

Evaluation of heart rate variability among caregivers of pediatric patients undergoing surgery

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Abstract

Background: Caregivers of pediatric patients undergoing surgery are likely to suffer from mental and physical exhaustion leading to stress. This is important in view of the prevailing socio-economic as well as the healthcare system available in a developing country like India. Therefore the present study is designed to measure heart rate variability among this special group of population who give care to pediatric patients undergoing surgery. **Materials and Methods:** 15 female subjects were enrolled from among attendants of patients admitted with an immediate indication of surgery, who required constant care. They were free from any type of physical and mental health issues, non smokers and non addicts. Each care giver was subjected to HRV analysis on three occasions: The first record was performed on the first day of their arrival in the hospital as caregivers. The second observation was recorded after 3 days of care giving. The final HRV analysis was done after 1 month of care giving. Two types of parameters were analyzed: Time domain and frequency domain. Statistical analysis was done using paired t-test. **Results:** Both the HRV parameters – time and frequency domain, showed decreased values during the third day and one month recording as compared to the first day recording. The decrease is much more during the one month recording as compared to the third day recording. Statistically significant decrease is observed in mean RR interval, heart rate, VLF and LF only when the first day recording is compared with the third day recording but when the first day recording was compared with the one month recording significant decrease was found in mean RR interval and heart rate. **Conclusion:** Subjects involved in taking care of pediatric patients are likely to undergo a lot of physical and mental stress, thus affecting their autonomic status. HRV analysis using short term ECG recording was used to detect changes consequent to this stress. It was found that almost all HRV parameters measuring heart rate complexity were decreased in the period of care giving.

Key words: Care giver, Frequency domain, Heart rate variability, NN50, Pediatric surgery, RMSSD, RR interval

INTRODUCTION

The adverse consequences of stress as a risk factor for cardiovascular disease and reduced human performances

are well studied.^[1] Stress is known to change the balance existing between the sympathetic and parasympathetic divisions of the autonomic nervous system.^[2] Caregivers of pediatric patients are likely to suffer from mental and physical exhaustion leading to stress. Heart rate variability [HRV] is a non-invasive study of variation over a period of time between consecutive heart beats and has been proved to be a reliable marker of autonomic nervous system activity [ANS].^[3] HRV analysis is one of the best parameter available today for evaluation of stress.

The level of heart rate variability and the underlying stress is not well studied in India. This is important in view of the

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prevailing socio-economic as well as the healthcare system available in a developing country like India. Therefore the present study is designed to measure heart rate variability among this special group of population who give care to pediatric patients undergoing surgery.

MATERIALS AND METHODS

The data was acquired from 15 female subjects in the age group of 20 to 25 years free from any type of physical and mental health issues as determined by taking a detailed history and a thorough physical examination. All subjects were non smokers and free from any type of addiction or drug dependence.

These subjects were enrolled from among attendants of pediatric patients admitted for undergoing surgery who required constant care. Informed consent was obtained from the subjects. Ethical clearance was obtained from the institutional ethical committee. Each care giver was subjected to HRV analysis on three occasions: The first record was performed on the first day of their arrival in the hospital as caregivers. The second observation was recorded after 3 days of care giving. The final HRV analysis was done after one month of care giving. All recordings were obtained under similar conditions of time and body position after an adaptation time of 30 minutes.

The anthropometric parameters of each subject were recorded. This was followed by a short term 5 minute three lead electro cardiogram recording [ECG] using Biomed polygraph. From the data thus obtained HRV analysis was done. The RR interval time series were extracted from ECG records using Biomed HRV analysis software. Two types of parameters were analyzed. Time domain parameters like mean RR interval, RMSSD (ms): Square root of the mean of the sum of the squares of differences between adjacent NN intervals. This gives information regarding HRV in short time interval, NN50: Number of pairs of adjacent NN intervals differing

by more than 50ms in the entire recording, pNN50 (%): NN50 count divided by the total number of all NN intervals and frequency domain parameters like VLF (ms²): Power in very low frequency range (<0.04Hz), LF (ms²): Power in low frequency range (0.04-0.15 Hz), HF (ms²): Power in high frequency range (0.15-0.4 Hz), LF/HF ratio.

