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Relation of ABO blood groups to the lipid profile in hypertension

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Abstract

It is well established that no disease had developed due to lack of expression of ABO blood group antigens, but the susceptibility to some diseases has been linked with an individual's ABO phenotype. This study is aimed at determining the relation of ABO blood groups to the lipid profile in hypertensive subjects. Lipid profile and blood group was determined in sixty-eight (68) hypertensive subjects aged 35-70 years and thirty (30) non-hypertensive apparently healthy individuals. Blood group, blood pressure and lipid profile such as Total cholesterol (TC), Triglyceride (TG), High density lipoprotein (HDL), very low-density lipoprotein (VLDL) and Low-density lipoprotein (LDL) were evaluated from the blood collected from the patients using standard methods. The ABO and rhesus blood group of subjects was carried out by standard tile technique. Data were analyzed for statistical significance using t-test and Pearson correlation. The results obtained show that the level of triglycerides (1.369 ± 0.570 mmol/L) was higher in blood group A subjects with hypertension compared to blood group A control subjects (0.861 ± 0.259 mmol/L) (p=0.016). The level of LDL (4.133 ± 1.363 mmol/L) was higher in blood group B subjects with hypertension compared to blood group B control subjects (2.150 ± 1.015 mmol/L) (p=0.006). There was a significant correlation between total cholesterol, and systolic blood pressure in blood group A subjects (p = 0.012, r = 0.672). Again, there was a significant positive correlation between LDL and systolic blood pressure in blood group A subjects (p = 0.010, r = 0.685). The correlation between systolic and diastolic blood pressure with the other variables in blood group O and rhesus D positive subjects were not statistically significant. Triglycerides and low-density lipoprotein were higher in blood group A and Blood group B with hypertension. There was a significant positive correlation between total cholesterol, LDL and systolic blood pressure in blood group "A" individuals.

Keywords: ABO; Blood; Group; Hypertension; Triglycerides

1. Introduction

The ABO system develops as a result of polymorphism of complex carbohydrate with diverse antigenic structures of glycoproteins and glycolipids showed at the surface of erythrocytes, as glycan units of mucin glycoproteins [1].The A and B variants of the ABO system locus encode A and B glycosyltransferase activities, which turn precursor H antigen into either A or B origin, the A and B antigens possessing an additional saccharide unit to the O unit (N-acetylgalactosamine and galactose). In group O persons, there is absence of such transferase enzymes but express fundamental, stable H-antigen [2]. There are four possible blood types of ABO: A, B, AB, and O. There is another blood type known as rhesus D, the presence or absence of the rhesus D protein decide the blood group, resulting in rhesus D positive or rhesus D negative as possible blood types [3]. The clinical significance of ABO blood group system is not only narrowed to blood transfusion and solid organ transplantation but its association to various systemic disorders, venous and arterial thrombotic vascular disease has been studied [4, 5]. Several studies have demonstrated very important relationship between ABO blood groups and systemic disorders, such as, placental malaria infections, cholera, pancreatic cancer, type II diabetes mellitus (DM), thrombotic vascular diseases, gastric cancer and peptic ulcers,

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maxillofacial deformities [6-8]. A direct association has been established between ABO phenotype and the plasma level of two proteins taking part in blood clotting, factor VIII and von Willebrand factor [9].Various investigations have suggested that ABO blood groups, especially non-O blood groups [10], are connected with major cardiovascular risk factors [11-13]. It has also been suggested that the susceptibility in non-O blood groups are mediated to a certain extent by dyslipidaemia [14-17]. Even though, a lot has been done, there is still need to determine association between ABO and lipid profile/or dyslipidaemia- a major risk factor to cardiovascular diseases.This study aims to determine the relation of ABO blood groups to the lipid profile of hypertensive subjects

2. Material and methods

This case control study was carried out at medical outpatient's clinic of Enugu State University Teaching Hospital (ESUTH) from July to November 2024. Sixty-eight adult subjects (both male and females) aged between 30-70 years were selected.

