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CORRELATION BETWEEN THE HRV AND VANDERBILT PARENT RATING SCORE IN CHILDREN TREATED WITH METHYLPHENIDATE.

Physiology

Dr. Pramesh Dogra* Medical Officer, Department of Neurosurgery, Indra Gandhi Medical College, Shimla – 171001, India. *Corresponding Author

Dr. Sunita Mondal Director Professor, and Head, Department of Physiology Lady Hardinge Medical College and associated hospitals, New Delhi-110001, India.

Dr. Rajiv Bandhu Professor, Department of Physiology, Lady Hardinge Medical College and associated hospitals, New Delhi-110001, India.

Dr. Dinesh Kataria Professor, and Head, Department of Psychiatry, Lady Hardinge Medical College and associated hospitals, New Delhi-110001, India.

Dr. Om Sai Ramesh V Associate Professor, Department of Psychiatry, Lady Hardinge Medical College and associated hospitals, New Delhi-110001, India,

ABSTRACT

The present study was conceived with the objective to establish a correlation, between Heart Rate Variability (HRV) and Vanderbilt Total Score in children with Attention-deficit/hyperactivity disorder (ADHD) before and after treatment with Methylphenidate. Our study participants depicted a significant reduction in Vanderbilt Parent Rating score from the baseline after 12 weeks of methylphenidate treatment indicating a clinical improvement in the subjects. When the changes in HRV were compared with changes in Vanderbilt Total Score Post-therapy with pre-therapy, significant Positive correlation of change in HF (nu) with change in Vanderbilt Total score and a significant negative correlation of changes in LF (nu) and changes in LF/HF ratio with changes in Vanderbilt Total score were observed. This signifies that with the improvement as shown by reduction in Vanderbilt Total Score, the sympathetic domination increases, and parasympathetic domination reduces, and sympathovagal balance shifts towards the sympathetic arm.

KEYWORDS

HRV, Vanderbilt Parent Rating score, methylphenidate.

INTRODUCTION

Attention-deficit/hyperactivity disorder is one of the most common psychiatric disorder diagnosed in children and adolescents with the best available estimates of prevalence at around 7.2% for children and adolescents[1].

According to the fifth edition of the American Psychiatric Association's (APA) Diagnostic and Statistical Manual of Mental Disorders (DSM-V), ADHD is a behavioural and neurocognitive condition characterized by developmentally inappropriate and impairing levels of gross motor overactivity, inattention, and impulsivity[2].

The Methylphenidate is one of the most commonly used medications for ADHD treatment [3].

Studies on HRV have shown that stimulant-free children with ADHD showed a sympathetic under arousal and parasympathetic over arousal relative to control subjects and Methylphenidate shifted the autonomic balance of children with ADHD towards normal levels[4-8]

Vanderbilt Total Score is a useful instrument to evaluate the effectiveness of the treatment of ADHD [9].

To the best of our knowledge, there are very few prospective studies to systematically evaluate the correlation between the Vanderbilt Total Score and changes of HRV parameters before and after methylphenidate treatment in children with ADHD.

AIM

To study the correlation between the change in Vanderbilt Parent Rating score and changes of HRV parameters before and after methylphenidate treatment in children with ADHD.

METHODS

This study was carried out in the Department of Physiology in association with the Department of Psychiatry at Lady Hardinge Medical College and Smt. Sucheta Kriplani Hospital, New Delhi and was approved by the institutional ethics committee for human research. Drug-naive cases of Attention-deficit/hyperactivity disorder (ADHD) diagnosed by a Psychiatrist as per DSM – V criteria requiring methylphenidate treatment,52 in number and were between 6 to 12 years of age were recruited. A parent or legal guardian of the patients provided the informed written consent in either Hindi or English. Known patients of hepatic, renal, cardiovascular diseases, diabetes mellitus systemic inflammatory disorders, and mental retardation and patients showing other psychiatric co-morbidities including autism, oppositional defiant disorder, and conduct disorder or receiving medication known to affect autonomic function were excluded from the study. All the participants were given prerecording instructions as per standard protocol and called to the Physiology department in the morning hours, and general physical examination was carried out. Five minutes-segment basal recording of HRV was done after fifteen minutes of supine rest using Autonomic Neuropathy analyzer supplied by Recorders and Medicare System, Chandigarh, India as per the guidelines of Task Force of European Society of Cardiology and the North American Society of Electrophysiology (1996) [10]. The ambient temperature was maintained at 23-25°C. The Vanderbilt ADHD Parent rating scale is based on DSM-V criteria. The scale has two components: symptom assessment and impairment in performance. On this scale the symptom assessment screens for symptoms that meet criteria for both inattentive (items 1–9) and hyperactive ADHD (items 10–18). To meet DSM-V criteria for the diagnosis, one must have at least six positive responses to either the inattentive nine or hyperactive nine core symptoms or both. The questions were read one by one to the parents, and the responses were marked on the rating scale accordingly.

The patients were then put on methylphenidate for a period of 12 weeks. Mean dose of methylphenidate at the endpoint of the study was 20.58 ± 3.52 mg and mean dose per kg of body weight at the endpoint of the study was 0.70 ± 0.09 mg/ Kg.

HRV and Vanderbilt ADHD Parent rating were repeated at 12 weeks of study period.

