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A study of lipid profile abnormalities among patients with hypertension attending tertiary care teaching hospital

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Abstract
Background: High blood pressure has been associated with elevated atherogenic blood lipid fractions. A better understanding of the relation between blood pressure and blood lipids may provide insight into the mechanisms where by hypertension is associated with increased risk of coronary heart disease.
Methods: The serum lipid profiles of 100 hypertensive patients was studied and compared with those of healthy controls. The serum lipid profiles (TC, TGL.HDL, VLDL, LDL, TC/ HDL, LDL/HDL ratios) were studied with respect to various clinical profiles like age, sex, type, incidence etc. Study group consisted of patients with hypertension as identified by history, clinical examination, and other relevant examinations.
Results: Serum TC, TGL, VLDL, LDL, TC/ HDL, LDL/HDL were significantly elevated in hypertensive group as compared to healthy controls. Serum HDL was low in patients with hypertension as was compared with controls, which was statistically significant. The LDL was raised in obese compared to non-obese patients, which is statistically very significant. TC/ HDL and LDL /HDL were also raised in obese patients which is statistically significant. TC is raised in CVA group, which is statistically highly significant. LDL is raised in CVA group, which is statistically very significant. TC/ HDL and LDL/HDL are raised in CVA group compared to non-CVA group, which is statistically very significant. TC is raised in IHD group, which is statistically significant. LDL is raised in IHD group, which is statistically very significant. LDL/HDL is raised in men, which is statically significant.
Conclusion: There is significant alteration of lipid profile in hypertensive patients as compared to controls. Total cholesterol, LDL cholesterol, triglycerides, VLDL, TC/HDL and LDL/HDL ratios are significantly elevated in patients with hypertension. HDL is significantly reduced in hypertensive patients. Hyperlipidemia is seen in majority of cases of hypertension with Type IIa pattern being the most frequent. Mean TC, LDL, TC/HDL, LDL/HDL were higher in obese. Mean TC, LDL, TC/HDL and LDL/HDL ratios are raised in CVA group. Mean TC and LDL are raised in IHD group.

Keywords: Hypertension, lipid profile, cerebrovascular accident, ischemic heart diseases

Introduction
The proportion of elderly individuals is on the rise and hypertension is extremely common in this age group. In addition cardiovascular and cerebrovascular diseases associated with elevated blood pressure are greater in elderly people [1]. 52.2% of deaths due to CAD occur below the age of 70 years in India. There has been dramatic rise in the prevalence of coronary artery disease form 3.5% in 1960s to 11% in late1990s in urban India and it is projected to rise substantially in future [2].
Hypertension and abnormalities of lipid profile often co-exit. Several well-conducted epidemiological studies have demonstrated that cholesterol levels are significantly higher in hypertensive patient than in age, sex and body mass index matched normotensive patient [3].
Recent investigations have clearly demonstrated that atherosclerosis and left ventricular hypertrophy are major factor linking hypertension and lead to myocardial infarction. Mechanical stress, endothelial dysfunction, insulin resistance and genetic factors contribute to this association as common risk factors linking hypertension and myocardial infarction [4].
Mildly hypertensive and hyper insulinemic patients appear to have faster fractional catabolic rate of apo A1-HDL and lower HDL-cholesterol concentration. These changes appear to result from hyperinsulinemia rather than hypertension itself as they probably do in the patients with non-insulin dependent diabetes mellitus and hypertriglyceridemia [5].

Biological inter relationship between hypertension and hypercholesterolemia may influence the mechanism whereby blood pressure is associated with coronary heart disease. The two risk factors appear to have synergistic relationship [6].

So, early detection of risk factors before the catastrophic and life-threatening effect of severe atherosclerosis is a major problem for the general public as well as for the practicing physician.

The evaluation of different fractions of lipoproteins as risk factors for development of coronary artery disease and hypertension has been possible only recently, when methods to fractionate lipoproteins were made available. But cholesterol was incriminated as an etiological factor for atherosclerosis in the beginning of this century, when cholesterol was found in atheromatous plaques. Various studies around the world have well established that LDL and VLDL are atherogenic and HDL is a protective factor against coronary artery disease and hypertension. Serum lipid and lipoprotein concentration are commonly used to identify individuals who may have significant atherosclerotic disease.

Materials and methods

This study is carried out in Tertiary care teaching hospital, patients attending the hospital. A total of 100 patients admitted with hypertension were the participants of the study. The patients are in the range of 40-80 years. Both known hypertensive patients who were on treatment for a varying period of time and newly diagnosed hypertensive patients were included in the study.

