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A CASE CONTROL STUDY OF SERUM MAGNESIUM, SERUM LIPID PROFILE AND BLOOD GLUCOSE LEVELS AMONG HYPERTENSIVE PATIENTS IN TRIPURA, NORTH-EAST INDIA.

Biochemistry

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ABSTRACT

Background: This study has been conducted to explain the role of blood glucose, lipid profile and serum Magnesium among individuals suffered from hypertension. All the parameters were explained biochemically. **Materials and Methods:** The study consists of 80 samples (50 cases and 30 controls). **Results:** It is found that individuals with hypertension were associated with dyslipidemia without any change in HDL concentration. Any type of correlation between cases and controls regarding serum Magnesium were absent. In the aforementioned study, it is elicited that serum Magnesium among cases with hypertension is slightly higher than that of healthy Controls. Fasting blood sugar levels of hypertensive cases are significantly higher than that of normal healthy controls. But this variation may be because of the presence of 12% diabetic cases occurred in the study. There is also a tendency to form impaired glucose tolerance in hypertensive cases. Both systolic and diastolic blood pressures were noted separately as a measurement of blood pressure. The systolic blood pressure has been found more significant than the diastolic blood pressure as the age groups increase gradually. **Conclusions:** Dyslipidemia is associated with hypertension which may be due to genetic predisposition, sedentary lifestyles and fatty food consumption among the cases when compared to healthy controls.

KEYWORDS

Blood glucose, Magnesium, lipid profile, SBP, DBP.

INTRODUCTION

Hypertension itself is considered to be a disease as a specific trait in contrast to a particular disease and projects a quantitative rather than qualitative fluctuation from the normal range. It is blood pressure which projects as the main force that plucks blood from blood vessels to distribute nutrients and oxygen to the tissues and organs of the body and carry away waste materials and metabolites. The systolic blood pressure (SBP) lower than 120 mm Hg and diastolic blood pressure (DBP) less than 80 mm Hg are considered to be optimal. On the other hand, hypertension is portrayed as SBP level higher than 140 mm Hg and/or a DBP higher than 90 mm Hg. Chronic hypertension is also referred as an elevated arterial blood pressure which is a prevalent health problem through the world with continuous global increase in the incidence. Hypertension attacks almost 25% of the adult population. Though hypertension historically referred as "an elevation of blood pressure" alone, it is also associated with systemic vascular resistance, arterial compliance and cardiac output abnormalities.[6]

The top risks are tobacco consumption, iron deficiency, alcohol consumption, underweight, high cholesterol with obesity, smoke from fuels, hygiene, sanitation, high blood pressure and unsafe water as per the WHO report 2019 in terms of burden of disease globally and regionally.[3] All of these account for grater than 1/3rd of the deaths throughout the world. Survey of epidemiological studies projects that hypertension is prevalent in 25% (34 million) urban and 10% (31.5 million) rural subjects in India. Among these stage-1 hypertension consists of 70%. Hypertension is divided into two groups- primary or essential hypertension and secondary hypertension. Primary hypertension is referred as an "increase in blood pressure due to unknown reason." Secondary hypertension presents as the "rise in blood pressure due to endocrine, kidney or some other organs disease." Less than 5% of hypertensive subjects convert to malignant hypertensive patients.

Hypertension is moreover graded upon 3 stages based on the elevated blood pressure.[1] A prevailing and continuous high blood pressure has deteriorating effects on the brain (cerebrovascular accident), heart (hypertensive cardiomyopathy) and kidneys (benign and malignant hypertension). There is increased risk of systolic hypertension among peoples of 50 years or older.16 The differential effect of SBP and DBP on blood pressure staging in a project sample of the population of middle-aged in Spain, which shows a high incidence of cardiovascular disease.

