Section: Physiology

Original Research Article

EFFECT OF ISOTONIC AND ISOMETRIC EXERCISE ON HEART RATE VARIABILITY IN INDIVIDUALS OF DIFFERENT BLOOD GROUPS OF ABO SYSTEM

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ABSTRACT

Background: Heart rate variability (HRV) is a non-invasive and reproducible test for autonomic nervous function. ABO blood groups have been associated with various disease phenotypes, particularly cardiovascular diseases which are the most common causes of death. Exercise can unleash the potential cardiovascular risk of a person, and this can be used as a sensitive and specific marker to determine the cardiac function and its interplay with the autonomic nervous system (ANS). **Objective:** Study of HRV response to isometric and isotonic exercise in relation with ABO blood groups in young adults. **Materials and Methods:** 60 healthy young male and female adults, in the age group of 18-22 years who satisfied the inclusion criteria were included. AD Instruments Power Lab was used to record the frequency and time domain analysis of HRV from the limb leads. Subjects were made to exercise by running on treadmill for isotonic exercise and hand grip dynamometer was used for isometric exercise. Kruskal Wallis test was applied to know the relationship of HRV response to isometric and isotonic exercise in individuals of different blood groups of ABO system. **Result:** At rest, all blood groups have a better sympatho-vagal balance. On performing isotonic exercise blood group O had no change in the parameters suggesting better sympatho-vagal balance when compared to other blood groups. But following isometric exercise, blood group O had an increase in LF/HF ratio indicating increase in sympathetic activity compared to the other blood groups. In time domain analysis of isotonic exercise, there was increase in SDNN indicating an increase in sympathetic activity in all blood groups. **Conclusion:** Blood group O has better sympatho-vagal balance following isotonic exercise as compared to other blood groups, but in isometric exercise not much variation was seen among subjects of different blood groups.

INTRODUCTION

Heart as a pump, functions regularly and continuously helping in delivery of blood throughout the body.[1] Heart rate variability is a physiological process where there is variation in the time interval between the consecutive heartbeats in milliseconds.[1] Resting heart rate and HRV is used clinically to assess the function of the autonomic system, as heart is innervated by sympathetic and parasympathetic nerves.[1] Notably, these two components of the autonomic nervous system (ANS) balance between them the consistency in the time between heart beats. HRV is regulated both physiologically and pathologically. Sympathetic regulation is slow, i.e., it acts in seconds whereas the parasympathetic regulation is fast i.e., in milliseconds. So, the beat-to-beat regulation of the heart is mainly influenced by the parasympathetic system. HRV is a result of complex interactions between extrinsic environmental and behavioral factors and intrinsic cardiovascular regulatory mechanism.[2] HRV is analysed in both time and frequency domain. Time domain indices are the mathematical calculations of consecutive RR intervals whereas frequency domain indices are based on spectral analysis, that is used to

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analyse the sequence of RR intervals of short term or entire 24-hour period recordings. Previous findings have identified the potential use of HRV for recognizing healthy and diseased states since the vagal-mediated HRV indices were inversely associated with several risk factors for diabetes, glucose intolerance, insulin resistance, central obesity, dyslipidemia and hypertension.[1]

In 1900, Karl Landsteiner described the ABO blood group system. In the present scenario, clinical relevance of ABO blood group system extends beyond the concept of transfusion and organ transplantation. Various studies have showed the correlation of ABO blood groups with various diseases like duodenal ulcer, gastric carcinoma etc. Presently cardiovascular disease is the leading cause of death globally as stated by World Health Organization. Recently, studies have pinpointed that ABO blood group system is also a locus for thrombus formation, myocardial infarction, and various cardiovascular biomarkers. The study has shown that people with blood group O had a natural protection against cardiovascular disease and people with blood group A and B are at high risk of CVD (Cardio Vascular Disease).[3] Study of Autonomic function tests in an individual will act as a guide for prevention of cardiovascular morbidity.[4]

Exercise is a bodily activity that requires physical effort and is carried out to improve health and fitness. Exercise is performed for various purposes, like to aid growth, improve muscle strength, improve the cardiorespiratory fitness, weight loss and for the pleasure.[5-8] Regular physical activity will boost the immune system and help in prevention of obesity, cardiovascular disease, and type 2 diabetes. Exercise, a common physiological variance will help in eliciting any normal physiological changes and also the probable cardiovascular abnormality.[5-8] It can be used as a sensitive and specific marker to determine the competence of cardiac function and the precise relationship between the cardiac and the autonomic activity.[5-8]

As there is a limited data showing the relationship of HRV with ABO blood groups and effect of exercise on HRV in association with blood group, the present study was taken up to study the relationship of HRV with ABO blood group not only at rest but also its relationship on exercising in the young adults.

