RESEARCH ARTICLE

COMPARISON OF HEART RATE VARIABILITY IN DIFFERENT ABO BLOOD GROUPS OF YOUNG ADULTS

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ABSTRACT

Background: ABO blood groups have been associated with various disease phenotypes, particularly cardiovascular diseases. The analysis of the heart rate variability (HRV) signal is an important tool for studying the autonomic nervous system.

Aims & Objectives: The present study was designed to find out the association between different A, B, O blood groups and HRV in normal individuals.

Materials and Methods: This cross sectional study included 120 volunteered healthy medical students. The subjects were grouped into four groups A, B, AB and O. HRV was analyzed by using time domain and frequency domain method during normal breathing at rest for five minutes. HRV was also analyzed during deep breathing for one minute using time domain method.

Results: The analysis of HRV showed that during normal breathing, there was no statistically significant difference ($P>0.05$) in HRV among the ABO blood groups. HRV during deep breathing showed that there was a statistically significant increase in SDNN value ($P<0.05$) (standard deviation of NN interval) in O blood group subjects compared to A, B and AB blood groups. Frequency domain method did not show any statistically significant difference in (LF nu) and (HF nu) among the ABO blood groups.

Conclusion: This study showed a better HRV during deep breathing in O blood group individuals. The blood type O may offer some protection from cardiovascular diseases. High risk blood group individuals can adopt a healthier lifestyle as a preventive measure for the development of cardiovascular diseases in their future.

Key Words: Blood Groups; Heart Rate Variability; Time Domain Analysis; Frequency Domain Analysis; Standard Deviation of NN Intervals (SDNN)

Introduction

Many diseases, especially digestive disorders, cardiovascular diseases, cancer, and infection - express preferences choosing between the ABO blood types.[1-5] Cardiovascular disease is one of the major causes of sudden death. The known risk factors for cardiovascular diseases are tobacco use, decreased physical inactivity, dietary factors, alcohol abuse and genetics. But a recent study published in the United States' journal, Arteriosclerosis, Thrombosis and Vascular Biology,[6] found that a person's blood group also can determine his or her risk of heart disease. It was shown that individuals with blood group O benefit from some natural protection against cardiovascular disease and individuals with blood groups A and B are more at risk whereas individuals with blood group AB are the most vulnerable for cardiovascular diseases.

Heart rate variability (HRV) has become a common non-invasive research tool in cardiology, as it reflects the effects of autonomic system on the sinus node of the heart.[7] Time and frequency domain measures of HRV have provided prognostic information on the significance of changes in the regulation of heart rate changes. Previous studies have shown that reduced HRV implicates an increased risk of cardiovascular disease and mortality.[8,9]

The literature lacks data on the association of blood groups and HRV. As HRV is a non-invasive test to assess the cardiovascular autonomic regulation, the present study was designed to find out association between different A, B, O blood groups and HRV in normal individuals, if any, as decreased HRV is a dependable predictor of future cardiovascular disease.

Materials and Methods

This cross sectional study included 120 volunteered healthy medical students, in the age group of 18-22 years, of both sexes, from Kasturba Medical College, Mangalore. The study was approved, and the procedures were followed in accordance with the institutional ethical standards. At orientation, each subject was explained the purpose, procedures and confidentiality of

this study prior to their written informed consent. A detailed history was taken. They were subjected to preliminary medical check-up. A general physical examination was done for all the subjects and the height (in meters), weight (in kilograms), blood pressure (mmHg) and pulse rate (per minute) were noted. Body Mass Index (BMI) was calculated as the weight in kilograms divided by the square of the height in meters. Pulse rate and blood pressure were measured in sitting position after five minutes of rest. The basal recording of blood pressure was done using sphygmomanometer by standard Riva Rocci method. A systemic examination was also carried out for each subject. The following exclusion criteria were accepted for the investigation: presence of any serious cardiovascular disease, including arterial hypertension, metabolic, neurological, respiratory disorders, and history of smoking and alcohol intake that could influence heart rate variability.

Determination of ABO blood groups was by antigen-antibody reaction ABO Slide Agglutination Test. Then subjects were grouped into four groups A, B, AB and O.

