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Original Research Article

Carotid intima-media thickness as a marker for assessing the severity of coronary artery disease on coronary angiography

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ABSTRACT

Background: Coronary artery disease (CAD), the leading cause of death worldwide, has a huge area of primary prevention where patients at risk can be identified for more intensive, evidence-based medical interventions to reduce cardiovascular events. Whereas coronary angiography has stood the test of time to assess atherosclerotic burden, it is still unavailable to a huge population at risk of CAD. This study was devised in search of a cheap and simple tool to assess atherosclerotic burden. We aimed to investigate the relationship between Carotid Intima Media Thickness (CIMT) and Coronary Artery Disease (CAD) in patients evaluated by coronary angiography for suspected CAD and whether CIMT could predict the extension of CAD.
Methods: This study was a cross-sectional study conducted from March 2013 to September 2015 in Department of Medicine, SMHS Hospital, J and K, India. A total of 100 patients admitted to for undergoing coronary angiography indicated for suspected coronary artery disease were enrolled. the risk factors evaluated in this study included age, body mass index, sex, dyslipidemia, hypertension, diabetes mellitus and smoking. CAD was assessed and classified by coronary angiography and CIMT was assessed by carotid doppler.
Results: There was a positive relationship between CIMT and CAD. Risk factors like Age, smoking, BMI, cholesterol, hypertension, and diabetes had significant positive effect on CIMT; whereas gender, VLDL, triglycerides, HDL and LDL were statistically insignificant in affecting CIMT.
Conclusions: CIMT is a cheap and simple tool to predict the extent of CAD.

Keywords: Atherosclerosis, Carotid intima media thickness, Coronary artey disease

INTRODUCTION

Coronary artery disease (CAD) is the leading cause of death worldwide. Previously thought to affect primarily high-income countries, CAD now leads to more death and disability in low- and middle-income countries, such as India, with rates that are increasing disproportionately compared to high-income countries.[1] Atherosclerosis is a systemic disease, and carotid and coronary arteries are the two most common sites of involvement of atherosclerosis.[2,3] To prevent death and morbidity from CAD there has been a great interest in identifying asymptomatic patients at high risk who would be candidates for more intensive, evidence-based medical interventions to reduce Cardiovascular events.[4,5]

The traditional approach to CAD risk assessment involves identifying and quantifying the presence or absence of CAD risk factors. The National Cholesterol Education Program (NCEP) recommends estimating the 10-year risk for CAD death using the Framingham Risk Score model[6-8]. Imaging of arteries to identify and

quantify the presence of subclinical vascular disease has been suggested to further refine CAD risk assessment.[9,10] Whereas coronary angiography has stood the test of time to assess atherosclerotic burden in coronary arteries, the cost and skill needed to perform this test has left this test unaffordable and unreachable to many. This study aimed to search for a cheap and simple tool to assess atherosclerotic burden. This surrogacy for atherosclerosis, however, should meet several criteria before it can be validly used. Carotid intima-media thickness (CIMT) is a simple and inexpensive tool to assess the cumulative effect of atherosclerotic risk factors and has been proven to be an independent predictor of future cardiovascular risk in various studies.[11-15]

Many studies on CIMT have found a positive correlation with coronary artery atherosclerosis as assessed by both computed tomography coronary calcification and coronary angiography.[16,17] However, conflicting reports in the literature regarding the association of CIMT with risk factors of carotid and coronary atherosclerosis.[18,19] Considering the variability in the findings of different studies, we attempt to establish or refute the surrogacy of CIMT as a marker for coronary atherosclerosis.

Primary objective was to investigate the relationship between intima-media thickness (IMT) in carotid arteries and coronary artery disease (CAD) in patients evaluated by coronary angiography for suspected coronary artery disease; and secondary objective was to establish whether CIMT is predictive of the extent of Coronary artery disease.

METHODS

This study was a 2.5-year cross-sectional study conducted from March 2013 to September 2015 in Postgraduate Department of Medicine, SMHS Hospital which is an associated tertiary care hospital of Government Medical College Srinagar, J and K, India.

Study population

Inclusion criteria

Patients admitted to cardiology division for undergoing Coronary Angiography indicated for suspected coronary artery disease.

Exclusion criteria

Patients who did not give consent or were clinically unstable. The risk factor variables evaluated in this study included age, body mass index, sex, dyslipidemia, hypertension, diabetes mellitus and smoking. coronary artery disease was assessed and classified by coronary angiography and carotid intima medial thickness was assessed by carotid doppler.

