Research Article

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A Comparitive Study: Autonomic Functions in Cerebral Palsy Individuals and Their Siblings

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Abstract

Introduction: It is defined as an "umbrella term covering a group of non-progressive, but often changing, motor impairment syndromes secondary to lesions or anomalies of the brain arising in the early stages of its development"[1] primarily leading to a disorder of movement and posture. **Objective:** To assess autonomic functions in cerebral palsy individuals and their siblings. **Method:** Twenty cerebral palsy and sibling volunteers with no neurological damage were recruited for the study. Heart rate variability was used to assess the autonomic function. HRV was recorded in supine position for 5 minutes under quiet, calm conditions. Time domain parameters and frequency domain parameters were analyzed. **Results:** There was no statistically significant difference in any of the HRV parameters. There was no significant difference in HRV parameters in children with CP and healthy children indicating a normal sympatho-vagal balance. **Conclusion:** The presence of normal sympatho vagal balance in CP predicts that patients with CP have the same predilection as the general population to abnormalities associated with sympatho-vagal balance.

***Key Words**: Cerebral palsy, HRV, sympathetic activity, parasympathetic activity, sympatho vagal balance.*

Introduction

Cerebral palsy (CP) is defined as an "umbrella term covering a group of non- progressive, but often changing, motor impairment syndromes secondary to lesions or anomalies of the brain arising in the early stages of its development".[1] The brain is the most complex organ in the human body and any injury may bring disturbances of function, both along the line of motor control and sensation. Cerebral palsy (CP) is the major physical disability affecting the functional development of children (Boyle et al 1994, Thorogood 2001), characterized by inability to control motor functions, this problem with movement and posture makes certain activities difficult, and has the potential to have a negative effect on the overall development of a child by affecting the child's ability to explore, speak, learn, and become independent.[2] By convention, brain injuries occurring at any stage antenatally and postnatally till the age of 2 years are included in the definition of CP.[3,4] 75% - 80% of the cases are due to prenatal injury. Less than 10% is due to significant birth trauma or asphyxia.[5]

Autonomic Nervous System(ANS) has two main branches: the sympathetic and parasympathetic nervous system. The normal variability in HR is due to autonomic neural regulation of the heart and the circulatory system. Balance between sympathetic nervous system (SNS) and parasympathetic nervous system (PNS) controls the HR. Increased SNS or diminished activity of PNS results in cardio-acceleration. Conversely, a low SNS activity or a high PNS activity causes cardio-deceleration. Heart rate variability (HRV) is used as a non - invasive tool to assess autonomic functions. It can be measured non-invasively by using changes in an heart's response as a proxy for changes in ANS activity. HRV refers to beat-to-beat alterations in heart rate.[6] The parasympathetic influence on heart rate is mediated by the vagus nerve.[7]

Variations in heart period are largely dependent on vagal modulation.[8] The vagal and sympathetic activity

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constantly interact.[6] HRV is used to demonstrate the development of tonic vagal influence on the heart.[9]

The peak of QRS complex is R wave, the duration between two consecutive R wave peaks is termed the RR interval. It is also called NN intervals when the heart is beating at sinus rhythm. This difference is assessed by calculating both the time domain and frequency domain of HRV using Power Spectral Density (PSD). Time intervals between each successive normal QRS complex are first determined.All abnormal beats not generated by sinus node depolarizations are eliminated from the HRV analysis.

Objectives of the Study

To compare any disturbances in autonomic functions in children with cerebral palsy and their sibling volunteers.

Material and Method

HRV was used to determine autonomic function in twenty five known cerebral palsy cases (mild to moderate CP)of age group 6-16 years (study). They were recruited from schools for individuals with special needs. Fifteen sibling volunteers within the same age group and similar nutritional status were analysed using HRV (control). Testing procedure and protocol was explained to study group, control group and their parents/guardian. An informed written consent was obtained from parents/ guardian of both study and control group to participate in the study. A detailed medical and family history was taken. Any history of medications affecting the ANS was noted. A complete systemic examination of cardiovascular and respiratory system were conducted. Consumption of stimulants and beverages like coffee or tea was avoided on subjects at least a day before the scheduled HRV recording. All recordings were conducted from 10am to 12pm to eliminate the effect of circadian influence. Repeated recordings were done in CP patients in order to avoid artefacts. Subjects were rested comfortably in supine position for 5 minutes and then ECG of the subjects were recorded in Lead II for 5 minutes using three electrodes placed in right infraclavicular region, left infraclavicular region and left iliac region. HRV parameters - Time and Frequency domain were measured according to the Task Force of the European Society of Cardiology and North American Society of Pacing and Electrophysiology. The obtained artefact free recording was analysed using RMS Vagus HRV software (RMS, India)

The following HRV parameters were analyzed:

TIME DOMAIN:

- **SDNN-** Standard deviation of Normal to Normal RR interval, it reflects all the cyclical components responsible for variability in the period of recording.
- **RMSSD-** It is square root of the mean squared difference of successive Normal to Normal RR interval.
- **NN50** - Number of interval differences of successive Normal to Normal RR intervals greater than 50ms.
- **pNN50** - The proportion of successive Normal to Normal RR interval greater than 50 milliseconds.

