Correlation of Intima Media Thickness of Carotid Arteries with Coronary Artery Disease

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Abstract: <u>Introduction</u>: The demonstration of a correlation between IMT and cardiovascular events in clinical events in clinical studies have led to accepting 2D ultrasound as a valid technique in measuring atherosclerosis. This technique is non-invasive, costeffective, simple, safe and reproducible. <u>Aims and Objectives</u>: To correlate intima media thickness with coronary artery disease. <u>Result</u> <u>and Observations</u>: IMT was significantly increased in patients who had acute coronary syndrome. p value<0.01. Mean IMT was significantly increased in the cases than the controls and the difference was statistically significant. p value<0.01. Mean IMT was higher in the case group with triple vessel disease than in the group with single or double vessel disease and the difference was statistically significant. Positive predictive value for diagnosis of CAD with plaque occurrence is 74%. <u>Conclusions</u>: Thus the present study shows that carotid IMT is marker of atherosclerosis. It can be used as a surrogate marker in prediction of coronary events.

Keywords: Intima media thickness, carotid arteries, atherosclerosis

1. Introduction

Atherosclerosis is a generalized inflammatory process, simultaneous affection of various arterial beds is seen. An early sign is hypertrophy of the arterial wall. Measurement of intima-media thickness [IMT] in carotid arteries has been proved as a surrogate marker for atherosclerosis. IMT of the carotid arteries is influenced by the same risk factors as of CAD. The demonstration of a correlation between IMT and cardiovascular events in clinical events in clinical studies have led to accepting 2D ultrasound as a valid technique in measuring atherosclerosis. This technique is non-invasive, cost-effective, simple, safe and reproducible. Key advantages of external ultrasound methods are: a. lower cost compared with most other methods b. relative comfort and convenience for the patient being examined c. lack of need for any IV contrast, and d. lack of any X-Ray radiation; Ultrasound can be used repeatedly, over years, without compromising the patient's short or long term health status. The IMT corresponds to the thickness of the histological intima and media. IMT is defined as the distance from the leading edge of the lumen-intima interface of the far wall to the leading edge of the media-adventitia interface of the far wall. The rate of change of IMT with age in previous studies has been calculated to be 0.01mm/year in the general population and 0.03-0.06mm/year in patients with CAD. The present study is undertaken in order to correlate the role of IMT in patients with CAD.

2. Aims and Objectives

To correlate intima media thickness with coronary artery disease.

3. Materials and Methods

Selection of patients

For the study, patients with diagnosis of Myocardial infarction or Unstable/ stable Angina, admitted for coronary angiography, were taken as cases. Patients without any angiographic abnormality of coronary arteries were designated as control subjects.

No. of cases- 204 No. of controls-70

Mode of selection of cases:

Each case was studied as per the proforma prepared.

Inclusion criterion

All patients presenting with ACS or patients admitted for coronary angiography.

Exclusion criterion

Patients with carotid artery stenosis already confirmed by Doppler or angiography. Patients on long term oral hypolipidemic drugs.

102 patients with ACS were studied based on the history, ECG changes and estimation of cardiac markers if indicated.

- a) **History of angina**: The onset, situation, radiation, duration, aggravating and relieving factors were studied.
- b) **ECG changes**: Resting ECG obtained in all patients. ECG studied for ST deviation, new onset left bundle branch block and significant Q waves.

Method of Study

Informed consent was obtained from all patients.

Each patient was subjected to a detailed history and clinical examination. History of hypertension, diabetes mellitus, chronic kidney disease, dyslipidemia were noted.

Clinical examination included blood pressure measurement, general physical examination, anthropometric measurement, body mass index and systemic examination.

Biochemical assessment included fasting and random blood sugar, blood urea, serum creatinine and lipid profile.

Presence of hypertension was defined as per the Joint National Committee (JNC) vii criteria.

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Presence of diabetes mellitus was defined by American Diabetic Association criteria. Smoking status was recorded as number of pack years smoked.

Dyslipidemia was diagnosed on ATP III guidelines (JAMA2001).

BMI was calculated by Quetlet index:

BMI= Weight (in kg)/Height (in metres)²

- BMI<18.5- Underweight.
- 18.5-24.9- Normal
- 25-29.9-Overweight
- 30-39.9-Obese
- >40-Morbid obese.