Coronary angiography was performed by standard techniques. CAD being defined as diameter lumen stenosis of 50% in at least 1 major coronary artery. According to the number of diseased vessels, our patients were classified into one of the following four patient groups:

- Group 1- patients with no vessel disease;
- Group 2- patients with single-vessel disease;
- Group 3- patients with double-vessel disease;
- Group 4- patients with triple-vessel disease.

Carotid intima-media thickness measurement

High resolution B mode, colour doppler ultrasonography of both carotid arteries was performed with an ultrasound machine (philips) equipped with a 7.5 MHz linear array transducer. For the common carotid artery measurement, the most distal 10 mm of the common carotid artery before widening into the bifurcation was used.

Statistical analysis

Data analysis was performed using SPSS version 20 (IBM). Continuous variables were expressed as mean± SD. One-way ANOVA with post hoc analysis was done to establish relationship between CIMT and four levels of CAD. The effect of other risk factors was established by using multiple regression analysis.

RESULTS

A total of 100 patients were enrolled. There were 84 males and 16 females. Mean age of study population was 57.09±10.25 years. 62 patients (62%) were hypertensive, 22 patients (22%) were diabetic, 76 patients (76%) were smokers 16 patients (16%) had hypercholesterolemia.

Coronary artery disease was present in 68.5% patients; with single vessel disease in 31.50% patients, double vessel disease in 24.70% patients and triple vessel disease in 12.30% patients. No vessel disease was present in 31.5% patients. In 100 patients, CIMT ranged from 0.400 to 1.395 with a mean of 0.762 and SD of 0.195. One Way Analysis of Variance of CIMT Vs CAD (4 levels as on CAG) is shown in Table 1 and Figure 1.

Table 1: One-way analysis of variance of CIMT vs CAD (4 levels as on CAG).

CIMT	Sum of Squares	Df	Mean Square	F	Sig.
Between groups	2.310	3	0.770	50.485	0.000
Within groups	1.464	96	0.015		
Total	3.775	99			

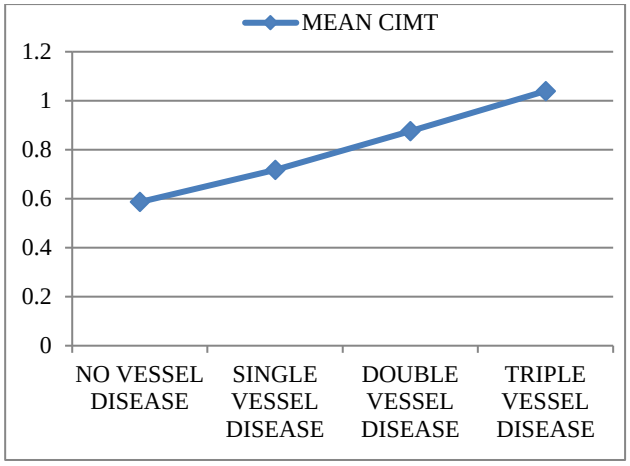

Figure 1: One-way analysis of variance of CIMT Vs CAD (4 levels as on CAG).

A post-hoc test was done to determine the significance of difference between means in various ordinal groups and it was found that those subjects who did not have any kind of vessel disease scored significantly lower on CIMT than those who had developed single vessel disease or double vessel disease or triple vessel disease". It also predicted a constantly increasing change in CIMT across levels of CAG

Further to investigate the impact of risk factors (demographic, habitual and health factors) on CIMT, Multiple Regression Model was used. The overall significance of the explanatory variables indicated by F-test (F = 30.315; df = 12, 62; P = 0.00) showed that some of the variables were statistically significant in explaining the variation in the regress and; meaning that there is significant impact of risk factors (demographic, habitual and health factors) on CIMT.

In the multiple regression model 11 regressors (variables) were used and it was found that Age (coeff. = 0.005); Smoking (coeff. = 0.005); BMI (coeff. = 0.013); Cholesterol (coeff. = 0.004); hypertension (coeff. = 0.060); and diabetes (coeff. = 0.162); have significant positive effect on CIMT. The rest of the variables like Sex, VLDL, Triglycerides, HDL and LDL showed no significant impact on CIMT. The estimated results of multiple regression model are shown in Table 2.

Table 2: Multiple regression model of variables studied.