Inclusion criteria: for the selection of cases for the present study were as follows: - Patients with essential hypertension with or without complication of hypertension and on medication were included for study. Systolic blood pressure > 140 mm Hg and diastolic >90 mmHg based on average of two readings or one in case of known hypertensive and on antihypertensive medication.

Exclusion criteria: (1) Secondary hypertensive subjects were excluded from the study. (2) Patients with acute illness like high grade fever and first two weeks following surgery were excluded from the study. Purpose of elimination was to obtain a pure picture of relationship between hypertension and serum lipids. (3) Patients with diabetes mellitus, hypothyroidism and those receiving lipid-altering drugs were excluded.

(a) **Control study:** Control group consisted of 50 subjects.

After selection of cases for the study each patient was subjected for the followings as per format

1. A detailed history
2. Laboratory investigations

- Lipid profile – total cholesterol, HDL cholesterol, LDL cholesterol, VLDL, Triglycerides

Results

A total of 100 patients suffering from essential hypertension and 50 healthy controls were studied. The results of various clinical and biochemical parameters and their inter relation are as follows.

Table 1: Age and sex wise distribution of hypertensive patients

Age group	Male	Female	Total
40-49	20	3	23
50-59	25	5	30
60-69	36	6	42
70 +	5	0	5
Total	86	14	100

Table – 1 shows age and sex distribution of subjects studied. A total number of 100 cases were studied among them 86 were males and 14 were females. Youngest patient in the study was 46 years old and oldest was 76 years.

Table 2: Comparison of lipid levels between hypertensive patients and healthy controls

Subjects	No. of cases	(Mean ± S.D)						
		TC	TGL	HDL	LDL	VLDL	*TC/ HDL*	LDL/HDL
Hypertension	100	194.0 ± 39.49	163.6 ± 60.8	39.78 ± 6.37	121.0 ± 41.2	32.7 ± 12.2	4.96 ± 1.31	3.10 ± 1.25
Healthy	50	155.6 ± 15.4	125.5 ± 22.7	54.5 ± 4.2	76.1 ± 11.4	25.3 ± 4.5	2.8 ± 0.2	1.4 ± 0.2
Significance		$p<0.0001$	$p<0.0001$	$p<0.0001$	$p<0.0001$	$p<0.0001$	$p<0.0001$	$p<0.0001$

$p<0.05$ - significant, $p<0.001$ - highly significant, $p<0.01$ - very significant, NS - not significant

Table - 2 Shows definite increase in total cholesterol (mean 194.0), when compared to 155.6 among healthy which is highly significant. Triglyceride level in hypertensive subjects was 163.6 compared to 125.5 among healthy controls, which is highly significant. A mean HDL level of 39.78 is noted in hypertensive when compared to 54.5 among healthy controls, which is highly significant. There is significant increase in LDL level (mean 12.0) when compared to 76.1 among healthy controls, which is statistically highly significant. VLDL values of 32.7 are noted in hypertensive subjects as compared to 25.3 among healthy, which is highly significant.

The ratio of TC /HDL shows a definite increase with a mean of 4.96 in hypertensive subjects when compared to 2.8 in healthy controls which is highly significant. The ratio of LDL / HDL shows definite increase with mean of 3.10 in hypertensive subjects when compared to 1.4 in healthy control which is highly significant.

Table 3: Comparison of lipid levels between obese and non-obese hypertensive patients

Subjects	No. of cases	TC	TGL	HDL	LDL	VLDL	TC / *HDL*	LDL / HDL
Obese	25	205 ± 41.4	163.0 ± 49.3	40.1 ± 7.01	141.0 ± 43.0	32.7 ± 9.85	5.49 ± 1.43	3.55 ± 1.55
Non-obese	75	187 ± 38.8	164.0 ± 64.8	39.7 ± 6.23	114.0 ± 38.6	32.7 ± 13	4.79 ± 1.23	2.95 ± 1.11
Significance		NS	NS	NS	$p<0.01$	NS	$p<0.05$	$p<0.05$

$p<0.05$ - significant, $p<0.001$ - highly significant, $p<0.01$ - very significant, NS - not significant

Table - 3 Shows the mean values with standard deviations of the various lipid fractions of obese and non-obese hypertensive patients. Mean TC, LDL, TC /HDL, LDL/HDL were higher in obese. The LDL was raised in obese compared to non-obese patients, which is statistically very significant. TC/ HDL and LDL /HDL were also raised in obese patients compared to non-obese, which is statistically significant.

