Original Article

Expanding role of a blood center

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Abstract:

Materials and Methods: The study was performed on prospective donors who reported to the Department of Transfusion Medicine. Individuals deferred due to hypertension contributed the study population. They were compared with age and sex matched donor controls. Demographic details were recorded in a proforma. On identification of a hypertensive individual, consequent two comparable donors were taken as controls with a total of 50 hypertensive subjects. Hypertensive status of the subjects were assessed based on the criteria formulated by the WHO-ISH and US Seventh Joint National Committee report on prevention, detection, evaluation and treatment of high blood pressure. **Results:** About 0.95% of healthy blood donors had undetected hypertension. Mean age at detection of hypertension in the study group was 35.44 ± 7.69 years. Higher BMI was observed in the hypertensive group compared to normotensive control group with *P* value significant at 0.0001. **Conclusion:** About 1% of healthy individuals were found to have undetected hypertension. Though the study was not designed to determine the prevalence of hypertension in the region, it is a rough estimate of the proportion of undetected hypertension in the local population as donors are considered as representative of healthy population.

Key words:

Blood donation, hypertension, high ferritin and hematocrit

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Introduction

Number of donors coming for donation gives an opportunity for Blood Center to expand their role as not only a place to donate blood but also contribute in the health of the donor and community. This can accentuate the flow of blood donors and enhance blood supply.[1] Such a positive interaction can encourage more people for donation. Donors receive a mini check up as part of donor selection with estimation of pulse, blood pressure and hemoglobin determination. Advice given as part of health issues in the Blood Bank can go a long way as a place to monitor personal health parameters as well. This paper summarizes the various measures undertaken by the Blood Bank in promoting the health of the donor based on studies conducted.

As part of routine procedure, donors were checked for weight, height, pulse, BP, chest examination and clinical assessment of anemia. In addition to that, screening program was conducted for the determination of ferritin and hematocrit values which are known potential cardiovascular risk factors.

Hypertension

Hypertension is estimated to cause 7.1 million premature deaths and 4.5% of the disease burden (64 million disabilities –adjusted life years (DALYs). Proportion of global disease burden attributable to hypertension is approximately one million people worldwide with prevalence in many developing and developed countries.[2] Hypertension affects approximately 50 million people in the USA and between 15-35% of urban and adult population of Asia.[3,4] Hypertension usually does not have any warning signs and has been called the 'silent killer'. It is usually detected when an individual becomes symptomatic as routine checkup of healthy individuals is not a practice in our population. Objectives of the study were to ascertain the proportion of hypertensive individuals in the healthy donor population, determine the mean age of onset of hypertension and identify demographic risk factors. Analyzing the causes of deferral among donors over a period of three years, it was seen that 18.4% were rejected on the basis of hypertension. Apart from losing donors, this has a negative impact on future donor return rates to the Blood Bank. In addition, the sequelae of hypertension such as cardiac failure, renal failure, stroke and sudden death etc. with increased risk of morbidity and mortality pose a public health problem too. The study was, therefore, taken up with the aim of determining the prevalence of risk factors among apparently healthy donor population and to identify plausible risk factors.

Materials and Methods

The study was undertaken with the approval of Institute Ethics Committee. All consecutive prospective donors who reported to the Blood Bank were screened. For health screening of blood donors, donor registration card was used. A blood donor is expected to be a healthy individual with a weight

(≥45 kg) and hemoglobin (12.5 g/dl and above), normotensive and pulse rate within normal limits with no major illness or surgeries or blood transfusions in the last one year and, with no drug intake or medications for acute and chronic infections. Individuals deferred due to hypertension constituted the study population. They were compared with age and sex matched non-deferred (accepted) donor controls. Informed consent prepared both in English and vernacular was obtained for detailed data collection from both groups. Demographic details like age and sex, height and weight, education and occupational status, food habits, smoking, alcohol intake, use of oral contraceptives, self reported history of diabetes and medications were recorded in a performa. Parental consanguinity and history of hypertension and diabetes among their parents and siblings were also recorded to examine any familial tendency. Weight and height were recorded for calculation of BMI. All donor data, males and females reporting to the Blood Bank were recorded in the performa for this pilot study. Rural/urban residence status was obtained from the donor card.

Sample size and sampling method

On identification of a hypertensive individual, consequent two comparable donors were taken as controls. A total of 50 hypertensive subjects were detected during the period of study and the sample size appeared to be sufficient for recording the demographic information.

Blood pressure and anthropometric measurements

The hypertension status of the subjects was assessed based on the criteria formulated by the WHO/International Society of Hypertension (WHO-ISH) and US Seventh Joint National Committee report[5] on the prevention, detection, evaluation and treatment of high BP (SBP-140 mm Hg or DBP-90 mm of Hg). Both systolic and diastolic readings were recorded to the nearest 2 mm of Hg.

