

ECG Screening in Attention Deficit Hyperactivity Disorder

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Abstract- Attention Deficit Hyperactivity Disorder (ADHD) is a behavioral and developmental disorder. ADHD is one of the most common childhood neurological disorders and can continue through adolescence and adulthood. There is no single cause for ADHD. Scientists agree that ADHD is a medical disorder affecting the several areas of the brain with the frontal area likely having the greatest involvement. The analysis of heart function provides insights into the autonomic control of the heart and gives important information about cardiac sympathetic and parasympathetic interaction. Although many clinicians have recommended the electrocardiograms routinely for children with ADHD before they start medications to treat ADHD and proved that the autonomic regulation of the heart is impaired in ADHD, the information about this is limited. Because many researchers have demonstrated that heart functioning test before medication is not compulsory and shows that the cardiac variations in ADHD occurs in similar proportions as in general populations. But most of the studies show that there is an alteration in heart rate and blood pressure of ADHD subjects. However, family history of cardiovascular problems should be considered, before medication is commenced. Hence this review paper summarizes the studies of cardiac variations in ADHD.

Keywords – ADHD, Childhood neurological disorder, Cardiac variations.

I. INTRODUCTION

ADHD always begins in childhood. For some people, though, ADHD is not diagnosed until adulthood. That means adults who are newly diagnosed have actually had ADHD for years, and have had to endure symptoms as they've matured. Long-term studies have shown that 40% to 60% of children who have ADHD still have symptoms into adulthood. Untreated adults have an increased incidence of aggressive behavior, anti-social personality disorder, conduct disorder, depression, divorce, school drop-out and alcohol and drug abuse. Symptoms include difficulty staying focused and paying attention, difficulty controlling behavior, and hyperactivity. It is a chronic condition that affects millions of children and often persists into adulthood. Children with ADHD also may struggle with low self-esteem, troubled relationships and poor performance in school. ADHD can cause significant emotional, social and educational problems. However, when ADHD causes are known early and properly, the condition can be treated effectively, so children can grow up to have productive, successful and fulfilling lives. But the medication of ADHD may cause heart variations and its other related parameters [2, 4, 5, 10, 11]. Recently many scientists reported that ADHD drugs do not vary heart related parameters in healthy ADHD subjects [1, 3, and 8]. Hence this review paper summarizes the variations of heart related parameters in ADHD, before and after the medications.

There is no single cause for ADHD. Researchers believed that hyperactivity and disruptive behavior in children could be caused by a biological defect, which was either inherited or resulted from some pre or post natal injury. Several authors during early days felt that the behavioral problems were due to brain damage without physical evidence [4,5,9]. Even the recent studies show that unfavorable factors in pregnancy and delivery could cause damage to the brain of different severity ranging from small injuries leading to mild behavioral problems like ADHD more severe injuries leading to the problems like cerebral palsy. Other risk factors for ADHD have to do with factors that can influence brain development and functioning such as exposure to toxic substances in the developing fetus and acquired brain injury due to trauma or disease [6,7]. While the exact cause of ADHD remains a mystery, brain scans have revealed important differences in the structure and brain activity of people with ADHD. Like many other neurological disorders, ADHD probably results from a combination of factors.

II. PROPOSED ALGORITHM

The exact cause of ADHD is unknown. However, there is strong evidence that the frontal lobes of the brain may have a role in ADHD. The frontal lobes have long been known to play a critical role in regulating attention, activity, and emotional reactions. Recent studies have shown decreased blood flow in the frontal areas of children with ADHD [4]. It has also been demonstrated using advanced scanning methods that adults with ADHD have reduced brain glucose metabolism in the frontal lobes of the brain, compared to non-ADHD individuals, while concentrating on any particular task. Psychological conditions mainly influence the autonomic nervous control of the cardiovascular morbidity in neurological disorders [4, 9].

