

ORIGINAL RESEARCH

Evaluation of Lipid Profile in ABO Blood Group Phenotypes

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ABSTRACT

Aim and Objectives: To evaluate lipid profile in ABO blood group phenotypes.

Materials and Method: This prospective study was conducted to find the association between different blood groups and their lipid profile, which can further be used for the strategy for prevention of risk factor of cardiovascular disease and atherosclerosis.

Results: The mean cholesterol was significantly highest in individuals with blood group O (149.86±25.96) and lowest in individuals with blood group AB (92.79±26.93). The mean triglyceride was highest in O blood group (144.67±24.57) and lowest in AB blood group (108.67±32.70). The mean LDL was significantly highest in individuals with blood group O (108.50±24.01) and lowest in individuals with blood group AB (67.35±31.63). The mean VLDL was highest in O blood group (26.09±3.94) and lowest in AB blood group (21.71±4.65). The mean HDL was highest in B blood group (41.25±13.33) and lowest in O blood group (28.78±8.65). The mean cholesterol/HDL ratio was highest in individuals with blood group O (5.57±1.45) and lowest in individuals with blood group AB (3.34±1.02).

Conclusion: The lipid profile has been found to vary significantly in different blood groups. As the levels of cholesterol, triglyceride, LDL, VLDL and HDL are directly associated with various cardiovascular diseases, the blood group of an individual can be used as a predictor for the development of those diseases.

Keywords: ABO group phenotype, VLDL, LDL

INTRODUCTION

ABO gene is responsible for glycosyltransferase enzyme production which involve in the attachment of a sugar onto a carbohydrate structure known as H antigen. ABO and H antigen are primarily represented on glycoproteins and glycolipids by small carbohydrate epitopes by H gene which is involved in the production of the H antigen substrate, act as precursor of A and B antigen. This glycosyltransferase enzyme activity is missing in O blood type due to loss of function mutation.¹

Several investigations have been conducted to assess the relationship between the ABO blood types and systemic diseases like gastric cancer, periodontal diseases, thrombotic vascular diseases, malarial infections, Maxillofacial deformities, pancreatic cancer, cholera, peptic ulcer, type II diabetes mellitus, and various cardiovascular diseases.^{2,3}

Various studies showed that specific diseases are more commonly found in specific blood types i.e. blood group O phenotype has higher chances of tuberculosis, A and O phenotype have more affinity for plasmodium vivax (Malarial protozoan)infection and phenotype B shows more association with plasmodium falciparum (Malarial protozoan) infections Several investigations have proved that ABO blood types, especially O-phenotype having individuals have higher chances of cardiovascular incidents due to more association with cardiovascular risk factors. It has also been found in some studies that A blood group phenotype have more affinity for cardiovascular diseases and O phenotype is more protective against atherogenic factors.⁴

It may be due to genetic predisposition or may be the result of immunological interaction in different ABO blood phenotypes against different diseases. To date, strong association of cardiovascular diseases and lipid profile with genetic predisposition has been found, thus quantification and differentiation of possibilities of cardiac problems in specific blood group phenotypes as compared to others may be possible.⁴

Cardiovascular diseases have been proved as the major cause of mortality all over the world.⁵ According to a report by the world health organization in 2016, about 15.2 million deaths were due to ischaemic heart disease and stroke. So, cardiovascular diseases (CVD) have been proved as a leading cause of mortality worldwide for the last 15 years. Lipids and lipoproteins which play significant role in metabolism have seek attention in case of association with coronary heart disease. Dyslipidaemia have been accepted as a significant risk factor of cardiovascular diseases. Risk factors related to cardiovascular disease are increased with the increase in total cholesterol (TC), low density lipoprotein (LDL) and serum triglycerides (TGs) but decreased with increased serum high density lipoprotein (HDL) thus it has been considered that HDL plays a protective role against heart diseases and stroke as being involved in reverse cholesterol transport.