There is a presence of strong associations between blood pressure and the risk of congenital heart defect (CHD) and stroke. There is also presence of associations between serum cholesterol and risks of congenital heart defects. Various epidemiological studies have presented that hypertensive subjects have a marked increase in the prevalence of diabetes, hypomagnesemia, hypertriglyceridemia, hypercholesterolemia etc. There is the examination of the longitudinal study, which assessed risk of women throughout a wide spectrum of baseline BMI (kg/m^2) values and observed waist circumference (wc, cm) fat man (FM, kg), body fat percentage on incidence of hypertension among group-wise analysis. 592 women presented hypertension during a mean of 16.7 years through follow-up, it shows higher BMI, even within the normal range, was accompanied with greater risk of hypertension.[14]

The aforementioned study covers the lipid profile in hypertensive patients. This study concludes the evaluation of Magnesium which plays a pivotal role in several metabolic reactions especially those consist of cellular energy ATP. Magnesium is the fourth most prevalent cation in the human body and the second most abundant cation inside human cells. The approximate quantity of body Mg in an adult of 70 kg weight is about 2000 mEq. Mg is present 50-70% in bones, 1% in ECF and remaining inside the cells, especially in the mitochondria.[12] The levels of blood glucose among patients with hypertension are also included to obtain the involvement of hypoglycaemia with hypertension. The causes of increased incidence of hypertension include sugar rich diet, high fat processed foods, lifestyle changes and sedentary behaviour.[8] 'Dyslipidaemia' is considered to be common metabolic disease. Hyperlipidaemia may be formed from a lipid metabolism abnormality or as a secondary proliferation of other conditions. The incidence of dyslipidaemia in a young population (7-17 years) with type 2 DM showed the relationship between lipid parameters and some other cardiovascular risk factors. Increased apo B levels with normal LDL-C levels specify the utility of full lipid panel including apo-B for definition of potential modifiable cardiovascular risk among peoples who have high rates of smoking, obesity and poor glycaemic control.[13]

Aims and Objectives

A) To evaluate:
i) Concentrations of serum Magnesium and blood glucose
ii) Concentrations of serum lipid profiles in hypertensive patients and healthy controls .
B) To establish:
i) Inter-relationships between various lipid biomarkers among the patients.

MATERIALS AND METHODS

This study has been conducted in the Department of Biochemistry in collaboration with Department of Medicine, Tripura Medical College, Tripura from August 2020 to June 2021. 50 patients (27 males and 23 females) with hypertension admitted in the Medicine wards of Tripura

Medical College were added up for this study with the age group of 30-72 years. The patients with secondary hypertension were excluded in the study. Total 30 of age and sex matched attendants without any history of diabetes, hypertension, renal or cardiac disease were included in this study. According to the recommendations of JNC-VII[2], blood pressure among all subjects were estimated. All the blood samples were obtained from the subjects in fasting stage with anti-coagulants and centrifuge at 1500 rpm for 5 min and serum is obtained in clean and fresh vial for biochemical observations by using standard methods.

Study Method

Approval by Ethical Committee was collected for the study. Written informed consent was taken from all participants of this study.

Statistical Method of Analysis:-

Statistical analysis was performed using SPSS statistical package version 21. Data is explained as the form of Mean ± SD. The results between the study group and control group were compared by unpaired student's t-test. The p value less than 0.05 was considered as statistically significant.

RESULTS

The aforementioned study consists of 80 subjects comprising of 50 cases and 30 healthy controls. Estimation of fasting blood glucose, serum Magnesium, lipid profile and blood pressure were conducted in both case and control groups. The result is given below.

Table No. 1: Age-wise Distribution In Cases And Controls

Age Group (in years)	Case	Controls
30-39	04	25
40-49	11	13
50-59	13	07
60-69	20	05
70-79	02	-

The group of 30-71 years consist of hypertensive subjects. The mean age is 55±10.61 years and the controls in the age group of 31-69 years is of 48.53±9.58 years (table No.1).

Table No. 2: Sex-wise Distribution In Cases And Controls.

Group	Male	Male	Female	Female	Total
	Number	%	Number	%	
Cases	27	54	23	36	50
Controls	18	36	12	24	30

Out of 50 cases, 27 are males and 23 are females. In case of 30 controls 18 are males and 12 are females (Table No.2).

Table No. 3: Group Status

Group status		SBP (mm Hg)	DBP (mm Hg)	FBS (mg/dl)	Mg (mg/dl)
Case	Mean	163.8	87.65	101.63	1.95
Case (n=50)	±SD	16.73	17.86	33.79	0.06
Control	Mean	114.64	73.32	82.45	1.91
Control (n=50)	±SD	6.61	0.52	10.7	0.07

Systolic blood pressure and diastolic blood pressure are calculated separately for blood pressure. The mean SBP of the hypertensive subjects is 163.8±16.73 mm Hg and that of the controls is 114.64±6.61 mm Hg, The mean DBP of the hypertensive cases is 87.65±17.86 mm Hg and that of the controls is 73.32±0.52 mm Hg. The mean of the cases is significantly higher than healthy Controls ($p<0.05$) (Table No.1).

