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Original Article

A prospective study on the relationship between blood pressure and blood group among adult male blood donors in a Tertiary care center

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Abstract

Background and Aim: The ABO blood type, an easily accessible factor in patient's genetic make-up has been associated with many diseases; perhaps the ABO antigens play a role by influencing renin levels. It may be speculated that since blood pressure (BP) is multifactorial, the ABO antigens may indirectly influence arterial pressure. Therefore, in the present study, we intend to assess the relationship between BP and blood group among the male blood donors (20–60 years) attending the blood bank in a tertiary care center.

Methods: Basal cardiovascular parameters such as basal heart rate, systolic BP, diastolic BP (DBP) and rate pressure product (RPP) were recorded. ABO and Rh (D) blood groups were also determined for each subject. Tube test for ABO and Rh typing of red cells and serum typing was done on the donor blood samples.

Results: The test group comprised of 767 subjects within the age-group of 20–60 years. All the values were expressed as mean ± standard deviation with the $P < 0.05$ as statistically significant. DBP was found to be significantly associated with blood group.

Conclusion: There was a positive correlation between DBP and blood groups, but RPP was not found to be significant between the groups. Hence, we presume that further studies with a population-based screening of various blood groups might help in identifying and modifying the risk factors for hypertension.

Key words: ABO blood group, diastolic blood pressure, hypertension systolic blood pressure

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INTRODUCTION

Hypertension has been termed "silent killer", a chronic illness with a long asymptomatic phase that if undetected and untreated silently damages the heart, brain and kidneys. It is estimated to cause 7.1 million deaths globally (13% of total).[1] In developing countries, hypertension is on the rise due to the increase in urbanization and adoption to western lifestyles.[2] Hypertension in adults has a large impact on the quality of life of individuals and economic burden of the country.[3] Since uncomplicated hypertension is an asymptomatic condition, many people are unaware that they have high blood pressure. Therefore, diagnosis of hypertensive patients is of paramount importance. But, to diagnose hypertension, recognition of its probable risk factors would be important.[4] Both normotensive and hypertensive persons show tremendous inter individual variability in their blood pressure responses to dietary sodium. This variability which has lead to some questioning about the "salt hypothesis" indicates a strong genetic underpinning.[1]

The ABO blood group system, which was the first human blood group system to be discovered, is exclusively and integrally heritable, genetically determined at conception and remain fixed for the life. Hence, its frequency distribution follows a known

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pattern governed by gene transmission from generation to generation and varies with the race and geographical distribution of the human being.[5] Familial patterns of primary hypertension are common. This familial pattern suggests that there could be some genetic factors for the development of hypertension. There are reports of increased cardiovascular (CV) risks in different blood groups and increase in BP is considered as a common CV risk. Therefore, in the present study, we have assessed the prevalence of high BP in individuals with different blood groups, donating blood in a tertiary care hospital.

MATERIALS AND METHODS

Hospital-based cross-sectional study was carried out on male blood donors aged between 20 and 60 years attending the MOSC Medical College, Blood bank from March 2014 to August 2014 (6 months). The study group comprised of 767 subjects. All procedures were approved by the MOSC Ethics Committee, and all subjects gave informed written consent to participate in the study.

Inclusion criteria

- Subjects >20 years and <60 years
- Newly diagnosed hypertensives who are not on any antihypertensive medication
- Body weight >45 kg

Exclusion criteria

- Subjects <20 years and >60 years
- Previously diagnosed hypertensives and who are on antihypertensive medication
- Subjects diagnosed as diabetic
- Subjects with renal disorder

Data collection method

Detailed history about the name, age, occupation, personal, past history and habits of the subjects was taken. The parameters such as systolic BP (SBP), diastolic BP (DBP) and resting heart rate were measured. Family history of hypertension and diabetes, was enquired.

Procedure of recording basal heart rate and blood pressure

The basal heart rate, SBP, and DBP [Table 2: JNC staging][6] was recorded with a mercury sphygmomanometer, in the right upper limb by both palpatory and auscultatory method. They were recorded in the resting supine position. Two recordings were taken, and their average was recorded. All efforts were made to minimize the factors, which might affect BP such as anxiety, fear, stress, and recent activity. If the two recordings differ by >4 mmHg, additional readings were taken. Rate-pressure product (RPP), a determinant of myocardial oxygen consumption and work load was calculated using the formula,

$$RPP^{[7]} = (BHR \times SBP) \times 10^{-2}$$

Procedure of blood grouping in the blood bank

Tube test for ABO and Rh typing of red cells and serum typing is done on the donor blood samples.

