

Frequency Domain Parameters of Heart Rate Variability in Patients with Gastro-Oesophageal Reflux Disease

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Abstract

Background: Gastro-oesophageal reflux disease (GERD) has been associated with autonomic nervous dysfunction along with reduced Heart Rate Variability.

Objective: To observe cardiac autonomic nerve function status by heart rate variability analysis in patients with Gastro-oesophageal reflux disease (GERD).

Methods: This cross-sectional study was carried out in the Department of Physiology, Sir Salimullah Medical College (SSMC), Dhaka from 1st January, 2017 to 31st December, 2017. For this, total 30 male and female diagnosed GERD patients from the Out Patient Department (OPD) of Gastroenterology, BSMMU aged 20-35 years were included in the study group. Low Frequency norm (LF norm), High Frequency norm (HF norm) and LF/HF ratio of HRV parameters were recorded. Thirty age and BMI matched healthy subject also included as control. For statistical analysis, unpaired t-test was done as applicable.

Results: The mean LF norm was 72.10 ± 13.97 n.u. and the mean LF/HF was 3.34 ± 1.14 . Which were significantly ($p < 0.001$) higher in GERD patients in comparison to that of healthy subjects. Which indicate sympathetic overactivity in GERD patients. However, the mean HF norm was 24.54 ± 10.56 n.u. Which was significantly ($p < 0.001$) lower in GERD patients as compared to that of apparently healthy subjects. Which indicate decreased parasympathetic activity in GERD patients.

Conclusion: Parasympathetic hypofunction and sympathetic over activity were found in GERD patients.

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Keywords: Heart rate variability, Gastro-oesophageal reflux disease (GERD)

Introduction

Gastro-oesophageal reflux disease (GERD) is a widely prevalent gastrointestinal disorder around the world including Asia.¹ The prevalence rate was 6.3% in urban and 4.8% in rural community of Bangladesh and the male and female percentage of this disorder was 4.41% and 6.73%.²

Gastro-oesophageal reflux disease (GERD) is one of the most common diseases of upper part of the gastrointestinal tract.³ The reflux of gastric material into esophagus causes symptoms, tissue damage or both, the resulting condition is called Gastro-oesophageal reflux disease (GERD). Reflux causes esophagitis, esophageal stricture and columnar epithelial metaplasia.⁴

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GERD is multi-factorial in origin. Motor abnormalities, such as transient lower esophageal sphincter relaxations (TLESR), impaired esophageal acid clearance and delayed gastric emptying contribute to pathophysiology of GERD.⁵The typical symptoms of GERD are heart burn and regurgitation.⁶In GERD the parasympathetic activity of autonomic nervous system was reduced and causes both contraction and transient relaxation of the lower esophageal sphincter that leading to the occurrence and progression of GERD.⁷

Heart rate variability (HRV) test are non-invasive methods of evaluating the integrity and functional state of the autonomic nervous system. HRV is beat to beat variation in heart rate (i.e. in R-R interval) under resting conditions. The parameters were recorded by eight active channels, Power Lab.⁸ Usually, time domain and frequency domain methods are used for HRV measurement.⁹

Measurements of two major LF and HF power components (μs^2), also expressed in normalized units (n.u.) represent the relative value of each autonomic component. The vagal activity is a major contributor to the HF component. The LF component is an indicator of sympathetic modulation, but few researchers also propose it is contributed by a parameter both sympathetic and vagal influences. LF/HF ratio is considered as a mirror of sympatho-vagal balance.⁹

Some researchers were studied both in patients with GERD and also in healthy control and found LF norm, HF norm values were significantly lower and LF/HF ratio was significantly higher in GERD patients in comparison to that of healthy control.³

Some researchers were observed decreased sympathetic function in GERD patients as compared to that of control.¹⁰

On the contrary, Some researchers were observed HF norm and found no significant changes in GERD patients as compared to that of healthy control.¹¹

Therefore, this study has been designed to investigate the autonomic nerve function status in GERD patients.