MATERIALS AND METHODS

This is a cross-sectional study which included 60 young adults in the age group of 18-22yrs, of both sexes. The study was approved by the institutional ethical committee. Subjects were explained about the procedure and written informed consent was taken. A general physical examination of all the subjects was performed and the height (in meter) and body weight (in kilogram) were measured, and body mass index was calculated using Quetelet's index. Blood group was determined by slide agglutination method.

Subjects in the age group of 18-22yrs, BMI less than 23 Kg/m^2, non-smokers, non-alcoholics, and who had no history of cardiovascular disease were included in the study. Subjects were allocated to different groups based on their blood groups as A, B, AB and O.

All the subjects were asked to abstain from caffeinated beverages and excessive physical activity at least 12 hours before the data collection. The subjects were habituated to the equipment, protocol and the personnel. The recording of HRV was done in the limb lead II of all the subjects using Powerlab instrument. The HRV was analyzed using a Lab Chart Pro software package developed by AD instruments, Australia. The HRV was recorded in supine position, after the person was fully relaxed and breathing normally for a period of five minutes, which gave the "short term HRV". After this, subject was asked to do isotonic exercise i.e., to run on treadmill according to Bruce Protocol and HRV was recorded immediately after isotonic exercise and after 10 minutes of rest following exercise. Next, the same individual was asked to perform isometric exercise using handgrip dynamometer with 30% of his/her efficiency and HRV was recorded immediately after isometric exercise. Both time and frequency domain of HRV was recorded and analysis was done at rest, immediately after isotonic and isometric exercise. HRV analysis was done as per the guidelines issued by Task force of The European Society of Cardiology and The North American Society of Pacing and Electrophysiology. Time domain indices in milliseconds includes SDNN– Standard Deviation of the all NN interval, RMSSD– square root of the mean of the sum of the squares of differences between adjacent NN interval. Frequency domain indices includes LF-AV (Low-Frequency power- Absolute values) in $msec^2$, HF-AV (High-Frequency power- Absolute values) in msec,[2] and LF/HF ratio. HF reflects parasympathetic cardiac drive, LF reflects predominantly sympathetic component and that the LF/ HF ratio is used as a measure of sympatho-vagal balance.[8] RMSSD mainly reflects the activity of the parasympathetic nervous system and SDNN represents the standard deviation of all coupling intervals for all consecutive regular beats and reflects the sympatho-vagal balance.[9]

RESULTS

In the present study, the subjects of various blood groups were well balanced in the demographic statistics. HRV was recorded in 60 young adults. Both time and frequency domain analysis of HRV was done following rest, isotonic and isometric exercise. Descriptive statistics with Kruskal Wallis test was applied. When compared the time domain and frequency domain parameter among individuals of different blood groups at rest, it showed no significant change.

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But following isotonic exercise LF parameter was decreased in all blood groups compared to rest showing insignificant sympathetic activity. In blood group B, HF parameter was decreased compared to rest indicating decline in parasympathetic activity. LF/HF ratio which denotes the sympatho-vagal balance was decreased following isotonic exercise in blood group A, B, AB indicating a decrease in sympathetic activity. But with time domain analysis SDNN was increased in all blood groups except blood group O indicating an increase in sympathetic activity in all other blood groups. RMSSD is also increased in all blood groups except blood group O indicating an increase in parasympathetic activity in all other blood groups. Though the variations were seen in parameters between rest and following isotonic exercise they were not significant. When the time domain and frequency domain parameters were compared between rest and isometric exercise of various blood groups there was a decrease in LF and SDNN values denoting a decrease in sympathetic activity though it was not significant. LF/HF, RMSSD were increased in blood group O compared to rest following isometric exercise but was not significant.

