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Original Research Paper

Biochemistry

ATHEROGENIC INDICES IN HYPERTENSION

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ABSTRACT

Hypertension and dyslipidemia are major risk factors for cardiovascular disease.

AIM - To study the serum lipid profile and atherogenic indices in hypertensive individuals.

MATERIALS &METHODS - Cross sectional study conducted at government medical college ,Trichy with 50 hypertensives and 50 normotensives . Blood pressure measurement, estimation of lipid profile including total cholesterol (TC), triglyceride (TGL), low density lipoprotein (LDL), high density lipoprotein (HDL)and calculation of lipid ratios.

RESULTS - The serum levels of TC, TGL , and LDL were higher while HDL levels were lower in hypertensive subjects compared to normotensives, which was statistically significant ($P<0.001$). a statistically significant positive linear correlation between hypertension and Castelli's Risk Index I, Castelli's Risk Index II, atherogenic Coefficient and atherogenic Index of Plasma (AIP)

CONCLUSION - Atherogenic indices are the predictors of cardiovascular disease. These indices are elevated in hypertensives and hence estimation of these lipid ratios along with lipid profile is useful.

KEYWORDS : Hypertension, Cardiovascular diseases, Atherogenic indices

BACKGROUND

Hypertension along with other risk factors such as hyperglycaemia dyslipidemia, obesity, micro-albuminuria , increased levels of inflammatory markers such as C-reactive protein and homocysteine levels are associated with Cardiovascular disease. {Martín-Timón, 2014 #1} The leading cause of morbidity and mortality in developing countries is cardiovascular disease which is due to clustering of these risk factors. A strong and independent risk factor for cardiovascular disease is dyslipidemia. High blood pressure levels are associated with elevated atherogenic blood lipid fraction. {Kannel, 1983 #2} Estimation of the atherogenic indices, in addition to the lipid profile helps in identifying individuals with higher risk of cardiovascular disease.

AIMS & OBJECTIVES

To measure the plasma lipids and to assess the cardiovascular risk by using new atherogenic indices in hypertensive individuals.

INTRODUCTION

High arterial blood pressure is probably the most important public health problem in developed countries. Hypertension is one of the leading cause of mortality in the world . It is one of the most common, asymptomatic, easily detectable, treatable condition. Untreated and uncontrolled hypertension leads to complications like of cardiac failure , stroke, myocardial infarction , peripheral vascular disease, aortic dissection, atrial fibrillation and end-stage renal disease. {Safar, 2000 #3} Systolic blood pressure (SBP) of < 120 mmHg/or diastolic blood pressure (DBP) of < 80 mmHg is the optimal blood pressure . Hypertension is defined as systolic pressure > 130 mmHg and diastolic pressure > 90 mmHg as per 2003 European Society of Hypertension—European Society of Cardiology guidelines for the management of arterial hypertension. Age, race, sex, obesity, smoking, alcohol intake and glucose intolerance are the major factors that alter the prognosis of this disease. {Thayer, 2010 #4} Serum cholesterol, high-density lipoprotein cholesterol, low -density lipoprotein cholesterol and triglyceride levels are the factors that predispose to the development of arteriosclerosis. Plasma lipids contains TGL ,LDL which has pro-atherogenic properties and HDL which has anti-atherogenic properties. {Barter, 2005 #5} Lipid profile test is used to assess the atherogenic status of individuals at risk of CAD . The major lipoprotein which has a strong relationship with CVD is LDL . The deranged lipid profile pattern accelerates atherosclerotic process. Based on the Adult Treatment Panel III, dyslipidemia is defined as the presence of high total cholesterol (TC) (>5.2 mmol/L), high low-density lipoprotein cholesterol (LDL-C) (>3.38 mmol/L) or low highdensity lipoprotein cholesterol (HDL- C) (<1.0 mmol/ L in men or if ≤ 1.3 mmol/L in women), and triglycerides (TGL) ≥ 1.7 mmol/L. The newer atherogenic lipid ratios used for predicting the risk of CAD are Atherogenic Index of Plasma (AIP), Castelli Risk Index (CRI) and Atherogenic Coefficient (AC) . Lipid profile includes serum triglycerides (TGL), serum total cholesterol (TC) and its sub fractions like HDL and LDL . {Aboulgasem, 2014 #6} Derangement of lipid profile has a well established role in the progression of CAD in hypertensive individuals.

The possibility of cardiovascular disease cannot be ruled out in the presence of normal lipid profile . {Khachadurian, 1964 #7} The different combinations of the lipid profile parameters are used to identify such individuals. {Ranjit, 2015 #8} Adult Treatment Panel III (ATP III) guidelines have recommended threshold values for treatment of dyslipidemia. The risks of cardiovascular disease events attributable to dyslipidemia are better assessed by using various ratios of the different components of the plasma lipid profile . {Isomaa, 2001 #9} The Castelli risk index I (CRI – I) assesses the ratio of total cholesterol to high density lipoprotein cholesterol (TC /HDL) and sets healthy value at 3.5 or less . Castelli risk index II assesses the ratio of low density lipoprotein cholesterol to high density lipoprotein cholesterol while atherogenic index of plasma (AIP) is the logarithm of molar ratio of triglyceridemia to high-density lipoprotein cholesterol (log10 TGL/HDL-c) and this reflects the relationship between atherogenic and anti atherogenic lipoprotein {Onat, 2010 #10}

MATERIALS & METHODS

This cross sectional study with 100 subjects was conducted at K.A.P.V Govt. Medical College and MGMGH, Trichy during the period January 16 – JUNE 2016.

