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Carotid intima media thickness in relation with blood pressure and body mass index in hypertensive patients

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Abstract
Background: Hypertension will causes structural changes of intima media of large vessels which further causes atheroma formation. Arterial wall thickness can be measured by B-mode ultrasonic measurements of carotid intima media thickness (CIMT) and the extent of carotid atherosclerotic vascular disease may be estimated. The test measures the thickness of the inner two layers of the carotid artery, the intima and the media.
Methods: A cross sectional study carried out over a 2 year period. 120 in which 60 are normal healthy individuals and 60 are Hypertensive patients with 3 grades. In all the participants BMI, Blood Pressure and CIMT were measured.
Results: In the present study systolic and diastolic blood pressure was significantly increased in hypertension patients compared with Control. The Carotid Intima Media Thickness (CIMT) both Left and Right side were significant higher in Hypertension patients when compared with Control. Blood pressure which includes Systolic and Diastolic blood pressure was positively correlated with cardio vascular risk factor CMIT and it is statistically significant.
Conclusion: Present study finding suggested that there is a raised value of CIMT in hypertensive patients. Using CIMT with ultrasonography is a cost effective, noninvasive, easy and reproducible and help as warning signal.

Keywords: Carotid Intima Media Thickness, ultrasonography, hypertension

Introduction

Hypertension is a chronic condition where the systemic blood pressure was elevated. It is affected worldwide and it is a no communicable cardiovascular problem [1]. In Hypertension 95% of patients are primary or idiopathic very small percentage are secondary hypertension [2]. Hypertension is the risk factors for peripheral vascular disease, myocardial infarction, stroke and heart failure and also a leading cause of chronic kidney disease [3].

Hypertension is a main risk factor for development of atherosclerosis and mainly it affects elastic arteries like aorta, carotid and iliac arteries and also medium and large sized muscular arteries [4]. Hypertension will causes structural changes of intima media of large vessels which further causes atheroma formation [5]. The Arterial wall alterations represent an early involvement of the atherosclerosis changes in patients with hypertension [6]. Atherosclerotic changes start in the carotid arteries and aorta simultaneously [7]. Early detection of subclinical and clinical target organ damage is a main factor in the management of hypertension patients. Practical and applicable examination for predicting blood vessel damage has been great importance. One of major practical examination for predicting the damage is measuring the intima media thickness [8].

Arterial wall thickness can be measured by B-mode ultrasonic measurements of carotid intima media thickness (CIMT) and the extent of carotid atherosclerotic vascular disease may be estimated. The test measures the thickness of the inner two layers of the carotid artery, the intima and the media. Early detection of these changes may hint the need for a more aggressive approach towards heart disease and stroke [9]. Ultrasound estimation of intima media thickness and plaque presence in the carotid arteries are great value not only for the assessment of structural alterations but also assess the extent of atherosclerosis in these vessels reflects the arterial damage severity [10].

The ultrsaonography method is safe, simple, non-invasive, inexpensive and reproducible method for measuring common carotid arteries intima media thickness. It more accurate technique for quantifying of the CIMT and it is consider as sonographically early marker for

atherosclerosis. Extra cranial carotid arteries are better and reproducible site for CIMT measurement because of their accessibility, limited movement, and adequate size. The B-mode ultrasonic estimation of intima media thickness of the carotid arteries useful tool evaluating the presence and progression of arteriosclerosis in hypertension patients [11].
Though hypertensive can have a deleterious consequence of Cardiovascular disease and increased mortality, estimation CIMT might throw a warning sign of the future risk. Early intervention could help the hypertension patients for a better life and outcome. The present study was taken to establish a relationship between CIMT and blood Pressure and BMI

Methodology

Type of study

Case-Control study.

Study Population

Study population are hypertensive patients and attendants who attend the Department of Radiology.

Sample size

120 in which 60 are normal healthy individuals and 60 are hypertensive patients.

Selection Criteria

Inclusion Criteria

The patients diagnosed with hypertension with age between 40 to 60 years. Hypertension was defined as blood pressure levels higher than or equal to 140/90 mmHg in at least two consecutive measurements. Using World Health Organization (WHO) Hypertension classification they are classified as Grade 1 hypertension (systolic blood pressure (SBP) 140-159 mmHg, diastolic blood pressure (DBP) 90-99 mmHg); Grade 2 hypertension (SBP 160-179 mmHg, DBP 100-109 mmHg), and Grade 3 hypertension (SBP ≥ 180 mmHg, DBP ≥ 110 mmHg).

Exclusion Criteria

Subjects below 40 years and above 60 years and pregnant women were excluded. Hypertension with blood pressure < 140/90 mmHg, patients with secondary hypertension data obtained from patient history record. Known Subjects with history of smoking, alcoholism are excluded. Patients with any debilitating illness also excluded. Hypertension patients who did not provide inform constant were excluded.

Study design

The study consists of 60 hypertensive patients divided into 3 Grades based on systolic and diastolic blood pressure and 60 normal healthy individuals, age and sex matched individuals. Informed consent will be taken from the patients and controls. Demographic data will be collected followed by history regarding current health status, history of medication, alcoholism and Active smoking. A questionnaire was given to all patients and detailed clinical examination was performed.
In all the participants Height (in meters) and weight (in kilograms) were recorded. The Body Mass Index (BMI) was calculated as by using ratio of measured weight to square of the measured height (kg/m2). BMI was classified as underweight (BMI< 18.5); normal (BMI 18.5-24.9); overweight (BMI 25.0-29.9); and obese (BMI≥ 30). In all the participants blood pressure measured by using mercury sphygmomanometer both systolic and diastolic blood pressure was measured based on 1st and 5th korotkoff phase. An average of two readings was considered.

