

## EVALUATION OF CAROTID INTIMA-MEDIAL THICKNESS BY B'MODE ULTRASONOGRAPHY IN HYPERTENSIVE PATIENTS COMPARED WITH NORMOTENSIVE PATIENTS

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Received : 04/07/2023  
Received in revised form : 10/08/2023  
Accepted : 22/08/2023

**Keywords:**

Vascular complications, Common carotid artery, BMI, under-weight, Blood pressure.

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DOI: 10.47009/jamp.2023.5.5.6

Source of Support: Nil,  
Conflict of Interest: None declared

*Int J Acad Med Pharm*  
2023; 5 (5); 29-33



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### Abstract

**Background:** Increased atherogenic phenomena in patients with hypertension cause micro and macrovascular problems. The carotid intima medial thickening is a direct assessment of atherosclerosis, and we will be able to detect the early stages of atherosclerosis by assessing it using B-mode ultrasonography. The goal of this study is to evaluate carotid intima medial thickness in hypertensive (HTN) and non-hypertensive (NHTN) populations, as well as to analyse the relationship between carotid intima medial thickness and microvascular morbidity in HTN. **Materials and Methods:** The comparative analytical research was carried out for one and a half years at the Mahatma Gandhi Medical College and Research Institute in Puducherry, which involved two groups of fifty patients each. The risk variables that may alter carotid intima medial thickness were examined in the recruited participants. Micro and macrovascular problems and carotid intimal medial thickness were measured in the study and control groups using 2D ultrasonography to measure the intimal medial thickness of the common carotid artery (CCA) on both the right and left sides. **Result:** Mean age of hypertensive (HTN) individuals was 49, and that of non-HTN was 44, with a significant difference ( $p=0.0001$ ). CIMT was more common in individuals with hypertension than in non-hypertensive patients, with a positive connection between CIMT and vascular problems ( $p < 0.0001$ ). More underweight patients were observed in the HTN group than in the NHTN group ( $p < 0.0001$ ). There is no statistically significant relationship between neuropathy and CIMT. **Conclusion:** The measurement of CIMT is a surrogate marker of vascular complications, and ultrasound screening of carotid intima medial thickness in hypertensive patients should be made mandatory to detect early atherosclerosis and thus prevent the development or further acceleration of both micro and macrovascular complications through prompt initiation of preventive or therapeutic interventions.

## INTRODUCTION

Adhesion of blood leukocytes to the active endothelium monolayer, directed migration of bound leukocytes into the intima, maturation of monocytes (the most abundant of the leukocytes recruited) into macrophages, and lipid absorption, resulting in foam cells, are all components of early atherosclerosis.<sup>[1]</sup> atherosclerosis is The underlying disease process that leads to ischemic heart disease, cerebrovascular accidents, and peripheral vascular illnesses. It is the greatest cause of illness and death worldwide. It is a slow-progressing illness with several risk factors.<sup>[2]</sup> Diabetes, a high-fat diet, hypercholesterolemia, hypertension, and smoking are all modifiable risk

factors. Atherosclerosis is indicated by an increase in common carotid intima-media thickness and carotid stenosis caused by carotid plaque.<sup>[3]</sup>

Hypertension (HTN) is a major public health concern in developed and developing nations. In the human vascular system, hypertension is an independent risk factor for atherosclerotic disease.<sup>[4]</sup> HTN is a leading cause of significant cardiovascular disease and other potentially fatal conditions such as stroke, coronary artery disease (CAD), and peripheral vascular disease (PVD). The frequency of CAD has grown in the last 30 years.<sup>[5]</sup> HTN has risen in urban and rural India in the second part of the previous century.<sup>[6]</sup> Over the last two decades, hypertension in rural regions has climbed from 15-25% to 25-30% compared to urban

areas, where it has stabilised at around 25-30% due to urbanisation.<sup>[7]</sup>