Methods

This cross sectional study was carried out in the year 2017 at the Department of Physiology, Sir Salimullah Medical college & Mitford Hospital (SSMCH) to observe cardiac autonomic nerve function status by Heart rate variability in patients with Gastro-esophageal reflux disease.

For this, total thirty (30) diagnosed GERD patients age ranged from 20-35 years were included in this study. They were selected on the basis of inclusion and exclusion criteria from the Out Patient Department (OPD) of Gastro-enterology, Sir Salimullah Medical College and Mitford Hospital and Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka. In addition to this, thirty (30) apparently healthy age and BMI matched individuals were selected from personal contact as control. All subjects were belonged to middle socio-economic status.

After proper counseling the aim, objectives, risk and procedure of the study were explained in details to the subjects. They were encouraged for voluntary participation and they were allowed to withdraw themselves from the study even after participation whenever they like. Only positive respondents were recruited as research participants. The ethical permission was taken from the Institutional Ethics Committee (IEC) of Sir Salimullah Medical College. Written Informed consent was taken from the participants. Detailed history about personal,

family, medical and occupation of the participants were taken and thorough physical examination of all participants were done and recorded in a prefixed questionnaire. Detail of the procedure of HRV test was explained to the participants and preparation was done for the procedure.

All the subjects were requested to be present at the Department of Physiology (BSMMU) between 8am to 10 am on fasting state, a day before the HRV recording. Then, blood was collected for biochemical test and ECG was done.

After enrollment the subject were advised to follow some instruction in the previous night of HRV test day. They were advised to finish their meal by 9:00 pm on previous day, to remain free from any type of stress, not to take sedative hypnotic medication. They were requested to take light breakfast without tea and coffee and to attend the autonomic nerve function test laboratory in the Department of Physiology, BSMMU between 9:00 am to 11:00 am on the test day. A thorough physical examinations including pulse, BP, height, weight were measured and BMI was calculated. The subject was advised to take rest for 15-20 minutes in controlled laboratory environment. During this period the subject was not allowed to talk, eat or drink, to perform physical or mental activity, even

sleep. ECG was recorded on lead II for 5 minutes by data acquisition device Power Lab 8/35 (AD instrument, Australia). HRV recording was analyzed by Lab chart software.

Data were expressed as mean \pm SD (Standard Deviation). The Statistical analysis was done by using Statistical Package of Social Science (SPSS) for Windows version 22. Unpaired “t” test was used to compare the data as applicable. p value ≤ 0.05 was considered as statistically significant.

Results

In this study, all GERD patients were similar to healthy control by age, BMI. There was no statistical significant difference of SBP & DBP was observed.

In this study, the mean value of LF norm was significantly ($p < 0.001$) higher in GERD patients than that of control group.

The mean value of HF norm was significantly ($p < 0.001$) lower in GERD patients than that of control group.

The mean value of LF/HF was significantly ($p < 0.001$) higher in GERD patients than that of control and the difference was statistically highly significant ($p < 0.001$).

Table I: Age and BMI of the subjects in both groups (N=60)

Parameters	Control (n=30)		Study (GERD) group (n=30)		
Age (years)	26.70 (20 - 35)	\pm	3.77 27.43 (20 - 35)	\pm	4.76
BMI (Kg/m ²)	21.44 (19.30 - 23.90)	\pm	1.26 21.26 (18.70 - 22.90)	\pm	1.01

Data were expressed as mean \pm SD. Figure in parenthesis indicate ranges. The Statistical analysis was done by unpaired “t” test. n= total number of subjects, BMI= Body mass index.

Table II: Blood pressure of the subjects in both groups (N=60)

Parameters	Control (n=30)			Study group (GERD) (n=30)			p value
Systolic BP (mm of Hg)	115.00 (110 - 120)	±	5.09	116.33 (110 - 120)	±	4.90	0.305 ^{ns}
Diastolic BP (mm of Hg)	76.00 (70 - 80)	±	4.98	76.50 (70 - 80)	±	4.76	0.693 ^{ns}

Results were expressed as mean ± SD. For statistical analysis, Unpaired t test was performed to compare both groups. Figure in parenthesis indicate ranges. ns = not significant.

