Status of Lipid Profile in Hypertensive Patients of A, B, O and AB Blood Groups

Shalini Arora¹, Tariq Mahmood²*, Gaura Dadheech³, Ramesh Chandra Gupta⁴

ABSTRACT

Background: Hypertension is the most common illness of circulatory system and is a worldwide health challenge affecting both developed and developing nations. The development of hypertension is a multi-factorial process and the risk factors for its development are many such as genetic factors, obesity, age & sex factors, salt sensitivity, dyslipidemia, hyperinsulinemia & insulin resistance, environmental factors, socio economic imbalances, free radicals/reactive Oxygen species, oxidative stress, blood groups etc. The role of blood groups in the etiology of essential hypertension has long been suspected.

Methods: The study design was a cohort study consisting of 15 hypertensive patients of the A, B, AB and O each. Anthropometric parameters such as Blood pressure (SBP/DBP) and Body Mass Index (BMI) and Biochemical parameters such as Blood grouping, Blood Glucose levels, Haemoglobin levels, Lipid profile, which included Triglycerides, Total cholesterol, HDL cholesterol and LDL and VLDL cholesterol, were measured using standardized methods. The various parameters were compared between hypertensives of the various blood groups and statistical analysis was done using SPSS. Mean and SD of each group was calculated, and Unpaired student’s t-test was applied (P < 0.05 considered as significant).

Results: When BMI was compared among hypertensive groups we observed significant increased level of BMI in group A as compared to group O hypertensives. (10.36%; P<0.05). While comparing SBP between hypertensive groups we observed significant raised level of SBP in group A as compared to group B (9.38%; P<0.01) and O (10.45%; P<0.01). Similarly, DBP was found to be increased significantly in group A as compared to group B ((5.34%; P<0.05) and O hypertensive patients (5.06%; P<0.001). LDL-C and HDL-C were non-significantly altered in these groups however value of VLDL-C was found increased in group A as compared to group O hypertensives (20.38%; P< 0.05). Conclusion: The study concluded that there is a significantly higher SBP and DBP in the hypertensives of the A blood group as compared to the hypertensives of the B and O blood groups. It also found increased levels of serum triglycerides, total cholesterol, LDL-C, VLDL-C along with decreased levels of HDL-C was in hypertensive patients predominantly in group A and AB hypertensive. The hypertensive patients of A blood group have shown a statistically significant increase in BMI as compared to hypertensives of the other blood groups.

Keywords: Biochemical markers, Percutaneous coronary intervention, Risk of myocardial damage, Surface ECG

INTRODUCTION

Hypertension is the most common illness of circulatory system. It is a worldwide health challenge affecting both developed and developing nations and in regard to its spread in population it is an important social, medical & economical problem (Falkner et al; 2010).[1]

According to the World Health Report of 2002, cardiovascular diseases will be the largest cause of death and disability by 2020 in India and 2.6 million Indians are predicted to die due to coronary heart disease which constitute 54.1% of all cardiovascular deaths especially in middle aged individuals (Kumar et al; 2009).[2]
Three serial epidemiological studies (criteria ≥ 140/90 mmHg) during 1994, 2001, 2004 and 2007 were carried out in the study area i.e. Jaipur. The author demonstrated a rising prevalence of hypertension, 30%, 36%, 51% and 53% respectively, among males (Gupta et al; 2017).

The development of hypertension is a multi-factorial process and the risk factors for its development are many such as genetic factors, obesity, age & sex factors, salt sensitivity, dyslipidemia, hyperinsulinemia & insulin resistance, environmental factors, socio economic imbalances, free radicals/reactive Oxygen species, oxidative stress, blood groups etc.

The role of blood groups in the etiology of essential hypertension has long been suspected.

Biochemically the defining sugars in blood groups A, B, AB and O are glycoproteins containing D-galactose, methyl pentose fucose, D-glucosamine, D-galactosamine present as N-acetyl derivatives and other amino acids such as threonine, serine.

The difference between A, B, H substance seems to be in the carbohydrate portion of the molecule.

It is suggested that a common blood group substance exists which is converted though a series of stages to the final specific blood group products. The conversions are almost certainly affected by specific enzymes the synthesis of which is controlled be genes (Watkins; 1967).