Carotid artery intima media thickness Test

Carotid artery ultrasound scans recorded for each participant with a 10-MHz linear-array transducer to measure intima media thickness (IMT) in the far wall of the right and left common carotid arteries within 2 cm proximal to the carotid bulb. The region with the thickest IMT, excluding areas with focal lesions, was measured. The average IMT was calculated from the right and left IMT measurements. All focal plaques within the carotid tree (common, internal, and external carotid arteries and bulb) identified as wall thickness. The area of each plaque was calculated as the average lesion thickness (in mm) multiplied by the lesion length (in mm). In those participants with multiple plaques, plaque area is the sum of the areas of all plaques observed in the carotid tree [12].

Statistical analysis

Data will be expressed in Mean and Standard deviation (mean ± SD). Z test was used for comparison of means between controls and cases. The statistical significance was determined at 5% ($p< 0.05$) level. The Pearson correlation coefficient was calculated for bivariate associations.

Results

A total of 120 subjects were included. They are further divided into Hypertensive (60) and Normal healthy individual as control (60).
Table1 shows the mean age of the hypertension patients was 47.61years±10.12 Control it was 45. 92 years ± 10.67. As regards the sex distribution, the majority of subjects were male in hypertensive 60% and Control 60%. In the present study systolic and diastolic blood pressure was significantly increased in hypertension patients compared with Control. There is no significant change of BMI in hypertensive when compared with Control.

Table 1: Profile of Hypertension patients and Control

	Hypertension patients	Control
Number	60	60
Age (mean ± SD) years	47.61±10.12	45.92±10.67
Sex (Males %)	60	60
(Females %)	40	40
BMI (KG/m^2)	24.26±4.19	23.22±3.81
Blood pressure (mm Hg)		
Systolic	159.75±21.97**	110.28±10.28
Diastolic	100.12±7.83**	69.21±8.83
Stages of Hypertension		
Grade 1 hypertension	30	-
Grade 2 hypertension	22	-
Grade 3 hypertension	8	-

**=$p< 0.001$

Table 2 shows the Carotid Intima Media Thickness (CIMT) both Left and Right side were significant higher in Hypertension patients when compared with Control. The mean CIMT was significantly higher in Hypertension patients (0.82mm ± 0.32) compared with control (0.54 mm ±0.09).

Table 2: CIMT in Hypertension patients and Control group

Parameters	Hypertension patients	Control
CIMT Left side (mm)	0.85±0.29**	0.57±0.10
CIMT Right side (mm)	0.79±0.36**	0.52±0.09
Mean CIMT (mm)	0.82±0.32**	0.54±0.09

**=p< 0.001

Table 3 shows anthropometric measurement BMI was not correlated to CMIT. Blood pressure which includes Systolic and Diastolic blood pressure was positively correlated with cardio vascular risk factor CMIT and it is statistically significant. (p< 0.001).

Table 3: Correlation of BMI, Systolic and Diastolic Blood pressure with CIMT

Parameters	Mean CIMT (mm)	p value
BMI	r=0.02131	Not Significant
Systolic Blood Pressure	r=0.6811	p< 0.001
Diastolic Blood Pressure	r=0.7011	p< 0.001

Discussion

In the present study hypertensive are more systolic and diastolic blood pressure when compared with control. In this study most of the hypertensive belongs to Grade 1followed by Grade 2 and Grade 3. In the present study in hypertensive patients CIMT was higher in both left and right side compared to control. Hypertensive patients shows aging process of the arterial walls earlier than normotensives because high blood pressure will shows the impact in intima media by accelerating aging and leads to high CIMT in hypertensives [13].

In this study, CIMT correlated positively with Systolic BP and Diastolic BP of hypertensive patients (Pearson correlation for Systolic BP is 0.68 and Diastolic BP 0.70). The previous studies also shown similar result. [14] It is noticed that CIMT increased with increased blood pressure. In hypertensives elevated blood pressure causes injury to the endothelium blood vessels which further causes intima media thickness via hypertrophy of media. In hypertensive patients arterial wall thickening is adaptive mechanism to compensate for the persistent increased blood pressure [15].

In this study, the method used for CIMT was obtained by taking three measurements 1cm proximal to right and left carotid bulb and the mean value of the three measurements were recorded for each side; Using this method allows rapid identification of the target area and ensures that an identical area is assessed on follow-up. [16] CIMT is a marker for generalized atherosclerosis and good indicator for coronary heart disease [17].

Atherosclerosis asymptomatic unless it is sever so direct examination of the vessel wall in early stages is necessary in the affected individual [18]. Atherosclerosis changes in carotid artery is assumed to be indicative of atherosclerosis changes in the major arteries and peripheral arteries [19]. The International Atherosclerosis Project suggested that the atherosclerotic process occurs at time in carotid, coronary and cerebral arteries [20]. Carotid artery intimal medial thickness (CIMT) is well-established index of systemic atherosclerosis that correlate well with the incidence of coronary heart disease and stroke in hypertensive patients [21].

From the findings of present study, it was concluded that there is a raised value of CIMT in hypertensive patients. Using CIMT with ultrasonography is a cost effective, noninvasive, easy and reproducible. Early detection of CIMT and correction of systolic blood pressure and diastolic blood pressure assist in the reducing progression deleterious effects.

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Declarations

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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