If the difference between the first and the second BP readings were more than 4 mm of Hg for either SBP or DBP, a third measurement was taken. The average of the readings of SBP and DBP was taken as the BP of the participant.[6] Pulse pressure was calculated as the difference between systolic and diastolic blood pressures. Body weight and height of all participants were measured using a standardized protocol.[7] Weight was recorded to the nearest 0.5 kg and height was measured to the nearest 0.5 cm. BMI was computed as the weight in kg divided by the square of the height in meters. A pre tested structured questionnaire to collect information on demographic characteristics, medical history and information on lifestyle habits was collected by the doctor.

Statistical treatment of data

Quantitative variables like age, body weight and height, systolic and diastolic blood pressure were recorded as actual and qualitative variables were categorized. Participants were asked to report the highest level of education they had attained (<10^{th} and ≥ 10^{th}), physical activity was divided into sedentary, mild, moderate and heavy. Socio economic status was grouped into lower, middle and upper based on their education and occupation. Pulse pressure was divided into three groups as ≤ 40, 41 to 60 and > 60 mm of Hg. History of consanguinity, oral contraceptives and self reported diabetes were taken as 'yes' or 'no'. Family history was recorded for first degree relatives and considered positive when any of the relatives were affected with hypertension or hypertension induced complications. BMI was categorized as < 20, 20-24, 25-29 and 30.

Statistical analyses

The variables as recorded were analyzed using SPSS package 14.0 for Windows. Data were presented as mean ± SD for quantitative variables and frequency distribution for qualitative variables. Statistical tests of significance applied were ANOVA, Bonferroni t-test and Chi square. A *P* value less than 0.05 was considered statistically significant.

Results

Verification of records over a period of three years (2004-06), showed that out of a total of 18452 donors, 951 were deferred and, among them 175 were due to hypertension. Thus about 0.95% of healthy blood donors had undetected hypertension. Characteristics of the study and control subjects are presented in Table 1. The mean age at detection of hypertension in the study group was 35.44 ± 7.69 yrs with a range from 23 to 53 years. The incidence increased with increasing age. The proportion of hypertensive's in the younger age group with less than 30 was 1.8% (12/681) followed by 10.6% (25/237) in the age group of 30-39 and 21.3% (13/61) in those above 40 years. There were only three females among the donors found to be hypertensive. This is in commensurate with the limited number of females donating blood. One significant observation is the higher body mass index in the hypertensive group compared to control group with odds ratio of 4.71 (95% CI 2.098-10.590 with $P < 0.0001$). Mean systolic and diastolic BP was higher in hypertensive group compared to normotensive control group with *P* value significant at 0.0001 [Table 2]. Among the hypertensive individuals, proportion of individuals with a pulse pressure of > 60 was significantly more [Table 3]. Family history of hypertension, CAD and stroke were significantly high among those with hypertension ($P < 0.002$, 0.006 and 0.001 respectively). The odds ratio for positive family history of hypertension was 2.325 (95% CI, 1.0162-5.324). The prevalence of parental consanguinity was higher among hypertensive, though the difference was not significant [Table 4].

Table 1: Blood Donor Characteristics

	Control (n=100)	Study (n=50)
Age (Years)	35.09 ± 7.29	35.44 ± 7.7
Weight (Kg)	68.71 ± 8.96	75.00 ± 10.93*
Height (m)	1.70 ± 0.07	1.69 ± 0.64*
BMI (kg/m²)	23.69 ± 2.80	25.97 ± 2.77*

Values represent mean ± SD, *P value < 0.0001

Table 2: Systolic and Diastolic Blood pressure of Blood Donors

	Control (n=100)	Study (n=50)
SBP (mm Hg)	126.02 ± 7.83	152.16 ± 8.87*
DBP (mm Hg)	80.50 ± 5.25	98.72 ± 5.04*

Values expressed as mean ± SD, *P value<0.0001

Table 3: Pulse Pressure of Blood Donors

Pulse pressure	Control (n=100) %	Study (n=50)* %
≤40 mm Hg	46	8
41-60 mm Hg	54	66
> 60 mm Hg	0	26

*x^2_4 $P < 0.0001$

Table 4: Family History and Consanguinity

	Control (n=100) %	Study (n=50)* %
Normal	31	18
Hypertension	15	16*
DM	19	6
CAD	8	6*
Stroke	16	18*
Hypertension/DM	7	30
Hypertension+CAD+Stroke	4	4
DM+CAD/Stroke	0	2
Parental Consanguinity	5	8