2.1. Study Location

This was a tertiary care teaching hospital based study done in Chemical pathology laboratory at Enugu State University Teaching Hospital.

2.2. Subjects

Participants were subjects exceeding 30 years of age and diagnosed of hypertension at Enugu State University Teaching Hospital.

2.3. Sample collection

Five milliliters of venous blood samples were obtained after overnight fast into an accurately labeled plain bottle for each individual. Some aliquots of the blood sample were dispensed into EDTA containers for ABO blood grouping and plain bottle for lipid profile. ABO and Rhesus blood groups were determined using the tile method. The blood samples for lipid profile were centrifuged with a laboratory centrifuge within two hours of collection, and the serum was separated into clean, dry, plain tubes that were labeled in line with the initial blood sample bottle. The lipid profile assay comprising of serum total cholesterol, triglycerides, high density lipoprotein cholesterol were done by the methods based on enzymatic determination using the kits purchased from Randox laboratories Ltd. United Kingdom. Low Density Lipoprotein (LDL) was calculated from friedewald formula (LDL = Tc − HDL − TG/5.0 (mg/dL) [18].

2.4. Determination of ABO & Rhesus

The ABO and rhesus blood groups were determined using the tile method according to Cheesbrough [19]

2.5. Determination of total cholesterol

Total cholesterol levels were determined using the enzymatic endpoint methodas described by Richmond (20). Cholesterol esters are first converted to cholesterol and fatty acids. Next, cholesterol is oxidized with O_2 to form cholesten-3-one + H_2O_2. Lastly, the hydrogen peroxide reacted with 4-aminoantipyrine and p-HBS to yield quinoneimine (red dye) and water. The absorption measured at 520 nm, is proportional to the concentration of cholesterol in the sample.

2.6. Determination of triglycerides

The triglycerides levels were measured using a colorimetric method as described by Trinder [21]. The triglyceride (TG) colorimetric assay uses the enzymatic hydrolysis of the triglycerides by lipase to glycerol and free fatty acids. The glycerol released is subsequently measured by a coupled enzymatic reaction system. The glycerol formed is phosphorylated to glycerol-3-phosphate in a reaction catalysed by glycerol kinase. The glycerol-3-phosphate is oxidized by glycerol phosphate oxidase producing dihydoxyacetone phosphate and hydrogen peroxide. Peroxidase catalyzes the redox-coupled reaction of H_20_2 with 4-aminoantipyrine (4-AAP) and N-Ethyl –N-(3-sulfopropyl)-M-anisidine (ESPA), producing a brilliant purple color. The absorbance is measured at 540nm.

2.7. Determination of High Density Lipoprotein-cholesterol

High Density Lipoprotein Cholesterol was measured using the precipitation method described by Lopes-Virella [22].Low density lipoproteins (LDL) and very low density lipoprotein (VLDL) and chylomicron fractions are precipitated quantitatively by the addition of phosphotungstic acid in the presence of magnesium ions. After

centrifugation, the cholesterol concentration in the high density lipoprotein (HDL) fraction, which remains in the supernatant, is determined.

2.8. Statistical analysis

Data was analyzed using SPSS version 25. Comparison of participant lipid profile and control were done by t-test. The relationship between lipid parameters and blood pressure were done by Pearson correlation. The statistical significance was set at $p<0.05$

3. Results

Table 1 Lipid profile of blood group A

Blood group A			
Parameters (mmol/L)	**Hypertension patients(N=13)**	**control subjects (N=9)**	**P**
TC	5.184±0.952	4.315±0.902	0.078
Tg	1.369 ±0.570	0.861±0.326	0.016*
HDL	0.984±0.326	0.915±0.146	0.528
VLDL	0.630± 0.262	0.392±0.118	0.015*
LDL	3.892±1.066	3.007±0.885	0.103

Table 3.1 showed mean ± SD of lipid parameters of blood group 'A" hypertensive patients and apparently healthy subjects. Triglycerides of hypertensive subjects (1.369 ± 0.570) were significantly higher compared to apparently healthy subjects (0.861±0.326) ($p = 0.016$). Very low density lipoprotein of hypertensive subjects (0.630 ± 0.262) were significantly higher compared to apparently healthy subjects (0.392±0.118) ($p = 0.015$).