Assessment of HRV

All the subjects were asked to abstain from consuming caffeinated beverages and undertaking excessive physical activity, including gymnastics, for 12 hrs preceding the data collection. They were also requested not to eat and drink on the morning of the experiment and not to take a shower. The students were fully habituated to the equipment, the protocols and the experimenters. Our investigation was performed in a semi-darkened, temperature-controlled, quiet laboratory which was at room temperature (21^0C). Before the experiment, the participants rested in a laboratory room in a sitting posture for about 20 min. The records were taken between 09.00AM-10.00AM. The Autonomic activity was assessed by recording the electrocardiogram (ECG) from the limb lead II from all the subjects by using a BPL ECG machine. The analogue output from the machine was digitized by using an A/D converter from National Instruments, Bangalore. The HRV was analyzed by measuring the R-R intervals using a software "HRV soft 1.1 Version" software package (built by using the LabView software from Texas Instruments, USA) which was provided by the All India Institute of Medical Sciences (AIIMS), New Delhi. The ECG was recorded from all the subjects while they were in a supine position, fully relaxed and breathing normally for a period of five minutes, which gave the "Short term HRV". After this, a break of 2 minutes was given. HRV is also analyzed by deep breathing HR test[10] recorded during deep breathing for one minute. Before beginning the deep breathing test, the subject were taught to breath at a rate of 6 respiratory cycles per min, 5 seconds for each inhalation and 5 seconds for each exhalation. Lead II was then recorded continuously at a speed of 25 mm/seconds for 60 seconds while the subjects were deep breathing as instructed. The HRV was analyzed both by the time domain method and frequency domain analysis both during normal and deep breathing. In the time domain method, root of the mean of the squared successive R-R interval differences (RMSSD) and standard deviation of normal RR intervals in milliseconds (SDNN) were analyzed. The two main frequency components, i.e. the low frequency (LFnu) components (0.04 to 0.15Hz), and the high frequency (HFnu) components (0.15 to 0.4 Hz) in normalized units, was measured.

Statistical Analysis

Statistical analysis of the data was done by SPSS (Statistical Package for Social Sciences) version 11.5. Statistical tests included in this study were ANOVA (analysis of variance), Kluskal Wallis test and Mann Whitney U test. P-value was taken as statistically significant at 5 percent confidence level ($P<0.05$).

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Results

In the present study, the demographic characteristics (Table 1) of the subjects with different blood groups was well balanced and they did not differ significantly in factors like age, weight, body mass index, waist/hip ratio and blood pressure.

HRV of 120 subjects' during normal and deep breathing was studied (Table -2). The analysis of HRV showed, that during normal breathing, there was no statistical significant difference ($P>0.05$) in HRV among the ABO blood groups. But the values of RMSSD and SDNN were slightly higher among subjects with O blood group, compared to the other ABO blood groups, but it was statistically not significant. HRV during deep breathing showed, that there was a statistical significant increase in SDNN value ($P<0.05$) in O blood group subjects, compared to A, B and AB blood groups - but there was no statistical significant change in RMSSD.

Analysis of the data (Table 3) showed that when HRV was compared between different ABO blood groups

during normal breathing using frequency domain method, the low frequency component in normalized units (LF nu) and high frequency component in normalized units (HF nu) did not show any statistically significant difference among the ABO blood groups.

Table-1: Demographic characteristics of A, B, AB and O blood group subjects

Parameters	Blood groups				P value
	A (n=32)	B (n=29)	AB (n=12)	O (n=47)	
Age (years)	19.62 ± 1.3	19.48 ± 1.5	19.75 ± 1.7	19.59 ± 1.3	0.954 NS
Weight (kg)	57.03 ± 8	54.41 ± 8	54.58 ± 8	54.02 ± 7.4	0.395 NS
Height (m)	1.62 ± 0.07	1.60 ± 0.10	1.58 ± 0.06	1.57 ± 0.09	0.169 NS
Body Mass Index	21.57 ± 1.7	20.86 ± 1.6	21.69 ±1.8	21.29 ± 1.6	0.343 NS
Waist-Hip Ratio	0.79 ± 0.06	0.76 ± 0.05	0.76 ± 0.07	0.77 ± 0.05	0.238 NS
Systolic BP (mm Hg)	114.8 ± 4.4	115.7 ± 4.4	116.33 ± 4.07	115.14 ± 4.4	0.712 NS
Diastolic BP (mm Hg)	77.43 ± 3.9	75.93 ± 3.9	78.16 ± 3.1	76.38 ± 3.9	0.234 NS

Values are as Mean ± Standard deviation. n = number of subjects; BP = Blood pressure; NS = not significant

Table-2: Comparison of HRV between different ABO blood groups during normal breathing (NB) and deep breathing (DB) using time domain method

