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"Correlation of Apolipoprotein A1 and Apolipoprotein B100 with Systolic Blood Pressure in Essential Hypertensive Subjects.''

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KEYWORDS

Essential hypertension (ET), Apolipoprotein A1 (Apo A1), Apolipoprotein B100 (Apo B), Systolic blood pressure (SBP), Diastolic blood pressure (DBP),

ABSTRACT:

Aim of the study- To investigate the correlation of apolipoprotein A1, apolipoprotein B, and their ratio in essential hypertensive subjects.

Material and Methods- This study was conducted in the Department of General Medicine of J. A. Group of Hospitals associated with Gajara Raja Medical College, Gwalior, Madhya Pradesh. We have selected 100 patients of essential hypertensive subjects and 100 healthy normal individuals as controls. We analyzed lipid profile, apolipoprotein A1, and apolipoprotein B with the help of BA 400 fully automated analyzer.

Results- We found TC, TG, LDL-C, and VLDL-C were increased in essential hypertensive subjects except for HDL-C, which was found to be decreased. Apo A1 was found to be significantly decreased in essential hypertensive subjects compared to the controls. Apo B and the ratio of ApoB/A1 were significantly higher in the essential hypertensive group than in the control group. The mean values of Apo A1 in the essential hypertensive group and the control group were 145.10±12.10 and 149.12±13.08 respectively. Furthermore, Apo B in the essential hypertensive group and the control group were 115.96±14.67, and 87.52±11.41 respectively. Apo A1 was negatively correlated (r value -18) with SBP, while Apo B and ApoB/A1 were highly positively correlated with SBP with r values of +0.24 and +0.64, respectively.

Conclusion- We have concluded that Apolipoprotein A1 and Apolipoprotein B, along with their ratio Apo B/Apo A1, should be used to predict CVDs in essential hypertensive subjects.

Introduction

Essential hypertension is defined as a systolic blood pressure (SBP) of ≥140 mm Hg and a diastolic blood pressure (DBP) of ≥90 mm Hg, irrespective of medication (Armstrong C et al. 2014). In India, the prevalence of hypertension is nearly 33% in urban areas and 25% in rural areas (Gupta R et al. 2018).

Hypertension has been among the most studied topics of the previous century and has been one of the most significant comorbidities contributing to the development of stroke, myocardial infarction, heart failure, and renal failure (Frost CD, Law MR et al., 1991).

The evidence points to a causal link between a chronically high salt intake and the development of hypertension, when the kidneys are unable to excrete the ingested amount of sodium unless blood pressure is increased. In conjunction with this primary causal factor,

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a number of adjunctive factors, such as obesity, diabetes, aging, emotional stress, sedentary lifestyle, and low potassium intake, may increase the probability of developing hypertension (Filippini T et al. 2020 & Greer RC et al. 2020).

Essential hypertension remains a major modifiable risk factor for cardiovascular disease (CVD) despite important advances in our understanding of its pathophysiology and the availability of effective treatment strategies. High blood pressure (BP) increases the risk of CVD for millions of people worldwide. Several prospective studies have identified the major risk factors for hypertension, like obesity, smoking, alcohol consumption, and dyslipidemia, apart from dietary patterns (Bhavani BA et al. 2003).

Apolipoprotein A1 (Apo A1) is a key component of HDL-C, the antiatherogenic lipoprotein. Apo A1 is favored over high-density lipoprotein cholesterol in predicting cardiovascular diseases (Nurtazina et al. 2020). Apolipoprotein B 100 (Apo B) is the major apoprotein of atherogenic LDL-C. LDL-C contains variable amounts of cholesterol but has only one Apo B. Therefore, Apo B reflects the number of LDL particles better than LDL-C (Sniderman AD et al. 2011). Apo B is a superior predictor of cardiovascular disease (CVD) compared to total blood cholesterol and triglyceride levels (Landazuri P et al. 2011).

