# Correlation between Conners' Parent Rating Score and HRV in ADHDchildren treated with methylphenidate.

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**ABSTRACT:**-The present study was conceived with the objective to study the correlation between the Conners' Parent Rating Score and HRV in children with Attention-deficit/hyperactivity disorder (ADHD) before and after treatment with Methylphenidate. ADHD is associated with autonomic dysfunction which gets further modulated with drug therapy. There are few prospective studies to evaluate the correlation between the Conners' Parent Rating Score and HRV before and after methylphenidate treatment in drug-naive patients with ADHD. There was a significant Positive correlation between the absolute values of LF and HF with the Conners Score at baseline. There was a significant Positive correlation between the absolute values of HF and normalized units of HF with the Conners' Score after 12 weeks of methylphenidate treatment. The Spearman's Correlation test did not yield any significant correlation in the other parameters in HRV after 12 weeks of methylphenidate treatment. Hence some components of HRV can be used as a physiological markers along with Conners' ADHD rating scale to monitor the improvement in response to treatment with methylphenidate in children with ADHD.

Keywords – ADHD, Conners' Parent Rating Scale, HRV, methylphenidate

## I. INTRODUCTION

Attention-deficit/hyperactivity disorder (ADHD) is one of the most common psychiatric disorders diagnosed in children and adolescents with the worldwide prevalence of 7.2 %<sup>1</sup>. According to the fifth edition of the American Psychiatric Association's (APA) Diagnostic and Statistical Manual of Mental Disorders (DSM-V), ADHD is a behavioral and neurocognitive condition characterized by developmentally inappropriate and impairing levels of gross motor overactivity, inattention, and impulsivity<sup>2</sup>.

The Methylphenidate is one of the most commonly used medications for ADHD treatment<sup>3</sup>.

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<sup>4-8</sup>

The abbreviated version of Conners' rating scale is useful not only for diagnosis but also as an instrument to evaluate the effectiveness of the treatment of ADHD with Methylphenidate <sup>9</sup>.

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

## II. AIM

To study the correlation between the change in Conners' Parent Rating Score and alterations of HRV parameters before and after methylphenidate treatment in children with ADHD.

#### III. METHODS

The study was carried out in the Department of Physiology in association with the Department of Psychiatry at Lady Hardinge Medical College and Smt. SuchetaKriplani 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 were recruited <sup>2</sup>. The subjects were 52 in number and were between 6 to 12 years of age. Known patients with cardiovascular diseases, diabetes mellitus, systemic inflammatory disorders, and mental retardation were excluded from the study. Patients showing other psychiatric co-morbidities including autism, oppositional defiant disorder, and conduct disorder or receiving medication known to affect autonomic function were also excluded from the study. Only male patients were recruited for the study as no female patient met our inclusion criteria. A parent or legal guardian of the patients provided the informed written consent which was written in either Hindi or English.

All the participants were given prerecording instructions as per standard protocol and called to the Physiology department between 9 am to 11 am, and general physical examination was carried out. No psychotropic medicine or any medicine that affects HRV was allowed to the patients before the basal recording of HRV. 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)<sup>10</sup>. The ambient temperature was maintained at 23-25°C.

Conners' 10-item Abbreviated Parent Rating Scale was used to assess the severity of the disease. This scale has ten questions regarding the child's behavior in the last one month with four possible answers: - Not at all (0), Just a little (1), Pretty much (2) and very much (3). The questions were read one by one to the parents, and the responses were marked on the rating scale accordingly. This scale has a maximum Score of 30.

The patients were then put on methylphenidate in a dosage of 0.3mg to 1mg per Kg body weight for 12 weeks. Mean dose per kg of body weight at the endpoint of the study was  $0.70 \pm 0.09$  mg/ Kg.

HRV and Conners'10-item Abbreviated Parent Rating Scale 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 Conners' Scores and HRV were assessed with Spearman correlation coefficient.

## IV. RESULTS

There was a significant Positive correlation between the absolute values of LF and HF with the Conners score at baseline. The Spearman's Correlation test did not yield any significant correlation in the other parameters of HRVat baseline(**Table 1**).

After 12 weeks of methylphenidate treatment there was a significant Positive correlation between the absolute values of HF and normalized units of HF with the Conner's score. There was a significant Negative correlation between the LF: HF ratio and Conner's ARS score. The Spearman's Correlation test did not yield any significant correlation in the other parameters in HRV and the Conners score(**Table 2**).

#### V. DISCUSSION

Post Therapy with Methylphenidate, the Conners' ARS showed significant negative correlation with LF (nu) and LF: HF ratio (nu). This observation signifies that as the sympathovagal balance shifts towards sympathetic preponderance post-therapy, those children who showed lesser Connors ARS values which indicate clinical improvement had greater LF(nu) and LF: HF ratio (nu) values thus, emphasizing the impact of methylphenidate on autonomic modulation. Hence HRV can be used as a physiological marker along with Conners' ADHD rating 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 Conners' Score, the sympathetic domination increases, and parasympathetic domination reduces, and sympathovagal balance tilts towards the sympathetic arm which can be measured with HRV. Therefore, the present study is in accordance with Buchhorn et al. 2012<sup>11</sup> and Kim et al. 2015<sup>12</sup>.

Though the mechanism by which HRV and the autonomic tests are altered in ADHD cannot be deciphered from this study but the possible mechanisms that could play a role in HRV may be postulated. HRV is an index of central-peripheral neural feedback and CNS-ANS integration <sup>13</sup>, and HRV analysis can show the possible links between mental processes and cardiac autonomic regulation. 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 <sup>14</sup>. Accordingly, a change in the mental state can also affect the autonomic nervous system and can thus affect HRV parameters, whether the treatment causes it or not.

There are a few limitations in our study. The study sample constitutes only male patients as no female patient met our inclusion criteria during the study period. The sample size is small constituting only 52 patients as patients with psychiatric co-morbidities receiving drugs in addition to methylphenidate were excluded from the study.

DADA METERG		
PARA-METERS	Conner's ARS	
	Correlation Co-efficient(r)	P value
LF(ms2)	0.338	0.014*
LF(nu)	-0.023	0.874
HF(ms2)	0.299	0.031*
HF(nu)	0.053	0.709
LF:HF	-0.045	0.751
SDNN	-0.206	0.144
RMSSD	-0.235	0.094
	* Significant p value	

# Table 1: Correlation between baseline HRV parameters and Conners' Parent Rating Score in ADHD patients (n=52)

Table 2: Correlation between HRV parameters with Conner's scale after 12 weeks of methylphenidate treatment in ADHD patients (n=52)

PARA-METERS	Conner's ARS	
	Correlation Co-efficient(r)	P value
LF(ms2)	0.012	0.934
LF(nu)	-0.333	0.016*
HF(ms2)	0.277	0.016*
HF(nu)	0.321	0.020*
LF:HF	-0.336	0.015*
SDNN	-0.137	0.331
RMSSD	-0.144	0.421

\*Significant p value



Fig.1: Graphs showing significant correlation between Baseline HRV parameters and ConnersScore.

Fig.2:Graphs showing significant correlation between HRV parameters and ConnersScore after 12 weeks of methylphenidate treatment





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