Dependent variable in the model is CIMT	B	Std. Error	Sig.	95% confidence interval for B	
				Lower bound	Upper bound
[Sex = 0]	-0.058	0.035	0.110	-0.128602	0.0133294
Age	0.005	0.001	0.000	0.0029469	0.0075899
BMI	0.013	0.004	0.001	0.0057868	0.0203044
Smoking	0.005	0.001	0.002	0.002988	0.009866
[Hypertension=1]	0.060	0.024	0.014	0.10776	0.0124678
[Diabetes=1]	0.162	0.028	0.000	0.2181754	0.1049246
Triglycerides	-0.0000559	0.0002455	0.821	-0.0005469	0.000435
Cholesterol	0.001	0.001	0.004	0.0007003	0.0023018
HDL	-0.001	0.001	0.247	-0.0035185	0.0009218
LDL	0.001	0.001	0.220	-0.0008393	0.0035771
VLDL	-0.001	0.0003060	0.144	-0.0017306	-0.0005067

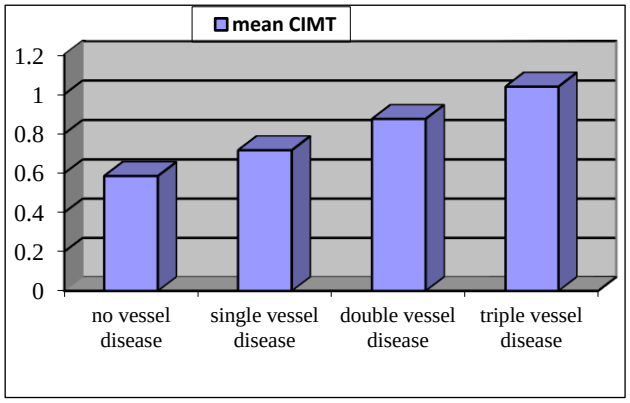

Figure 2: CIMT Vs CAD (4 levels as on CAG).

The differential coefficient for CAG implies that in patients who fall in the higher levels of CAD, CIMT is expected to increase by 0.113 mm on an average as compared to those who do not have any vessel disease (Figure 2).

DISCUSSION

In our study patients admitted to cardiology division for undergoing coronary angiography indicated for suspected coronary artery disease were studied with respect to age, body mass index, sex, dyslipidemia, hypertension, diabetes mellitus and smoking. all patients underwent high resolution B mode colour doppler ultrasonography of both carotid arteries.

The one-way Analysis of Variance (ANOVA) provided statistically significant evidence (P<0.01) that mean CIMT is not the same for all four levels/groups of CAG. Almost similar results were concluded by A Kablak-Ziembicka, et al, when they found a significant correlation between mean CIMT and advancing CAD (p<0.0001).[20]

Post hoc analysis showed that those subjects who do not have any kind of vessel disease had significantly lower values of CIMT than those who had single, double or triple vessel disease. These findings were consistent with a study conducted by Gupta Hansa, et al, where they found that the maximum CIMT was significantly higher in the coronary disease group compared to the controls (1.02 vs. 0.80 mm).[21] The average intima-media thickness was also significantly higher in the coronary disease group (0.82 vs. 0.67 mm). Our results of multiple regression analysis was in accordance with a study conducted by Holaj R et al, where they found that age (P=0.15), CIMT (P<0.01), and total cholesterol (P=0.09) were independent parameters for the prediction of significant CAD.[22]

In our study age and cholesterol level were found to be significant risk factors for increase in CIMT. Similar results were obtained Holaj R et al, who using multiple regression analysis found that age (P=0.15), CIMT (P<0.01), and total cholesterol (P=0.09) were independent parameters for the prediction of significant CAD.[22] Like in our study Ramachandran Meenakshisundaram, et al, also found that CIMT was significantly associated with age and dyslipidemia.[23]

Our study establishes a positive correlation between CIMT and Smoking. As the number of pack years smoked increases by one unit, the CIMT increases by .005 mm. Similar results were concluded by Rosvall M., et al.[24] There was a positive correlation between CIMT and Body Mass Index. DS Freedman et al, also examined the relation of adiposity at various ages to the carotid intima-media thickness (IMT) and concluded a positive correlation.[25] In our study we found that hypertension and diabetes were significantly correlated with CIMT. Hypertensive and diabetic patients had higher CIMT values (statistically significant) than normotensive and non-diabetic patients. These results were consistent with Ugur Coskun, et al, who used Logistic regression analysis to identify CIMT (OR 4.3, p <0.001) and hypertension (OR 2.4, p = 0.04) as the most important factors for predicting CAD and Steven M Haffne et al, who found that both diabetes and CAD were associated with increased atherosclerosis in the CCA.[26,27]Other variables like sex, VLDL, triglycerides, HDL and LDL were statistically insignificant in showing impact on CIMT.

CONCLUSION

To conclude, it was found that there is a positive relationship between carotid intima-media thickness (CIMT) and coronary artery disease (CAD). Also, CIMT is predictive of the extent of Coronary Artery Disease. Multiple risk factors which include age, smoking, bmi, hypertension, diabetes and cholesterol have positively significant effect on CIMT. The rest of the risk factors like sex, VLDL, triglycerides, HDL and LDL were statistically insignificant in showing impact on CIMT.

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