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Use of Carotid Doppler to measure Carotid Intima Media Thickness and establish its relationship with different Cardiovascular events.

Radiology

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ABSTRACT

Background: Carotid intima-media thickness (CIMT) is a simple and inexpensive tool to assess the cumulative effect of atherosclerotic risk factors and is an independent predictor of future cardiovascular (CV) risk. **Objectives:** This study was aimed to investigate the relationships between prevalent cardiovascular events (myocardial infarction, stroke and peripheral arterial disease) and carotid intima-media thickness (CIMT) in middle-aged and older adults. **Material and Methods:** It was a cross sectional study conducted in between 1st Jan 2015 to 31st December 2015 at Integral Institute of Medical Sciences and Research, Lucknow under Department of Radiology. 200 adult subjects were included with evidence of cardiovascular events (including Myocardial Infarction, stroke and Peripheral Artery Disease) and risk factor status (including hypertension and diabetes), adjudicated based on a review of data collected from hospitalizations and outpatient records. According to the carotid ultrasonography, subjects with maxIMT <0.9 mm were defined as normal, while with maxIMT ≥0.9 mm abnormal. The abnormal group included subjects with wall thickening (0.9 mm≤maxIMT <1.2 mm) and with carotid plaque (localized thickenings protruding into the lumen with maxIMT ≥1.2 mm). **Results:** Our study included 200 study subjects in which 110 were male and 90 were female. It included middle to elderly population with average age of study subjects 62.5 years. The subjects with prevalent cardiovascular events (including MI, stroke and PAD) have higher mean CIMT and higher abnormal CIMT proportion and the results were statistically significant. **Conclusion:** In summary the combined measurement of IM shows the best index association with prevalent cardiovascular events like MI, Stroke and PVD.

KEYWORDS:

Carotid Intima Media thickness, Cardiovascular events, Myocardial Infarction

Introduction:

Atherosclerosis is the underlying disorder in the majority of the cardiovascular events which is the leading cause of death in the industrialized world. Its increasing prevalence in the urban developing world is a significant cause of mortality and morbidity. Identification of individuals with sub-clinical atherosclerosis can alert the physician while the patient is still asymptomatic and allows him to implement preventive measures to manage the risk factors.

Carotid intima-media thickness (CIMT) is a simple and inexpensive tool to assess the cumulative effect of atherosclerotic risk factors and is an independent predictor of future cardiovascular (CV) risk.[1-5] CIMT is a measure of the thickness of the intima and media layer of the carotid artery most commonly assessed by B-mode ultrasound. CIMT is commonly used as a surrogate end point in research trials as a marker of atherosclerosis.[6] More important from a clinical perspective, CIMT has been shown to correlate with cardiac risk factors,[2,7-9] to improve with therapy of known benefit in preventing atherosclerotic events,[6,10-13] and to be an independent predictor of future myocardial infarction and stroke risk.

CIMT can be measured using a high frequency gray scale ultrasound. It is non invasive, relative inexpensive, reliable, repeatable without any adverse effects and does not involve radiation. No patient preparation is required, and is therefore done in an OPD setting without any complications or aftercare. It has been recommended by the American Heart Association for evaluation of risk of CVD and is a FDA approved procedure.

Aims and objectives:

This study was aimed to investigate the relationships between prevalent cardiovascular events (myocardial infarction, stroke and peripheral arterial disease) and carotid intima-media thickness (CIMT) in middle-aged and older adults.

Material and methods:

It was a cross sectional study conducted in between 1st Jan 2015 to 31st December 2015 at Integral Institute of Medical Sciences and Research, Lucknow under Department of Radiology. The study was approved by the institutional medical ethics committee, and informed consent was obtained from all subjects participating in study. 200 adult subjects were included with evidence of cardiovascular events (including Myocardial Infarction, stroke and Peripheral Artery Disease) and risk factor status (including hypertension and diabetes), adjudicated based

on a review of data collected from hospitalizations and outpatient records.

Myocardial Infarction (MI) is defined by a history of acute MI; and if pathological Q waves or coronary T waves are noted in the electrocardiogram (ECG) and correspondingly regional wall motion abnormality is confirmed by echocardiography. Stroke is diagnosed by a history of acute cerebral infarction, intracerebral haemorrhage due to cerebrovascular diseases (which are confirmed by a CT or MRI scan) or transient ischaemic attack. Peripheral Artery Disease (PAD) is diagnosed when the subject suffers from intermittent claudication, the peripheral pulses are diminished and Doppler ultrasound shows plaques at the arterial walls and more than 50% luminal stenosis. Anthropometric variables like Height, weight, waist and hip circumferences were measured and body mass index (BMI) and waist–hip ratio (WHR) were calculated. Mean systolic blood pressure (SBP) and diastolic blood pressure (DBP) were calculated, and heart rate (HR) was recorded. Hypertension was defined as an SBP of 140 mm Hg or over, or a DBP of 90 mm Hg or over or current anti-hypertensive drugs for known hypertension. A fasting blood sample was collected for diagnosis of diabetes.