Another clinically the much significant blood group system is the Rhesus factor (Rh) based blood group system. It is the largest blood group (with 49 antigens) of all blood group systems described so far. This blood group is represented by a huge group of antigens which express themselves on the membrane of red blood cells. Which may responsible for ammonia transport⁶ or transport of CO₂, or play a structural role in red blood cell membrane and may not involve in transport. Two major Rhesus proteins RhD and RhCE carry Rh-antigens and their variations are related to the changes in their amino acid sequences.

Hypertriglyceridemia is considered as a cardiovascular disease (CVD) risk factor. Serum triglycerides (TGs) number should be below 150 mg/dl. Serum total cholesterol includes two major forms, one is the free cholesterol and other is cholesteryl ester. Most commonly circulated fraction of cholesterol in the blood is the cholesteryl ester. In the plasma about 70% of total cholesterol is esterified by different fatty acids. Cholesterol is included in heterogeneous group of fats and is the principal sterol found in the living beings which is needed to synthesize cell membranes and to regulate the fluidity of membranes across a range of temperatures.⁷

As it is evident that dyslipidemia is an important cause of cardiovascular accidents. In our study we are also working to seek if there is any important relationship between ABO blood group and dyslipidemia. So early detection of lipid disorders in the people having concerned blood group will change the morbidity and mortality.

MATERIAL AND METHOD

This prospective study was conducted to find the association between different blood groups and their lipid profile, which can further be used for the strategy for prevention of risk factor of cardiovascular disease and atherosclerosis.

Study Population

The study included haemoglobin should be more than 12.5 gm/dl, Healthy subject within age range of 18-30 years and Weight above 45 kg. The study excluded subject with pregnancy, Diabetes mellitus, chronic illness and those who are suffering with cardiovascular heart disease, Smokers, subjects which are using type of lipid lowering drugs like statin and patient not giving consent.

The investigations to be done for Blood grouping and Biochemical parameters: Serum lipid profile – Total cholesterol, LDL, HDL, triglyceride, VLDL, Cholesterol/HDL ratio.

The study sample of 380 healthy individuals were included in this study, considering inclusion and exclusion criteria. Then they underwent blood grouping test and lipid profile evaluation test in the Department of Pathology and Department of Biochemistry, from 1 year after getting the approval from ethical committee.

After overnight fasting, 2 ml of venous blood is taken into each 2 vials EDTA and plain for blood grouping and lipid profile respectively. Samples in EDTA anticoagulant was tested for blood grouping, immediately. Blood sample in plain vial is allowed to clot and centrifuge. Serum was separated and removed in another clean vial and stored frozen till analysis was done in biochemistry lab in biochemistry fully automated analyzer (model-Cobas C501) at room temperature.

Statistical Analysis

The information was tabulated in Microsoft Excel, and the SPSS V.24 programme was used to do the analysis. When presenting the continuous variables, the mean and standard deviation (SD) were utilised as presentation tools. When presenting the categorical variables, we relied on frequency and percentage as our primary presentation tools. The independent t test and the one-way analysis of variance were utilised in the comparisons. If the p value is less than 0.05, then it is considered significant

RESULT

Table 1: showing distribution of cases in different groups

| | | Number | Percentage |
|--------------|-------------|--------|------------|
| Age (years) | <20 years | 15 | 3.9% |
| | 20-25 years | 300 | 78.9% |
| | 26-30 years | 65 | 17.1% |
| Gender | Male | 212 | 55.8% |
| | Female | 168 | 44.2% |
| Blood groups | A | 24 | 6.3% |
| | B | 235 | 61.8% |
| | AB | 33 | 8.7% |
| | O | 88 | 23.2% |

The age of the individuals was categorized as <20 years, 20-25 years and 26-30 years. Majority of the individuals was from the age group of 20-25 years (78.9%) followed by 26-30 years (10.0%) and <20 years (3.9%). Among the individuals, 55.8% were males and 44.2% were females. Majority of the individuals had blood group B (61.8%) followed by blood group O (23.2%), blood group AB (8.7%) and blood group A (6.3%).

