Open Access Journal
International Journal of Medical Research and Pharmaceutical Sciences
Volume 4 (Issue 3): March 2017 ISSN: 2394-9414
DOI- 10.5281/zenodo.376352 Impact Factor- 3.109

CLINICAL STUDY OF ESSENTIAL HYPERTENSION WITH REFERENCE TO LIPID PROFILE

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Keywords:
Essential hypertension, cardiovascular disease, Cholesterol, Triglyceride, LDL, HDL, VLDL.

Abstract

A study of serum lipid profile in patients of essential hypertension was carried out in the Department of Medicine, Down Town Hospital, Guwahati. All available literatures related to the problem of essential hypertension and serum lipid profile have been extensively reviewed. Hundred patients of essential hypertension were included in the present study and another fifty healthy, age and sex matched subjects were taken as controls. The patients in the present study varied from 31 years to 90 years with the mean age of 61.35 years. The maximum numbers of cases (44%) belong to age group of 50-70 years, followed by 29% in 30-50 year age group and 27% in above 70 year age group. Fifty two percent of patients had age at onset of hypertension between 30-50 year age group (52%), followed by 47% of cases in 50-70 year age group. The maximum numbers of cases (35%) were having hypertension of 6 year to 10 year duration, followed by 29% between 1 year to 5 years duration. Both 11-15 years and more than 15 years group had 18 % of cases each. The patients with essential hypertension had significantly increased levels of TC, TGL, VLDL, TC/HDL and LDL/HDL. There is general derangement of the lipid profile among the Index cases as BMI increases. It was as also found to be the same pattern among males and female index cases. Total Cholesterol ($p<0.001$), Triglyceride ($p<0.05$), LDL ($p<0.05$), VLDL ($p<0.05$), TC/HDL ($p<0.01$) and LDL/HDL ($p<0.01$) are statistically significant in overweight (BMI>30) male hypertensive cases as compared to overweight controls. No statistical significant changes are observed between lipid profiles of healthy weight hypertensive males and healthy weight males in control group. Total Cholesterol (TC), Triglyceride (TGL), Low Density Lipoprotein (LDL), Very Low Density Lipoprotein (VLDL), TC/HDL and LDL/HDL were raised in CVA cases as compared to Non-CVA cases in Index group, but not significant statistically. Also High Density Lipoprotein (HDL) was lower in CVA group as compared to Non-CVA but not significant statistically. Both alcohol and smoking have adverse effects on heart as CHD in the patient of hypertension in the Index group. Also smoking has one more adverse effect as CVA. Alcohol had increased incidences of CVA, TIA and Retinopathy, but not significant statistically. Smoking has also increased the incidences of TIA and Retinopathy, but not significant statistically

Introduction

Hypertension is the major risk factor for heart disease and stroke which are the leading causes of mortality and morbidity. It is number one attributable risk for death throughout the world [(1)]: it is both preventable and treatable in majority of the patients. Despite these impressive statistics, hypertension continues to be neglected. About 30% of all deaths is attributable to Cardio Vascular Disease worldwide each year,[(2)] and except for the sub-Saharan Africa, CVD is the leading cause of mortality in every region of the world, for the infectious diseases still prevail as the leading causes in sub-Saharan Africa. CVD is a broad term and it includes Coronary Heart Disease (CHD),

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Cerebrovascular Accidents (CVA), Peripheral Vascular Diseases (PVD), Congestive Heart Failure (CHF), Hypertension, and Valvular and Congenital Heart Diseases. The projected trends in the global burden of CVD over the next 2 decades are elucidated and ongoing efforts by the world community [including the World Health Organization (WHO)] to combat and contain the current epidemic are outlined. In 2006, CVD was more prevalent in China and India than in all developed countries combined, and it is projected that developing countries will account for 70% of deaths caused by coronary heart disease and 75% of deaths caused by stroke. [(3)] By 2020, the WHO estimates that there will be nearly 20 million CVD deaths worldwide every year, and the number will increase to 24 million by 2030. [(4)] The prevalence of hypercholesterolemia in patients with hypertension and vice versa is about twice seen than in normotensive population. This implies that all patients with hypertension should have their cholesterol measured, and all patients with hypercholesterolemia should have their blood pressure measured. Few attempts have been made to analyze the relation between blood pressure and serum lipid levels. A better understanding of interrelation between blood pressure and serum cholesterol may be of relevance for the understanding of how essential hypertension is related to the etiology and pathogenesis of arteriosclerosis and, thereby, also for selecting the appropriate therapeutic approach.