Intima medium thickness (IMT), a marker of atherosclerotic vascular disease, is regarded as a complete picture of all modifications on the artery walls generated by various risk factors throughout time.<sup>[8]</sup> As a result, it can be described as a reliable predictor of vascular risk. Carotid intima-media thickness (CIMT) is a good predictor of vascular atherosclerosis.<sup>[9]</sup> The atherosclerotic process begins concurrently in the carotid arteries, aorta, brain, and coronary vessels. Hence, it modifies the local morphology of carotid vessels and correlates to the generalised atherosclerotic process; CIMT is utilised as a surrogate marker to identify early atherosclerosis alterations in patients with subclinical illness.<sup>[10]</sup>

Traditional and developing cardiovascular disease risk factors have been linked to IMT in patient and general population epidemiological investigations. It is readily assessed, particularly at the carotids, using B mode ultrasonography, a simple method representing a safe, precise, and reliable measurement.<sup>[11]</sup> Ultrasonography (USG) is quite useful in determining carotid artery stiffness. USG is a dynamic, safe, inexpensive, and non-invasive method for measuring intima-media thickness. High-resolution B-mode imaging of carotid artery intima-media thickness has been found to mirror histopathologically validated atherosclerosis. It is, therefore, commonly utilised to identify and quantify non-invasive atherosclerosis measures.<sup>[12]</sup>

#### **Aim**

This study assesses and correlates CIMT between hypertensive and normotensive individuals in an Indian subgroup.

## **MATERIALS AND METHODS**

This study was carried out with the agreement of the Mahatma Gandhi medical college and the research institution's ethical committee and institute research committee. A case-control study was conducted on patients with hypertension who visited our hospital outpatient departments and were admitted to our hospital wards. They were compared to age and gender-matched non-hypertensive individuals evaluated at our hospital for other reasons. It is case-control research carried out over two years and involved two groups of fifty patients each. The percentage distribution of age and gender was maintained in the study and control groups.

#### **Inclusion and Exclusion Criteria**

Our study included hypertensive patients of any age who attended our hospital outpatient departments and were admitted to our hospital wards for various other ailments, as well as sex-matched non-hypertensive patients who attended our hospital outpatient departments and were admitted to our hospital wards for various other ailments. Patients having a history of secondary hypertension, diabetes, smoking, obesity, postmenopausal women, stroke, or coronary

artery disease were barred from participating in the trial.

To choose patients for the trial, a random sampling approach was used. The first group consisted of 50 hypertension individuals, whereas the second group comprised 50 non-hypertensive patients. After obtaining ethical committee approval and patient consent, baseline patient characteristics such as age, gender, height (cm), demographics, and fasting blood sugar level were checked. The patients' blood pressures were measured sitting on the left arm using a standard mercury sphygmomanometer. HT and BMI were estimated, and patients were characterised based on WHO guidelines [Table 1].

The CIMT was examined utilising a 12.0MHz linear transducer MINDRAY DC-8 ultrasound scanner. On both CCA, CIMT was measured in the far wall 1 cm proximal to the carotid bulb. The mean value was computed, and more than 0.7 mm results were deemed abnormal.

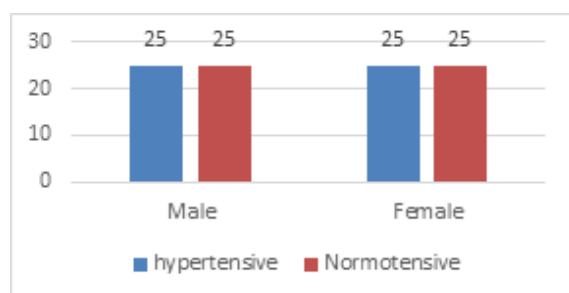
#### **Statistical Analysis**

The collected data was entered into a data sheet and analysed with EPI Info 7.0. The variables were summarised using the mean + standard deviation. Binary logistic regression analysis was performed. If the p-value was equal to or less than 0.05, the comparison between mean and percentage was declared statistically significant. Appropriate significance tests were performed for categorical variables, such as the independent t-test and the Chi-square test. The Student t-test (two-tailed, independent) was used to determine the significance of research parameters on a continuous scale between two groups (Intergroup analysis). The Chi-square test determined the importance of research parameters on a categorical scale between the two groups. Tables and graphs were used to present the findings.