Table III: Frequency domain measures of HRV of the subjects in both groups (N=60)

Parameters	Control (n=30)			Study group (GERD) (n=30)			p value
LF norm (n.u.)	56.96 (34.77 - 70.85)	±	11.32	72.10 ± 13.97 (39.03 – 85.35)			<0.001***
HF norm (n.u.)	42.29 (29.34 - 61.22)	±	10.60	24.54 ± 10.56 (15.44 – 58.52)			<0.001***
LF/HF	1.49 (0.57 - 2.41)	±	0.62	3.34 ± 1.14 (0.67 – 5.53)			<0.001***

Results were expressed as mean ± SD. For statistical analysis, Unpaired t test was performed to compare both groups. Figure in parenthesis indicate ranges. LF norm = Low frequency power (n.u.), HF norm = High frequency power (n.u.), LF/HF = ratio of low frequency & high frequency. n = total number of subjects.

*** = significant at p<0.001, ns = not significant

Discussion

The study was undertaken to observe autonomic nerve function status in gastroesophageal reflux disease (GERD) patients by analysis of heart rate variability (HRV). In order to assess cardiac autonomic nerve function status, 30 diagnosed GERD patients, age ranged from 20 to 35 years were selected. HRV of all subjects were assessed. HRV data were also obtained from age and BMI matched 30 apparently healthy subjects and their data were normally distributed. Among HRV indices, LF norm represent sympathetic activity while HF norm represent parasympathetic activity and LF/HF ratio indicate sympatho-vagal balance where high value of LF/HF ratio indicate dominant sympathetic activity and low value indicate dominant parasympathetic activity.⁹

In addition to HRV, systolic blood pressure (SBP) and diastolic blood pressure (DBP) were also recorded which are the marker for end organ response of cardiovascular autonomic activity.

In the present study all the subjects of both groups were age and BMI matched and they were normotensive, non-diabetic and having normal kidney function.

In the study, Systolic blood pressure (SBP) and diastolic blood pressure (DBP) during rest were measured both in control group and GERD patients to observe their basal status. Both SBP and DBP of control group and GERD patients were within normal range. No significant difference was observed between them. Similar type of findings were reported

by some other researchers in GERD patients.¹² On the contrary, some researchers found significantly higher systolic blood pressure in GERD patients than that of healthy control. These researchers also found higher diastolic blood pressure in GERD patients as compared to that of healthy control but the result was not statistically significant.¹³ This discrepancy might be due to geographical or ethnic factors, large population diversity and laboratory assessment method (long term, 24 hours analysis of HRV).

HRV parameters- (Frequency domain): LF norm: In this study, the value of LF norm was significantly higher in GERD patients in comparison to that of control group. Similar findings were reported by other researchers.¹⁴ On the contrary, some researchers found significantly lower value of LF norm in nonerosive reflux disease (NERD) as compared to that of erosive reflux disease (ERD) and healthy control.¹⁵ This discrepancy might be due to decrease in sympathetic modulation in NERD patients. Similar result was also observed in reflux positive patients as compared to that of reflux negative patients.¹²

HF norm: In this study, the values of mean HF norm was significantly lower in GERD patients as compared to that of control group. Similar findings were also reported by several researchers.¹³ On the contrary, some researchers found significantly higher value of HF power in GERD patients than that of healthy control.¹⁵ This discrepancy might be due to anatomical and/or functional alteration of the esophagus.

LF/HF ratio: In this study, mean value of LF/HF ratio was significantly higher in GERD patients than that of control group. Similar findings were also reported by some other investigators.¹⁵ On the other hand, some

researchers did not find any significant difference of LF/HF ratio between GERD patients and healthy control.¹⁶ On the contrary, some researchers found significantly lower value of LF/HF ratio in GERD patients in comparison to that of healthy control.¹⁵ This discrepancy might be due to decrease sympathetic component (LF).

Conclusion

From this study it can be concluded that, autonomic dysfunction occurs in GERD patients which is characterized by decreased parasympathetic activity and sympathetic overactivity.

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