Materials and Methods

A comparative case control study was conducted on 100 randomly selected patients with essential hypertension from the General Medicine Department Outpatient J A Group of hospitals associated with Gajara Raja Medical College, Gwalior, Madhya Pradesh. Age and gender matched 100 healthy control subjects were taken from the general population. Both men and women hypertensive patients aged between 25 and 60 years with systolic blood pressure (SBP) ≥ 140 mmHg and/or diastolic blood pressure (DBP) ≥ 90 mmHg were included in this study. Relevant sociodemographic data and history were obtained, physical examinations were carried out, and anthropometric measurements were taken during subjects' first visits to the general medicine OPD of the hospital. Blood pressure was taken on the left arm after 5 minutes' relaxation, in a sitting position, using a standard mercury sphygmomanometer with appropriate cuff size; systolic (SBP) and diastolic (DBP) blood pressures corresponded to Korotkoff sounds 1 and V, respectively. We have taken an average of three readings, at the first visit, were used for further analysis. Height and body weight were measured with participants standing without shoes and heavy outer garments. Body mass index (BMI) was calculated as weight divided by height squared (kg/m2). Patients with secondary hypertension, renal diseases, liver diseases, diabetes mellitus endocrinopathy, known cardiac abnormalities, nutritional disorders were excluded from the study. Pregnant and lactating women were also excluded from this study. The patients taking any kind of antihypertensive drug or on treatment with any kind of immunosuppressant were excluded from the study.

Serum total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), and triglycerides (TG) were determined enzymatically, while low-density lipoprotein cholesterol (LDL-C) and very low-density lipoprotein (VLDL-C) were calculated using Friedwald's formula. Apolipoprotein A1 and Apolipoprotein B were analyzed with the help of a BA 400 fully automated biosystem biochemistry analyzer established in the lab using the immunoturbidimetry method.

Blood Sample Collection and Serum Separation

A peripheral blood sample of 5 ml was collected from each subject after overnight fasting, and 3 ml of the blood sample was transferred into a plain tube that allowed clotting adequately for 15 min at room temperature and centrifuged at 3000 rpm for 10 min to collect the serum. Nearly 2 ml of blood was transferred into a fluoride tube (a tube containing sodium fluoride) for collecting plasma to estimate fasting glucose.

Results

Table 1 shows the baseline parameters BMI, SBP, and DBP are statistically significantly increased in the essential hypertension group compared to the control group. The mean values of BMI, SBP, and DBP in the case group were 29.61±2.30, 150.37±14.51, and 111.30±16.38, respectively. The mean values of BMI, SBP, and DBP in the control group were 22.82±1.73, 123.93±4.88, and 83.28±4.30, respectively. The p-values of BMI, SBP, and DBP were <0.0001.

Table 2 shows total lipid parameters total cholesterol, triglyceride, LDL-C, and VLDL-C were statistically significantly increased in the case group as compared to

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the control group. While HDL-C was found to be statistically significantly decreased in the case group compared to the control group. The mean values of total cholesterol, triglyceride, LDL-C and VLDL-C, and HDL-C in the case group were 202.05±41.49, 120.24±30.95, 127.75±41.22, 25.05±7.12, and 50.24±8.91, respectively. The mean values of total cholesterol, triglyceride, LDL-C and VLDL-C, and HDL-C in the control group were 182.49±13.60,108.34±19.93, 108.73±16.44, 17.07±2.12, and 53.06±12.96, respectively. The p-values of TC, TG, HDL-C, LDL-C and VLDL-C were <0.0001, <0.001, 0.07, <0.0001, and <0.0001, respectively.

Table 3 shows Apo B and Apo B/A1 are statistically significantly increased in the case group compared to the control group. While Apo A1 is statistically significantly decreased in the case group compared to the control group. Moreover, Apo B and Apo B/A1 were highly positively correlated with SBP, while Apo A1 was negatively correlated with SBP.

Figure 1 shows the correlation of Apo A1 with SBP. Apo A1 was negatively correlated with SBP with an r value of -0.18.

Figure 2 shows the correlation of Apo B with SBP. Apo B was positively correlated with an r value of +0.24.

Figure 3 shows the correlation of Apo B/A1 with SBP. The ratio was highly positively correlated with SBP, with an r value of +0.65.

Table 1. *Values of baseline parameters in both case and control groups*.

Parameters	Case (N=100) (Mean±SD)	Control (N=100) (Mean±SD)	P-value
Age	42.71±10.92	40.92±9.31	0.21
Weight	66.76±8.42	63.15±9.00	0.003
BMI	29.61±2.30	22.82±1.73	<0.0001
SBP	150.37±14.51	123.93±4.88	<0.0001
DBP	111.30±16.38	83.28±4.30	<0.0001

Note: BMI = Basal Metabolic Index; SBP = Systolic Blood Pressure; DBP = Diastolic Blood Pressure

Table 2. *Values of different lipid variables in both the case and control groups*.