The study aims to study the abnormalities of serum lipid profile in patients of Essential Hypertension, to study the relationship of various epidemiological factors with serum lipid abnormalities in patients with Essential Hypertension and to study the relation between lipid abnormalities and cardiovascular complications in patients with Essential Hypertension..

Methodology

The present study is cross sectional study that includes hundred cases of Essential Hypertension, admitted in Department of Medicine, Down Town Hospital, Guwahati. Fifty, age and sex matched control subjects were randomly selected from normal population without history of hypertension, hyperlipidemia and diabetes.

Selection Of Cases

The cases were selected randomly irrespective of sex, socioeconomic status, BMI (Body Mass Index), severity, duration, control of hypertension and presence or absence of cardiovascular complications. No patients were selected below 30 years of age. The criteria of accepting the patients as hypertensive is taken as the persistent elevation of systolic blood pressure above 140 mmHg and/or diastolic blood pressure above 90 mmHg or normal systolic and diastolic BP but on anti hypertensive drugs in adults (JNC 7). The patients with obvious cause of hypertension, like renovascular, renal parenchymal disease, pregnancy, young hypertensives who have underlying pathology for elevation of blood pressure, definite history of drugs which raise the blood pressure, and the patients receiving hypolipidemic agents have been excluded from the study.

Collection of blood samples

Venous blood samples of the selected cases were taken for fasting blood glucose, blood serum cholesterol, and triglyceride and lipoprotein fractions in morning after 10 hours or overnight fasting in same sitting. Blood samples were collected from the controls for measurement of fasting blood glucose, serum triglycerides and lipoprotein fractions.

Estimation of Lipid Profile

VITROS Chemistry Products Calibrator Kit 2 was used for determination of all Lipid profile.

Thyroid Profile

Enhanced Chemiluminescence Immunoassay method was used to measure Thyroid Stimulating Hormone (TSH), Free Thyroxine Hormone (FT_4) and Free Triiodothyronine (FT_3).

Chest X-Ray

To look for evidence of lung parenchymal lesion, cardiac enlargement, ventricular aneurysm, signs of heart failure.

Ultrasonography of abdomen

It was used to look for any evidence of tumor in adrenal glands, kidney size, and any renal parenchymal disease.

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Elecrocardiography
12-Lead ECG was done to look for any evidence of ventricular enlargement and myocardial ischemia.

Echocardiography
It was used to look for heart chambers enlargement and/or hypertrophy, ejection fraction, valvular disease.

Ethical considerations
The study has been approved by the Ethics Committee of Down Town Hospital, Guwahati. Informed consent was taken in writing from all the participants in the study.

Result & Observation

The present study includes one hundred cases of Essential Hypertension, admitted in Medicine wards of Down Town Hospital. Fifty non hypertensive controls were selected randomly from patients admitted for other ailments not included in the exclusion criteria.

The age incidence ranged from 31 years to 90 years, with mean age of 61.35 years. Maximum numbers of cases were recorded in the age group of 50 years to 70 years (44 cases i.e. 44.0%). Maximum numbers of cases were recorded in age group of 50 year to 70 years both for male and female cases, same as the combined male and female cases. 52% patients had age at onset of hypertension between 30-50 year age group, followed by 47% of cases in 50-70 year age group. Males had slightly higher incidence of onset of hypertension in all age groups, except age group of above 70 years, where just single female developed hypertension above 70 years.

Figure No. 1: Pie chart showing frequency of duration of hypertension in the Index group

Maximum numbers of cases (35%) were having hypertension of 6 year to10 year's duration, followed by 29% between 1 year to 5 years duration. Both 11-15 years and more than 15 year groups had 18 % of cases each. It was found that 41% of Index cases were receiving combination of various anti-hypertensive treatments against 52% cases with monotherapy for hypertension. 7% of hypertensive cases were on none of anti hypertensive medicine. Study shows that Positive family history of hypertension was found in 40% cases, followed by CHD (14%). 10% cases had positive family history of Hyperlipidemia and 8% cases had positive family history of CVA.