Regarding ADHD medication, American Heart Associations published that stimulant medications used to treat ADHD can increase heart rate and blood pressure, and although these side effects are insignificant for most children with ADHD, they are an important consideration for children who have certain forms of congenital heart disease arrhythmias with a predisposition for sudden cardiac arrest. Because “some of the cardiac conditions associated with sudden cardiac arrest might not be detected on a routine physical examination, we are suggesting that an ECG be added to increase the likelihood of identifying significant cardiac conditions that might place the child at risk,” the author Dr. Victoria V write [10,2,9]. Many of the scientists support these publications and even proved that the screening of heart related parameters before and after the medications is must. But some recent studies revealed that, like most of other medications, ADHD medications are also having side effects and may slightly change the cardiovascular parameters temporarily. Table 1 shows the tabulation of importance of ECG screening in ADHD cases. Detailed examination of cardiovascular response to all types of activities in ADHD subjects may shed additional light on this area.

Table -1 ECG screening in ADHD

Sl. No	First Author	Parameters considered	No. and type of cases	Methods used	Duration of observation	Author's opinion
1	Crystal Phend	QT interval	817	Baseline ECG	NA	Given the findings and the disparate approaches recommended for cardiac screening, data to clarify the risk of sudden cardiac problems with stimulant medications are urgently needed, the researchers concluded.
2	Denchev. P	Cardiovascular system	40,000	ECG	10 years	The authors conclude that ECG screening for heart conditions in children with ADHD is borderline cost-effective.
3	Eitan Nahhoni	Heart rate, QT	50+55	ECG traces	NA	The rate of early repolarization in ADHD is significantly higher than controls. Heart rate QT and QTc were within normal range.
4	Gary Stiefel	Heart rate, Blood Pressure, QT interval	NA	ECG	NA	ECG before medication is not compulsory. However, family history of cardiovascular problems should be considered, before medication is commenced.
5	Ingrid Tonhajzerova	R-R interval	36	Heart rate variability analysis	6 months	R-R interval is significantly shorter in ADHD compared to controls in all positions.
6	Mahon AD	Oxygen uptake, respiratory exchange ratio and perceived exertion	ADHD with and without medications	BP, HR and ECG	NA	Examining the cardiovascular response to exercise/exertion may shed additional light on this area.
7	Norbert borger	Continuous performance test and heart rate variability	200	Mean reaction time, MANOVA	2 years	Compared to controls, ADHD subjects had a greater 0.10-Hz component, which was associated with poor performance over time.
8	R. Bart Sangal	Sleep disorders (REM), ECG(RR)	85 children, 6-14	Poly Somnogram	6 Months	There is a statistically significant difference in the RR interval and greater incidence of decreased appetite and greater incidence of

		interval)	years	hy		insomnia after stimulant medications.
9	Robert Hamilton	ECG, ST elevation, prolonged QT		ECG statistical analysis	NA	ADHD subjects considered to need long term treatment should undergo periodic evaluation of their cardiovascular status.
10	Richerd Weisler	Vital signs & RR, PR, QRS,QT	349	Statistical and ECG analysis	12 months	Statistical analysis of ADHD subjects shows that there are noticeable changes in the heart functioning related parameters
11	Suyash Prasad	QT interval	6000	Statistical methods ANOVA	---	Prior treatment history with stimulants were associated with significantly longer mean QT.
12	Victoria L (AHA)	Physical examination focused on the cardiovascular system- ECG	Millions, Before age 12	ECG screening	Several years	Children with ADHD should get careful cardiac evaluation and monitoring - including an ECG - before treatment with stimulant drugs
13	William T	Ventricular pre-excitation, bicuspid aortic valve	1470	ECG, stress test Holter monitor	2 years	ECG screening for children with ADHD can successfully identify cardiac disease in otherwise asymptomatic subjects, although the positive predictive value is low.

ECG-Electrocardiogram, NA-Not available, ANOVA-Analysis of variance, MANOVA-Multiple analysis of variance, AHA-American heart association and REM- Rapid eye movement.

IV.CONCLUSION

Cardiac function is extremely sensitive to autonomic influences. Hence the link between cognitive and emotional processes and the resulting changes in autonomic nervous system is an important issue in the case of ADHD. ADHD may not alter the entire heart function but the medications may slightly increase the heart rate, blood pressure and other parameters like QT lengthening, ST elevations, R-R interval etc. So it is better to monitor the variability of heart functioning in ADHD cases. Overall, much evidence points no electrocardiogram changes, rare cardiovascular complaints, and no causal relationship with sudden death or other serious cardiovascular adverse event, in healthy children with ADHD.

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