International Journal of Research in Medical Sciences
Rafiq N et al. Int J Res Med Sci. 2019 Apr;7(4):1276-1281
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: http://dx.doi.org/10.18203/2320-6012.ijrms20191339

Original Research Article

Comparison of cardiac autonomic response in different ABO blood groups of young adults

Nadeema Rafiq[1], Tauseef Nabi[2]*, Quratul Ain Arifa[3]

[1]Department of Physiology, Government Medical College, Baramulla, Jammu and Kashmir, India
[2]Department of Endocrinology, Government Medical College, Srinagar, Jammu and Kashmir, India
[3]Department of Community Medicine, Government Medical College, Baramulla, Jammu and Kashmir, India

Received: 30 January 2019
Accepted: 07 March 2019

***Correspondence:**
Dr. Tauseef N. Khushoo,
E-mail: dr.tauseefnabi@gmail.com

ABSTRACT

Background: ABO blood group has been associated with various disease phenotypes, particularly cardiovascular disease. Abnormal autonomic response also plays a role in cardiac morbidity. Increasing attention is being focused on the role of autonomic nervous system in health and disease. The literature lacks data on the association of blood groups and cardiac autonomic function. The aim of the study was to find out the association between different blood groups and cardiovascular autonomic functions in young adults.
Methods: 150 healthy young students of MMU aged 18-25 years, divided into four groups based on ABO blood grouping, determined by agglutination test (group A, group B, group O and group AB). Various autonomic function tests done were lying to standing test, Valsalva maneuver, Hand grip test (HGT) and Cold pressor test (CPT).
Results: The mean baseline heart rate was significantly higher in group O as compared to group A. No parasympathetic alteration between different ABO blood groups was seen. Blood pressure response to HGT and CPT was not statistically significant between different blood groups.
Conclusions: Present study revealed no alteration in cardiac autonomic function with regards to ABO blood grouping in young adults.

Keywords: ABO blood groups, Cold pressor test, Hand grip test, Lying to standing test, Valsalva maneuver

INTRODUCTION

ABO blood type antigens are polymorphic, inherited structures present on the surface of red blood cells.[1] The carbohydrate antigens have several functions, including transporters and channels, receptors for ligands, viruses, bacteria and parasites, adhesion molecules, enzymes and structural proteins.[2] Although ABO blood group antigens are the most important antigens in transfusion medicine but their main role is not clearly clarified yet. The presence and lack of blood antigens in some blood groups induce blood membrane changes, morphologically and functionally. The structure-dependent functions of blood types can link the blood groups to health and diseases.[3]

Although correlation between ABO blood group and susceptibility to certain infectious and non-infectious diseases is a controversial issue because lack of blood type antigens has not been related to significant diseases or health risks.[4] It has been hypothesized that blood type antigen system may be apparently involved in the pathophysiology of a wide range of human diseases by

interaction between glycan structures on red blood cell surfaces and different agents.[4] Although, early research relied on using statistical methods to associate the blood groups with diseases such as infection, malignancy, and coagulation, these associations have more recently been given scientific validation through extensive research in infectious disease, tumor immunology, and membrane chemistry.[5]

Blood groups as a potential risk factor for cardiovascular morbidity is still under evaluation. Studies have been done in the past between relation of blood group and risk of developing cardiovascular diseases in future.[6] Abnormal autonomic response also plays a role in cardiac morbidity. Increasing attention is being focused on the role of Autonomic nervous system in health and disease.

Studies showed that subjects with high cardiovascular sensitivity accompanied by delayed recovery time after the stimulus subsides are at a comparatively greater risk of cardiovascular morbidity, in specific hypertension, in the later life.[7] Sympathetic overactivity plays a significant role in the development of neurogenic hypertension.[8] Many studies have reinforced that the chances of a person becoming hypertensive later in life have abnormal sympathetic response.[9] The association between hypertension and sympathetic over activation has been established.[10-12] In other study, author have shown offspring's of hypertensive parents have increased sympathetic reactivity with no parasympathetic modulation in early life as compared to offspring of normotensive parents, thus have higher susceptibility for development of future hypertension.[13] Study has also confirmed that prehypertension is associated with autonomic dysfunction, which is reflected by an elevated sympathetic tone.[14] There is gender difference to cardiac autonomic reactivity in young adults as shown by higher sympathetic activity in men compared to women.[15] Body Mass Index (BMI) also alters autonomic function in healthy young adults by causing impaired sympathetic activity with no parasympathetic modulation in obese young adults (article in press). So, weight reduction and moderate intensity aerobic exercise programs should be incorporated into daily living, which may delay or prevent the onset of hypertension. Hence, if a particular blood group individual has an abnormal cardiovascular autonomic response this would reinforce that this blood group is a potential risk factor for cardio vascular morbidity. The literature lacks data on the association of blood groups and cardiac autonomic function. Only two studies are present in the literature. Study by Anthony DM et al, showed that autonomic response to cold pressor test (CPT) in relation to ABO blood groups was not different while study by Uppangala C et al, compared heart rate variability (HRV) in different ABO blood groups of young adults showed O group had better HRV during deep breathing hence predicting some protection from cardiovascular disease.[16,17] As autonomic function tests are non-invasive tests to assess the cardiovascular autonomic regulation, the present study was designed to find out an association between different A, B, O blood groups and cardiac autonomic function in healthy young adults.