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Table No. 1: Incidence of Alcohol intake in Index group

Alcohol intake		Alcohol		Total
		Absent	Present	
SEX	Male	22	30	52
	Female	45	3	48
Total		67	33	100

Table No. 2: Table showing Body Mass Index (BMI) distribution of both male and female in index cases and controls

BMI	Index cases		Controls	
	Male	Female	Male	Female
Healthy (18.5-24.99)	4	9	14	10
Overweight (25-29.99)	19	15	16	10
Obese I (30-34.99)	25	23	0	0
Obese II (35-39.99)	4	1	0	0

It is seen that 13% of the total Index cases had normal weight, 34% cases were overweight, 48% cases were grade I obese and 5% cases were grade II obese.

Table No. 3: Lipid profile of cases in Index group and Control group

	Index Cases		Controls		Significance (Two-tailed)
	Range	Mean & S.D.	Range	Mean & S.D.	
TC	123-275	194.90±37.43	83-174	137.36±22.08	P<0.001
TGL	55-400	157.99±71.48	39-237	106.72±44.50	P<0.001
HDL	13-116	42.07±12.0	21.9-68.5	40.42±9.43	NS
LDL	31.5-210	121.06±36.51	25-115	74.98±22.09	P<0.001
VLDL	11-80	31.83±14.72	7.8-47.4	21.34±8.89	P<0.001
TC/HDL	1.26-11.85	4.91±1.46	2.01-6.67	3.55±0.93	P<0.001
LDL/HDL	0.27-8.46	3.08±1.22	0.48-5.02	1.98±0.82	P<0.001

It was observed that the patients with essential hypertension had statistically significantly increased levels of TC, TGL, LDL, VLDL, TC/HDL and LDL/HDL as compared to subjects in control group. TC, TGL, LDL, VLDL, TC/HDL and LDL/HDL were statistically significantly raised in hypertensive males as compared to males in the control group.

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Table No. 4: Lipid Profile in Index group according to BMI

BMI Grades - Total	No. of cases	TC	TGL	HDL	LDL	VLDL	TC/HDL	LDL/HDL
Healthy	13	170.38 ±23.1	131.08 ±53.51	38.89 ±11.83	103.92 ±21.4	26.23 ±10.62	4.9 ±2.28	3.06 ±1.74
Over weight	34	164.27 ±23.99	148.4 ±76.90	43.12 ±14.88	92.16 ±21.68	30.87 ±16.51	4.06 ±1.03	2.31 ±0.77
Obese I	48	219.42 ±28.01	170.94 ±69	42.39 ±10.26	142.38 ±31.31	33.85 ±13.98	5.42 ±1.23	3.54 ±1.06
Obese II	5	231.60 ±16.81	168.8 ±88.56	40.22 ±5.70	157.40 ±32.39	33.60 ±17.76	5.84 ±0.89	3.98 ±1.02

Table No. 4 shows lipid profile of cases according to their BMI categories. It can be seen from the above table that as BMI increases, generally, there is derangement of lipid profile. It can also be seen that lipid profile of healthy weight index cases is slightly higher than that of overweight Index cases. This may be attributed to confounders such as age, sex which could not be controlled due to limitation of sample size. It is clear that out of hundred cases of Hypertension in Index group, 84 patients had dyslipidemia. Sex wise, 48 males and 36 females had dyslipidemia. 92.31% (48 out of 52 males) and 75% (36 out of 48) were dyslipidemic. Rest 16 cases (4 males and 12 females) in Index group had normal lipid profile. In control group, 14 cases (10 males and 4 females) had dyslipidemia. Rest 36 cases (20 males and 16 females) had normal lipid profile. In Index group out of 84 cases of dyslipidemia, 25 cases (13 males and 12 females) i.e. 29.76% had Type I dyslipidemia. Also 17 cases (8 males and 9 females) i.e. 20.24% had Type IIa, 10 cases (6 males and 4 females) i.e. 11.9% had Type IIb, 28 (18 males and 10 female) i.e. 33.33% had Type III and 4 (3 males and 1 female) i.e. 7.76% had Type IV dyslipidemia.

Percentage values were calculated considering 84 dyslipidemic patients. In this study, none of patient was found to have Type V dyslipidemia. Total Cholesterol ($p<0.001$), Triglyceride ($p<0.05$), LDL ($p<0.05$), VLDL ($p<0.05$), TC/HDL ($p<0.01$) and LDL/HDL ($p<0.01$) were statistically significant in overweight (BMI>30) male hypertensive cases as compared to overweight controls. No significant changes were observed between lipid profiles of healthy weight hypertensive males and healthy weight males in control group.