*x^2_1, $P < 0.01$

Hypertension is an important cause of cardiovascular morbidity and mortality with high prevalence reported among middle aged individuals and positivity associated with increasing age and elevated BMI.[8] It is being increasingly known that high BP is an important public health problem in developing countries.[9,10] When an individual presents with cardiovascular or renal sequelae of chronic hypertension, the damage is usually done. It is therefore essential to detect and regulate blood pressure before it becomes symptomatic. About 1% of healthy individuals were found to have undetected hypertension. Though the study was not designed to determine the prevalence of hypertension in the region, this is likely a rough estimate of the proportion of undetected hypertensive in the local population, as donors can be considered as a representative of healthy individuals. The prevalence and causative factors vary between populations due to both genetic and environmental factors. Overweight, sedentary behavior, alcohol intake, higher social class, diabetes mellitus, salt intake and smoking are risk factors for hypertension, in most of the countries in Asia.[4] The study showed a positive association with increasing age. Another important observation was the association of higher body mass index with hypertension. An increase in BMI above 27 has also been reported to be associated with high risk of CAD, hypertension and other chronic diseases.[11] An increased pulse pressure is a good measure of the inelasticity of the arteries. It is linked to an increased risk of heart attack, heart failure and stroke. Pulse pressure higher than 60 was more frequently seen among untreated and newly detected hypertensive. Compared to other parameters, baseline pressure measurements including pulse pressure are the best predictors of cardiovascular mortality.[12] There was also significantly higher incidence of positive family history among hypertensive [Table 4]. A number of life style modifications have been shown in clinical trials to lower BP and incidence of hypertension. These include weight loss in the obese, physical activity, moderation of alcohol intake, diet with increased fruits and vegetables and reduced saturated fat content, reduction of dietary sodium intake and increased potassium intake.[13-18] Other risk factors associated with population transition from rural to urban economies also contribute to greater food consumption and sedentary life style.[19] This study gives a rough estimate of the liability to hypertension among the apparently healthy population of the region. No significant differences were observed for the demographic variables like education, socio-economic status and place of residence. Physical activity, food habits, smoking and alcohol intake were comparable between the two groups of donors. None of the females reported the use of oral contraceptives.

Thus increasing age, higher BMI and positive family history can be considered as the major predisposing factors for hypertension in the local population. There is growing need for health education and health screening among the blood donors as well as the general population on hypertension awareness and preventive measures.[20,21] Offering health screens appears to motivate many potential candidates for blood donation and is widely appreciated by them as a means of early health seeking. Awareness of hypertension among our blood donors is poor. Identification of plausible risk factors will help in planning interventional programs like dissemination of information on life style modification and health education.

Limitations of the study

One limitation of the study was the inability to confirm the hypertensive status by repeated recording of blood pressure at longer time intervals. Another possible bias is that only the apparently healthy individual volunteer to donate blood and some undetected hypertensive may not come to Blood Bank due to general feeling of malaise. Hence the estimate of hypertensive may be more. Donors are in the selected age group of 18 to 60 years and this is not likely to affect the results as hypertension becomes symptomatic generally in this age group.

High ferritin

Further focus was on ferritin, the iron storage protein. Iron has been suggested to play a role in the development of cardiovascular disease (CVD) through its pro-oxidant properties. Although iron is an essential and important nutrient, excess levels can cause adverse effects. Iron is a catalyst of free radical production and a major oxidant *in vivo*.

Ferritin has been described in atherosclerotic lesions, suggesting that iron play a role in its development.[22] Iron may accelerate the progression of atherosclerosis by stimulating the formation of oxidized low density lipoprotein (LDL), a major atherogenic factor. Also increased iron stores predict the development of diabetes in epidemiological studies.[23] Study was conducted to estimate serum ferritin, total iron binding capacity (TIBC) and transferrin saturation (TS) in regular blood donors and persons who have never donated blood.

Materials and Methods

The study was undertaken for a period of two years. Regular blood donors with not less than 10 donations in the last three years were selected from the voluntary blood donor list. Healthy adult males who have never donated blood were included as controls. Subjects with history of recent infection, inflammation or hepatic disease were exempted from study. They also did not have history of diabetes, hypertension and drug intake including iron or vitamins or acute blood loss. After 12 h of fasting, blood was collected and serum was seperated for estimation of serum iron, serum ferritin, and total iron binding capacity. Serum iron and TIBC was estimated by calorimetric assay and ferritin by ELISA method. Transferrin saturation was calculated by dividing the value of serum iron by TIBC.

Results

51 regular donors and 54 controls were included in the study.

Mean age of regular donors was 38.5 and mean age of control group was 31.4 years. The mean ferritin value in regular donors were 36.1 (SD 48.2), where as the mean ferritin in non donors were 93.6 (SD 97.8). Mean TIBC in regular donors was 313 (SD 55.4) and TIBC in non donors was 259 (SD 117). Transferrin saturation in regular donors was 26.6 (SD 8.4) and in non donors 34.9 (SD 9.4). Statistical significance was observed in the two groups for all the three parameters. The results are shown in the Table 5.