Table 4: Comparison of lipid levels between cva and non-cva patients with hypertension

Subjects	No. of cases	TC	TGL	HDL	LDL	VLDL	TC / HDL	LDL / HDL
CVA	15	227.0 ± 25.7	181.0 ± 71.9	38.8 ± 5.13	152.0 ± 28.8	36.2 ± 14.1	5.91 ± 0.95	3.93 ± 0.89
Non-CVA	85	188.0 ± 38.9	161.0 ± 58.9	40.0 ± 6.61	115.0 ± 40.7	32.1 ± 11.8	4.80 ± 1.30	2.96 ± 1.26
Significance		$p<0.001$	NS	NS	$p<0.01$	NS	$p<0.01$	$p<0.01$

$p<0.05$ - significant, $p<0.001$ - highly significant, $p<0.01$ - very significant, NS - not significant

Table - 4 shows the mean values of lipid fractions of CVA with hypertension and non-CVA with hypertension. It can be seen that TC is raised in CVA group, which is statistically highly significant. LDL is raised in CVA group, which is statistically very significant. TC/ HDL and LDL/HDL are raised in CVA group compared to non-CVA group, which is statistically very significant. TGL, HDL and VLDL are not statistically significant.

Table 5: Comparison of lipid levels between IHD and non-IHD patients with hypertension

Subjects	No. of cases	TC	TGL	HDL	LDL	VLDL	TC / HDL	LDL / *HDL*
IHD	29	209 ± 36	161 ± 50.2	40.8 ± 6.3	146 ± 65.5	32.1 ± 10.0	5.22 ± 1.17	3.32 ± 1.30
Non-IHD	71	188 ± 39.7	165 ± 65.3	39.4 ± 6.45	115 ± 39.6	33.0 ± 13.1	4.86 ± 1.36	3.01 ± 1.23
Significance		$p<0.05$	NS	NS	$p<0.01$	NS	NS	NS

$p<0.05$ - significant, $p<0.001$ - highly significant, $p<0.01$ - very significant, NS - not significant

Table – 5 shows the mean values of lipid fractions IHD patients and non –IHD patients. It can be seen that TC is raised in IHD group, which is statistically significant. LDL is raised in IHD group, which is statistically very significant. TGL, HD, VLDL, TC / HDL and LDL / HDL are not statistically significant.

Table 6: Comparison of lipid levels between men and Women hypertensive patients

Subjects	No. of cases	TC	TGL	HDL	LDL	VLDL	TC / HDL	LDL / HDL
Men	86	195 ± 43.3	160.0 ± 63.2	39.4 ± 6.5	124.0 ± 43.6	32.0 ± 12.6	5.06 ± 1.37	3.20 ± 1.32
Women	14	184.14 ± 13.78	186.71 ± 40.8	42.0 ± 5.49	104.07 ± 12.48	37.35 ± 8.17	4.37 ± 0.6	2.44 ± 0.47
Significance		NS	NS	NS	NS	NS	NS	$p<0.05$

$p<0.05$ - significant, $p<0.001$ - highly significant, $p<0.01$ - very significant, NS - not significant

Table 7: Comparison of HDL-c levels in relation to various habits in hypertensive patients and healthy subjects

Subjects	Alcoholics	Non-alcoholics	Significance	Smokers	Non-smokers	Significance
Hypertension	36.8 ± 5.60 n=31	41.1 ± 6.32 n=69	$p<0.01$	36.6 ± 5.75 n=40	41.9 ± 5.97 n=60	$p<0.0001$
Healthy	52.2 ± 2.49 n=10	57.4 ± 19.4 n=40	NS	47.7 ± 3.72 n=11	58.7 ± 19.6 n=39	NS
Significance	$p<0.0001$	$p<0.0001$		$p<0.0001$	$p<0.0001$	

Table – 7 shows the mean and standard deviation of HDL levels in hypertensive subjects and controls with or without smoking and alcohol intake. It was found that HDL-C levels are lower in alcoholics and smokers in hypertensive group as compared to control group. It was also found that HDL level are significantly lower in non-alcoholic and non-smokers in hypertensive group compared to control group.

Table 8: Types of hyperlipidemia encountered in the study

Types of hyperlipidemia	Male	Female	Total	%
Type I	8	4	12	16.43
Type IIa	25	0	25	34.24
Type IIb	18	2	20	27.39
Type III	0	0	0	0
Type IV	10	6	16	21.91
Type V	0	0	0	0

The types of hyperlipidemia encountered in the present study are shown in table 8. 73 patients had hyperlipidemia among which 61 were males and 12 females. 16.43 % belong to Type I, 34.24 % belong to Type IIa, 27.39 % belong to Type IIb and 21.91 % belong to Type IV hyperlipidemia.

