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Original Research Article

A Study on Effects of Development on Vagal Modulation of Cardiac Rate in Paedaitric Age Groups

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Abstract:

Introduction: Cardiac autonomic tone is beat to beat fluctuation in heart rate. There is paucity of data on normal values of HRV in newborn infants. This study was an initiative to assess the feasibility of measurement and analysis of short term HRV in healthy term neonates.

Material & Method: 20 healthy term neonates who met the inclusion criteria of gestational age > 37 weeks & APGAR score >= 8 at 5minutes were included in the study and patients with major congenital anomalies, obvious cardiac anomalies & Illness requiring admission in neonatal intensive care unit were excluded in the study.

Results: The baseline parameters included birth weight, postnatal age (hours of life), APGAR score at 1 min and 5 min of life, body temperature (Celsius), respiratory rate and the anthropometric measurement of head circumference and length (cm) was calculated.

Conclusion: Heart rate variability in neonates is feasible. However, at present, lack of standard criteria for the analysis of heart rate variability, prevents precise comparisons among the various studies.

Keywords: Heart rate, Modulation, Children.

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Introduction

Clinically, normal or average baseline variability is considered as a valid indicator of fetal well being' with increasing knowledge of dealing with measurement and physiological interpretation, HRV is rapidly gaining importance for its clinical application but its role to neonates is still not yet well established. Normal values of HRV in newborn infants are not widely available. This problem may be partially attributed to the lack of standardization of different methods. This study was just an initiative to see the utilityand feasibility to establish short term HRV measurement in clinical practice in healthy term neonates and to record and analyze the normal HRV data of newborn. It's just a small initiative to further explore the potential of this non invasive tool of cardiac autonomic tone detection into a bigger value like early detection of sepsis, neuro- developmental outcomes in hypoxic ischemic encephalopathy patients. Cardiac autonomic tone commonly known as Heart rate variability (HRV) is beat to beat fluctuation in heart rate (i.e. in R-R intervals) within physiological limit under resting conditions. These beat to beat variations occur due to continuous changes in the cardiac autonomic sympathetic and parasympathetic outflow to the heart. Heart rate variability is now one of the most frequently used non invasive method in scientific study for assessment of sympatho-vagal balance (Cardiac autonomic tone) in health and disease condition [1]. Till two decade ago heart's rhythm fluctuation were ignored in practical cardiology and it was believed that irregularity of cardiac function is a pathological phenomenon. Thus, an observation that an absolutely regular sinus rhythm can also be a negative prognostic factor came as a surprise to many clinicians and cardiologists. The beat-to-beat variation having intrinsic oscillations reflects a complex interplay between ionic membrane current responsible for SA node automaticity and the regulatory influences of autonomic nervous system. In absence of autonomic innervations to heart (as occurs in transplanted heart), there is absolute regularity of heart rate with minimal variations. [2,3,4]

Material & Method

20 healthy term neonates who met the inclusion criteria of gestational age > 37 weeks & APGAR score >= 8 at 5minutes were included in the study and patients with major congenital anomalies, obvious cardiac anomalies & Illness requiring admission in neonatal intensive care unit were excluded in the study.

Results

The mean birth weight of neonates in the study was found to be 2.78+/- 0.36 kg while the mean age was 3 postnatal days (72 hours). No gross deviation were observed in head circumference and length measurements from the normal range described for neonates. The temperature and respiratory rate of the neonates in the study lied within the normal range described for neonates. (Table 1). The average RR interval was between 487.5 —546.5 ms, the average heart rate was between 110.2-123.7 bpm lying well within physiological limits of the newborns. The HRV parameters included in this study were time domain, frequency domain and non- linear analysis. Time Domain values were expressed in first quartile and third quartile of SDSD were between (10.78 — 36.43ms), RMSSD were (10.82 - 36.4) ms and pRR50 and (0.39 -16.82). (Table2) Frequency domain values expressed in first quartile and third quartile of LF were (56.04 —72.97 n.u.), HF were (26.76 —41.58 n.u). Value of the LF/ HF ratio is (1.33- 2.72). Non linear values expressed in first quartile and third quartile of SDI were between (7.62 — 25.76 ms) & SD2 were (25.50-46.03 ms). (Table 3)