Table 2 Lipid profile of blood groupB

Blood group B			
Parameters (mmol/L)	**Hypertension patients(N=12)**	**control subjects (N=6)**	**P**
TC	5.300 ±0.664	4.900±0.595	0.213
Tg	1.075 ±0.400	0.700±0.217	0.022*
HDL	1.075±0.171	1.083±0.520	0.964
VLDL	0.491± 0.188	0.733±0.059	0.477
LDL	4.133±1.363	2.150±1.015	0.006*

Table 3.2 showed mean ± SD of lipid parameters of blood group 'B" hypertensive patients and apparently healthy subjects. Triglycerides of hypertensive subjects (1.075 ± 0.400) were significantly higher compared to apparently healthy subjects (0.700±0.217) ($p = 0.022$). Low density lipoprotein of hypertensive subjects (4.133 ± 1.363) were significantly higher compared to apparently healthy subjects (2.150±1.015) ($p = 0.006$).

Table 3 Lipid profile of blood group O

Blood group O			
Parameters (mmol/L)	**Hypertension patients(N=43)**	**control subjects (N=15)**	**P**
TC	5.630 ±1.631	5.225±0.592	0.106
Tg	1.265 ±0.819	0.944±0.291	0.011*
HDL	1.097±0.289	1.044±0.237	0.406

VLDL	0.586± 0.369	0.581±0.186	0.938
LDL	4.260±1.817	3.841±0.537	0.151

Table 3.3 showed mean ± SD of lipid parameters of blood group 'O" hypertensive patients and apparently healthy subjects. Triglycerides of hypertensive subjects (1.265 ± 0.819) were significantly higher compared to apparently healthy subjects (0.944±0.291) (p = 0.011).

Table 4 Correlation of lipid parameters and blood pressure according to ABO & Rh D

ABO blood group	**variable**	**systolic (mmHg)**		**diastolic (mm/Hg)**		
		r	**p**	**r**	**p**	**n**
Blood group A	TC	0.672	0.012*	0.407	0.168	13
	TG	- 0.015	0.961	0.068	0.825	13
	HDL	0.526	0.065	0.246	0.417	13
	VLDL	0.011	0.972	0.088	0.776	13
	LDL	0.685**	0.699	0.417	0.157	13
Blood group B	TC	0.029	0.928	0.281	0.376	12
	TG	0.303	0.339	-0.469	0.124	12
	HDL	0.625**	0.030	0.120	0.709	12
	VLDL	0.344	0.274	-0.502	0.096	12
	LDL	-0.100	0.758	0.306	0.334	12
Blood group O	TC	-0.024	0.878	-0.090	0.567	43
	TG	0.283	0.066	0.081	0.607	43
	HDL	0.004	0.981	-0.014	0.929	43
	VLDL	0.278	0.071	0.063	0686	43
	LDL	-0.089	0.569	-0.121	0.438	43
Rhesus "D" Positive	TC	0.052	0.679	0.039	0.758	66
	TG	0.123	0.679	0.043	0.733	66
	HDL	0.236	0.056	-0.044	0.725	66
	VLDL	0.136	0.275	0.024	0.848	66
	LDL	-0.010	0.933	0.024	0.848	66

Table 3.4 shows correlation between lipid profile and blood pressure according to blood group & rhesus of hypertension patients. Significant positive correlation was found between total cholesterol, low density lipoprotein (LDL) and systolic blood pressure in blood group "A" patients ($p<0.05$). Significant positive correlation was found between high density lipoprotein (HDL) and systolic blood pressure in blood group "B" patients ($p<0.05$). However, blood group "O" & rhesus "D" positive hypertensive patients showed no significant correlation ($p>0.05$).