The mean FBS of hypertensive subjects is 101.63±33.79 mg/dl as compared to healthy Controls which is 82.45±10.7 mg/dl. The mean of hypertensive cases is significantly higher than the healthy Controls ($p<0.05$). However, it may be because of 10% diabetic cases present in hypertensive subjects.

The mean serum Magnesium of hypertensive subjects is 1.95±0.06 mg/dl and that of Controls is 1.91±0.07 mg/dl. Though the mean of cases are higher than controls but the increase is not statistically significant ($p>0.05$)(Table No.3).

Table No.4: Group Status

Group status	Group status	TC (mg/dl)	HDL (mg/dl)	LDL (mg/dl)	VLDL (mg/dl)	TGL (mg/dl)
Case (n=50)	Mean	209.2	41	135.31	35.78	180.89
Case (n=50)	±SD	31.64	5.91	29.25	13.43	68.6
Control (n=30)	Mean	172.7	42.93	107	22.86	114.6
Control (n=30)	±SD	13.42	3.55	12.1	3.45	17.61

The mean total cholesterol in hypertensive cases is 209.2±31.64 mg/dl, and in controls is 172.7±13.42 mg/dl. The mean of hypertensive cases is significantly higher than controls ($p<0.001$). The mean HDL of hypertensive cases is 41±5.9 mg/dl and of control is 42.93±3.55 mg/dl. The increase in mean of HDL in controls than in cases is not statistically significant ($p>0.05$). The mean LDL in cases is significantly higher than that of controls ($p<0.001$). The mean VLDL of hypertensive cases is 35.78±13.43 mg/dl and in control is 22.86±3.45 mg/dl. The mean VLDL in cases is significantly higher than that of controls ($p<0.001$). The mean TGL of hypertensive subjects is 180.89±68.6 mg/dl and that of controls is 114.6±17.61 mg/dl. The mean TGL of cases is significantly higher than controls ($p<0.001$)(Table No.4).

DISCUSSION

More than 80% of people associated with hypertension have other complications like glucose intolerance, hyperinsulinemia, obesity, reduced HDL cholesterol, elevated triglycerides and LDL cholesterol etc. More than 50% of hypertensive subjects have two or more complications. The present study is conducted to observe the trend of lipid profile in hypertensive subjects as compared to healthy controls. We have obtained blood pressures of these two groups. Fasting blood samples were collected for the estimation of serum magnesium, blood glucose and lipid profile.

In the Table No.1, it has been depicted that out of 50 cases aged 30-71 years while 60-69 years consist of maximum number of cases. In Table No.2, we can see that out of 50 cases 27 were males and 23 were females. In Table No.3, it has been proved that SBP (163.8 mm Hg±16.73) is higher than that of controls (114.64 mm Hg±6.61). This increase is considered to be significant ($p<0.05$). The SBP is increased as per the progression of age and the DBP in hypertensive subjects (87.65 mm Hg±17.86) is also significantly higher as compared to controls (73.32±0.52 mm Hg)($p<0.05$). The DBP itself is stabilized who has not been increased as the age increased. These findings portray that SBP is the better predictor in elderly than DBP[5]. However, the SBP should be reduced to below 140 mm Hg and the DBP below 90 mm Hg[10]. In the Table No 3, it has been elicitated that Fasting Blood Glucose (FBS) of hypertensive cases(101.63mg/dl±33.79) is higher than that of healthy controls (82.45 mg/dl±10.7). The increase is statistically significant ($p<0.05$). Though it may be because of the presence of 10% diabetic cases here, even then, there is a trend of developing impaired glucose tolerance in hypertensive subjects.