Parameters	Case (N=100) (Mean±SD)	Control (N=100) (Mean±SD)	P Value
TC (mg/dl)	202.05±41.49	182.49±13.60	<0.0001
TG (mg/dl)	120.24±30.95	108.34±19.93	<0.001
HDL –C (mg/dl)	50.24±8.91	53.06±12.96	0.07
LDL-C (mg/dl)	127.75±41.22	108.73±16.44	<0.0001

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VLDL-C (mg/dl)	25.05±7.12	17.07±2.12	<0.0001
Apo A1 (mg/dl)	145.10±12.10	149.12±13.08	0.02
Apo B100 (mg/dl)	115.96±14.67	87.52±11.41	<0.0001

Note: TC = Total Cholesterol; TG = Triglyceride; HDL-C = High Density Lipoprotein Cholesterol

LDL-C = Low Density Lipoprotein Cholesterol; VLDL-C = Very Low Density Lipoprotein Cholesterol;

Table 3: Correlation of Apolipoproteins with SBP and DBP in the Essential Hypertensive Group.

Variables	SBP		DBP	
	r value	p value	r value	p value
BMI	+0.01	<0.01	+0.09	<0.01
Apo A	-0.18	<0.01	-0.12	<0.01
Apo B	+0.24	<0.001	+0.11	<0.01
Apo B/A1	+0.65	<0.001	+0.26	<0.01

Note- Apo A1 = Apolipoprotein A1; Apo B = Apolipoprotein B100.