Discussion

Hypertension and hyperlipidemia are recognized as major risk factors in development of CHD as evidenced by a number of epidemiologic studies through out the world. According to these concepts, the development of atherosclerotic plaque begins when low density lipoprotein migrates from the blood stream through the arterial endothelium into the arterial wall. Here it is picked up by receptor sites and taken into smooth muscle cells from the media. The atherosclerotic process starts when these cells migrates into the intima, proliferate and ultimately break down into atherosclerotic plaque. Hypertension in this scheme plays its role by damaging the endothelial lining of the artery and facilitating the passage of LDL, particularly at the sites of arterial bifurcation were stress and shear are maximal [7].

The Framingham study revealed that HDL-C level was a major potent lipid risk factor having an inverse association with the incidence of CHD both in men and women; the proposed hypothesis that HDL facilitates the uptake of cholesterol form peripheral tissue and helps in its transport to liver for degradation and excretion. However lower HDL level, higher LDL levels and TC/ HDL ratio are more predictive of coronary heart disease [8].

In the present study a total of 100 patients of essential hypertension and 50 healthy control subjects were included. Hypertension was defined according to JNC VII, a systolic blood pressure of ≥ 140 mmHg and diastolic blood pressure of ≥ 90 mmHg. Blood samples were drawn for lipid profile analysis, from all the patients. Lipid profile values were analyzed with various clinical parameters as discussed below.

Serum lipids in hypertension compared with those of healthy controls

The present study has shown that all the lipid fractions TC, TGL, LDL-C, VLDL, TC/HDL-C & LDL/HDL-C ratio were higher in the hypertensive than those in the healthy controls which is in accordance with most of the previous reports by various workers. In the present study all the lipid fractions were elevated except HDL-C, which was reduced. The change in TC, TGL, HDL-C, LDL-C, VLDL-C, TC/HDL-C, LDL-C/HDL-C was statistically significantly higher in hypertensive subjects compared to healthy controls.

Castelli W. P, Anderson K.A (1986) had supported that blood pressure and serum cholesterol are correlated with 'r' factor of 0.12 suggesting that those with higher blood pressure values tend to have higher serum cholesterol in Framingam heart study. Coronary heart disease developed with great consistency in patients with a ratio of total cholesterol to HDL-C of more than 4.5. Half of the women and more than half of the men who presented with hypertension were already having abnormal lipid profile [9].

Bonna K.H, Thelle D.S (1991) had supported that in both sexes total and non HDL-C level increased significantly with increasing systolic or diastolic blood pressure. The association between blood pressure and total cholesterol level increased with age in women but decreased with age in men. Smoking, physical activity and alcohol consumption had little influence on the association between blood pressure and serum lipids [10].

Chen Y-DI *et al*. (1991) in their study found that mildly hypertensive patients appears to have faster catabolic rate of Apo-A1/HDL and lower HDL-C concentration [11].

Lipid levels compared between obese and non-obese subjects with hypertension

In the present study, mean TC, LDL, TC /HDL, LDL/HDL were higher in obese. The LDL was raised in obese compared to non-obese patients, which is statistically very significant. TC/ HDL and LDL /HDL were also raised in obese patients compared to non-obese, which is statistically significant ($P<0.05$) Raj Lakshman M., *et al*. (1996) found that plasma triglycerides increased progressively with increasing obesity, where as HDL decreased with increasing obesity [12].

Serum lipids and hypertension in cerebrovascular accident

In the presents study it can be seen that TC was raised in CVA group, which is statistically highly significant. LDL was raised in CVA group, which is statistically very significant. TC/ HDL and LDL/HDL were raised in CVA group compared to non-CVA group, which is statistically very significant. TGL, HDL and VLDL are not statistically significant.

This study is compared with the study done by Rajwade.N A., *et al*. (1996), the levels of total cholesterol, LDL-C lipoprotein and triglyceride, the strokes patients were observed to have higher levels but not significantly than those of matched normal subjects [13].

Blood lipids levels compared between men and women with hypertension

In the present study LDL/HDL is raised in men, which is statically significant while in others not. TC, LDL-C, TC/HDL are raised in men compared to women which is statistically not significant. TGL, HDL-C and VLDL were raised in women compared to men, which is statistically not significant.

Castelli W. P (1986) stated that triglycerides were a powerful predictor of CHD in women over age of 50, whereas no relationship was seen in men in univariate analysis. On multivariate analysis triglycerides are statistically significant risk factor in women [9].

Karpanov E. A *et al*. (1992) in study concluded that serum lipid and Apo variation during the menstrual cycle differ significantly between hypertensive and normotensive women. He states that, this should be taken under consideration in overall treatment of patients with the added risk of hypertension [14].