CIMT Scan was obtained using a high resolution linear ultrasound transducer (Siemens ACUSON X 300) of frequencies 7-10 MHz at an appropriate depth of focus (e.g. 30-40 mm) and optimal frame rate of 25 Hz (>15Hz) was used. The IMT was measured at the end of the Common Carotid artery (CCA) where the double-line pattern is observed along the longitudinal arterial segment. IMT measurement was made from the plaque free region. Measurement was done using manual semi-automated method: Mannheim carotid Intima-media Thickness Consensus (2004-2006)[14] in which measurements were taken at CCA, Bifurcation (bulb) & ICA.

According to the carotid ultrasonography, subjects with maxIMT <0.9 mm were defined as normal, while with maxIMT ≥0.9 mm abnormal. The abnormal group included subjects with wall thickening (0.9 mm≤maxIMT <1.2 mm) and with carotid plaque (localized thickenings protruding into the lumen with maxIMT ≥1.2 mm).

Continuous variables with normal distribution, such as SBP, DBP and BMI, were expressed as mean±s.d, and t t-test was used to compare between two groups. *P*-value <0.05 was considered significant. All analyses were performed using SPSS 17.0 software for Windows.

Results:

Our study included 200 study subjects in which 110 were male and 90 were female. It included middle to elderly population with average age of study subjects 62.5 years. The cardiovascular risk profile and the cardiovascular event in percentage has been shown in Table 1. 79% were Hypertensives; 30 % were Diabetics and 30 % were smokers. Event % was 11%, 15%, 05% respectively for MI, Stroke, and PVD. The average BMI of study subjects was 26±3.3.

The subjects with prevalent cardiovascular events (including MI, stroke and PAD) have higher mean CIMT and higher abnormal CIMT proportion and the results were statistically significant (Table 2).

Characteristics	All subjects (200)	Male (110)	Female (90)
Age (years)	62.5 (56-71)	64 (58-71)	63 (54-69)
Hypertension (%)	79	78	80
Diabetes Mellitus (%)	30	32	28
Smokers (%)	30	55	05
Myocardial Infarction (%)	11	15	07
Stroke (%)	15	16	14
PAD (%)	05	05	05
BMI (Kg/m^2)	26±3.3	25.8±3.6	26.2±3.0
SBP (mm Hg)	135±18	136±18	133±18
DBP (mm Hg)	80±10	79±11	81±10

Table 1: Demographic and characteristics of study subjects

Events	Mean IMT (mm)	Abnormal CIMT (%)	p-value
Total events			
Yes	0.75	79.2	p<0.001
No	0.66	65.5	
Myocardial Infarction			
Yes	0.76	78.5	p<0.05
No	0.66	66.7	
Stroke			
Yes	0.78	77.8	p<0.001
No	0.66	65.3	
PAD			
Yes	0.72	78.8	p>0.05
No	0.65	64.7	

Table 2: Comparison of CIMT between groups with or without events

Discussion:

CIMT can reflect atherosclerotic process directly and is an important tool in evaluating cardiovascular diseases.[15] In our study, CIMT was related to cardiovascular diseases in a univariate analysis. The subjects with cardiovascular events had significantly higher CIMT and higher abnormal CIMT proportion. However the Atherosclerosis Risk in Communities study[16] and the Cardiovascular Health Study (CHS)[17] have demonstrated that CIMT is an independent predictor of cardiovascular disease after adjustment for traditional risk factors, even as powerful an indicator of cardiovascular events as the traditional risk factors.[17] Similar results were obtained in the Angina Pectoris Study in Stockholm[18] and in Rotterdam study.[19]

Now there are not sufficient evidences that CIMT might provide predictive information beyond traditional risk factors and be used in risk stratification, which might partly be due to different sites of measurements as well as actual differences in the number of risk factors included in the analyses and the age groups studied. Therefore further prospective studies are needed to establish a strong relationship.

Limitations of study:

As it is a single centre study with a relatively small study population, results cannot be generalized to the entire population.

Conclusion:

In summary the combined measurement of IM shows the best index association with prevalent cardiovascular events like MI, Stroke and PVD.

Acknowledgement:

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