Table 2 showing cholesterol level in accordance to age and gender

| | | Mean | SD | p-value |
|------------|-------------|--------|-------|---------|
| Age groups | <20 years | 144.53 | 53.65 | 0.037* |
| | 20-25 years | 133.45 | 47.62 | |
| | 26-30 years | 149.55 | 44.29 | |
| Gender | Male | 147.36 | 43.84 | <0.001* |
| | Female | 123.1 | 48.81 | |

The mean cholesterol was highest in individuals from the age group of 26-30 years (149.55±44.29) and lowest in individuals from the age group of 20-25 years (133.45±47.62). The mean cholesterol was higher in males (147.36±43.84) than females (123.10±48.81).

Table 3 showing comparison of lipid profile in different blood groups

| | A | | B | | AB | | O | | p-value |
|------------------------------|--------|-------|--------|-------|--------|-------|--------|-------|---------|
| | Mean | SD | | | | | | | |
| Total Cholesterol | 141.38 | 55.66 | 137.66 | 47.27 | 92.79 | 26.93 | 149.86 | 25.96 | <0.001* |
| Triglyceride | 124.08 | 16.16 | 129.27 | 25.44 | 108.67 | 32.7 | 144.67 | 24.57 | <0.001* |
| LDL | 97.24 | 18.22 | 98.07 | 32.17 | 67.35 | 31.63 | 108.5 | 24.01 | <0.001* |
| VLDL | 25.69 | 3.6 | 25.35 | 4.82 | 21.71 | 4.65 | 26.09 | 3.94 | <0.001* |
| HDL | 37.04 | 11.58 | 41.25 | 13.33 | 31.21 | 14.34 | 28.78 | 8.56 | <0.001* |
| Cholesterol/HDL ratio | 3.73 | 0.84 | 3.95 | 2.38 | 3.34 | 1.02 | 5.57 | 1.45 | <0.001* |

The mean cholesterol was highest in individuals with blood group O (149.86±25.96) and lowest in individuals with blood group AB (92.79±26.93). The mean triglyceride was highest in O blood group (144.67±24.57) and lowest in AB blood group (108.67±32.70). The mean LDL was highest in individuals with blood group O (108.50±24.01) and lowest in individuals with blood group AB (67.35±31.63). The mean VLDL was highest in O blood group (26.09±3.94) and lowest in AB blood group (21.71±4.65). The mean HDL was highest in B blood group (41.25±13.33) and lowest in O blood group (28.78±8.65). The mean cholesterol/HDL ratio was highest in individuals with blood group O (5.57±1.45) and lowest in individuals with blood group AB (3.34±1.02).

DISCUSSION

Cardiovascular diseases have been proved as the major cause of mortality all over the world and lipids and lipoproteins which play significant role in metabolism have seek attention in case of association with coronary heart disease. ¹⁴⁵ Dyslipidaemia have been accepted as a crucial risk factor of heart diseases, moreover, cardiovascular disease risk factors are increased with the increase in LDL and total cholesterol and serum

triglycerides but these risk factors are inversely related to serum HDL thus it has been considered that HDL-c plays a protective role against conditions like cardiovascular diseases and cerebrovascular diseases as being involved in the transportation of reverse cholesterol.^{8,9}

In the current study, it was observed that the mean total cholesterol, triglycerides, low density lipoproteins, very high density lipoproteins and cholesterol/HDL ratio were highest in the blood group O and lowest in the blood group AB; the mean HDL was seen higher in the blood group B and lower in the blood group O in comparison to the other blood groups. The O blood group was found to important link to abnormal lipid profile.

*Ketch et al.*¹⁰ reported that, O blood group patients had higher prevalence of hypercholesterolemia ($p=0.002$) and atherosclerosis with vascular diseases ($p=0.017$) and that ABO blood types, especially O-phenotype having individuals have higher chances of cardiovascular incidents due to more association with cardiovascular risk factors. This is in accordance with the present study where the O blood group patients have been found to be more prone to have increased cholesterol in their blood.