An H gene codes for a fucose transferase that adds a fucose on the end of the glycolipid or glycoprotein, forming the H antigen that is usually present in individuals of all blood type (Storry et al; 2009). The basic structure of antigen H is Fucose-Gal-GalNAc – Protein.

Individuals who are type A have a gene which code for a transferase (N-acetyl-galactosaminyl transferase) that catalyze placement of a terminal N-acetylgalactosamine on the H-antigen where as individuals who are type B have a gene which codes for a transferase (galactosyl transferase) that place a terminal galactose (Patenaude et al; 2002, Takasaki et al; 1978).

A antigen: Fucose Gal NAC – Protein

GalNAc

B antigen: Fucose – GalGalNAc – Protein

Gal

Individuals who are type AB have both the transferases and who are type O have neither, so the H antigen persists.

ABO antigens are not just involved in matching for blood transfusion but also have a role in various diseases such as cardiovascular disease viz. hypertension, ischemic heart disease, adverse lipid/lipoprotein metabolism (Horby et al; 1998) and measurement of anthropometric parameters. There are several studies demonstrating positive correlation between elevated serum cholesterol levels in group A (Tarjan et al; 1995) and group AB hypertensive patients (Meade et al; 1994, Wong et al; 1992, Gillium et al; 1991, George et al; 1987).

A study by Wu et al.; 2008 revealed the relationship between non ‘O’ group entities with numerous forms of vascular involvement viz intravascular thrombosis, including arterial and venous side, cerebral ischaemia and coronary ischemia manifesting as angina.

A study carried out by Reid, (2009) showed that cholesterol levels were very significantly elevated in the blood group A compared to non-A group.

A recent study of potential mechanisms of future role of blood groups in identifying those at risk of arterial and venous disease found that ABO (H) antigens has a modest effect on arterial disease with a consistent effect observed in peripheral vascular disease and the higher risk was associated with non-O group individuals (Clark et al; 2011).

METHODS

Study Subjects:
Male patients of hypertension between the age group of 40-65 years visiting the medical OPD at NIMS hospital of Jaipur. These patients were divided into four cohorts of A, B, AB and O blood groups.

INCLUSION CRITERIA:
Male hypertensive patients attending the OPD of NIMS hospital, Jaipur, who have been diagnosed as having essential/ primary hypertension.

EXCLUSION CRITERIA:
Patients with known secondary causes of hypertension.
Patients with diabetes, congestive heart failure/ heart block.
Malignant or clinically significant hematological disease.
Anemic patients.
Patients suffering from infectious diseases.
Patients with the negative blood groups.
Female hypertensives.
Cigarette smokers & alcoholics.
Those who are on current use of any medication including dietary supplements.

Study Group.
This group included 60 cases of essential hypertension. All these patients were selected from the NIMS Hospital and Research Centre, Jaipur Patients with a systolic blood pressure (SBP) ≥140 mmHg and diastolic blood pressure (DBP) ≥ 90 mmHg and were considered as patients with essential hypertension.

The study included the anthropometric assessment, blood biochemical investigations and lipid-profile estimation. NIMS Hospital labs were used to conduct the biochemical estimations.

PLAN OF THE STUDY

The Study was designed as a Cohort study of 60 patients of Essential Hypertension.
ANTHROPOMETRIC ASSESSMENT
Blood pressure: Systolic blood pressure (SBP) and Diastolic blood pressure (DBP) was measured using a sphygmomanometer.
Body Mass Index (BMI)

BLOOD BIOCHEMICAL INVESTIGATION
Determination of ABORH Blood groups – by the use of monoclonal agglutinating antibodies (Dacie & Lewis; 2001).
Determination of Haemoglobin – by Cynmethaemoglobin technique (Drabkins et al; 1932).
Estimation of Blood glucose (Trinder; 1969).

LIPID PROFILE
Estimation of serum Total Cholesterol (TC) (Roeschalu’s 1974).
Estimation of High density lipoprotein cholesterol (HDL – C) – (Brustein et al; 1970).
Very low density lipoprotein cholesterol (VLDL-C) and Low density lipoprotein cholesterol (LDL-C) were calculated by applying Friedwald’s formula (Friedwald et al; 1972).

