

Original Research Article

A study to find the usefulness of carotid intima-media thickness in assessing the severity of coronary artery disease and its correlation with coronary angiogram

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Abstract

Introduction: CAD, which was once considered the disease of the west, is now one of the leading causes of death in middle-income countries like India. It has indeed reached epidemic proportion in India. CIMT measurement directly correlates with the pathology, parallels the significance of traditional risk factors and indicates the thickness of the arterial wall making it the preferred noninvasive technique for assessing atherosclerosis.

Aim: To study the Usefulness of Carotid Intima-Media Thickness in assessing the severity of Coronary Artery Disease and its correlation with Coronary Angiogram.

Materials and methods: 75 patients diagnosed to have CAD in the previous one month and have undergone CAG have been included in the study. Patients were subjected to various symptom analysis, clinical examination, laboratory investigations and CIMT measurement by B mode ultrasound technique using a 10 MHZ probe. Patients were grouped into normal and increased CIMT groups with reference to 0.90 mm. The severity of disease was compared in terms of a nonobstructive CAD, SVD, DVD, TVD, and CAG severity was calculated by the modified Gensini score. The relation between IMT and severity of CAD was determined.

Results: The modified Gensini levels in normal CIMT group were meaningfully less than increased CIMT group by 1.55 times with a mean difference of 11.31 points. The CAG findings with triple

vessel disease in normal CIMT group were only 16.33%, when compared to increased CIMT group where its occurrence is 53.85%. There was meaningfully a real increase in the risk of developing triple vessel disease with increased CIMT. The CAG findings in normal CIMT group was predominantly normal (34.69%) when compared to increased CIMT group where in it was triple vessel disease (53.85%) with a 'p' value of 0.0263.

Conclusion: CIMT correlates significantly with the severity of coronary artery disease. CIMT > 0.90 mm correlates to advancing CAD. Hence CIMT is a useful atherosclerosis progression marker which when employed in an asymptomatic at-risk individual will definitely decrease disease morbidity if intervened appropriately.

Key words

Atherosclerosis, Atherosclerotic disease, Coronary artery disease, Carotid intima-media thickness.

Introduction

Coronary heart disease (CHD) is the leading cause of death in India and the leading cause of death worldwide. The well-known risk factors of CHD are systemic hypertension, tobacco use, lipids, physical inactivity, diabetes mellitus, obesity, diet, and population aging [1]. These risk factors can be assessed by symptom analysis, clinical examination, anthropometric measurements, and laboratory investigations and are being employed in routine clinical practice [2]. There have been various invasive and noninvasive methods of assessing the severity of coronary artery disease, upcoming of which carotid intima-media thickness measurement by B mode ultrasound technique is proven to be highly efficient, easily reproducible and cost-effective [3]. The CIMT measurement directly correlates with the pathology and is indicative of the thickness of the arterial wall, and is precisely imaged using ultrasound technology. In clinical studies, the CIMT measurement parallels the significance of traditional cardiovascular risk factors. Hence CIMT measurements represent the preferred technique for noninvasively assessing atherosclerosis in most clinical trial studies [4, 5].

Materials and methods

This cross-sectional study was done from March 2017 - October 2017 in the Department of Cardiology, Royapettah Government Hospital. Totally 75 Patients diagnosed with coronary

artery disease within the previous 1 month and had undergone coronary angiogram ICCU; cardiology and medical wards were included in the study. Patients fulfilling the inclusion criteria were subjected to symptom analysis, clinical examination, laboratory investigations and carotid intima-media thickness measurement by B mode ultrasound technique using a 10 MHz probe in the department of radiology, Stanley Medical College and Hospital by a well-experienced radiologist. Patients were preferably grouped into a normal CIMT and an increased CIMT group. The severity of the disease was compared in terms of a non-obstructive CAD, SVD, DVD, and TVD. Coronary angiogram stenosis severity was calculated by using a modified Gensini score.

Inclusion criteria

- All patients between 20 and 60 years of age who have been diagnosed having coronary artery disease which includes chronic stable angina, ST elevation MI, non-ST elevation MI, unstable angina within the last 1month and have undergone CAG
- All patients between 20 and 60 years of age who have undergone primary/facilitated PCI within the above mentioned time.