Method of carotid Doppler study

Ultrasonographic scanning of the carotid arteries was performed in the supine position with the neck extended, using a high frequency; imaging probe(7.5-12.0megahertz) with Logic alpha ultrasound, at a depth of 2 cm, as the carotid vessels are relatively superficial. The carotid vessels were followed from the clavicular head cephalad to their bifurcation and 3-4 cm of the proximal internal and external carotid arteries were studied. The IMT was measured at different points on both sides in the far wall of carotid arteries. Maximum carotid IMT was taken into consideration. Plaques were not included in calculating IMT, but their presence was noted.

IMT values more than 0.8mm were considered significant for correlating the association between IMT and CAD. Plaque was defined as localized thickening>1.2mm that does not involve whole common carotid artery or bulb[IND J Rad Imag 1998].

Statistics analysis:

Data were presented as mean+SD. The statiscal analyses were performed with the SPSS statiscal software package. Clinical parameters in patients with and without CAD were compared by univariate analysis using student's t test for continuous variables and Chi-square test for categorical variables. The variables that were significantly different between CAD and non-CAD patients in multiple univariate analysis were subjected to multivariate analysis using a stepwise logistic regression. For all analysis, a p value less than 0.05 was considered significant.

4. Observations

Tabl	e 1:	Distri	bution	of	Patients	Accord	ling 1	to A	ge

Age	Cases	Controls
30-39	14	16
40-49	54	30
50-59	84	20
60-69	44	04
70-75	08	00



Table 2	2:	Mean	Age	in	Cases	and	Control	s
								-

Cases	Controls		
52.9+ 9.5 years	45.2 ± 8.2 years		

Table 3: Intima Media Thickness in Cases and Controls

	Cases	Controls [Normal Angiography]
IMT<0.8mm	28	60
IMT>0.8mm	176	10

Yates corrected chi square test: 45.03 Risk ratio (95% CI): 0.14 Odds ratio (95% CI): 0.02 p value; 0.000001 i.e., p value<0.01.

In the case group, 88 patients had IMT greater than 0.8mm while in control group, only 5 patients had more than 0.8mm. IMT was significantly increased in patients who had acute coronary syndrome.



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Table 4: MEAN IMT	(MM) in	cases and	controls
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Cases	Controls	
0.86 ± 0.12	0.66 <u>+</u> 0.08	
P value<0.01 (p va	lue=0.000001)	

Mean IMT was significantly increased in the cases than the controls and the difference was statistically significant.

Table 5: Mean IMT	and Age According to No. of Vessels
	Involved

mvorved						
		Cases				
	Single vessel	Double vessel	Triple vessel			
	disease	disease	disease			
Number	92	74	38	70		
Male : Female	44:2	36:1	13:6	30:5		
Mean age (years)	50.03	55.27	55.9	45.15		
Mean IMT (mm)	0.77 <u>+</u> 0.08	0.88 ± 0.05	1.29 <u>+</u> 0.04			
P value	< 0.01	< 0.01	< 0.01			

Mean IMT was higher in the case group with triple vessel disease than in the group with single or double vessel disease and the difference was statistically significant.

Table 6: Mean IMT and Plaque Occurrence in Cases and

Controls				
Cases Controls				
IMT (mean)	0.86	0.66		
Plaque occurrence	102 (50%)	14 (20%)		

One or more plaques were seen in carotid artery in about 50% of ACS patients, while only 20% controls had plaques in their carotid arteries. Positive predictive value for diagnosis of CAD with plaque occurrence is 74%.

5. Discussion

Coronary artery disease (CAD) is a major cause of mortality and morbidity in developed world, and in developing countries the incidence is rising. Atherosclerosis is the major cause of CAD. CAD manifests as acute coronary syndrome (ACS) and stable angina. Atherosclerosis can be detected and documented in early stages by examining intima media thickness (IMT) of peripheral arteries, especially carotid artery. IMT is measured by B-mode ultrasound. Reproducibility of IMT determination is best in carotid artery of healthy subjects and in patients with advanced atherosclerosis. Ultrasound scanning of carotid IMT is of clinical value in the screening of patients with CAD.

Both coronary and carotid vascular beds share common risk factors (Geroulokas). Atherosclerotic plaques start to develop in the carotids at approximately the same time as in aorta and preceeds in coronary arteries. A close histologic relation between carotid and coronary atherosclerosis has been seen in autopsy studies [Mitchell et al 1992]. Finally, carotid IMT has been a good indicator of the presence and extent of CAD in many observational studies. The present study is done to correlate carotid IMT in patients with ACS.