Parameters	Blood groups				P value
	A (n=32)	B (n=29)	AB (n=12)	O (n=47)	
NB-RMSSD (ms)	51.30 ± 20	51.97 ± 17	59.36 ± 20	59.79 ± 16	0.738 NS
NB-SDNN (ms)	58.07 ± 15	65.54 ± 21	66.24 ± 19	70.95 ± 15	0.44 NS
DB-RMSSD (ms)	57.07 ± 21	60.04 ± 20	59.72 ± 19	63.07 ± 15	0.616 NS
DBSDNN (ms)	72.03 ± 13	73.21 ± 12	72.49 ± 14	75.67 ± 12	0.04 S

Values are as Mean ± Standard deviation. n = number of subjects; NS = not significant; S = significant

Table-3: Comparison of HRV between different ABO blood groups during normal breathing using frequency domain method

Parameters	Blood groups				P value
	A (n=32)	B (n=29)	AB (n=12)	O (n=47)	
LF nu	53.65 ± 17	52.97 ± 23	59.93 ± 23	51.69 ±19	0.633 NS
HF nu	46.35 ± 17	47.03 ± 23	40.07 ± 23	48.31 ± 19	0.633 NS

Values are as Mean ± Standard deviation. n = number of subjects; NS = not significant

Discussion

Among the blood group systems, the ABO system is the most important in humans. The relevance of the present study was to find out, if blood groups can be implicated as one of the risk factors in the causation of cardiovascular diseases, by assessing the HRV in normal individuals.

In the present study, the demographic characteristics (Table 1) of the subjects with different blood groups was well balanced, and they did not differ significantly in factors like age, weight, body mass index, waist/hip ratio and blood pressure values, which are well known to affect HRV.[11-14]

HRV was compared among different ABO blood groups, during normal and deep breathing, using time domain method. Analysis of HRV using time domain method and frequency domain method, during normal breathing in A, B, AB and O blood groups, showed that there was no statistical significant difference in the RMSSD, SDNN, LFnu and HF nu - among the ABO blood groups. But the values of RMSSD and SDNN were slightly higher among subjects with O blood group, compared to the other ABO blood groups. Previous studies have shown that RMSSD primarily reflect the parasympathetic tone[15,16] and SDNN is considered to reflect both the sympathetic and the parasympathetic influence on heart rate variability.[17] Hence, the results of the present study probably suggest that there might be a better parasympathetic activity in O blood group subjects, but it did not attain a statistically significant level.

During deep breathing, the heart rate can increase and decrease with each respiratory cycle by as much as 30%.[18] Heart rate variability during deep breathing (DB-HRV) is approximately double than during quiet breathing. During deep breathing, the vagal activity is increased due to respiratory manoeuvre which spills over the cardiac tissue and the HRV under deep breathing condition is a better indicator of parasympathetic role in heart.[18] So in the present study, we tried to analyze, if there is any difference in the heart rate variability in different blood group individuals during deep breathing, as heart rate variability doubles during deep breathing. Time domain analysis of HRV in A, B, AB and O blood groups during deep breathing showed (Table.2) a statistically significant increase in SDNN value ($p<0.05$) among O blood group subjects compared to A, B, AB blood groups, but there was no statistically significant change in RMSSD value between the different ABO blood groups. Numerous previous studies have demonstrated the association between ABO blood groups, particularly non-O blood groups and cardiovascular major risk factors. This association is attributed to lower activated partial thromboplastin time (APTT) ratio, and levels of VWF factor in non-O blood group subjects.[19-22] The probability of parasympathetic activity being better in O blood group individuals, as per the results of the present study, may be one of the reasons for a lesser incidence of cardiovascular diseases in O blood group individuals, but it needs further study in a larger sample size.

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Reduced HRV has been shown to be a risk factor for the development of cardiovascular diseases.[8,9] This study showed a better HRV (increased SDNN value) during deep breathing in O blood group individuals, compared to A, B and AB blood group subjects, which was statistically significant. The blood type O may offer some protection from cardiovascular diseases, but blood type alone will not compensate for other factors that are linked to the cardiovascular diseases. Blood group is a non-modifiable risk factor, but the high risk blood group individuals can adopt a healthier lifestyle as a preventive measure, for the development of cardiovascular diseases in their future.

Conclusion

This study showed a better HRV during deep breathing in O blood group individuals. The blood type O may offer some protection from cardiovascular diseases. High risk blood group individuals can adopt a healthier lifestyle as a preventive measure for the development of cardiovascular diseases in their future.