Data obtained was subject to statistical evaluation using a Graph Pad Prism Version 7 software. The D'Agostino & Pearson normality test, Shapiro-Wilk normality test and KS normality test were applied to test for normal Gaussian distribution. Correlations between Vanderbilt scores and HRV was assessed with Spearman correlation coefficient.

RESULTS

There was a significant decrease in the Vanderbilt score thereby implying that the patients in the study group have shown improvement in disease severity **(Table no. 1)**. There is a significant Positive correlation of change in HF normalized units with a change in Vanderbilt Total score and a significant negative correlation of change in LF normalized unit and LF/HF ratio with a change in Vanderbilt Total score. Correlation of other parameters did not yield any significant result **(Table no. 2)**.

DISCUSSION

Post Therapy with Methylphenidate, it was observed that there was a significant Positive correlation of change in HF normalized units with a change in Vanderbilt Total score and a significant negative correlation of change in LF normalized unit and LF/HF ratio with a change in Vanderbilt Total score. When the changes in HRV were compared with changes in Vanderbilt Total Score Post-therapy vs pre-therapy with methylphenidate, significant Positive correlation of change in HF (nu) with change in Vanderbilt Total score and a significant negative correlation of changes in LF (nu) and changes in LF/HF ratio with changes in Vanderbilt Total score were observed. This signifies that as the sympathovagal balance shifts towards sympathetic preponderance post-therapy in children who showed lesser Vanderbilt Total score which indicate clinical improvement had thus, emphasizing the impact of methylphenidate on autonomic modulation. Hence HRV can be used as a physiological marker along with Vanderbilt Total score scale to monitor the improvement in response to treatment with methylphenidate in children with ADHD.

This signifies that with the clinical improvement as shown by reduction in Vanderbilt Total score, the sympathetic domination increases, and parasympathetic domination reduces, and sympatho vagal balance tilts towards the sympathetic arm which can be measured with HRV. Therefore, the present study is in accordance with Negaro et al 2011[8] and Buchhorn et al 2012[11]. Though the mechanism by which HRV and the autonomic tests are altered in ADHD cannot be understood from this study but the possible mechanisms that could play a role in HRV may be proposed. HRV is an index of central-peripheral neural feedback and CNS-ANS integration [12]. Psychological state is known to influence the autonomic nervous control of the cardiovascular system in patients with mental disorders and psychological state also can influence HRV because the central nervous system modulates the autonomic nervous system, and cardiac function is sensitive to autonomic influences [13]. Accordingly, a change in the mental state can also affect the autonomic nervous system and can thus affect HRV parameters, whether it is caused by treatment or not.

This study has a few limitations. No control group was recruited to compare the autonomic functions with patients of ADHD. Only male patients were recruited in our study as no female patient met our inclusion criteria. The sample size was small (52 patients).

Table 1: Changes in Vanderbilt score from baseline to 12 weeks after methylphenidate treatment in the study group(Mean ± S.E.M values) (n=52)

Parameters	Baseline	After treatment	p value
Vanderbilt Combined score	12.15 ± 0.28	9.86 ± 0.29	0.0001

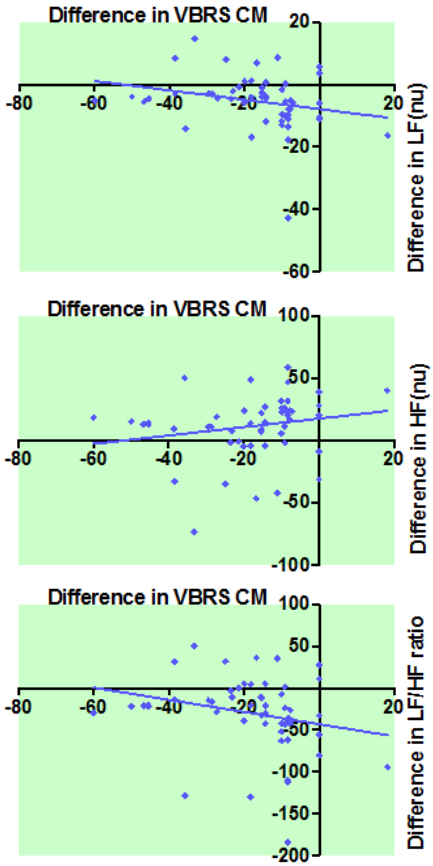
p value- > 0.05-Non-Significant (NS), <0.05-Significant*, <0.01-Very Significant, <0.001-Highly Significant*****

Table 2: Correlation between change in parameters of HRV with a change in Vanderbilt Total score from the baseline to 12 weeks of methylphenidate treatment in pooled data of ADHD patients (n=52)

HRV PARAMETERS	Change in Vanderbilt Total score	
	Correlation Co-efficient(r)	P value
LF(ms2)	-0.119	0.399
LF(nu)	-0.376	0.006*
HF(ms2)	-0.021	0.883
HF(nu)	0.362	0.008*
LF: HF	-0.381	0.005*
SDNN	-0.155	0.273
RMSSD	-0.273	0.050

***Significant p value**

Graphs showing a significant correlation between change in HRV parameters and change in Vanderbilt score after 12 weeks of methylphenidate treatment.



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