Serum lipids and hypertension in ischemic heart disease

In the present study, it can be seen that TC is raised in IHD group, which is statistically significant. LDL is raised in IHD group, which is statistically very significant. TGL, HD, VLDL, TC / HDL and LDL / HDL are not statically significant.

Rost P.H., Devis B.R., *et al*. (1996) in the systolic hypertension in the elderly program (SHEP) supported the concept that plasma cholesterol, LDL-C and ratios of TC/HDL-C & LDL-C/HDL-C were significantly higher in CAD men and women [15].

Mannimen V, *et al*. (1992) in the Helsinki heart study and Misra K.P. *et al*. (1980) found that LDL-C/HDL-C ratio, had more prognostic value than LDL-C and HDL-C alone and hypertriglyceridemia was a strong indicator of short term CAD risk especially when LDL-C / HDL-C ratio was also high [16].

HDL-C levels in relation to smoking and consumption of alcohol

In the present study it was found that HDL-C levels are lower in alcoholics and smokers in hypertensive group as compared to control group. It was also found that HDL-C levels are significantly lower in non-alcoholic and non-smokers in hypertensive group compared to control group. The difference between alcoholic and non-alcoholic group was statistically very significant. The difference between smoking and non- smoking group was statistically highly significant. In healthy smoker and alcoholic had lower HDL-C as compared to non-smoker and non-alcoholic but the difference were not statistically significant.

Rastogi R., *et al*. (1989) in study of lipid profile in smokers found that mean value of HDL-C in smokers was significantly lower in all groups of smokers as compared to non-smokers. The changes in mean levels were maximum in heavy smokers and persons smoking for more than 20 years [17].

Gar J.P and Vidhulekha Garg (1982) showed that serum cholesterol, triglycerides and lipoproteins showed no significant changes while serum free fatty acids rise significantly immediately after smoking in control subjects as well as in hypertensive subjects [18].

In the present study, alcoholic hypertensive subjects had significantly lower HDL-C levels compared to healthy alcoholic subjects. Chene Y. DI *et al*. (1991) states that hypertensive subjects had faster catabolic rate of Apo-A1 and HDL-C and lower HDL-C level [11].

Langer R.D *et al*. (1992) states that alcohol is known to increase HDL-C level [19]. Raj Laksman M., *et al*. (1996) in their study showed that plasma cholesterol in HDL and HDL subclasses and plasma Apo-A, increased significantly with increasing alcohol consumption [12]. In the present study, in alcoholic subjects had a lower HDL-C level compared to non-alcoholic in both hypertensive and control groups. But it was not statistically significant.

Incidence and type of hyperlipidemia

In the present study 73 patients had hyperlipidemia among which 61 were males and 12 females. 16.43 % belong to Type I, 34.24 % belong to Type IIa, 27.39 % belong to Type IIb and 21.91 % belong to Type IV hyperlipidemia.

Hakim A.S Mamatha S.A., Mehta *et al*. (1997) found that in hypertensive subjects dyslipidemia was present in 40 % of patients. Male to female ratio was 3:2. In their study most prevalent abnormal lipid pattern was hypercholesterolemia encountered in 55% of patients and isolated high triglyceride with normal cholesterol was 13% [20].

Assmann G. and Schulte H, (1988) in PROCAM study found that most prevalence of lipid abnormality was TC 200-250 mg/dl and TC < 200 mg/dl encountered 37.4 % for man and 41.3 % for women. TC 251-300 mg/dl and TG < 200 mg was 24.8 % for men and 28.7% for women. TC 200-300 mg/dl and TG 200-500 mg/dl was 20.4% for men and 62% for women [21].

In the present study 73 patients had hyperlipidemia among which 61 males and 12 females. Male to female ratio was 5:1. 16.43 % belong to Type I, 34.24 % belong to Type IIa, 27.39 % belong to Type IIb and 21.91 % belong to Type IV hyperlipidemia.

Conclusion

There is significant alteration of lipid profile in hypertensive patients as compared to controls. Hypertension was more common in middle aged and elderly subjects and males are more commonly affected than females. Total cholesterol, LDL cholesterol, triglycerides, VLDL, TC/HDL and LDL/HDL ratios were significantly elevated in patients with hypertension. HDL is significantly reduced in hypertensive subjects. Hyperlipidemia is seen in majority of cases of hypertension with Type IIa pattern being the most frequent. Among patients with CVA with hypertension and non-CVA with hypertension it can be seen that TC, LDL, TC/ HDL and LDL/HDL ratios were raised in CVA group. Between IHD and non –IHD patients it can be seen that TC and LDL were raised in IHD group.

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