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Research Article

ANTHROPOMETRIC MEASUREMENTS AND ITS CORRELATION WITH ATHEROGENIC INDEX OF PLASMA IN HYPERTENSIVE PATIENTS – A CROSS SECTIONAL STUDY

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A B S T R A C T

Background: Hypertension, obesity and dyslipidemia are the risk factors causing one third of deaths worldwide. The anthropometric measures of obesity has stronger association with cardiovascular risks. Atherogenic index of plasma (AIP) is a strongly upcoming index to predict the risk of atherosclerosis and cardiovascular diseases.

Aim: To determine the association between atherogenic index of plasma and anthropometric measurements in hypertensive patients.

Materials & Methods: This cross sectional study was conducted in 110 hypertensive patients. Based on 2017 ACC/AHA/ABC Updated Classification, patients were grouped intostage I and stage II,with 55 in each. AIP was calculated by the formula of log (TG/HDL-C). and correlated with their anthropometric parameters.

Results: Pearson's correlation analysis showed strongly positive correlation between atherogenic index of plasma and neck circumference ($p<0.0001$) in hypertensive patients whereas waist circumference, waist hip ratio showed weaker correlation ($p<0.05$).

Conclusion: This study, revealed higher AIP values in hypertensives with central obesity. Hence AIP can be used as a regular monitoring index in preventing cardiovascular diseases.

INTRODUCTION

Cardiovascular diseases are the primaryca use of death globally accounting for 31%.(1)

Hypertension and obesity are important risk factors for cardiovascular diseases.(2) The prevalence of hypertension and the risk of cardiovascular events have increased significantly as the age of a person increases .Increase in cardiac output without a reduction in systemic vascular resistance may contribute to the aetiology of hypertension in obese individuals. Therefore, the necessity to understand about the current status of hypertension in general population has increased significantly.

Dyslipidemia and moderate to severe obesity acts as primary contributors to atherosclerosis which tends to increase the risk for cardiovascular disease either directly or indirectly through intervening risk factors such as hypertension.(3)Atherogenic index of plasma (AIP) is an accurate and reliable index that is strongly correlated with CVD risks.(4)So it can be used as a diagnostic tool for assessing CVD risks.

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AIP is the logarithm of ratio of plasma concentration of serum triglycerides to high density lipoprotein cholesterol, AIP=log (TG/HDL-C). When AIP value is < 0.1there is low risk for CVD, with AIP 0.1-0.24 there is moderate risk and with AIP >0.24 there is high risk for CVD.(5)

Overweight and obesity represents rapidly growing threat to healthy population. Of the different types of obesity, central obesity has increased the risk of developing cardiovascular disease, thereby increasing the morbidity and mortality of hypertension. The body mass index (BMI), neck circumference (NC), waist circumference (WC) and waist hip ratio (WHR) are the indicators of body fat distribution which are consistently associated with cardiovascular risk. Neck circumference which is easy to measure is used to identify overweight or obese persons and also the type of obesity.(6) It also acts as an important index of subcutaneous fat in upper body which is an independent risk factor for CVDs.

Thus, this study aims to explore the potential relationships between anthropometric measurements (height, weight, BMI, neck circumference, waist circumference, hip circumference and waist hip ratio) and AIP in hypertensive individuals.

MATERIALS AND METHODS

Ethical consideration

The study was conducted after obtaining Institutional Ethical permission and written informed consent from all the participants.

Participants

This Cross Sectional Observational study was conducted in 110 individuals with hypertension attending noncommunicable diseases clinic (NCD) at Rajiv Gandhi Government General Hospital, Madras medical college, Chennai from June 2018 to September 2018.

Inclusion criteria

Both male and female participants aged between 30 and 60 years with hypertension were included in this study.

Exclusion criteria

Participants with cardiac failure, myocardial infarction, thyroid dysfunction (goiter), neck tumors, previous neck surgeries, pregnancy, ascites, and those on chronic medications likelipid lowering agents, oral contraceptive pills, corticosteroids and drugs for weight loss were excluded from this study.

Data collection

Aquestionnaire was given to collect the basic information, health status, drug history, potential risks such as smoking, drinking, etc. from the participants attending NCD clinic at Rajiv Gandhi Government General Hospital, Madras medical college, Chennai.

The blood pressure of the participants was recorded using sphygmomanometer in the left arm of the participant after allowing the participant to rest for 5 minutes in sitting posture. The participants were divided into two groups (stage I with BP : 130-139/80-89 and stage II with BP - ≥140/≥90) based on 2017 ACC/AHA/ABC updated classification.(7)

Subject's height was measured by using wall mounted stadiometer.
Weight was measured by using weighing machine, with light clothes and no shoes.
Waist circumference, neck circumference and hip circumference were recorded by using a stretch resistant measuring tape.
Waist circumference was recorded at a point midway between the inferior margin of the lower most rib and the iliac crest in a horizontal plane.
Hip circumference was measured with the greater trochanters of femur as reference points.
Neck circumference was measured around the lower border of thyroid cartilage to the upper border of C7 vertebra.
BMI was calculated using the formula: Weight (kg)/Height (m2).
Waist hip ratio was measured using the formula: waist circumference (cm)/hip circumference (cm)
Atherogenic index of plasma is derived by the formula: log (serum TG/HDL-C).
Blood sample was collected and lipid profile was done.

Statistical Analysis

Statistical analysis was done using SPSS version 16. The correlation between anthropometric measurements, AIP and hypertension was done using Pearson's correlation coefficient. Statistically significant differences were reported at P<0.05.