STATISTICAL ANALYSIS
Mean & standard deviation (S.D) was calculated separately for all the groups.
Unpaired student’s t-test was applied (P < 0.05 considered as significant).

RESULTS
When BMI was compared among hypertensive groups we observed significant increased level of BMI in group A as compared to group O hypertensives. (10.36%; P<0.05) (Table 1 and Figure 1.)
While comparing SBP between hypertensive groups we observed significant raised level of SBP in group A as compared to group B (9.38%; P<0.01) and O (10.45%; P<0.01). Similarly, DBP was found to be increased significantly in group A as compared to group B (5.34%; P<0.05) and O hypertensive patients (5.06%; P<0.001) (Table 1 & Fig. 1)

Table 1: Comparison of anthropometric parameters between hypertensive groups

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Blood Groups</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>BMI</td>
<td>26.06±2.23</td>
</tr>
<tr>
<td>SBP</td>
<td>163.33±14.29</td>
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<tr>
<td>DBP</td>
<td>94.80±8.49</td>
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Units a = kg/m², b = mmHg, Values are expressed as mean ± S.D of 15 subjects
Values in parenthesis represent percent change (+) = increase, (-) = decrease as compared to values of Blood Group A.
*P <0.05, ** P< 0.01, *** P<0.001
NS = Non-Significant

Table 2: Comparison of Serum lipid profile between hypertensive groups

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Blood Groups</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>TG</td>
<td>183.66±72.38</td>
</tr>
<tr>
<td>TC</td>
<td>225.33±63.32</td>
</tr>
<tr>
<td>HDL-C</td>
<td>44.87±7.70</td>
</tr>
<tr>
<td>LDL-C</td>
<td>126.00±66.30</td>
</tr>
<tr>
<td>VLDL-C</td>
<td>36.74±14.48</td>
</tr>
</tbody>
</table>

Units a = mg/dl, Values are expressed as mean ± S.D of 15 subjects
Values in parenthesis represent percent change (+) = increase, (-) = decrease as compared to values of Blood Group A.
*P <0.05, ** P< 0.01, *** P<0.001
NS = Non-Significant
DISCUSSION

Essential hypertension is often associated with lipid abnormalities which may appear with abnormal pattern in blood lipids. Contiero et al, 1994,[20] had also examined the variability of lipid levels in ABO blood group and found that TG levels were higher in individuals with B antigen (B+AB) than the subjects of blood group O: without this antigen. It is commonly noticed that hypertension is associated with metabolic abnormalities and oxidative stress. Earlier studies also found elevated levels of total cholesterol and triglycerides in hypertensive patients, as also observed in our study (Biswas et al; 2010,[21] Kumari et al, 2010[22])

Our findings are in agreement with earlier investigation done by Saha et al; 2006,[23] who found higher levels of TG, TC and LDL-C in hypertensive subjects and suggested that may be due to genetic factors, stress, increasing age and sex. Essential hypertension, which also include dyslipidemia may directly lead to impaired vasodilation resulting the loss of small blood vessel density and surface area (rarefaction) and capillary shunting. This pathophysiological alteration suppress the enzyme lipoprotein lipase which are expressed on the endothelium at the vascular lumen surface responsible for triglyceride catabolism (Litthell et al; 1981).[24]

The reason for high levels of serum lipids including TG and TC in group A individual could be the effect of red cell antigen on the enzyme. Furthermore, the influence of erythrocyte associated intestinal alkaline phosphatase of different blood groups and their effect on lipid metabolism was investigated by Bayer and colleagues (Bayer et al; 1980).[25] Intestinal alkaline phosphatase, which is manufactured in the small intestine, has the primary function of splitting dietary fats and cholesterol esters.

They found that red cells of blood group A and AB binds almost all intestinal alkaline phosphatase and erythrocytes of blood group B or O to a much lesser degree and this is in accordance with the fact that intestinal alkaline phosphatase is found more frequently in the serum of individuals of blood group B or O than in serum of individuals of blood group A and AB (Nakata et al, 1995, [26] Domar et al; 1991[27]). It might be the reason for lower levels of this enzyme in blood group A and AB and the subsequent inability to breakdown dietary fat or due to inactivation of this enzyme by type A antigen itself resulting in higher levels of serum TG and cholesterol in these subjects. Inability to breakdown dietary fats which in part predisposes Type A and Type AB to higher cholesterol and more heart diseases.