METHODS

A total of 150 healthy young adults were included in this study with age range from 18 to 25 years. The study was conducted in the Department of Physiology at Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana, Ambala, Haryana, India. The study was approved by the Institutional ethical committee.

Informed and written consent of all the participants was taken before conducting the study. The non-smoker, non-alcoholic with systolic (SBP) and diastolic blood pressure (DBP) <140/90 mm/Hg were included in the study.

Exclusion criteria included Subjects with SBP ≥140 and or DBP ≥90 mm/Hg, subjects on antihypertensive drugs or any other medication, under-going regular physical training and with history of acute or chronic illness like diabetes mellitus, renal disease or any neuro-psychiatric disorder which can affect autonomic function. The blood group of each of the subjects was determined by agglutination test by using known commercial anti-sera by tile method. Subjects were divided into four groups based on blood group.

- Group A = 25 (16%),
- Group B = 46 (31%),
- Group O = 66 (44%),
- Group AB = 13 (9%).

A detailed history was taken and general physical examination of all the volunteers was done, with the main emphasis on cardiovascular diseases, renal diseases. None of the subjects took any medication at the time of the study.

All the students were explained about the procedure of tests and tested under similar laboratory conditions in a comfortable environment. Subjects were instructed not to have heavy meals/tea/coffee at least 2 hours before the test and were asked to rest just before the commencement of the test, and then all basal parameters like heart rate, blood pressure and respiratory rate were measured. Various cardiovascular autonomic function tests that were performed are as follows.

Tests of cardiovascular autonomic function

Parasympathetic tests

- Heart rate response to standing,
- Heart rate changes during the Valsalva maneuver.

Sympathetic tests

- Blood pressure response to sustained Hand Grip test,
- Blood pressure response to Cold Pressor test.

Heart rate response to standing (lying to standing test)

In this test, heart rate response to standing was assessed. Each subject initially took supine rest on a couch for 5 min, ECG limb leads were attached, baseline ECG was recorded. Then subject attained standing posture within 3 seconds.

A continuous ECG (lead II) was recorded during the procedure for measuring heart rate. 30:15 ratio was calculated as the ratio of the longest R-R interval at or around 30th beat after standing/shortest R-R interval at or around 15th beat after standing. The normal value of 30:15 ratio is ≥1.04.[18]

Heart rate changes during the Valsalva maneuver (Valsalva ratio)

The test was done in a sitting posture. The subject blows into a mouthpiece attached to sphygmomanometer to raise the pressure to 40 mmHg for 15 seconds. At the end of 15 seconds, the pressure was released. A continuous ECG (lead II) was recorded 1 minute before the maneuver, during the maneuver and 40 seconds following the release of strain period. Valsalva ratio is calculated as the ratio of the longest R-R interval after the strain/shortest R-R interval during the strain. The normal value of Valsalva ratio is >1.21.[18]

Blood pressure response to sustained Hand Grip Test (HGT)

The baseline blood pressure was recorded. The subject was asked to press handgrip dynamometer at 30% of maximum voluntary contraction (MVC) for 15 seconds. Blood pressure was recorded just before the release of hand grip after 1 minute and 5 min of grip release. Maximum rise in diastolic blood pressure above baseline was noted. A rise of more than 10 mmHg in diastolic blood pressure after the test was considered normal.[19]

Blood pressure response to Cold Pressor Test (CPT)

First, the baseline blood pressure was recorded and then the subjects were instructed about the test. They were instructed to indicate to the investigator if they were not able to keep the hand immersed in water for 1 minute. The cold water of 10ºC was prepared. Subject immersed the right hand in cold water up to the wrist without touching the bottom of a cold-water bath for 1 minute. After that hand was removed from the water, it was covered by the towel. The blood pressure was recorded from left hand just at the end of 1 minute of immersion and again at 1 minute after the hand was withdrawn from the cold water. A rise of 10 mmHg in diastolic blood pressure after test was considered normal.[18]

Each test was performed after a resting period of 10 minutes, in a supine or sitting position. Blood Pressure recording was done by using an Omron (SEM 1 Model), the automatic blood pressure monitor (Omron Healthcare Co. Ltd, Kyoto, Japan). The heart rate was measured from R-R interval of ECG using lead II of electrocardiograph machine (CADIART 108T-DIGI, BPL LIMITED). Hand grip strength was measured from handgrip dynamometer.