References

1. Mentis A, Blackwell CC, Weir DM. ABO blood group, secretor status and detection of Helicobacter pylori among patients with gastric or duodenal ulcers. Epidemiol Infect. 1991;106(2):221-9.
2. Abdollahi AA, Qorbani M, Salehi A, Mansourian M. ABO Blood Groups Distribution and Cardiovascular Major Risk Factors in Healthy population. Iranian J Publ Health. 2009; 38(3):123-6.
3. Sheila C, Langman MJS, Macleod IN, Mosbech J, Rahtkens K. ABO blood groups in patients with gastric carcinoma associated with pernicious anemia. Gut. 1971;12(6): 465–7.
4. Naresh K, Mahathi N, Vishnu R, Gopal K. Association of ABO blood groups with Chikungunya virus. Virology Journal. 2010;7:140-6.
5. Alexandra R, Herbert D, Thomas N, William B. Blood groups and malaria: fresh insights into pathogenesis and identification of targets for intervention. CurrOpinHematol. 2009;16(6):480–7.
6. He M, Wolpin B, Rexrode K, Manson JE, Rimm E, Hu FB, et al. ABO blood group and risk of coronary heart disease in two prospective cohort studies. ArteriosclerThrombVasc Biol. 2012;32(9):2314-20.
7. Sztajzel J. Heart rate variability: a noninvasive electrocardiographic method to method to measure the autonomic nervous system. Swiss Med Wkly 2004:134:514-22.
8. Bigger JT, Fleiss JL, Steinman RC, Rolnitzky LM, Kleiger RE, Rottman JN. Frequency domain measures of heart period variability and mortality after myocardial infarction. Circulation. 1992;85:164-71.
9. Stein PK and Kleger RE. Insights from the study of heart rate variability. Annu Rev med. 1999;50:249-61.
10. Katz A, Liberty IF, Porath A, Ovsystcher I, Prystowsky EN. A simple bedside test of 1-minute heart rate variability during deep breathing as a prognostic index after myocardial infarction. Am Heart J. 1999;138:32-38.
11. Murata K, Araki S, Yokoyama K, Sata F, Yamashita K, Ono Y. Autonomic neurotoxicity of alcohol assessed by heart rate variability. J Auton Nerve syst. 1994;48(2):105-11.
12. Freeman R, Weiss ST, Roberts M, Zbikowski SM, Sparrow D. The relationship between heart rate variability and measures of body habitus. Clin AutonRes. 1995;(5):261–6.
13. Tulppo MP, Makikallio TH, Seppanen T, Laukkanen RT, Huikuri HV. Vagal modulation of heart rate during exercise: effects of age and physical fitness. Am J Physiol. 1998;274:424-9.
14. Sevre K, Lefrandt JD, Nordby G. Autonomic function in hypertension and normotensive subjects: The importance of gender. Hypertension. 2001;37(6):1351–6.
15. Task force of European society of Cardiology and the North American society of Pacing and electrophysiology. Heart rate variability: standards of measurement, Physiological interpretation and clinical use. Eur Heart J. 1996;93:1043-65.
16. Hilz MJ, Dutsch M. Quantitative studies of autonomic function. Muscle Nerve.2006;33:6–20.
17. Bigger JT, Fleiss JL, Steinman RC, Rolnitzky LM, Kleiger RE, Rottman JN. Correlations among time and frequency domain measures of heart period variability two weeks after acute myocardial infarction. Am J Cardiol. 1992;69(9):891-3.
18. Wheeler T, Watkins PJ. Cardiac denervation in diabetes. BMJ.1973;4:584-6.
19. Green D, Jarrett O, Ruth KJ, Folsom AR, Liu K. Relationship among Lewis, clotting factors and other cardiovascular risk factors in young adults. J LabClin Med. 1995;125:334-9.
20. Wong FL, Kodama K, Sasaki H, Yamada M, Hamilton HB. Longitudinal study of the association between ABO phenotype and total serum cholesterol level in a Japanese cohort. Genet Epidemiol. 1992;9(6):405-18.
21. Ionescu DA, Ghitescu M, Marcu I, Xenakis A. Erythrocyte rheology in acute cerebral thrombosis: Effects of ABO blood groups.Blut.1979;39:351-7.
22. Meade TW, Cooper JA, Stirling Y, Howarth DJ, Ruddock V, Miller GJ. Factor VIII, ABO blood group and the incidence of ischaemic heart disease.Br J Haematol. 1994;88:601-7.
23. Garrison RJ, Havlik RJ, Harris RB, Feinleib M, Kannel WB, Padgett SJ. ABO blood group and cardiovacular disease: the Framingham study.Atheroslerosis. 1976;25:311-8.

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