal Lobes, and Frontal Lobe were affected in the brain structure regions. (Figure 2). The distribution of ADHD symptoms and the region of brain abnormality are presented in Table 1.

Table 1: Distribution of symptoms, demographic data by types of ADHD and brain abnormality in participants

Samples	ADHD type	Age	Gender	Brain structural abnormalities (MRI)	
				Normal	Abnormal area
1	AD	7	Male		Retro cerebellar Archanoid
2	HD	9	Male	ND	
3	combined	11	Male		Splenium
4	AD	8	Female	ND	
5	HD	12	Male	ND	
6	combined	14	Male		Splenium
7	HD	13	Female	ND	
8	AD	12	Male	ND	
9	combined	10	Female		Pineal Gland
10	AD	9	Male		Retro cerebellar Archanoid
11	AD	7	Male		Splenium
12	AD	7	Male		Frontal &Temporal Lobes
13	AD	8	Female		corpus callosum
14	HD	13	Male	ND	
15	AD	12	Female		Cerebral hypoplasia

AD= Attention deficit Disorder, HD=Hyperactivity disorder ND= not detectable

DISCUSSION

Attention-deficit /hyperactivity disorder (ADHD) is the most common neuropsychiatric disorder that occurs in approximately 3-9% of the childhood population[8,9]. Neurobiological dysfunction dorsal front striatal and fronto-cerebellar circuits could lead to symptoms of ADHD[8]. Since that ADHD shows a wide range of causes then neurobiological investigations could be helpful for diagnosis and control the disease progression.

In our research, despite the limited number of participants we observed a higher incidence of ADHD among male patients than females, which was agreed with other populations, study around the world[10-13]. In our study, a different part of the brain was damaged and Splenium part of the brain was correlated to the combined phenotype of the disease. Patients with hyperactivity symptoms did not have any changes or abnormalities in the brain. This result agreed with others investigations[14,15]. There are many essential functional components associated with ADHD in the frontal lobes. Our results showed that two patients with attention deficit disorder had this kind of brain abnormality. This abnormality can be accompanied by slow-motivated behaviours[16,17]. To conclude, while numerous brain disorders have been reported to be associated with ADHD, and to some degree, our findings support these claims, none of the hyperactive patients have demonstrated an abnormality that could be traced by MRI.

CONCLUSION

Nevertheless, our results do not refute the presence of any brain abnormality in this population, since ADHD is followed by other anomalies such as neuron and neurotransmitter dysfunction that cannot be precisely tested by MRI. According to these findings, more research study on ADHD networks particular molecular and neurotransmitter dysfunctions is recommended.

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Competing Interest: None

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REFERENCES

1. Polanczyk G, De Lima MS, Horta BL, et al. The worldwide prevalence of ADHD: a systematic review and metaregression analysis. Am J Psychiatry 2007;164(6):942-8.
2. Ma F. Diagnostic and Statistical Manual of Mental Disorders-5 (DSM-5). Encycl Gerontol Popul Aging 2020;1-12.
3. Nissley-Tsiopinis J, Krehbiel C, Power TJ. Attention-deficit hyperactivity disorder. Handb Adolesc Behav Probl Evidence-Based Approaches to Prev Treat 2015;31(2):151-71.
4. Mazzone L, Postorino V, Reale L, et al. Self-esteem evaluation in children and adolescents suffering from ADHD. Clin Pract Epidemiol Ment Health 2013;9:96-102.
5. El Ameen N, Ibrahim MA, Mouner SM. MRI Evaluation of the Brain in Children with Attention Deficit and Hyperactivity Disorder; How to Hear the Whispers Early? Int J Pediatr 2019;7(5):9379-90.
6. He N, Palaniyappan L, Linli Z, et al. Abnormal hemispheric asymmetry of both brain function and structure in attention deficit/hyperactivity disorder: A meta-analysis of individual participant data. Brain Imaging Behav 2022;16(1):54-68.
7. Chen L, Huang X, Du Lei NH, et al. Microstructural abnormalities of the brain white matter in attention-deficit/hyperactivity disorder. J Psychiatry Neurosci 2015;40(4):280.
8. Cortese S, Castellanos FX. Neuroimaging of attention-deficit/hyperactivity disorder: current neuroscience-informed perspectives for clinicians. Curr Psychiatry Rep 2012;14(5):568-78.
9. Poissant H, Emond V, Joyal C. Structural and functional neuroanatomy in attention deficit and hyperactivity disorder (ADHD). Int J Dev Neurosci 2008;26(8):842-2.
10. Liu A, Xu Y, Yan Q, et al. The Prevalence of Attention Deficit/Hyperactivity Disorder among Chinese Children and Adolescents. Sci Rep 2018;8(1):1-15.
11. Joseph J, Devu B. Prevalence of attention-deficit hyperactivity disorder in India: A systematic review and meta-analysis. Indian J Psychiatr Nurs 2019;16(2):118.
12. Lola HM, Belete H, Gebeyehu A, et al. Attention deficit hyperactivity disorder (ADHD) among Children Aged 6 to 17 Years Old Living in Girja District, Rural Ethiopia. Behav Neurol 2019;2019:1753580.
13. Štuhec M, Švab V, Locatelli I. Prevalence and incidence of attention-deficit/hyperactivity disorder in Slovenian children and adolescents: A database study from a national perspective. Croat Med J 2015;56(2):159-65.
14. Carmona S, Proal E, Hoekzema EA, et al. Ventro-striatal reductions underpin symptoms of hyperactivity and impulsivity in attention-deficit/hyperactivity disorder. Biol Psychiatry 2009;66(10):972-7.
15. Batty MJ, Liddle EB, Pitiot A, et al. Cortical gray matter in attention-deficit/hyperactivity disorder: a structural magnetic resonance imaging study. J Am Acad Child Adolesc Psychiatry 2010;49(3):229-38.
16. Seidman LJ, Valera EM, Makris N. Structural brain imaging of attention-deficit/hyperactivity disorder. Biol Psychiatry 2005;57(11):1263-72.
17. Purper-Ouakil D, Ramoz N, Lepagnol-Bestel AM, et al. Neurobiology of attention deficit/hyperactivity disorder. Pediatr Res 2011;69(2):69-76.