Statistical analyses

The collected data was tabulated and analyzed with the help of Statistical Package for Social Sciences SPSS for WINDOWSTM (version 20). Student's independent t-test for quantitative differences was used for data analysis. The inter-group comparison was done by one-way ANOVA with post hoc test. Mean ± standard deviations were calculated, and t-test was applied for measuring statistical significance in the difference of means. P <0.05 was considered statistically significant and P ≤0.001 was considered highly significant.

RESULTS

Table 1 shows comparison of various anthropometric parameters (age, weight, height and BMI) between subjects with different blood groups. There was no statistically significant difference between three groups in terms of mean age, mean height and mean weight.

Table 1: Comparison of anthropometric parameters between different ABO blood groups.

Patient characteristics	Group A, N=25	Group B, N=46	Group O, N=66	Group AB, N=13	P value*
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	
Age (years)	19.2±1.6	19.4±1.8	19.1±2.2	19.9±2.0	0.656
Weight (Kg)	63.8±13.8	63.8±15.4	62.7±17.1	61.7±16.1	0.945
Height (cms)	163.4±8.7	162.9±9.6	156.5±5.0	159.5±6.0	0.152
BMI (Kg/m²)	23.8±4.3	24.0±5.4	24.8±6.8	23.6±5.8	0.309

*P-value <0.05 is considered statistically significant.

Table 2 shows that the basal heart rate of subjects between different blood groups. The basal heart rate of group O (86.7±7.5 beats/min) was higher when compared with group A and the difference was statistically significant (P <0.05). The basal SBP and DBP were comparable between different ABO blood groups.

Table 2: Comparison of basal parameters between different ABO blood groups.

Basal parameters	Group A, N=25	Group B, N=46	Group O, N=66	Group AB, N=13	P value*
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	
Basal heart rate (beats/min)	78.7±9.5	81.9±10.3	86.7±7.5#	85.9±10.0	0.035
Basal systolic (mm/Hg)	108.9±11.0	108.0±10.1	106.1±4.1	110.1±5.1	0.753
Basal diastolic (mm/Hg)	64.8±7.1	65.4±11.1	70.0±6.0	72.0±9.0	0.340

*P-value <0.05 is considered statistically significant. Intergroup comparison was done by one-way ANOVA with post hoc test. # indicates a significant difference (P <0.05) on intergroup comparison with group A.

Table 3 shows comparison of parasympathetic tests i.e. lying to standing test and Valsalva maneuver between different blood groups. The mean value of 30:15 ratio was not statistically significant between different groups (P=0.299). In the Valsalva maneuver, the mean of Valsalva ratio for different groups was not found statistically significant (P=0.299). There was no statistically significant difference in the values of both the parasympathetic tests between the four groups (P >0.05). Intergroup comparison of 30:15 ratio and Valsalva ratio done by one-way ANOVA with post hoc test did not reveal a significant difference, indicating that there is no significant change in parasympathetic activity with different blood groups.

Table 3: Comparison of parasympathetic tests between different ABO blood groups.

Parasympathetic tests	Group A, N=25	Group B, N=46	Group O, N=66	Group AB, N=13	P value*
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	
Lying to standing test					
R-R interval at 30th beat	16.52±2.96	16.72±2.74	16.47±2.45	15.85±2.76	0.676
R-R interval at 15th beat	12.96±2.52	13.00±1.98	13.17±1.85	12.46±1.90	0.751
30:15 ratio	1.33±0.19	1.29±0.15	1.26±0.12	1.31±0.21	0.299
Valsalva manoeuvre					
Longest R-R interval after strain	20.24±3.98	21.50±3.20	21.36±3.10	20.62±2.93	0.404
Shortest R-R interval during strain	12.44±2.06	12.64±1.96	12.88±2.06	11.38±1.61	0.203
Valsalva ratio	1.67±0.32	1.71±0.23	1.68±0.27	1.84±0.36	0.299

*P-value <0.05 is considered statistically significant.