Table No. 5: Lipid Profile values in different cardiovascular complications in Index group.

Cardiovascular Complications	No. of Cases	TC	TGL	HDL	LDL	VLDL	TC/HDL	LDL/HDL
CHD	55	207.04 ± 36.5	160.18 ±69.04	42.95 ± 13.01	131.81 ± 36.02	32.68 ± 14.5	5.09 ± 1.3	3.28 ±1.09
CVA	10	209.2 ±22.21	187.80 ±61.6	39.71 ±3.73	131.06 ±22.56	37.52 ±12.31	5.34 ±0.95	3.37 ±0.94
TIA	15	209.47 ±44.26	155.8 ±85.38	46.95 ±12.02	131 ±46.14	30.13 ±17.24	4.67 ±1.37	2.96 ±1.31

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Retinopathy	10	205.5 ±33.68	158 ±60.16	48.52 ±12.87	124.86 ±30.08	31.62 ±12.08	4.42 ±1.03	2.71 ±0.84

In Table No. 5.24 it can be seen that lipid profile of cases in index group with cardiovascular complications was deranged. TC was more than desired levels, LDL was more than optimal level and TGL was more than normal levels. (According to ATP III) CHD and CVA groups showed TC/HDL more than 5 and LDL/HDL more than 3.5. It is seen Total Cholesterol (TC), Triglyceride (TGL), Low Density Lipoprotein (LDL), Very Low Density Lipoprotein (VLDL), TC/HDL and LDL/HDL are raised in CVA cases as compared to Non-CVA cases in Index group, but not significant statistically. Also High Density Lipoproteins (HDL) was lower in CVA group as compared to Non-CVA but not significant statistically.

Table No. 6: Lipid Profile values in Alcoholics and non Alcoholics in Index group

Groups	**No. of Cases**	**TC**	**TGL**	**HDL**	**LDL**	**VLDL**	**TC/HDL**	**LDL/HDL**
Alcohol	**33**	208.52 ±34.89	175.27 ±70.79	41.04 ±8.83	131.75 ±34.14	34.95 ±14.19	5.25 ±1.24	3.36 ±1.13
Non-Alcohol	**67**	188.2 ±37.06	149.48 ±70.8	42.58 ±13.32	115.79 ±36.73	30.3 ±14.84	4.74 ±1.53	2.95 ±1.24
Significance (Two-tailed)		**P<0.01**	**NS**	**NS**	**P<0.05**	**NS**	**NS**	**NS**

It is seen from Table No. 6 that Total Cholesterol (TC) and Low Density Lipoprotein (LDL) were raised significantly in alcoholics as compared to non alcoholics in Index group. TGL, VLDL, TC/HDL and LDL/HDL were also raised in alcoholics as compared to non alcoholics, but not significantly. Also HDL was lower in the alcoholics as compared to non alcoholics which were not statistically significant. 75.8% alcoholics suffered from CHD compared to 44.8% of non alcoholic cases. This difference is statistically significant at $p<0.001$. (Chi Square test). Study shows that 19.4% of smoker cases in Index group had CVA as compared to 4.7% of non smokers. This result is statistically significant ($p<0.05$) according to Chi-Square test. 16.7% of smokers in the Index group had TIA as compared to 14.1% in patients who did not smoke. This result is statistically not significant in Chi-Square test.

Discussion

In the present study, hundred cases of essential hypertension were studied extensively and methodologically. Age and sex matched, healthy non hypertensive controls without positive family history of hypertension, obesity, hyperlipidemia, were also studied. Any patient with secondary hypertension was excluded from the study. The patients in the present study varied from 31 years to 90 years with the mean age of 61.35 years. The maximum numbers of cases (44%) belong to age group of 50-70 years, followed by 29% in 30-50 year age group and 27% in above 70 years age group. It has been shown by most of the workers from different part of the world that there is a gradual rise in blood pressure with increasing age. In this study, it is found that essential hypertension is a common condition in both sexes with some degree of variation. Out of 100 cases with essential hypertension, 52 cases (52%)