Determination of ABO type of red cells

One volume each of anti-A and anti-B (RhESOLVE-Ortho clinical diagnostics) was placed in clean, labeled test tubes. To each tube, one volume of 2–5% cell suspension of the red cell to be tested is added, and the contents are mixed gently and centrifuge at 1000 rpm for 15–30 s. The cell button is resuspended gently and examined for agglutination. The results were interpreted and recorded.

Rh typing

One volume of anti-D (Bioclone-Ortho clinical diagnostics) is placed in a clean, labeled test tube. One volume of red cell to be tested is added to the test tube and was mixed gently and centrifuge at 1000 rpm for 30–60 s. The cell button was gently resuspended and examined for agglutination. The reaction is read, interpreted, graded and recorded.

Serum grouping

Group A, B and O red cell reagents are prepared by pooling three samples of each group and washing the cells in normal saline 3 times and make a 2–5% cell suspension. 3 clean test tubes are labeled A, B and O and 2–3 volume of serum to be tested are added to each tube. One volume of "A", "B", "O" reagent red cell to tube labeled A, B, O, respectively, and the contents are mixed gently and centrifuge for 15–30 s at 1000 rpm. The cell button is gently resuspended and examined for agglutination or hemolysis. The test results are read, interpreted and recorded and compared with the corresponding cell grouping results.