Table 4: Comparison of sympathetic tests between different ABO blood groups.

Sympathetic tests	Group A, N=25	Group B, N=46	Group O, N=66	Group AB, N=13	P value*
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	
Hand grip test (HGT)					
SBP difference HGT	20.46±9.73	20.97±10.77	18.44±8.70	18.17±11.40	0.480
DBP difference HGT	16.77±8.39	18.55±8.71	16.24±7.86	17.74±8.69	0.677
Cold pressor test (CPT)					
SBP difference CPT	16.62±8.03	17.06±8.31	15.56±8.65	14.85±7.22	0.527
DBP difference CPT	14.62±7.96	15.74±5.16	15.60±6.36	15.57±6.29	0.943

*P-value <0.05 is considered statistically significant.

Table 4 shows that the mean SBP and DBP difference HGT was similar between various ABO blood groups and the difference was statistically insignificant (P >0.05). Intergroup comparison of SBP and DBP difference HGT was also statistically insignificant. Similarly, in case of CPT, mean SBP and DBP difference CPT was similar

between various blood groups and the difference was statistically insignificant (P >0.05). Intergroup comparison of SBP and DBP difference CPT was also statistically insignificant. The above results indicated that there is no statistically significant difference in sympathetic response to stressor between subjects with different ABO blood groups.

DISCUSSION

Blood group antigens are primarily tissue antigens and are widely distributed throughout the body. Both the ABO and Rh blood groups systems have been associated with a number of diseases, but this is more likely related to the presence or absence of these tissue antigens throughout the body and not directly or primarily related to their presence on RBCs.[5] Many diseases, especially cardiovascular diseases, digestive disorders, cancer, and infection express preferences choosing between the ABO blood types.[20-24] Cardiovascular disease is one of the major causes of sudden death.

Studies have been done in the past between relation of blood group and the risk of developing cardiovascular diseases in future.[6] Abnormal autonomic response also plays a role in cardiac morbidity. In this study, an attempt was made to determine the autonomic nervous system response to a stimulus and its variation with ABO blood group system.

In this study, the various demographic and anthropometric parameters (Table 1) of the subjects with different blood groups did not differ significantly. The basal heart rate of group O was higher when compared with group A. Evaluation of the status of the autonomic nervous system was assessed with the help of various non-invasive tests like lying to standing test, Valsalva maneuver, sustained hand grip test and cold pressor test. Evaluation of parasympathetic system tests primarily provides an index to cardiac vagal functions. While sympathetic tests are of prognostic importance to determine sympathetic reactivity. In this study, comparison of parasympathetic tests between different ABO blood groups was not statistically significant (P >0.05). There was no statistically significant difference in sympathetic response to a stressor (HGT, CPT) between subjects with different blood groups.

Anthony DM et al, in his study also did not find the relation between the blood pressure rise and different ABO blood groups.[16] The results of this study are in contrast to the study by Uppangala C et al, who compared heart rate variability (HRV) in different ABO blood groups of young adults and found O group had better HRV during deep breathing hence, predicting some protection from cardiovascular disease.[17] Since, there are very few studies, author cannot be sure whether there is a correlation-causal or otherwise. Research is complicated for several reasons- the ABO blood group system is highly polymorphic, with more than 20 distinct sub-groups, study findings are usually related to ABO phenotype but rarely to the ABO genotype, secretor status, and Lewis phenotype and animal models are unsatisfactory because their antigen glycosylation structure is different from humans.[25] How the blood group and surface antigens play a role in disease is only beginning to be investigated with sophisticated modern technologies, including recent studies of microbiome and metabolome associations with blood groups.

The sample size in the present study is small, especially the sample was drawn from one limited geographical area, which is inadequate for extrapolating the application of these findings to the general population. HRV as an autonomic function test could not be done because of limited sources, which could have specified the results.