Exclusion criteria

- Any patient taking antiplatelet or lipid-lowering agents for more than 1 month

- Patients with any form of a connective tissue disorder, chronic kidney disease
- Any patient < 20 and > 60 years of age
- Patients with BMI > 40
- Patients with short neck.

analyzed with the Chi-Square Test and Fisher Exact Test. Statistical significance was taken as $P < 0.05$. The data were analyzed using EpiInfo software (7.1.0.6 version; Center for disease control, USA) and Microsoft Excel 2010.

Statistical analysis

Descriptive statistics were done for all data and suitable statistical tests of comparison were done. Continuous variables were analyzed with the Unpaired t-test and categorical variables were

Results

By conventional criteria, the association between the study groups and age was considered to be not statistically significant since $p > 0.05$ (Table – 1).

Table – 1: Age distribution.

Age Distribution	All Patients	%	Normal CIMT (<0.9 mm)	%	Increased CIMT (≥ 0.9 mm)	%
≤ 45 years	15	20.00	10	20.41	5	19.23
46 to 60 years	60	80.00	39	79.59	21	80.77
Total	75	100	49	100	26	100

Table – 2: Hypertension status.

Hypertension Status	All Patients	%	Normal CIMT (<0.9 mm)	%	Increased CIMT (≥ 0.9 mm)	%
Normal	46	61.33	34	69.39	12	46.15
Hypertensive	29	38.67	15	30.61	14	53.85
Total	75	100	49	100	26	100
Chi-square value	3.87					
Degrees of freedom	1					
P value Chi-Squared Test	0.490					

Table – 3: Diabetes status.

Diabetes Status	All Patients	%	Normal CIMT (<0.9 mm)	%	Increased CIMT (≥ 0.9 mm)	%
Normal	45	52.00	31	63.27	14	53.85
Diabetic	30	48.00	18	36.73	12	46.15
Total	75	100	49	100	26	100
Chi-square value	0.543					
Degrees of freedom	1					
P value Chi-Squared Test	0.016					

By conventional criteria, the association between the study groups and hypertension status was considered to be not statistically significant since $p > 0.05$ (Table – 2).

By conventional criteria, the association between the study groups and diabetes status among study

subjects was considered to be statistically significant since $p < 0.05$. The diabetes status in normal CIMT group was meaningfully less than increased CIMT group by 1.26 times with a mean difference of 9.42 mg/dl. This difference was true and significant and has not occurred by chance (Table – 3).

Table – 4: LVEF (%).

LVEF (%) Status	All Patients	%	Normal CIMT (<0.9 mm)	%	Increased CIMT (≥0.9 mm)	%
≤ 40 %	13	17.33	9	18.37	4	15.38
41 to 55 %	40	53.33	27	55.10	13	50.00
56 to 70 %	22	29.33	13	26.53	9	34.62
Total	75	100	49	100	26	100

Table – 5: CAG- modified GENSINI scoring.

CAG- modified Gensini scoring	All Patients	%	Normal CIMT (<0.9 mm)	%	Increased CIMT (≥0.9 mm)	%
≤ 25	49	73.33	36	73.47	13	50.00
26 to 50	17	14.67	9	18.37	8	30.77
50 to 100	9	12.00	4	8.16	5	19.23
Total	75	100	49	100	26	100

Table – 6: Diagnosis.

Diagnosis	All Patients	%	Normal CIMT (<0.9 mm)	%	Increased CIMT (≥0.9 mm)	%
STEMI	38	50.67	31	63.27	7	26.92
NSTEMI	19	25.33	10	20.41	9	34.62
Unstable Angina	18	24.00	8	16.33	10	38.46
Total	75	100	49	100	26	100
Chi-square value	4.31					
Degrees of freedom	2					
P value Chi-Squared Test	0.016					

Table – 7: CAG findings.

CAG finding	All Patients	%	Normal CIMT (<0.9 mm)	%	Increased CIMT (≥0.9 mm)	%
Normal	20	26.67	17	34.69	3	11.54
Non Obstructive	11	14.67	9	18.37	2	7.69
SVD	9	12.00	8	16.33	1	3.85
DVD	13	17.33	7	14.29	6	23.08
TVD	22	29.33	8	16.33	14	53.85
Total	75	100	49	100	26	100
Chi-square value	5.24					
Degrees of freedom	4					
P value Chi-Squared Test	0.0263					

LVEF (%) was as per **Table – 4**. The modified Gensini levels in normal CIMT group were meaningfully less than increased CIMT group by 1.55 times with a mean difference of 11.31 points. This difference was true and significant and has not occurred by chance (**Table – 5**).