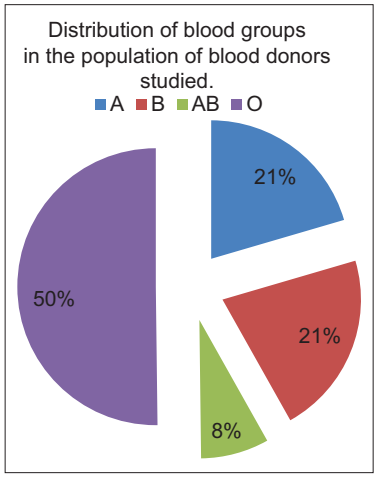

Figure 1: Frequency distribution of blood group

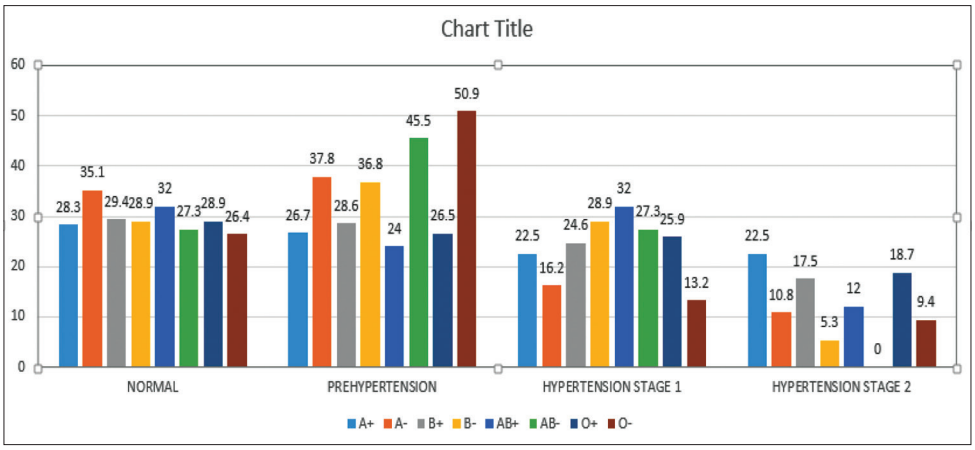

Figure 2: Systolic BP values in different blood groups

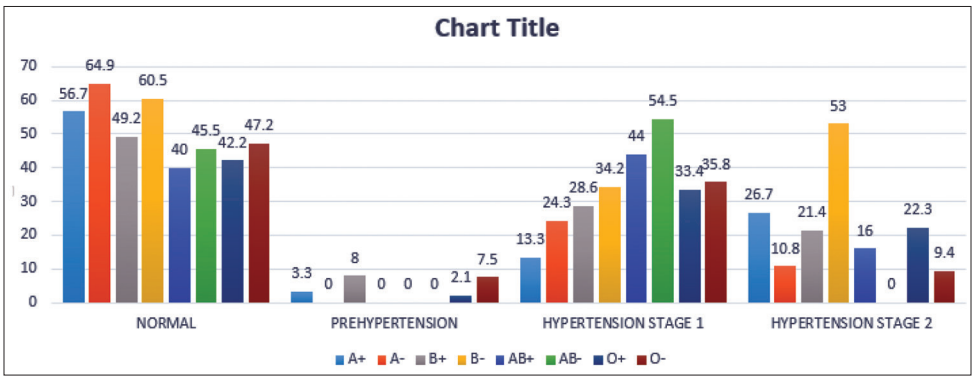

Figure 3: Diastolic BP values in different blood groups

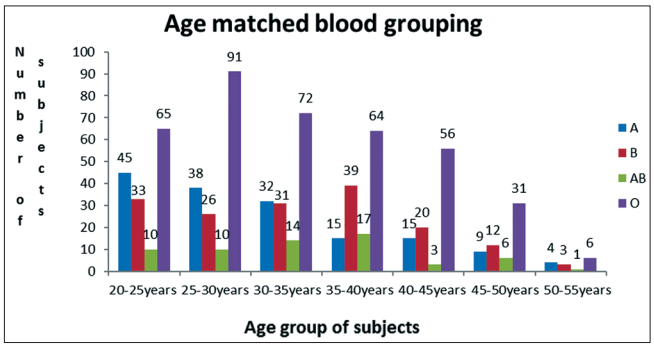

Figure 4: Age-matched blood grouping

Statistical analysis of data

Quantitative data were analyzed using mean, qualitative data using proportions. Chi-square was applied to find the association between qualitative variables and ANOVA was used to find the difference between the mean SBP, DBP and RPP with regard to various blood groups.

RESULTS

The incidence of SBP < 120 mmHg is more common in blood group A^- (35.1%), followed by AB^+ (32%), B^+ (29.4%), B^- (28.9%), O^+ (28.9%), A^+ (28.3%), AB^- (27.3%) and O^- (26.4%). The incidence of SBP between 120 mmHg and 140 mmHg is more common in blood group O^- (50.9%), followed by AB^- (45.5%), A^- (37.8%), B^- (36.8%), B^+ (28.6%), A^+ (26.7%), O^+ (26.5%) and AB^+ (24%). The incidence of SBP between 140 mmHg and 160 mmHg is more common in blood group AB+ (32.0%), followed by B^- (28.9%), AB^- (27.3%), O^+ (25.9%), B^+ (24.6%), A^+ (22.5%), A^- (16.2%) and O^- (13.2%). The incidence of SBP > 160 mmHg is more common in blood group A^+ (22.5%), followed by O^+ (18.7%), B^+ (17.5%), AB^+ (12.0%), A^- (10.8%), O^- (9.4%), B^- (5.3%) and AB^- (0%). These results were not found to be statistically significant (Chi-square value: 30.263 and $P = 0.087$).

The incidence of DBP <80 mmHg is more common in blood group A^- (64.9%) followed by B^- (60.5%), A^+ (56.7%), B^+ (49.2%), O^- (47.2%), AB^- (45.5%), O^+ (42.2%) and AB^+ (26.4%). The incidence of DBP between 80 mmHg and 89 mmHg is more common in blood group B^+ (8%), followed by O^+ (7%), O^- (4%), A^+ (3.3%), A^- (0%), AB^- (0%), B^- (0%) and AB^+ (0%). The incidence of DBP between 90 mmHg and 99 mmHg is more common in blood group AB^- (54.5%) followed by AB^+ (44%), O^- (35.8%), B^- (34.2%), O^+ (33.4%), B^+ (28.6%), A^- (24.3%) and A^+ (13.3%). The incidence

Table 1: Age, HR, SBP and DBP parameters of subjects of different blood groups expressed in mean±SD

Parameters	A	B	AB	O	*P**
Age (years)	31.48±8.35	34.10±8.46	34.11±7.49	33.78±8.33	0.01
HR (bpm)	78.49±7.58	79.95±7.37	78.39±6.88	78.28±8.60	0.15
SBP (mmHg)	136.58±21.27	135.64±18.52	133.77±16.21	136.90±19.56	0.65
DBP (mmHg)	86.21±13.61	87.26±12.13	86.98±10.14	88.27±12.75	0.35
RPP (mmHg/min)	108.63±27.31	109.61±25.15	105.75±21.59	108.61±27.31	0.81