RESULTS

BASELINE PARAMETERS

PARAMETERS	STAGE I HTN MEAN ± SD n = 55	STAGE II HTN MEAN ± SD n = 55
BMI	25. 47 ± 2.66	25.58 ± 2.95
NECK CIRCUMFERENCE (cm)	32.27 ± 1.45	34.35 ± 2.34
WAIST CIRCUMFERENCE (cm)	88. 64 ± 4.14	88.49 ± 5.20
HIP CIRCUMFERENCE (cm)	93.44 ± 3.94	93.78 ± 5.59
WAIST HIP RATIO	0.95 ± 0.03	0.94 ± 0.04
ATHEROGENIC INDEX	0.39 ± 0.15	0.63 ± 0.13

The study was conducted on a total of 110 participants whose mean BMI was found to be 25.47 ± 2.66 for stage I hypertension (mean ± SD) and 25.58 ± 2.95 for stage II hypertension (mean ± SD).

The mean neck circumference was 32.27 ± 1.45 (mean ± SD) for stage I hypertension and 34.35 ± 2.34 (mean ± SD) for stage II hypertension.

The mean waist circumference was 88.64 ± 4.14 (mean ± SD) for stage I hypertension and 88.49 ± 5.20 (mean ± SD) for stage IIhypertension.

The mean hip circumference was 93.44 ± 3.94 (mean ± SD) for stage Ihypertension and 93.78 ± 5.59 (mean ± SD) for stage IIhypertension.

The mean waist-hip ratio was 0.95 ± 0.03 (mean ± SD) for stage Ihypertension and 0.94 ± 0.04 (mean ± SD) for stage IIhypertension.

The mean atherogenic index was 0.39 ± 0.15 (mean ± SD) for stage Ihypertension and 0.63 ± 0.13 (mean ± SD) for stage IIhypertension.

Analysis

CORRELATION OF AIP WITH ANTHROPOMETRIC MEASUREMENTS

AIP	STAGE I HTN		STAGE II HTN	
	r	p	r	p
BMI	0.125	0.358	0.237	0.0733
NC	0.597	<0.001***	0.616	<0.001***
WC	0.284	0.033*	0.251	0.057
HC	0.109	0.423	0.172	0.196
WHR	0.279	0.037*	0.112	0.402

*P value < 0.05 was considered as significant
**P value <0.01 was considered as highly significant
***P value < 0.001 was considered as very highly significant

BMI=Body Mass Index, NC=Neck Circumference, WC=Waist Circumference, HC=Hip Circumference, WHR=Waist Hip Ratio.

Above table shows, AIP has positive correlation with anthropometric measurements of BMI, NC, WC, HC and WHR. Among the anthropometric measurements, BMI has a weaker correlation with AIP both in stage I and IIhypertension. NC has moderate correlation with AIP and its P value indicates that it is very highly significant in both stage I and

IIhypertension. This shows a stronger association of NC with AIP.

WC has a weaker correlation with AIP and its P value shows that it is significant in both stage I and II hypertension.

HC has a weaker correlation with AIP both in stage I and IIhypertension.

WHR has weaker correlation with AIP both in stage I and IIhypertension but P value is significant in stage I hypertension but it is not significant in stage IIhypertension.

DISCUSSION

The present study indicates increased levels of BMI and AIP in hypertensive subjects and the levels were elevated as the severity of hypertension increases.

Neck circumference (NC) shows a stronger association with AIP thereby increasing atherogenic risk of subjects. Neck circumference is an indicator for upper body subcutaneous adipose tissue distribution. Subcutaneous fat is a major source of free fatty acid release in the circulation. This increase in free fatty acid concentration leads to increased release of inflammatory factors which causes vascular endothelial damage. It is also the best predictor of lipid profile than BMI and WHR. Neck circumference also has good predictive value for variety of cardiovascular diseases.

The association between neck circumference and hypertension in this study can be explained as follows. When the neck circumference increases, F2-isoprostaglandin level and oxygen free radicals from free fatty acid increases, leading to increased vascular endothelial damage. It also causes increased synthesis of leptins from mature adipocytes leading to excitability of sympathetic nerves thereby releasing catecholamines which causes arterial contraction.(6)

As reported by Zhang and co-workers, increased NC causes decreased insulin sensitivity leading to insulin resistance causing compensatory hyperinsulinemia. This impairment in the pathway reduces the production and release of nitric oxide which leads to vasodilation impairment and arterial stiffness which promotes hypertension.(6)

NC measurement can be used as simple, quick, inexpensive, straightforward and a reliable method for the assessment of cardiovascular risk with less consumption of time, especially in the screening process. Therefore, measuring the changes in NC is beneficial to understand cardiovascular status

AIP, which is a new marker for atherogenicity is directly related to increased risk of atherosclerosis thereby affecting cardiovascular, cerebral, and renal vasculature. AIP is found to be significantly increased in this study thereby increasing the risk of coronary vascular disease.(5)

Ikewuchi and coworkers also reported in their study that atherogenic indices are powerful indicators of heart disease, the higher the value the higher the risk of developing cardiovascular diseases.(8) Studies even revealed the adverse effect of abnormal blood lipid and lipoprotein levels in the pathogenesis and progression of atherosclerosis and cardiovascular diseases.(9) Increasing HDL cholesterol level plays a major role in the improvement of cardiovascular risk due to its potent anti-inflammatory and anti-oxidant effect that inhibits the atherogenic process. (10,11). Hence, reduction in body fat is one of the most effective preventive measures in decreasing not only blood pressure but also cardiovascular risk.

CONCLUSION

The findings of our study suggests that there is a correlation between neck circumference and AIP in hypertensive individuals. Regular monitoring of AIP index and measuring neck circumference while screening for cardiovascular disease is highly beneficial as both are sensitive measurements, which can be easily calculated while other lipid profiles are within the normal range. Based on these findings, prevention of CVD risk can be attained by life style modifications like regular exercise, healthy diet plan and practicing yoga.

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