The fraction of total RR intervals labeled as normal to normal [NN] intervals was computed as NN/RR ratio. This ratio has been used as a measure of data reliability with the purpose to exclude records with a ratio less than 90% of threshold.^[4-6]

Statistical analysis

HRV features were depicted as mean ± standard deviation during the three set of recordings. Non linear properties of HRV were analyzed by the following methods: Time domain parameters and frequency domain parameters were compared using paired *t*-test.

RESULTS

It is clear from Tables 1 and 2 that fifteen females were enrolled in the study with mean age of 24.40±2.52 years, height 162.01±0.09 cm, weight 58.43±1.45 kg and BMI 21.60±0.02. Both the HRV parameters – time and frequency domain, showed decreased values during the third day and first month recording as compared to the first day recording. The decrease is much more during the first month recording as compared to the third day recording. Statistically significant decrease is observed in mean RR interval, heart rate, VLF and LF only when the first day recording is compared with the third day recording but when the first day recording was compared with the first month recording significant decrease was found in mean RR interval and heart rate.

DISCUSSION

In the present study various heart rate variability parameters were computed among caregivers of pediatric patients undergoing

Table 1: Comparison of HRV Time domain parameters

Parameter	First day mean±SD	After 3 days mean±SD	After 1 month mean±SD	P-value
RR interval (s)	0.77 ± 0.11	0.71 ± 0.10	0.68 ± 0.12	0.0149* A 0.0021** B 0.3101 C
Mean HR	79.10 ± 11.10	87.51 ± 11.45	89.01 ± 12.77	0.0071** A 0.0030** B 0.3000 C
RMSSD (ms)	22.54 ± 8.82	20.90 ± 8.51	21.19 ± 12.31	0.5700 A 0.6200 B 0.9300 C
NN50 (count)	7.54 ± 4.86	7.63 ± 5.21	7.62 ± 7.22	0.9701 A 0.9800 B 0.9990 C
pNN50 (%)	5.03 ± 3.14	5.02 ± 3.45	5.07 ± 4.77	0.1001 A 0.9710 B 0.9711 C

* Highly Significant
**Very Highly Significant
A=first day vs. after 3 days
B=first day vs. after 1 month
C=after 3 days vs. after 1 month

Table 2: Comparison of HRV Frequency domain parameters

Parameter	After first day mean±SD	After 3 days mean±SD	After 1 month mean±SD	P-value
VLF Power %	37.02 ± 16.01	24.01 ± 12.28	29.34 ± 17.94	0.021* A 0.232 B 0.301 C
LF	46.07 ± 13.08	55.01 ± 12.39	53.28 ± 15.49	0.022* A 0.771 B 0.781 C
HF	16.87 ± 11.86	21.34 ± 9.14	17.37 ± 5.87	0.201 A 0.891 B 0.181 C
LF/HF	2.78 ± 1.18	3.21 ± 1.93	3.62 ± 1.18	0.371 A 0.082 B 0.481 C

* Significant
A=first day vs. after 3 days
B=first day vs. after 1 month
C=after 3 days vs. after 1 month

surgery. Recordings were made on the first day of the patient being admitted to the hospital and the arrival of the attendant as caregiver. Subsequently repeat recordings were obtained after 3 days and 1 month after the first recording with the subject continuing as the primary caregiver of the concerned patient.

The mental stress associated with taking care of these patients is likely to produce a cardio-sympathetic excitation. This is reflected in a significant decrease in the mean RR interval. The mean RR interval is an indicator of the ratio of the cardiac sympatho-vagal balance. The results suggest an overall sympathetic dominance subsequent to taking up of the care giving among the subjects. The significant decrease in mean RR interval and increase in mean heart rate after 3 days reflects a decreased total HRV in the presence of mental stress. The mean value of the HF power is of lower magnitude after 3 days and 1 month of care giving but the decrease is not statistically significant except in the case of VLF and LF power. However the combined decrease in spectral power of all 3 bands contributes to the significant decrease in the total power during the care giving period. Decreased HRV indicates diminished responsiveness of the cardiac autonomic system to normal physiological stimuli. The frequency and time domain parameters show no change between 3 days and 1 month. The HRV was unchanged during this period probably because the level of stress induced in these subjects for 1 month might have started adaptive mechanisms counteracting the effect of stress.

CONCLUSION

Subjects involved in taking care of pediatric patients undergoing surgery are likely to undergo a lot of physical

and mental stress, thus affecting their autonomic status. HRV analysis using short term ECG recording was used to detect changes consequent to this stress.

It was found that almost all HRV parameters measuring heart rate complexity were decreased in the period of care giving.

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