*Significance was tested using one-way ANOVA. However, since the results are not found to be significant, *post-hoc* Tukey's test was not performed. SBP: Systolic blood pressure, DBP: Diastolic blood pressure, HR: Heart rate, SD: Standard deviation, RPP: Rate pressure product

Table 2: JNC staging of DBP

BP stage	SBP	DBP
Normal	<120	<80
Prehypertension	120-139	80-89
Stage 1 hypertension	140-159	90-99
Stage 2 hypertension	≥160	≥100

Lee Goldman, Andrew I Schafer: Goldman's CECIL MEDICINE 24th ed. Elsevier Saunders; P. 374 Table: 67-1. SBP: Systolic blood pressure, DBP: Diastolic blood pressure, BP: Blood pressure, JCN: Joint national committee

of DBP > 100 mmHg is more common in blood group A^+ (26.7%) followed by O^+ (22.3%), B^+ (21.4%), AB^+ (16.0%), A^- (10.8%), O^- (9.4%), B^- (5.3%) and AB^- (0%). The results analyzed were found to be statistical significant ($P < 0.001$ and Chi-square value: 54.801) [Table 1 and Figures 1-4].

There was no statistically significant association between blood group and RPP ($P = 0.81$).

DISCUSSION

High blood pressure is a major public health threat in India, which is rapidly increasing in both urban and rural populations.[7,8] The estimated total number of adults with hypertension around the globe in 2000 was 972 million (957-987 million). Especially in the economically developed and developing countries it is 333 million (329-336 million) and 639 million (625-654 million) respectively. The number of adults with hypertension in 2025 was predicted to increase by about 60% to a total of 1.56 billion (1.54-1.58 billion). Most of this rise can be attributed to an expected increase in the number of people with hypertension in economically developing regions.[9] Surveys of 26,000 adults in South India showed a hypertension prevalence of 20% (men 23% women 17%) but 67% of those with hypertension were unaware of their diagnosis [Table 2].

Though, hypertension is common in the general population. Until date, no study has been conducted to assess the prevalence of high BP among the blood donors in Indian population. Although BP is recorded routinely in blood donors of all blood groups, the data have never been computed and analyzed to know the prevalence of hypertension across the blood groups. Majority of hypertensive subjects still remain undetected, and the control of hypertension is also inadequate. This calls for urgent prevention and control measures for hypertension.[10] The RH locus has been reported to be composed of two homologous structural genes, one encoding the RH D polypeptide and the other encoding both the Cc and the Ee polypeptides. These findings thus suggest the genetic basis of essential hypertension in populations of different ethnicity.[11,12]

Thus, a nonmodifiable factor like blood group can be used as a predictor for hypertension and its awareness in the population can be used to initiate lifestyle modifications in the susceptible category. In this study, assessment of distribution pattern of ABO blood groups in a population of 767 male blood donors was done to identify the relationship of ABO blood groups with hypertension.

Blood group O is the most common group in India as evident from various studies. More than 60% of the population in India has blood group O and A. The least common group is AB blood group. A similar pattern was also seen in our study. Previous studies carried out by Alam *et al*. observed no significant difference in SBP and DBP among all blood groups.[13] However, in our study, it was found that the association between DBP and blood group was statistically significant with B^+ in the prehypertensive, AB^- in stage-I hypertension and A^+ in the Stage II hypertension categories, as per the JNC staging.[6] Previous studies have also reported higher DBP in subjects with blood group O than in their siblings with other ABO blood types from a study of 5777 members of 1068 Brazilian families, indicating the importance of genetic factors in familial aggregation of BP level.[14] However, our study does not reveal any particular ABO antigen or Rhesus factor as being prone for hypertension. This could be due to the influence other factors capable of modifying the BP.

Though, the rise in DBP *per se* is the CV risk, RPP an indicator of myocardial work load and oxygen consumption was apparently normal in different blood groups. This is the first study conducted in a larger population for reporting the BP level in different blood groups. However, studies

should be conducted in still larger cohort to assess the BP variability, and baroreceptor sensitivity for the estimation of CV risk in different blood groups.

Limitations of the study

Though, the strength of the study is the cohort sample size, only males have been included in this study, as the donors at the blood bank are usually males. However, this does limit the clinical application of the study.

CONCLUSION

DBP was found to be significantly associated with blood group, whereas the SBP and RPP did not show any statistical significance. This could be due to the other factor modifying BP. Hence, future large-scale studies are warranted in order to study the preponderance of any particular blood group antigen in the development of hypertension.

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