INCLUSION CRITERIA

Both males and females in the age group of 21-50 years were included and informed consent were obtained from all of them. The study population includes 2 groups , Control group with 50 normotensive individuals and Study group with 50 hypertensive individuals (Elevated blood pressure ≥ 130 mmHg systolic BP or ≥ 90 mmHg diastolic BP) . BP was measured by a physician using standard BP measurement protocol after the patient had rested for 10 minutes.

EXCLUSION CRITERIA

Individuals with acute inflammation, liver diseases, renal diseases , thyroid disorders, alcoholism and smoking were excluded from the

study. Individuals on lipid lowering drugs were also excluded.

SAMPLE COLLECTION

Informed consent was obtained from all subjects prior to the study. Under aseptic precautions, 5ml of venous blood sample was collected after an overnight fasting of 12 hours from all subjects. After retraction of the clot, samples were centrifuged at 2000rpm for 15 minutes for separation of serum

ESTIMATED PARAMETERS

Total Cholesterol was estimated by Cholesterol Oxidase- PAP method, Triglycerides by Glycerol Phosphate Oxidase –PAP method and HDL-C by Phosphotungstate /Magnesium precipitation method

CALCULATED PARAMETERS

LDL-c and VLDL-c were calculated using Fridewald's formula
VLDL-c = TGL/5 and **LDL-c** = TC-{HDL-c+VLDL-c}

The **Atherogenic ratios** were calculated as follows
Castelli's risk index **I** = TC / HDL-c
Castelli's risk index **II** = LDL-c / HDL-c
Atherogenic coefficient = (TC–HDL-c) / HDL-c
Atherogenic index of plasma = log(TGL / HDL-c)

RESULTS & STATISTICAL ANALYSIS

Statistical analyses were performed with the SPSS version 20.0 software programme. Statistical Data is expressed as Mean ±SD.To compare the variables student t test was used. A p ≤0.05 is considered statistically significant.

TABLE 1 DISTRIBUTION OF BLOOD PRESSURE BETWEEN CASES AND CONTROLS (n = 100)

	Group	N	Mean	Mean difference	Student "t" test p value
Systolic blood pressure (mm Hg)	Cases	50	139.8	29.26	**<0.001***
	Controls	50	110.53		
Diastolic blood pressure (mm Hg)	Cases	50	94.0	17.91	**<0.001***
	Controls	50	76.09		
Mean arterial pressure	Cases	50	108.22	19.62	**<0.001***
	Controls	50	88.59		

***Significant at 0.05 level**

COMMENTS

Cases had high mean systolic, diastolic and mean arterial pressure than controls and this difference was statistically significant.

TABLE II LIPID PROFILE OF CASES & CONTROLS

PARAMETERS	CASES	CONTROLS	P VALUE
TOTAL CHOLESTEROL (mg/dl)	229.03± 62	163.36 ± 38.81	**<0.001**
TGL (mg/dl)	208.13 ± 83.6	119.44 ± 24.5	**<0.001**
HDL(mg/dl)	40.11± 7.15	51.1 ± 5.68	**<0.001**
LDL (mg/dl)	149.37 ± 58.85	88.37 ± 36.24	**<0.001**
VLDL (mg/dl)	41.62 ± 16.7	23.88± 4.9	**<0.001**

***Significant at 0.05 level**

Cases had high mean total cholesterol,TGL, LDL and VLDL than controls and this difference was statistically significant. Cases had lower HDL-c than controls which was statistically significant

TABLE III LIPID RATIOS OF CASES & CONTROLS

CALCULATED PARAMETERS	CASES	CONTROLS	P VALUE
Mean Castelli's Risk Index I	5.46	3.43	<0.001
Mean Castelli's Risk Index II	3.48	1.94	<0.001
Mean Atherogenic Coefficient	4.46	2.43	<0.001
Mean Atherogenic Index of Plasma (AIP)	0.664	0.375	<0.001

***Significant at 0.05 level**

All the lipid ratios were elevated in the cases than the controls which was statistically significant

DISCUSSION

In the present study the mean total cholesterol value of controls (163.36 ± 38.81) was significantly lower than levels in cases (229.03± 62) P = <0.001. The serum TGL level had statistically significant higher mean in cases (208.13 ± 83.6) when compared with controls (119.44 ± 24.5) . The difference between the groups for low density lipoprotein cholesterol (LDL-C) and VLDL followed the same pattern as that of TC with statistically significant increase in hypertensives . Significant changes of serum lipid profile were found between female and male hypertensives. There was marked elevation of TGL and LDL in male hypertensives when compared to females. Increased total cholesterol , very marked increase in TGL and LDL are the main lipid abnormalities seen in hypertensives. Levels of HDL-c were higher in controls (51.1 ± 5.68)when compared to cases(40.11± 7.15) . Mean AIP values of cases and controls are 0.665 &0.375 respectively. There is a statistically significant positive linear correlation between hypertension and Castelli's Risk Index I, Castelli's Risk Index II, atherogenic Coefficient and atherogenic Index of Plasma . This implies that these atherogenic indices can be used as a surrogate marker for the risk of atherosclerosis in hypertensive individuals.

CONCLUSION

The present study shows that though dyslipidaemia is common among subjects with high-normal BP, the atherogenic indices helps in identifying persons with higher risk of cardiovascular diseases . There was a clear increase of plasma lipids concentrations in hypertensives . This study forms a base to stress the need for lipid profile screen at the time of identifying hypertension & life style modifications at the earliest to decrease the morbidity and mortlity associated with cardiovascular events in hypertensives.

LIMITATIONS

Small sample size & atherogenic indices in relation to the degree of hypertension

CONFLICT OF INTEREST NIL

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