4. Discussion

According to Landsteiner's discovery, the ABO system was considered as a causative factor for many diseases, such as carcinoma of the stomach and peptic ulcer [23]. ABO antigens are considered to be evolutionarily beneficial in given resistance against diseases. Nevertheless, the susceptibility to various conditions, for example cancer, infections hematologic and cardiovascular diseases has been associated with ABO blood groups [24].Coronary artery disease (CAD) which is cardiovascular disease is one of the leading causes of morbidity and mortality worldwide and is

correlated to the levels of serum cholesterol, Low-Density Lipoprotein-cholesterol, and very Low Density Lipoprotein [25]. A possible genetic interrelationship between ABO blood groups and Coronary artery disease is described, because the gene implicated in the cholesterol balance ATP-binding cassette 2 (ABCA2) and ABO blood groups are found on chromosome 9 (locus 9p34) [26] and ABO blood group might regulate plasma lipid levels [27]. Genome-wide association studies (GWASs) and their meta-analyses support the involvement of ABO genotypes in regulating circulating levels of Low Density Lipoprotein and Total cholesterol demonstrating causal risk factors for atherosclerotic heart diseases. Several studies have also reported the association between ABO blood group antigens and hyperlipidaemia. Some investigators stated that Low Density Lipoprotein cholesterol, total cholesterol and triglycerides were higher while high density lipoprotein cholesterol was lower in blood groups A and B, nevertheless, blood group AB was protective for hyperlipidemia [28].Other studies also reported that blood group A was associated with low density lipoprotein-cholesterol and increased total cholesterol, however, no association with HDL-cholesterol [29, 30]. The present study showed significant increase in triglycerides level of blood group A & O, significant increase in triglycerides and low density lipoprotein-cholesterol in blood groups B with hypertension which slightly agreed with study from [26, 27] stating that blood group A showed the higher levels of serum Tc and LDL-C in Japanese and in white adults and adolescents cohorts. However, a study reported that incidence of hypertension was highest in blood group O which could be explained by the genetic variation that could occur in different ethnic group [11, 31], which is also slightly in agreement with this study that observed high triglycerides levels in group O patients with hypertension compared with group O apparently healthy subjects. In the current study, no significant differences were seen in the HDL-c of the patients across the ABO, which completely agreed with report from Di Cesare *etal*., where they reported no differences across the ABO [32]. Elevated total cholesterol and high blood pressure are also the major risk factors for the development coronary heart disease [33, 34].In this study, we found a significant positive correlation of total cholesterol and LDL-c with levels of systolic blood pressure in blood group A .There was not significant association between levels of systolic blood pressure with total cholesterol or LDL-c values in blood group B .There was not significant association between total cholesterol, serum triglyceride and HDL-c, LDL-c values with level of systolic or diastolic pressure in blood group O and rhesus D positive. These finding could put blood group A patients at higher risk of coronary heart disease (CAD).

5. Conclusion

The result of this study revealed significant increase in triglycerides levels of blood group A & O patients with hypertension. Also the study reveals significant increase in triglycerides and low density lipoprotein-cholesterol in blood group B patients with hypertension. A significant positive correlation of total cholesterol and low density lipoprotein-cholesterol with systolic blood pressure was observed in this study.

Compliance with ethical standards

Disclosure of conflict of interest

Authors declared that no competing interests exist.

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This research did not receive any specific grant from any funding agency in the public, Commercial, or non-profit organizations.

Statement of ethical approval

Study protocol was approved by Research Ethics committee of Enugu State University Teaching Hospital (ESUTTH) Enugu

Statement of informed consent

Each participant in this study signed an informed consent form before blood sample was collected from them.

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