## **RESULTS**

There were 46 patients in the 35-45 age group (46%) and 54 in the 46-55 age group (54%). There are 14 individuals in the hypertensive group aged 35-45 years (28%) and 36 patients aged 46-55 years (72%). In the non-hypertensive group, 32 patients were aged 35-45 (64%), and 18 were aged 46-55 (36%). The prevalence of aberrant CIMT was greater in the older age group (45-55 years) than in the younger age group (35-45 yrs), and it was statistically significant ( $p = 0.002$ ). The mean age in the hypertensive group is 49. The normotensive group had a mean age of 44. When the two groups are compared, the p-value is 0.0001, indicating a statistically significant difference in age between the two groups. There are 25 male patients (50%) and 25 female patients (50%) in the hypertensive group. There are 25 male patients (50%) and 25 female patients (50%) in the non-hypertensive group [Table 2]. The P value calculated using the Chi-Square test is 1.000, indicating no statistically

significant difference in sex distribution between the two groups. [Figure 1].



**Figure 1: Sex Distribution between two groups**

In our study, 63 patients had CIMT >0.7 (63%), and 37 patients had CIMT =0.7 (37%). The mean BMI of the HTN group was 24.85, whereas that of the non-HTN group was 25.76, with no statistically significant difference (p = 0.195). There are 29 hypertensive patients with a BMI of 25 (58.0%), 21

patients with a BMI of 25-29.9 (42%), and 0 patients with a BMI >30 (0.0%). There are 23 patients with a BMI of 25 (46%), 19 patients with a BMI of 25-29.9 (38%), and eight patients with a BMI >30 (8.0%) in the non-hypertensive group [Table 2].

In the hypertensive group, 44 patients (88%) exhibited significant CIMT >0.7, whereas six patients (12%) had CIMT ≤ 0.7. In the non-hypertensive group, 19 patients had CIMT >0.7 (38%), and 31 patients had CIMT ≤0.7 (62%). When comparing the two groups based on the existence of substantial CIMT, there is a statistically significant difference (p-value 0.0001). When comparing hypertensive to normotensive persons, the chances of acquiring abnormal IMT were 11.96 in the HTN group.

The blood pressure indices, systolic, diastolic, and mean arterial pressure were significantly higher in the hypertensive group than in the normotensive group. A statistically significant rise in the CIMT on both sides in hypertension in the normotensive group.

**Table 1: WHO-based patient categorisation (HTN and BMI)**

Parameter		Terms
HTN	Grade 1	SBP 140-159 mmHg
		DBP 90-99 mmHg
	Grade 2	SBP 160-179 mmHg
		DBP 100-109 mmHg
	Grade 3	SBP ≥ 180 mmHg
BMI (kg/m <sup>2</sup> )	Underweight	< 18.5
	Normal	18.5-24.9
	Overweight	25.0-29.9
	Obese	≥30

**Table 2: Correlation of study population characters with abnormal CIMT**

Parameter	Abnormal IMT		Percentage	P value
	Yes	No		
Age in years				
35-45	21(33.3)	25(67.6)	46	0.002
46 - 55	42(66.7)	12(32.4)	54	
Total	63	37	100	
Gender				
Male	25(50)	25(50)	50	1.000
Female	25(50)	25(50)	50	
Total	50	50	100	

**Table 3:**

Variable	Group	Mean	Std. Deviation	P value
Blood Pressure				
	Systolic BP			
	HTN	150.0	15.386	0.0001
	NTN	119.60	10.293	
Diastolic BP	HTN	92.60	6.942	0.0001
	NTN	79.00	9.091	
CCA IMT Scores				
	Right			
	HTN	0.78	0.4468	0.003
	NTN	0.58	0.1570	
Left	HTN	0.74	0.1554	0.001
	NTN	0.61	0.1206	

## DISCUSSION

Hypertension (HTN) is a major public health concern in developed and developing nations. Genetic predisposition and renin-angiotensin hyperactivity, vascular inflammation, and other aggravating factors

like smoking, alcohol, nonsteroidal anti-inflammatory medicines, polycythemia, diet, and obesity are all implicated in the aetiology of HTN. Atherosclerosis is a condition that worsens with time. In the human vascular system, hypertension is regarded considered independent and individual risk

factor for atherosclerosis.<sup>[13]</sup> The current case-control research was conducted to assess the effects of hypertension on the intima media thickness of the common carotid artery. The carotid intima media thickness was measured and compared in normotensive and hypertensive subjects using B mode Ultrasonography.