Table 1: HRV parameters at rest

Blood group	LF (ms^2)	HF (ms^2)	LF/HF	SDNN (ms)	RMSSD (ms)
A	352.88500	279.22000	1.73500	84.5000	104.1000
B	260.50500	245.57000	0.99500	37.2500	33.9500
AB	932.04000	672.12000	1.38000	80.0000	44.2000
O	595.24000	666.84500	0.90000	68.2000	57.2000
P value* (Kruskal Wallis test)	0.313	0.3300	0.525	0.168	0.435

Table 2: HRV parameters after isotonic exercise.

Blood group	LF (ms^2)	HF (ms^2)	LF/HF	SDNN (ms)	RMSSD (ms)
A	252.3900	316.6000	0.7800	138.950	126.450
B	231.3500	139.5000	0.9000	48.300	40.800
AB	220.4000	703.7000	0.7600	142.600	104.900
O	595.24000	666.84500	0.90000	68.2000	57.2000
P value* (Kruskal Wallis test)	0.745	0.750	0.258	0.015	0.067

Table 3: HRV parameters after isometric exercise

Blood group	LF (ms^2)	HF (ms^2)	LF/HF	SDNN (ms)	RMSSD (ms)
A	191.2500	215.3500	0.8250	67.200	48.4500
B	311.7000	276.4000	0.9150	50.600	50.7500
AB	10.5000	5.8900	0.8700	22.600	17.4000
O	501.8000	266.6000	1.2300	78.900	77.9000
P value* (Kruskal Wallis test)	0.181	0.350	0.978	0.215	0.206

DISCUSSION

In the present study following isotonic exercise in blood group A there was decrease in LF, LF/HF ratio and increase in the HF, SDNN & RMSSD values indicating a decrease in sympathetic activity. In blood group B following isotonic exercise there was decline in LF, HF & LF/HF ratio but increase in SDNN and RMSSD showing a decrease in sympathetic activity. In blood group AB there was decrease in LF & LF/HF but increase in HF, SDNN, RMSSD which indicates an parasympathetic stimulation. In blood group O, no change in the parameters shown following isotonic exercise indicating that Blood group O has a better resistance to exercise compared to other blood groups.

Following the isometric exercise, in blood group A and AB all the parameters like LF, HF, LF/HF, SDNN and RMSSD were decreased showing a decrease in sympathetic activity. But in blood group B following isometric exercise they had an increase in LF, HF, SDNN and RMSSD indicating an increase in sympathetic activity is more than the parasympathetic activity. In blood group O following the isometric exercise, there was an increase in LF/HF ratio, SDNN, RMSSD but decrease in LF, HF value indicating again decreased sympathetic activity in them.

In the present study it showed that blood group O had a better resistance to isotonic exercise in comparison to the isometric exercise. Whereas in blood groups A there was a decrease in sympathetic activity compared to blood group B and AB following exercises. The results of the present study is similar to the results of the study conducted by Licurci et al,[5] where it has shown that when whole body vibrates in standing posture of an elderly adult has shown a significant increase in SDNN and RMSSD but no change in frequency domain parameters. So isotonic exercise causes whole body vibration and our result of change in SDNN corelates with the same.

Reduced HRV has been shown to be a risk factor for the development of cardiovascular diseases.[4] Study by Chaitra Uppangala, et al showed a better HRV (increased SDNN value) during deep breathing in O blood group individuals, compared to A, B and AB

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blood group subjects indicating that blood type O has some protection from cardiovascular diseases.[4] Earlier studies have proved that the duration, type and intensity of the exercise has a varied effect on HRV.[5] Long term exercise with moderate intensity is beneficial to the heart where it stimulates the parasympathetic activity and reduces the sympathetic activity.[5] A study conducted by Rafiq N et al has concluded that autonomic tests has no significance in the different blood groups.[11]

In the present study, we have seen the acute effect of an exercise on HRV of different blood groups where following isotonic exercise there was better sympatho-vagal balance found in blood group O and a significance was found in SDNN when compared to the rest. But following isometric exercise, blood group O had an increased sympathetic activity compared to other blood groups.

CONCLUSION

Blood group O has better sympatho-vagal balance following isotonic exercise as compared to other blood groups, but in isometric exercise not much variation was seen among subjects of different blood groups.

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