FREQUENCY DOMAIN: Power spectral analysis was used to determine the frequency domain parameters.

- **Low Frequency (LF)-** is influenced by both parasympathetic and sympathetic activity.
- **High Frequency (HF)** - influenced by parasympathetic activity.
- **LF/HF ratio** - indicates sympatho-vagal balance.
- **VLF** - is influenced by non-neuronal components affecting the heart like Renin- Angiotensin system, local factors, and thermoregulation.

Statistical Analysis

Mann-Whitney U test was used to compare the difference in HRV values in in cerebral palsy individuals and their siblings. The level of significance was fixed at $p < 0.05$ Data analysis was carried out using Statistical Package for Social Science (SPSS Software, Version 20).

Result

The data from twenty five cerebral palsy cases and fifteen sibling volunteer were analyzed. The time domain and frequency domain parameters were measured. Mann-Whitney U test was employed to compare the values. The values are expressed as median and range. However a trend towards reduction is seen in all the time domain parameters (Table no 1) and absolute LF, absolute HF, normalized HF in controls (Table no 2). Whereas a trend toward reduction in cases was seen in

normalized LF and LF/HR ratio (Table no 2).

Table 1: Comparison of Time domain parameters between CP and sibling volunteers.

Group		Median (Range)	p value
SDNN (ms)	Case	56.11 (16-89)	0.423
	Control	50.41 (20-75)	
RMSSD	Case	33.24 (10.7-59.15)	0.563
	Control	29.67 (15.31-63.4)	
NN50 (ms)	Case	36(0-90)	0.901
	Control	28 (1.0-115).	
pNN50	Case	17.85(0-48.3)	0.432
	Control	14.23 (0.35-45.10)	

Mann Whitney U test was employed with the level of significance fixed at $p < 0.05$

Table 2: Comparison of Frequency domain parameters between CP and sibling volunteers.

Group		Median (Range)	p value
LF (ms^2)	Case	138 (31.00-455)	0.850
	Control	135.5 (55-425)	
LF (nu)	Case	65 (53.50-69.10)	0.646
	Control	65.1(53.50-77.60)	
HF (ms^2)	Case	84.5 (17-305)	0.921
	Control	84 (38-225)	
HF (nu)	Case	32.1(20.80-44.60)	0.645
	Control	30.95(22.90-42.50)	
LF/HF	Case	2.18 (1.15-3.69)	0.659
	Control	2.32 (1.35-3.17)	

Mann Whitney U test was employed with the level of significance fixed at $p < 0.0$

Discussion

This study provides a unique and value added addition to the autonomic functional status of Cerebral palsy individuals and their comparison with the sibling volunteers. HRV was recorded only in the resting supine position without subjecting them to any special test (Orthostatic tilt test). No significant difference in supine position for the low frequency component, high frequency component or the low frequency/ high frequency ratio between the study and control groups. Time domain parameters between the cases and controls also showed no significant difference. The effect of posture has not been evident since HRV was recorded only in resting supine position. There is very few literature on Autonomic disturbances between CP and their siblings among the Indian population. The

findings from our study contributes as an important addition to the HRV in CP patients and their siblings, suggesting that HRV can be similar in them. Our study as well as the other studies have presented data in terms of median rather than mean as there was high range of standard deviation obtained. For such cases measures are presented in median and found to be statistically more accurate. Most of the studies so far have produced contradictory findings regarding the HRV related data in CP patients. Park et al., Yang et al., etc. The CP group in supine position presented greater sympathetic autonomic predominance in heart rate than the normal group by Zamenur et al (2011).

Conclusion

This study concludes that there is no statistically significant difference between cases and controls in resting supine position across all the parameters of HRV i.e. both time and frequency domain parameters studied. The calm, relaxed conditions during our recording, normal nutritional status, resting supine position and inclusion of mild to moderate CP children could have contributed to the significantly similar Heart rate variability parameters among the Cerebral palsy and their siblings. The presence of normal sympatho vagal balance in CP predicts that patients with CP have the same predilection as the general population to abnormalities associated with sympatho-vagal balance.

Conflict of Interest: 'The author(s) declare(s) that there is no conflict of interest'

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