Furthermore, we have found significant increased level of LDL cholesterol in all the hypertensive groups. However, the level of TC in HDL was found decreased. The same observation, increased level of serum TC and LDL-C have been reported by many workers.

Previously George et al; 1987,[28] have shown a positive association between the A antigen of the ABO locus and increased level of serum TC and LDL-C in hypertensive male subjects.

As we have reported that the concentration of LDL-C and VLDL-C were found to be increased significantly in hypertensive patients of blood group A, B, AB and O predominantly in blood group A and AB. Increased concentration of LDL causes uncoupling of endothelial nitric oxide synthase, activation of NADPH oxidase and consequently increased production of superoxide anions in the vessel wall which leads to increased oxidative stress. The reaction of NO by superoxide anions forming peroxinitrite thus may contribute to endothelial dysfunction in patients of hypertension and increased risk of cardiovascular diseases in them. Hypercholesterolemia and hypertension have a synergistic deleterious effect on coronary endothelial function. Elevated cholesterol and LDL cholesterol may lead to the development of atherosclerosis, and the oxidative stress is important for the development of this state. Several in vivo evidences of experimental animals and human had supported the important role of free radical reactions in atherogenesis and atherosclerotic coronary heart disease. (White et al, 1994,[29] Morel et al; 1984[30]).

Highly raised LDL-C and VLDL-C concentrations result in premature hardening of the arteries, obstruction of the carotid artery (the artery which supplies blood to the head and brain), peripheral artery disease, heart attack and stroke. Since all these disorders show higher rates of occurrence in blood group A, it is not surprising that studies have found a significant correlation between hyperlipoproteinemia and blood group A in patients who have suffered from heart diseases. Occurrence of oxidative degradation is one of the unfavorable consequences of hypertension on molecular systems. In these oxidation process peroxides and free radicals are produced which cause injuries and erosions in the wall of vessels. One of the most important oxidative process is oxidation of lipids and lipoproteins and the formation of their oxidized products, which ultimately can cause vessel wall injury and atherosclerosis (Assadpour Piranfar et al; 2009[31]).

CONCLUSION

The study concluded that there is a significantly higher SBP and DBP in the hypertensives of the A blood group as compared to the hypertensives of the B and O blood groups. The study also concluded that increased levels of serum triglycerides, total cholesterol, LDL-C, VLDL-C along with decreased levels of HDL-C was found in hypertensive patients predominantly in group A and AB hypertensive and this could be due to lower activity level of intestinal alkaline phosphatase which has the primary function of splitting dietary fats and cholesterol esters or inactivation of this enzyme by type A antigen itself resulting in higher levels of serum TG and TC in these subjects. This is in accordance with the fact that this enzyme; intestinal alkaline phosphatase have been found more frequently in the serum of individuals of blood group B or O than in the serum of individual of blood group A and AB.

Patients with increased BMI of either blood group had shown comparatively increased level of blood pressure than that of normal BMI in the same group. This may be due to hyperactivity of hypothalmic pituitary gland secreting an excess of adrenaline and noradrenaline affecting sympathetic nervous system to work as potent risk factor that results in hypervolemia along with increased concentration of free Ca2+ following depletion of Mg2+ levels resulting in increased contraction, peripheral resistance and elevation of blood pressure in obese or over weight hypertensives.

Hypertension affects physical, behavioral and mental aspect of a person’s life. There is very much need to search for the causes of essential hypertension and the futuristic approach in order to prevent and cure the incidence of this metabolic disorder by the use of powerful new techniques of genetics, genomics and proteomics integrated with system physiology of different blood group individuals.
Lipid Profile in Hypertensive Patients of A, B, O and AB Blood Groups

This is a pilot study which can be used to further investigate the relationship between ABO blood group type and lipid metabolism in patients of hypertension, metabolic syndrome and cardiovascular disease in Indian population.

REFERENCES