From the Table No.3, we can observe that serum Magnesium of hypertensive cases (1.95 mEq/L±0.06) is slightly higher than that of healthy controls (1.91 mEq/L±0.07). However, this increase is not statistically significant ($p<0.05$), which is in correlation with the observed higher prevalence of hypomagnesemia among women as compared to men. The patients with essential hypertension produced higher intra-erythrocytic Mg concentrations than the healthy controls. The serum albumin concentration is in correlation only with serum Mg. Recent studies have shown that subjects with hypertension have a marked increased incidence of hypercholesterolemia, diabetes, hypomagnesaemia, insulin resistance, obesity and hyper-triglyceridemia. The reason for these metabolic disorders may be genetic predisposition. Hypomagnesemia in women than men is mainly due to mitochondrial inheritance by the maternal lineage. The positive linking of hypertension and dyslipidaemia with hypomagnesemia is due to a mutation in mitochondrial t RNA. Members of maternal lineage is often associated with a marked increase in the urinary fractional excretion of Mg^{+2} (prevalent with the hypomagnesaemia cases) projecting impaired renal Magnesium reabsorption as the cause of hypomagnesaemia occurred in kindred syndrome. Determination of other urinary electrolytes had projected reduced urinary calcium through maternal lineage even with normal serum calcium levels. Also hypokalaemia was seen due to inappropriate renal loss and no difference in 24 hour urinary sodium excretion between maternal and non-maternal traits.

Serum Magnesium does not correlate with hypertensive cases and controls in this study, as we did not count serum protein in this study, as we did not count serum protein in this study. We have not found any gender or age difference related to Mg. From the Table No. 4, it can be

projected that serum total cholesterol of hypertensive cases (209.2 mg/dl±31.64) is higher than that of healthy controls (172.7 mg/dl±13.42), which is statistically significant ($p<0.001$). The serum HDL of hypertensive cases (41 mg/dl±5.91) is less than controls (42.93 mg/dl±3.55) but it is not statistically significant ($p>0.05$). The serum LDL of hypertensive cases (135.31 mg/dl±29.25) is higher than controls (107 mg/dl±12.1). It is considered to be statistically significant ($p<0.001$). The serum VLDL of hypertensive cases (35.78 mg/dl±13.43) is higher than controls (22.86 mg/dl±3.45). This increase is considered to be statistically significant ($p<0.001$). The serum TGL of cases with hypertension (180.89 mg/dl±68.6) is higher than healthy controls (114.6 mg/dl±17.61), which is statistically significant ($p<0.001$). So it can be determined that dyslipidaemia is seen in hypertensive subjects without any change in HDL concentration.

Essential hypertension is often associated with metabolic abnormalities, increased LDL and VLDL associated with decreased plasma level of HDL, hypercholesterolemia. Insulin resistance and hypertriglyceridemia were observed in many hypertensive cases.

They are men aged 50-59 years, where we can find unfavourable lipid and haemostatic profile. Anti-hypertensive treatment by β-blockers is accompanied by lower levels of HDL-related parameters, but treatment by ACE inhibitors produces small beneficial effect on total cholesterol and LDL-related parameters. The studies regarding hypertension commonly associated with dyslipidaemia to some extent. This dyslipidaemia with hypertension icreased morbidity compared to dyslipidaemia only and hypertension only, which suggests an important clinical entity. The relationships among ApoE alleles, genotypes, serum lipid levels and stroke risk factors (diabetes, hypertension etc) conclude that ApoE4 is an independent risk factor accompanied by fluctuated lipid profile.

Increased amount of GGT activities are also accompanied with an atherogenic lipid profile among population with cardiovascular and associated disorders[9]. So serum lipids and blood pressure are two prominent vascular risk factors that should be considered for the prevention of secondary stroke. On the other hand, the apoA-1, apoB and apoB/apoA-1 should be considered as highly predictive for the occurance of cardiovascular risk. Probably the genetic focus accompanied by dyslipidaemia with hypertension or diabetes may be the cause of abnormal lipid metabolism with hypertension closely linked to the LDL receptor and insulin receptor focus. There is a chance in future that dyslipidaemia units and the traditional hypertension may evolve into global cardiovascular risk management units[15].

CONCLUSION

The findings related to systolic blood pressure were more significant as compared to diastolic blood pressure with increasing age group in this study. There is presence of significant elevated levels of LDL, VLDL cholesterol and triglycerides and without any significance in the levels of HDL and Magnesium respectively. Fasting blood glucose levels are statistically significant in the hypertensive subjects as compared to healthy controls but the significance may be because of the presence of 12% diabetic cases in the hypertensive subjects. From the aforementioned study we can conclude that dyslipidemia is accompanied with hypertension which may be because of genetic predisposition, sedentary life styles and fatty food consumption. Presence of cholesterol and saturated fat in the food increases the blood cholesterol level and saturated fat is the main responsible for this which is associated with smoking and increased alcohol intake.

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