Correlation of Apo A1 with SBP

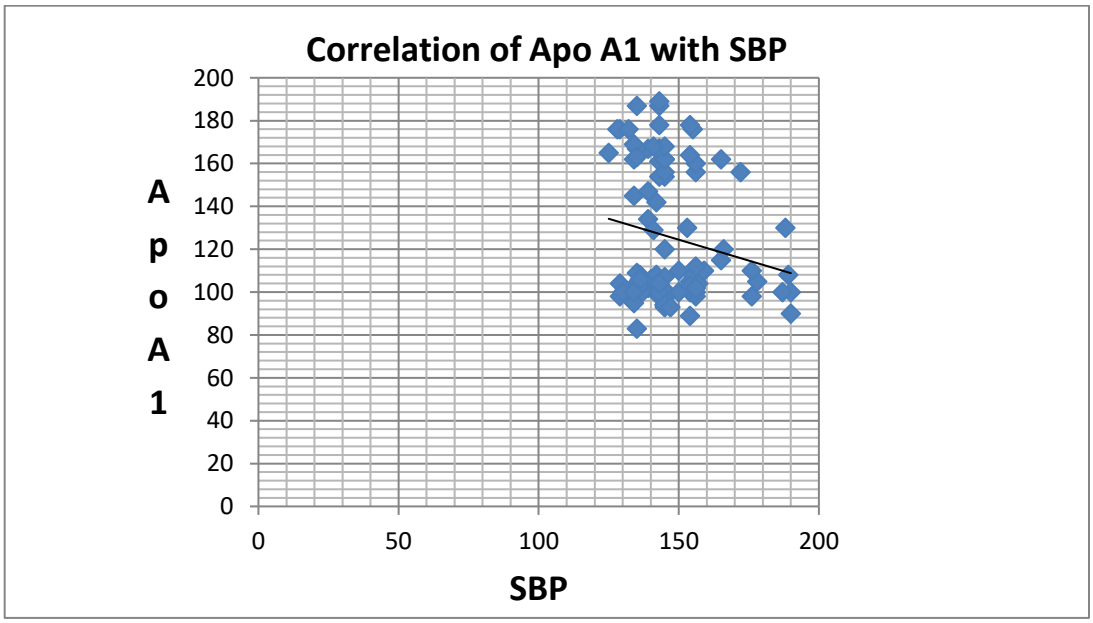

Figure 1. Correlation of Apolipoprotein A1 with SBP

Correlation of Apo B with SBP

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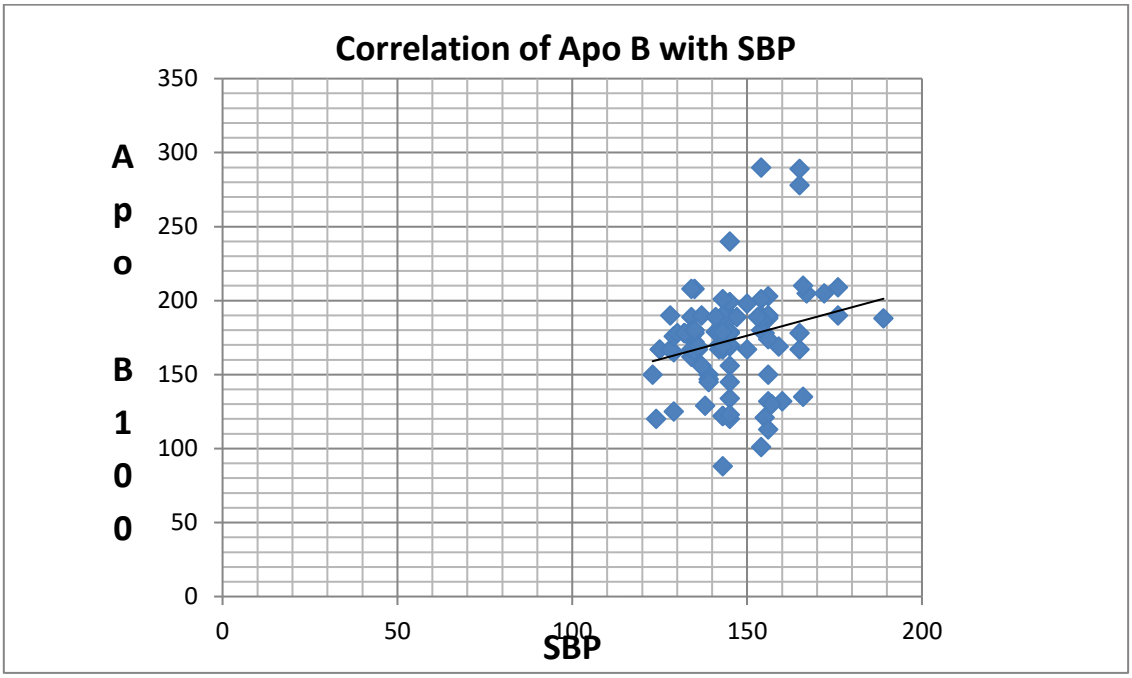

Figure 2. Correlation of Apolipoprotein B with SBP

Correlation of Apo B/A1 with SBP

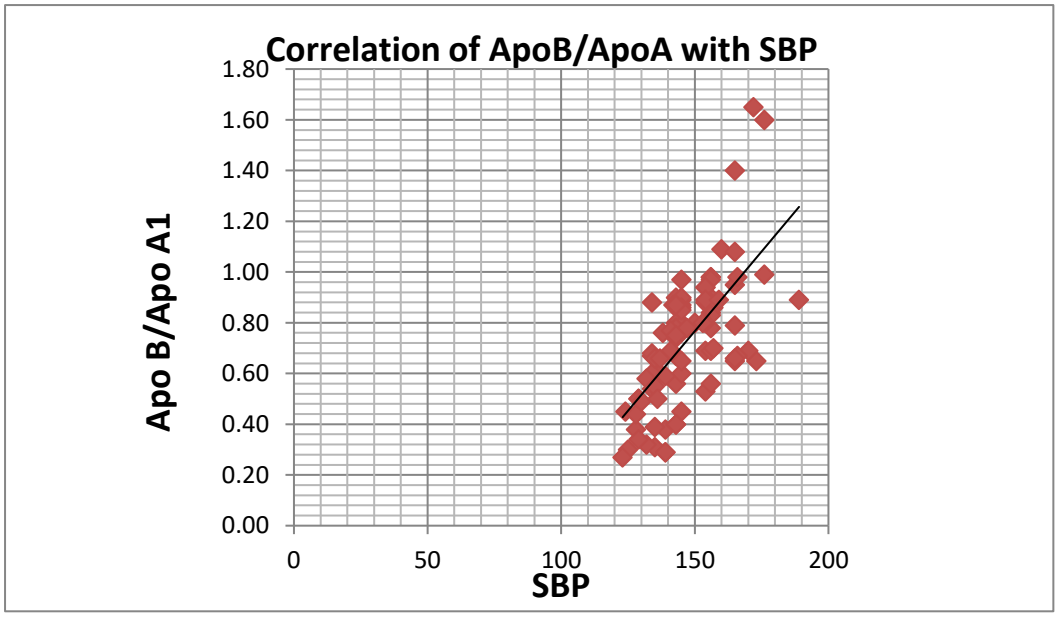

Figure 3. Correlation of Apo B/Apo A1 with SBP

Discussion

In the present study, blood pressure among patients with essential hypertension was significantly higher than in the control group. Systolic and diastolic blood pressure were significantly higher in essential hypertensive group than in the control group. These findings correlate with studies that have concluded that higher SBP and DBP are associated with a greater risk of future development of hypertension in adults under 50 years of age, and it should not be overlooked, as both DBP and SBP can independently predict cardiovascular risk (Kanegae H et