This indicated that there was a true difference between groups and the difference was significant. In simple terms, when studying the carotid intima-media thickness in assessing the severity of coronary artery disease, the diagnosis at admission in normal CIMT group was

predominantly STEMI (63.27%) when compared to increased CIMT group where it was Unstable angina (38.46%). It was statistically significant with a p-value of 0.016 according to chi-squared test (**Table – 6**).

This indicated that there was a true difference between groups and the difference was significant. In simple terms, when studying the carotid intima-media thickness in assessing the severity of coronary artery disease, the CAG findings in normal CIMT group was predominantly normal (34.69%) when compared to increased CIMT group where triple vessel disease (53.85%). It was statistically significant with a p-value of 0.0263 according to chi-squared test (**Table – 7**).

Discussion

Coronary artery disease, leading the list in all-cause mortality in India is a major setback to Indian economy since it has invaded the morbidity and mortality of young men in the working age group [6]. The novel laboratory evaluation of atherosclerotic risk markers is definitely useful in determining lifestyle modification or secondary prevention but it doesn't reflect the lumen's status or the severity of atherosclerosis [7]. Hence, CIMT which directly visualizes the vessel wall is an upcoming non-invasive cardiac risk predictor. CIMT is easy to perform, reliable, reproducible, ionization free, cost effective, less time consuming, which makes it the preferred technique for non-invasively assessing the severity of atherosclerosis [8]. The role of CIMT and its correlation with CAD has been proved beyond doubt by various studies. In our study 75 patients fulfilling the inclusion criteria were selected and were subjected to various symptom analysis, clinical examination, laboratory investigations, and CIMT measurement by B mode ultrasound of 10 MHz. In our study, the carotid intima-media thickness had a statistically significant positive association with the modified Gensini score [9]. In our study within the subgroup, there was a better association between them when the modified

Gensini score was between 50 and 100 than 26 and 50. This shows that as CIMT increases, the percentage of lesion of atherosclerosis increases and so does the severity of CAD [10]. The mean difference between the two groups is points in our study. This was in contrast to the study by Market al which showed a nonsignificant association between CIMT and modified Gensini score. Our study also supported the pathogenesis of different arms of the acute coronary syndrome. The CIMT was interestingly low in a patient with STEMI as compared to unstable angina [11]. Increased CIMT, observed in UA and NSTEMI groups supported the slow, progressive and not totally occlusive atherogenesis compared to plaque rupture and acute thrombosis which causes the obstruction in STEMI. It is also predicted that >50% of patients with STEMI would have had <50% stenosis pre-STEMI and is supported by Stein, J.H., Korcarz, et al. their respective studies [12]. Our study showed a significant association between CIMT and the number of vessels involved. In our study, the association between CIMT and TVD was significantly higher when compared to normal or nonobstructive CAD. And also the difference in CIMT between DVD and SVD is much more compared to the TVD and DVD supporting the various studies as quoted in the citations. His study with a mean age of 56 years was correlated to either have a normal or increased CIMT with a cut off value of 0.9mm, showed to have no association between different ages and CIMT, in contrast to one study where there was a positive association [12]. The possible reason could be the young adults between 20 and 60 years of age has been included in our study as against a relatively older group in other studies. The gender correlation with a male predominance of 68% showed to have a 'p' value of >0.05, which showed no significant association [13]. The smoking and its duration showed a 'p' value of 0.0487, with 44% of the study subjects who were smokers. The correlation of CIMT with diabetes status and also with the duration of diabetes showed a significant 'p' value of 0.016. Our study showed a similar association compared to the study by Willekes C., et al. [14].

Conclusion

The study showed a high positive predictive value and specifies for the presence of a triple vessel disease if a CIMT is well above 0.90mm, correlated for age. Also CIMT < 0.90 mm correlates better with normal coronaries and nonobstructive CAD. Also, the study also demonstrates the correlation between increased CIMT and the severity of coronary atherosclerosis, calculated using modified Gensini score. The median percentile scores of CIMT showed a progressive increase in the percentage of stenosis and number of coronary vessels involved. Hence we conclude that CIMT is a very useful noninvasive technique to assess the severity of CAD and has a positive association with coronary angiogram findings.

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