Table 1: Baseline Parameters

Parameters	Mean	SD	Median	1' quartile	3^ quartile
Birth weight (kg)	2.78	0.36	2.75	2.5	3.175
Hours of Life(Hours)	72	36.35	71	48	95
APGAR at 1 min	7.88	0.67	8	7	9
APGAR at 5 min	9	0	9		
Temperature (Celsius)	36.89	0.29	36.8	36.65	37.2
Respiratory Rate	49.22	7.51	48	44	55
Head circumference (cm)	32.96	0.78	33.2	32.45	33.5
Length (cm)	47.33	3.06	47.2	45.35	49

Table 2: Time Domain Measures

Parameter	Mean	SD	Median	1st quartile	3rd quartile
Average RR (ms)	507.88	54.13	504.05	487.5	546.5
Average Rate (BPM)	120.07	14.63	119.5	110.2	123.7
SDSD (ms)	23.84	16.60	18.91	10.78	36.43
RMSSD (ms)	23.83	16.60	18.89	10.82	36.4
pRR50 (%)	7.57	10.43	1.59	0.39	16.82

Table 3: Frequency Domain and Non-Linear measure

Parameters	Mean	SD	Median	1st quartile	3rd quartile
LF (nu)	64.98	12.47	69.60	56.04	72.97
HF (nu)	33.23	10.08	29.68	26.76	41.58
LF/HF	2.19	0.86	2.33	1.33	2.72
SD1 (ms)	16.85	11.74	13.37	7.62	25.76
SD2 (ms)	39.44	17.02	40.94	25.5	46.03

Discussion

Heart rate variability is one of the most frequently utilized tool to assess cardiac autonomic modulations by analyzing the spontaneous variability of continuous series of R-R interval (in an ECG) recorded under resting conditions. HRV reflects the response of ANS to intrinsic and extrinsic stimuli. Continuous changes in sympathetic and parasympathetic neural impulses leads to alterations in the heart rate and causes oscillations around the mean value, what is referred to as HRV. Heart rate variability studies provides an opportunity to understand the dynamic nature of heart functions and ANS functionality. [5,6] Earlier literature mentioned that the ratio of the power in the low frequency band to that in the high frequency band seems to decrease with gestational age and thus correlates with autonomic nervous system maturation in infancy.[8] HRV can be of special importance especially in preterms as it can help in understanding the developmental changes cardiac autonomic tone. Thus, it can be used as important tool for assessing maturation of autonomic nervous system in preterms at birth and with increasing postnatal age. Extracting the clinical significant features of HRV under various conditions, might help us understand the pathophysiology of derangement of autonomic function. HRV is a well-established noninvasive measure of cardiac autonomic control that has been shown to be related to hyper- tension [7,8] and to predict future adverse cardiovascular events in adults [9] and has been suggested for putative prognostic use in children [10]. While blood pressure as a cardiovascular risk factor has been shown to be inversely related to birth weight in adults, to our knowledge, a systematic

analysis of HRV parameters according to stardardized methods [11] so far has not been performed in adults with low birth weight. Alterations of HRV in adults, however, may not necessarily represent a prenatal initiated event according to the concept of fetal programming considering the close interaction with other neuroendocrine systems such as the hypothalamus-pituitary-adrenal (HPA) axis [12]

Conclusion

Heart rate variability in neonates is feasible. However, at present, lack of standard criteria for the analysis of heart rate variability, prevents precise comparisons among the various studies.Until recommendations for standardized analytical methods are made, clinical application of heart rate variability in neonatal and infant prognosis and therapy would remain premature.

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