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al. (2017) & Flint AC et al. (2019). This study showed similar results to previous studies (Mahapatro et al. (2020), Nayak et al. (2016), Osuji et al. (2012), Pyadala et al. (2017), and Sur et al. (2015). These studies have also found that SBP and DBP in essential hypertension subjects were higher than in the control. In this study, BMI was positively correlated with SBP and DBP in essential hypertension group. It is because there is an association among greater BMI, higher plasma volume, and cardiac output. Similar to our study, Nayak et al. (2016), Osuji et al. (2012), and Sur et al. (2015) have also found higher BMI in the essential hypertensive group as compared to the control group. We found a significantly higher level of blood glucose in essential hypertension subjects than in control subjects, and it was positively correlated with SBP and DBP in essential hypertensive subjects. It is because blood glucose level increases as a result of metabolic disorders and hyperglycemia with insulin resistance; the rennin-angiotensin system (RAS) may undergo alterations. This may have an effect on the patient's blood pressure (Jia et al 2016, Zhou et al 2015). Moreover, Nayak et al. (2016) has found a positive correlation of blood glucose with both SBP and DBP. Furthermore, Our study shows lipid parameters (total cholesterol, triglycerides, low-density lipoprotein cholesterol, and very low-density lipoprotein cholesterol) were significantly higher in the essential hypertensive group than in the control group, except for HDL, which was significantly lower. Similar to our study, Mahapatro et al. 2020), Nayak et al. 2016), and Osuji et al. (2012) have also found this type of dyslipidemic pattern in hypertensive subjects.

Apo A1 & Apo B100 are the two main apolipoproteins for lipid transport in the processes of atherosclerosis and its consequences (Walldius et al. (2001), Luc et al. (2002), Yusuf et al. (2004) and Meisinger et al. (2005). In the present study, the essential hypertension group had significantly higher levels of Apo B and lower levels of Apo A1 than the controls. In addition, Apo A1 was significantly negatively correlated with both SBP and DBP in essential hypertensive subjects because Apo A1 has antiatherogenic properties and it exhibits endothelium-stabilizing properties. Apo B was positively correlated with SBP & DBP. Apo B has atherogenic properties. In this study, the ApoB/ApoA1 ratio was also increased significantly in essential hypertensive subjects compared to control subjects, and the ratio of Apo B/Apo A1 was significantly and positively correlated with both SBP and DBP. Nayak et al. (2016) have observed a non-significant fall in the value of serum Apo A1 in the hypertensive subjects when compared to control subjects, whereas a significant increasing trend was observed in the levels of Apo B100 from the control group. In addition, Apo A1 was significantly negatively correlated with both SBP and DBP in essential hypertensive subjects, while Apo B 100 was positively correlated with both SBP & DBP.

In this study, ApoB/ApoA1 was significantly and positively associated with both SBP and DBP. This ratio is a better predictor of coronary artery disease (CAD) than conventional lipid particles and lipid ratios, as it signifies the balance between proatherogenicity and antiatherogenicity (Han SJ et al. 2020). Furthermore, Nayak et al. (2016) and Lee et al. (1986) have found a higher level of ApoB100/ApoA1 ratio in hypertensive patients compared to controls, but it was statistically insignificant. A Recent study Bandana et al. (2024) has also concluded that Apo B and the ApoB/ApoA1 ratios were significantly higher in individuals with hypertension. The ApoB/ApoA1 ratio may be more instrumental than the individual apolipoprotein level in identifying hypertension within families. Dubey R. et al. (2023) have concluded that essential hypertensive people with dyslipidemia and an elevated ApoB/ApoA1 ratio are at an increased risk for the development of cardiovascular disease. Furthermore, the Apo B/ApoA1 ratio may be used as a complementary marker for the prediction of the risk of cardiovascular disease in essential hypertension subjects. Similarly, P Nayak et al. (2016) concluded that the ApoB/ApoA1 ratio has emerged as an important complementary parameter for the evaluation of risk for future cardiovascular disease, especially in essential hypertensive patients.

Conclusion

We have concluded that Apolipoprotein A1 and Apolipoprotein B, along with their ratio ApoB/ApoA1, should be used to predict CVDs in essential hypertensive subjects.

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