The current investigation comprised 100 individuals, 50 of whom were normotensive and 50 of whom were hypertensives. The research included all of the patients who met the inclusion criteria. The statistically acquired data in this study revealed that age has a substantial connection with CIMT in hypertension patients, with CIMT growing gradually in hypertensive patients between the ages of 35 and 55. This is most likely attributable to the ageing process of the intima-media, as well as the influence of rising BP levels. When compared to normotensive participants, this elevated BP level is also a cause of the early ageing process of the artery wall in hypertension patients. Previous research by Ludwig et al. and Sharma et al. yielded similar results.<sup>[14,15]</sup>

Patients having SBP of 140mmHg or higher and DBP of 90mmHg or higher were included as case subjects in this research. Both groups' mean blood pressure values were estimated, and blood pressure was considerably higher in the HTN group. Both SBP and DBP were associated strongly with CIMT, as CIMT increased significantly in the HTN group compared to the NHTN groups. On the right side, the mean CIMT was 0.8 and 0.5mm in the HTN and NTN groups, respectively, and 0.7 and 0.6mm in the HTN and NTN groups. Our findings are consistent with recent research by Adaikappan et al. and Sharma et al. that found a substantial rise in CIMT in HTN patients.<sup>[15,16]</sup> However, compared to earlier research, the mean CIMT in hypertension individuals is lower. This discrepancy might be attributed to sampling size and racial disparities, as the sample size in this study is less (n=100) than in earlier studies (n=270). (20) Another finding in this study is that the CIMT on the right side is thicker than the CIMT on the left side.

This finding is consistent with the findings of Ibinaiye et al. and Lemne et al., who found that hypertension individuals had more plaques on the right side of CCA than the left.<sup>[17,18]</sup> This thickening and plaque development might be related to the artery wall's adaptive mechanism to adjust for the consistently elevated BP. On the other hand, BMI is known to impact CIMT, but its actual significance in the arterial thickening process is unknown. In this study, the two groups had no statistically significant difference in BMI (p=0.195). However, prior research by Ibinaiye et al. and Planvik et al. found a statistically significant difference between BMI and CIMT.<sup>[18-20]</sup>

#### **Limitations of this study**

As compared to earlier studies, include the inability to assess gender inclination for higher CIMT because this study comprised age and sex-matched people. Another flaw is the absence of other colour Doppler methods, such as PI and RI, which were employed in

research conducted by Staub et al.<sup>20</sup> These Doppler characteristics were shown to be relevant in predicting atherosclerosis, with prediction values comparable to well-established CIMT.

## **CONCLUSION**

The study's main finding is that hypertension individuals are likelier to have abnormal carotid intima-media thickness. It becomes worse as you get older and your blood pressure rises. The carotid intima-media thickness in hypertensive individuals can be used as a yardstick to assess the risk of developing cardiovascular and cerebrovascular disorders and the amount of atherosclerosis. B-mode ultrasound is a useful, dynamic, inexpensive, simple, and non-invasive technology utilised in hypertension control. Because hypertension is a vascular illness, hypertensive vascular problems can be anticipated by measuring the carotid intima medial thickness.

As a result, we conclude that CIMT measurement is a surrogate marker of vascular complications and that ultrasound screening of carotid intima medial thickness in hypertensive patients should be made mandatory to detect early atherosclerosis and thus prevent the development or further acceleration of both micro and macrovascular complications through the prompt initiation of preventive or therapeutic interventions. Government health promotion efforts should also incorporate routine CIMT testing in hypertension patients.

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