Discussion

Iron is a powerful prooxidant and oxidative stress is increased with increasing iron levels. Serum ferritin concentration had a positive correlation with blood glucose concentration, serum triglyceride concentration, and systolic blood pressure. Excess iron can destroy the insulin secreting cells of the pancreas and cause diabetes because pancreatic cells are highly sensitive to free radical attack. Both experimental and epidemiological findings support the hypothesis that lowering iron availability can decrease risk of coronary events. Salonen *et al*.[24] studied the effect of phlebotomy on the oxidation resistance of serum lipoproteins and demonstrated that increased oxidation resistance resulted from reduced ferritin level. In 1991 Sullivan proposed that blood donation could be used to prevent coronary vascular disease.[25]

Conclusion

Blood which is low in ferritin and low in transferrin saturation has more antioxidant property. Therefore, regular donors are benefited by increased antioxidant property in their blood. Hence regular blood donors by virtue of their low ferritin levels are less vulnerable to development of metabolic syndrome. Although various steps have been suggested for reducing body iron levels like drugs to reduce iron absorption and use of iron chelating agents, phlebotomy appears to be the safest method.

High hematocrit

Hematocrit is the most important determinant of whole blood viscosity. Blood viscosity and vascular resistance affect the total peripheral resistance to blood flow which is abnormally high in the established phase of primary hypertension.[26,27] Clinical studies have reported that increase of Hct is followed by increase in BP and possibly onset of hypertension in anemic patients.[28] Hematological disorders with an elevated Hct have an increased incidence of thromboembolic complications, including ischemic stroke. The size of the cerebral infarct accompanying carotid occlusion is greater in patients with an elevated hematocrit.[29]

Blood donors are generally screened for anemia. Usually little attention is paid to hematocrit (Hct) levels at the upper limit of normal, although it is known that Hct values over 0.48 may be a sign of disease and risk factor for vascular accidents.[30] A pilot study was conducted to find out the actual hemoglobin and Hct in 94 first time blood donors who came for blood donation in one month.

Table 5: Iron parameters in regular donors and others

Study group	Serum Ferritin µg/ l	TIBC µg/dl	Transferrin saturation %
Regular donors	36.1 (SD 48.2)	313 (SD 55.4)	26.6 (SD 8.4)
Non donors	93.6 (SD 97.8)	259 (SD 117)	34.9 (SD 9.44)

Materials and Methods

After the usual counseling and medical checkup, donors donated blood. All the first time male donors who donated in a month, irrespective of age and weight were included in the study and were given a questionnaire on parameters such as age, food, smoking and drinking habits. Data was obtained from 94 first time donors out of 550 donations. Post blood collection, a 2 ml blood sample was collected in EDTA along with sample for screening purposes. Hemoglobin and Hct were estimated by the cell counter. Depending on Hct values, donors were divided in to two groups- Hct up to 0.48 and above 0.48.

Results

Results showed that 66/94 had Hct values < 0.48 and 28/94 had > 0.48. When comparing the hemoglobin level, all the 28/94 group had Hb > 16. Comparing the age, 20/28 was below 30 years, 8/28 above 30 years, 40/66 were below 30 yrs and 26/66 were above 30 yrs. There was no significant difference in the age between the normal and high Hct groups. Mean age in < 30 years. group with Hct < 0.48 and > 0.48 was 24.8 ± 3.56 and 25.4 ± 2.91 respectively (P 0.52) and that > 30 years. group with Hct < 0.48 and greater than 0.48 was 36 ± 4.98 and 36.8 ± 5.12 respectively (P 0.7). There was no difference in food habits and almost all were non vegetarians. None of them had any respiratory problems. Cigarette smoking was present only in 10/28 persons. Of the 28/94 group, one person had very high Hct and Hb level, 63.6 and 21.2 respectively. Elevated hematocrit contributes to blood viscosity and stroke. Hematological disorders with an elevated Hct have an increased incidence of thromboembolic complications. Hct may become relevant to the pathophysiology of acute ischemic stroke because of cerebrovascular blood viscosity and is strongly associated with stroke risk factors such as hypertension, hypercholesterolemia, glucose intolerance and smoking. Donors are screened for high hematocrit and advised phlebotomy and periodic evaluation of Hct. The above findings indicate a health beneficial role of regular blood donation.

Though these studies are not designed to determine the prevalence of hypertension, high ferritin and hematocrit in the region, the findings are likely to be a rough estimate of the proportion of undetected risk factors in the local population, as donors are a representative of the healthy population. Identification of risk factors among blood donors has expanded the role of the Blood Bank in the community. This will help in planning interventional programs like dissemination of information on life style modifications. Observations of these studies warrant extensive screening of the population.

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