Volume 4 (Issue 3): March 2017 ISSN: 2394-9414
DOI- 10.5281/zenodo.376352 Impact Factor- 3.109

were males and 48 cases (48%) were females. The ratio between male and female hypertensive cases was 1.1:1.0. Woley [5] in a study conducted in New York found that the average blood pressure for males was higher than that of females. Similar blood pressure difference between male and female hypertensives was also found by Gupta et al [6] in Haryana and Mathur [7] in Agra. Master et al [8] stated that the hypertension is more common in males than females up to 40 years of age and then condition reverses. The apparent age of onset of hypertension in maximum number of cases (52%) varied from 30 years to 50 years followed by 50 to 70 years. Males have slightly higher incidence of hypertension in all age groups, except above 70 year group. This is consistent with the findings of Mathur [7] and Gupta et al. [6] The duration of hypertension in maximum number of cases (35%) varied from 6 to 10 years, followed by 29% from 1 to 5 years duration. Both 11-15 year and more than 15 year groups have 18% of cases each. In this study, 41% cases received combination therapy for hypertension as compared to 52% cases with monotherapy. However, 7% cases were not taking any of anti hypertensive medicines, either because they were unaware of the diagnosis of hypertension or because of poor compliance. Positive family history of hypertension was found in 40% of cases, followed by 14% in coronary heart disease. Positive family history of hyperlipidemia and cerebrovascular accident shared 10% and 8% respectively. It was observed that 57.69% of male hypertensives were alcoholic and 61.54% of male cases of hypertension were smokers. Among the 48 female cases of hypertension, 6.25% were alcoholic and 8.33% were smokers. Ramsay, [9] Clark [10] and Beevres [11] found positive correlation between alcohol intake and hypertension. Puddey [12] found that 16% cases of hypertension were attributed to alcohol. Fifty three percent of the total cases of hypertension were obese (BMI ≥30), of which 48% had grade I obesity. Total 13 cases were of normal BMI, as 34% were included in overweight category that has high chance of developing obesity. 55.77% male cases of hypertension were obese and 50% female cases were obese. Thus high BMI is found to be a risk factor for developing hypertension. As far as Lipid profile is concerned, 84% cases in the Index group were found to have associated dyslipidemia. Out of 52 male in Index group 48 males (92.31%) were dyslipidemic. Female constituted 75%, as 36 females in Index group were having several types of Dyslipidemia. Our study showed that Index hypertensives had significantly raised levels of TC, TGL, VLDL, TC/HDL and LDL/HDL. HDL was also found to be significantly lower in Index group as compared to controls. LDL was found to be high in Index group, but not statistically significant. Males in the Index group had statistically significant higher levels of TC, TGL, LDL, VLDL, TC/HDL and LDL/HDL. Mean HDL was almost equal in Index males and control group males. Females in Index group had statistically significant higher levels of TC, TGL, LDL, VLDL, TC/HDL and LDL/HDL as compared to females in control group. Our study showed the raised TC, LDL, VLDL, TGL, TC/HDL and LDL/HDL in male hypertensives as compared to female hypertensives and lower level of HDL in males as compared to females, though the relation were not statistically significant. BMI was found to be a risk factor for developing dyslipidemia in total Index cases. Though lipid profile of healthy weight Index cases were slightly higher than that of overweight Index cases, this may be attributed to confounders such as age, sex which could not be controlled due to limitation of sample size. In the present study, comparison was done between lipid profile of healthy males in Index group versus healthy males in control group and overweight males in Index group versus overweight males in control group. The same comparisons were done for females also. It was found that healthy males had higher levels of TC, TGL, LDL, VLDL, TC/HDL and LDL/HDL, though not statistically significant. Also, HDL was low in Index healthy males, but not statistically significant. On contrary, overweight males in Index group had statistically significant higher levels of TC, TGL, LDL, VLDL, TC/HDL and LDL/HDL. Results in females were little conflicting. Overweight females in Index group did not have significantly higher levels of TC, TGL, LDL and VLDL as compared to overweight females in control group, though there was a significant rise in the TC, LDL and LDL/HDL in Index healthy weight females as compared to healthy weight females in the control group. TGL, VLDL and TC/HDL were though raised in healthy weight females in Index cases as compared to healthy weight females in control group, but not statistically significant. Thus we conclude that BMI is risk for developing dyslipidemia also. Studies by Hong et al, [13] Brown, [14] Humayun [15] have shown that increased BMI is cause of dyslipidemia both in males and females. Among hundred cases of hypertension in Index group, 84 patients had dyslipidemia. Sex wise, 48 males and 36 females had dyslipidemia. 92.31% (48 out of 52 males) and 75% (36 out of 48) were dyslipidemic. Rest 16 cases (4 males and 12 females) in Index group had normal lipid profile. In control group, 14 cases (10 males and 4 females) had dyslipidemia. Rest 36 cases (20 males and 16 females) had normal lipid profile. In Index group out of 84 cases of dyslipidemia, 25 cases (13 males and 12 females) i.e. 29.76% had Type I dyslipidemia. Also 17 cases (8 males and 9 females) i.e. 20.24% had Type IIa, 10 cases (6 males and 4 females) i.e. 11.9% had Type IIb, 28 (18 males and 10 female) i.e. 33.33% had Type III and 4 (3 males and 1 female) i.e. 7.76% had Type IV dyslipidemia. Percentage values were calculated considering 84 dyslipidemic patients. In