CONCLUSION

Present study leads us to conclude that the ABO blood group system has no effect on cardiac autonomic function. Further studies are needed in this area that may implicate a particular type of blood group to abnormal autonomic response.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee of M. M. Institute of Medical Sciences and Research, Mullana, Haryana, India

REFERENCES

1. Mohandas N, Narla A. Blood group antigens in health and disease. Current Opinion Hematol. 2005;12(2):135-40.
2. Cartron JP, Colin Y. Structural and functional diversity of blood group antigens. Transfusion Clin Biolog. 2001;8(3):163-99.
3. Sandler SG, Mallory D. Biological functions of blood groups in health and disease. Haematol. 1995;27(1):1-3.
4. Amjadi O, Rafiei A, Ajami A, Valadan R, Janbaabaei G. Blood groups: In Health and Diseases. Res Mol Med. 2015;3(4):1-9.
5. Garratty G. Blood groups and disease: a historical perspective. Trans Med Rev. 2000;14(4):291-301.
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. Arteriosclerosis Thrombosis Vascular Biol. 2012;32(9):2314-20.
7. Pramanik T, Regmi P, Shrestha P. Detection of individuals prone to develop hypertension in their future life. Nepal Med Coll J. 2008;10(1):35-7.
8. Schneider GM, Jacobs DW, Gevirtz RN, O'Connor DT. Cardiovascular haemodynamic response to repeated mental stress in normotensive subjects at genetic risk of hypertension: evidence of enhanced

reactivity, blunted adaptation, and delayed recovery. J Human Hypertension. 2003;17(12):829.
9. Singh JP, Larson MG, Manolio TA, O'Donnell CJ, Lauer M, Evans JC, et al. Blood pressure response during treadmill testing as a risk factor for new-onset hypertension: the framingham heart study. Circulation. 1999;99(14):1831-6.
10. Champlain J, Ameringen MR. Regulation of blood pressure by sympathetic nerve fibers and adrenal medulla in normotensive and hypertensive rats. Circulation Res. 1972;31(4):617-28.
11. Mancia, Marco Di Rienzo, Cristina Giannattasio, Gianfranco Parati, Guido Grassi G. Early and late sympathetic activation in hypertension. Scandinavian Cardiovascul J. 1998;32(47):9-14.
12. DeQuattro V, Feng M. The sympathetic nervous system: the muse of primary hypertension. J Human Hypertension. 2002;16(S1):S64.
13. Rafiq N, Trigotra S, Nabi T. Sympathetic Overactivity in Offsprings with Hypertensive Parents. IJSR. 2018; 7(2): 18-22.
14. Rafiq N, Nabi T, Nazeer M. Cardiac Autonomic Dysfunction Contributes to Prehypertension Status. IJAR. 2018; 8(4): 19-21.
15. Rafiq N, Nabi T, Aara S, Arifa Q. Influence of Gender on Cardiac Autonomic Reactivity in Young Adults. JMSCR. 2018; 6(2): 810-7.
16. Anthony DM, Hamid SH, Rashmi TM. Autonomic Response to Cold Pressor Test in Relation to ABO Blood Groups. International Research Journal of Biological Sciences. 2013; 2(10):30-5.
17. Uppangala C, Kodavanji B, Na V, Noojibail A, Kini RD, Arunkumar N, et al. Comparison of heart rate variability in different ABO blood groups of young adults. Inter J Med Sci Pub Heal. 2014;3(12):1466-70.
18. Khandelwal E, Jaryal AK, Deepak KK. Cardiovascular autonomic functions and cerebral autoregulation in patients with orthostatic hypotension. Ind J Med Res. 2011;134(4):463.
19. Deepak D, Sinha AN, Gusain VS, Goel A. A study on effects of meditation on sympathetic nervous system functional status in meditators. J Clin Diagn Res. 2012;6(6):938.
20. Mentis A, Blackwell CC, Weir DM, Spiliadis C, Dailianas A, Skandalis N. ABO blood group, secretor status and detection of Helicobacter pylori among patients with gastric or duodenal ulcers. Epidemiol Inf. 1991;106(2):221-9.
21. Abdollahi AA, Qorbani M, Salehi A, Mansourian M. ABO blood groups distribution and cardiovascular major risk factors in healthy population. Iran J Pub Heal. 2009;38(3):123-6.
22. Callender S, Langman MJ, Macleod IN, Mosbech J, Nielsen KR. ABO blood groups in patients with gastric carcinoma associated with pernicious anaemia. Gut. 1971;12(6):465-7.
23. Kumar NC, Nadimpalli M, Vardhan VR, Gopal SD. Association of ABO blood groups with Chikungunya virus. Virol J. 2010;7(1):140.
24. Rowe JA, Opi DH, Williams TN. Blood groups and malaria: fresh insights into pathogenesis and identification of targets for intervention. Current Opinion Hematol. 2009;16(6):480.
25. Greenwell P. Blood group antigens: molecules seeking a function?. Glycoconjugate J. 1997;14(2):159-73.

Cite this article as: Rafiq N, Nabi T, Arifa Q. Comparison of cardiac autonomic response in different ABO blood groups of young adults. Int J Res Med Sci 2019;7:1276-81.