Intima Media Thickness [IMT] :

In the present study, IMT in patients with significant coronary stenosis (>50%) was studied and compared with controls, who have normal coronaries or less than 50% stenosis.

Of the 204 cases, 176 patients had IMT >0.8mm which was taken as significant IMT based on previous studies. Among 70 controls, only 10 had IMT >0.8mm and 60 had IMT <0.8mm.

On applying Chi-square test, the odds ratio (95% CI) is 0.02 and Risk ratio (95% CI) is 0.14 and p value is highly significant (p <0.001). This means that IMT was significantly increased in patients who had ACS and had significant coronary stenosis.

The mean IMT in cases was 0.86 + 0.12mm and in controls was 0.66+ 0.08mm. The difference was statistically significant (p<0.001).

Rosa et al showed that IMT in cases was 0.81 ± 0.25 and in controls, 0.62 ± 0.18 mm.

Rotterdam study showed that higher the baseline IMT, greater is the risk of cardiovascular events.

In **Jadhav et al** study, IMT was >0.8mm in cases. They observed 59.2% of CAD patients had significant IMT as against 40.8% in those without CAD.

IN **Cardiovascular health study**, the mean IMT was 1.03 ± 0.2 mm which is comparable to our study.

Adams et al reported IMT of 0.83 ± 0.20 mm in CAD. Blankenhorn et al reported IMT of 0.65 ± 0.11 mm and Lamont et al reported a mean of 0.79mm in CAD.

In the present study, we found that mean IMT in patients with single vessel disease was 0.76 + 0.08mm, in Double vessel disease was 0.86 + 0.05mm and in Triple vessel disease was 1.04 + 0.04mm. The difference between these 3 subgroups of ACS patients is statistically significant. It means that more the number of vessels involved, more is the risk of development of atherosclerosis, and its complications.

Jadhav et al demonstrated a higher incidence of IMT of >0.8mm was observed in all subgroups of patients with CAD i.e. with one or more risk factors.

Kablak. Ziembicka et al (2002, Acta cardiol. 57) demonstrated that hypertension, hyperlipidemia and DM are related to greater IMT.

IMT and Plaque occurrence:

In present study, plaques were observed in carotid arteries of about 50% of patients with CAD, while only 20% controls had them. Positive predictive value for CAD diagnosis with plaque occurrence is 74% in our study.

Demircan et al (Am J. Cardiol 2005 Sept) in their study found that carotid IMT was significantly increased and carotid artery atherosclerotic plaques were detected more frequently in patients who had early onset CAD compared with control subjects. The IMT was greater in patients who had ACS than those who had stable angina.

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Pasireski et al (Pol Arh. Med. 2004 Jan) found higher incidence of plaque occurrence in CAD patients. They calculated Positive predictive value for CAD diagnosis with detection of plaque in carotid artery of 93%.

Kanadasi et al (Angiology 2006 Oct) showed that presence of calcific plaque is a better predictor for CAD than that of fibrous plaque.

In our study, we also found that plaque occurrence did not relate to the type of ACS.

6. Summary & Conclusions

The present study included 204 patients of coronary artery disease with significant coronary artery stenosis (>50% stenosis) and 70 controls with <50% stenosis or normal coronaries.

In the study group, the mean age of presentation was 52.9 ± 9.5 years.

The mean IMT was significantly higher in patients with CAD.

Carotid IMT was significantly higher in patients with Triple vessel disease compared to patients with double or single vessel disease.

About 50% of cases showed presence of plaques in carotid arteries, while only 20% of controls had plaques.

Plaque occurrence in carotid arteries does not relate to the type of ACS.

7. Conclusions

- 1) The carotid intima media thickness was found to be higher in patients with significant coronary artery stenosis (>50%), as compared to controls. The difference between cases and controls was statistically significant.
- 2) The odds ratio for IMT exceeding 0.8mm in cases showed that it is an important marker of CAD.
- 3) Thus the present study shows that carotid IMT is marker of atherosclerosis.It can be used as a surrogate marker in prediction of coronary events.

Carotid B-mode ultrasound is safe, non-invasive procedure for detecting clinical and preclinical coronary artery disease.

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Volume 7 Issue 4, April 2018

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1057