Volume 4 (Issue 3): March 2017 ISSN: 2394-9414
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this study, none of patient was found to have Type V dyslipidemia. Thus, there is a higher chance for male hypertensive for developing dyslipidemia as compared to female hypertensive. Our study showed that 55 patients (33 male and 22 females) had Coronary Heart Disease, 10 patients (8 males and 2 females) had Cerebro - Vascular Accidents (CVA), 15 patients (6 males and 9 females) had Transient Ischemic Attack (TIA) and 10 patients (7 males and 3 females) had Retinopathy. CHD patients had higher levels of TC, TGL, LDL, VLDL, TC/HDL and LDL/HDL. But only TC and LDL were significantly raised. TC, TGL, LDL, VLDL, TC/HDL and LDL/HDL were raised in CVA patients as compared to Non-CVA patients of Index group, but they were not significantly raised. Also HDL was low in CVA group, but not statistically significant. In our study we compared the effects of Alcohol and Smoking on cardiovascular diseases viz. CHD, CVA, TIA and Retinopathy and the findings were as follows. 75.8% alcoholics suffered from CHD compared to 44.8% non alcoholics. This difference was significant at $p<0.001$ (by Chi Square). 12.1% alcoholic cases had CVA as compared to 9.0% non alcoholic cases. (Result is not statistically significant according to Chi Square). 15.2% of alcoholics suffered from TIA, which was not statistically significant as compared to 14.9% incidence of TIA in non alcoholic cases. 18.2% of alcoholic cases had Retinopathy as compared to 6.0% in non alcoholic cases, which was statistically not significant. 75.0% smokers suffered from CHD as compared to 43.8% of non smokers. This result is statistically significant ($p<0.01$) according to Chi-Square. 19.4% of smokers had CVA as compared to 4.7% of non smokers. This result is statistically significant ($p<0.05$) according to Chi-Square. 16.7% of smokers had TIA as compared to 14.1% of non smokers. This result is statistically not significant according to Chi-Square. 16.7% of smokers had retinopathy as compared to 6.2% of non smokers. This result is not statistically significant according to Chi-Square. Thus we conclude that both alcohol and smoking have adverse effects on heart as CHD in the patient of hypertension in the Index group. Also smoking has one more adverse effect as CVA. Alcohol had increased incidences of CVA, TIA and Retinopathy, but not statistically significant. Smoking has also increased the incidences of TIA and Retinopathy, but not statistically significant. Emberson [16] and Wannamethee [17] had shown the propensity of CHD in alcoholic hypertensives. Though, Rimm [18] reported that the amount of alcohol has more important role in causing CHD, as moderation of alcohol is beneficial for the heart. Meta - analysis by Reynolds et al [19] indicate that heavy alcohol consumption increases the relative risk of stroke while light or moderate alcohol consumption may be protective against ischemic stroke. Panwar et al [20] and Basu [21] showed that tobacco in any form has significant risk of developing CVD.

Conclusion

The association between serum cholesterol and its fractions with hypertension has been studied in hundred cases. The study reveals that these patients were associated with significant elevation in serum cholesterol, triglyceride and LDL-cholesterol and reduced levels of HDL-cholesterol. The influence of other variables in the association between blood pressure and cholesterol has also been studied. Of these, body mass index, alcohol and smoking significantly influenced the relation between lipid profile and hypertension. Development of cardiovascular complications was also influenced by levels of dyslipidemia, presence of hypertension, presence of alcohol and smoking. These results support that there are biological interrelations between blood pressure and serum lipids that may influence the mechanisms where blood pressure is related with coronary heart disease. Number of cases were however small in this series, so to come to a definite conclusion, there is a need for further studies to investigate the effects of serum lipid on blood pressure.

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