A study by *Contiero et al.*¹¹ on Italian population showed no significant relationship of HDL and LDL with ABO blood types ($p>0.05$) whereas levels of serum triglycerides were found higher in patients having B antigen (B and AB) as compare to those which did not possess this antigen.¹⁵² This results does not match with the outputs of the present study where significant relationship of HDL and LDL with ABO blood types was found ($p<0.05$).

*Girgla et al.*¹² observed that, serum cholesterol and LDL levels were found to be markedly high in the blood group O patients in comparison to the other different blood group patients ($p<0.001$). This is in accordance with the present study where the O blood group patients have been found to be more prone to have increased cholesterol in their blood.

*Airhomwanbor et al.*¹³ reported that, serum cholesterol, triglyceride, LDL and VLDL levels are higher in AB blood group in comparison to the other different blood groups and the differences were not important ($p=0.172$ for cholesterol, $p=0.312$ for triglyceride, $p=0.167$ for LDL and $p=0.296$ for VLDL). This results does not match with the outputs of the present study where serum cholesterol, triglyceride, LDL and VLDL levels were found to be markedly raised in the blood group O ($p<0.05$).

The study performed by *Stakisaitis et al.*¹⁴ found that, the frequency of O blood group in the individuals with coronary atherosclerosis was significantly low and the percentage of the blood group B among them was markedly high in comparison to the other different blood groups ($p=0.04$). But in current study, although the frequency of B blood group was highest, the O blood group showed the poorest lipid profile.

*Ureme et al.*¹⁵ reported that, total cholesterol level was highest in the B blood group; triglyceride and VLDL levels was higher in the A blood group and LDL level was higher in the O blood group ($p<0.05$). These results are partially matched with the present study where levels of all of these lipid parameters were observed to be significantly highest in the O blood group ($p<0.05$).

The work of *Iheanacho et al.*¹⁶ showed that, among the various lipid parameters, LDL level was markedly high in subjects with A blood group ($p<0.05$). In the present study, the LDL level was found to be significantly higher in O blood group ($p<0.05$).

*Rachana et al.*¹⁷ reported that, there was no marked difference in serum cholesterol, triglyceride and LDL levels among the blood groups ($p=0.227$ for cholesterol, $p=0.901$ for triglyceride and $p=0.172$ for LDL). This results does not match with the outputs of the present study where serum cholesterol, triglyceride and LDL were markedly higher in O blood group ($p<0.05$). However, they showed that, O blood group patients have important link to hypertension ($p=0.03$).

*Biswas S et al.*¹⁸ reported that, serum cholesterol, triglyceride levels were higher in B blood group which was not of any importance ($p=0.117$ for cholesterol and $p=0.928$ for triglyceride) but the LDL level was markedly high in the blood group B ($p=0.025$) and HDL level was markedly low in the blood group O ($p<0.001$). These results are partially matched with the present study where levels of all of these lipid parameters were markedly raised in O blood group ($p<0.05$).

In fact, high cholesterol, triglycerides and LDL as well as low HDL have strongly been considered as crucial factors for the atherosclerosis and cardiovascular diseases. Hence, in the present study, the blood group O has been observed to be significantly linked to abnormal lipid profile along with the chances of having cardiovascular diseases.

CONCLUSION

The lipid profile has been found to vary significantly in different blood groups. As the levels of cholesterol, triglyceride, LDL, VLDL and HDL are directly associated with various cardiovascular diseases, the blood group of an individual can be used as a predictor for the development of those diseases. The present study has found that the mean total cholesterol, triglycerides, LDL, VLDL and cholesterol/HDL ratio were highest in the blood group O and lowest in the blood group AB; the mean HDL was observed to be highest in the blood group B and lowest in the blood group O. The O blood group was found to be significantly associated with abnormal lipid

profile. Research with larger sample is recommended to measure and quantify the possibilities of various cardiac manifestations in different blood groups.

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