Contents lists available at ScienceDirect

Indian Heart Journal

journal homepage: www.elsevier.com/locate/ihj

Original Article

The association between increased carotid intima–media thickness and SYNTAX Score in coronary artery disease: A single center study

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ARTICLE INFO

ABSTRACT

Background: Carotid artery lesions frequently coexist with coronary arterial disease (CAD). The aim of this study was to investigate the relation between carotid intima-media thickness (CIMT) and the extent of CAD and whether CIMT could be predictive of severity of coronary atherosclerosis.
Methods: Coronary angiography and carotid ultrasound evaluations of 100 consecutive patients with CAD who had undergone elective coronary angiography were reviewed. IMT was measured at both carotid arteries. CIMT and severity of CAD relationship based on SYNTAX score was assessed. The relation between CIMT and cardiovascular risk factors was determined.
Results: Mean overall SYNTAX score was $15.76 + 4.82$. Mean right CIMT was 0.86 ± 0.29 and mean left CIMT was 0.83 ± 0.24. There were no significant correlation between the SYNTAX score and CIMT (r: 10, P: 30). There was significant relationship between hypertension,diabetes and CIMT (P: 0.01).
Conclusion: we found no relationship between CIMT and SYNTAX score in patients who underwent coronary angiography. Diabetes mellitus and hypertension are related to increased carotid intima-media thickness.

1. Introduction

Carotid artery disease is a manifestation of atherosclerosis and is very often present concurrently with coronary artery disease (CAD) and peripheral artery disease.[1]

Carotid artery intima-media thickness (CIMT) measurement is a non-invasive method to diagnose early atherosclerosis or predict the risk of myocardial infarction and stroke. Increased CIMT in the common carotid segment is accompanied by yearly risk of 0.7%–2.2% in coronary heart disease, 0.4%–1.8% for stroke and from 1.8% to 3.2% for total cardiovascular disease.[2]

SYNTAX score is a detailed angiographic scoring system based on the coronary obstructive lesions characteristics.[3] Previous studies have shown the association between SYNTAX score, which represents lesion complexity and prognosis of coronary revascularization and risk of major adverse cardiac events (MACEs) after percutaneous revascularization in patients with CAD. The scoring system has also been used recently to assess the relationship between IMT and CAD severity.[3–5]

The aim of the present study was to investigate the association between Intima-media thickness of the carotid artery stenosis and severity of coronary artery disease based on angiographic SYNTAX score system in patients with stable CAD undergoing elective coronary angiography.

2. Methods

2.1. Patients

One hundred consecutive patients who underwent elective coronary angiography for evaluation of suspected CAD were enrolled. All patients had at least single CAD with lesions of more than 50% diameter reduction, no previous history of carotid atherosclerosis/lesions and no history of previous revascularization.

This study was approved by our local ethical committee according to the Helsinki Declaration of the World Medical Association (2000).

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2.2. Coronary angiographic analysis

All coronary angiography data were analyzed by two expert cardiologists who were blinded to the patient's CIMT values. Based on the angiogram, each coronary lesion producing $\geq$50% diameter stenosis was scored, and these scores were combined to provide the overall SYNTAX score, which was calculated using the SYNTAX score algorithm.[6]

2.3. Carotid ultrasonography

Ultrasonography was performed with SonoSite M-Turbo® vascular ultrasound system. Patients were examined in the supine position with the head tilted backwards. The maximum IMT was measured manually at the near and far walls of the common carotid artery parallel to the transducer beam, and the lumen diameter was maximized in the longitudinal plane.[7] Carotid lesion was defined as the presence of focal wall thickening that is 50% greater than that of the surrounding vessel wall or as a focal region with IMT > 1.5 mm.[1,8] All measurements were performed by the same investigator who was blinded to clinical and angiographic data. (Fig. 1)

2.4. Statistics

Statistical analyses were performed with SPSS (version 15; SPSS Inc. Chicago, Illinois). Data were expressed as mean values ± standard deviation or count (%). All variables were tested for normal distribution with the Kolmogorov-Smirnov test. T-student test or Mann-Whitney U test was used to compare quantitative variables. Linear correlations between different quantitative variables were evaluated by Pearson's correlation coefficient. P values < 0.05 were considered significant.

3. Results

A total of 100 patients with CAD were studied. The baseline characteristics and cardiovascular risk factors for patients are shown in Table 1. Mean of overall SYNTAX score was 15.76 + 4.82.

Relationship between clinical data and CIMT are demonstrated in Table 2. There was a significant relationship between hypertension and CIMT (P: 0.01) and between diabetes mellitus and CIMT (p: 0.04). There was no significant correlation between the age and CIMT (r: 0.13, P: 0.18)

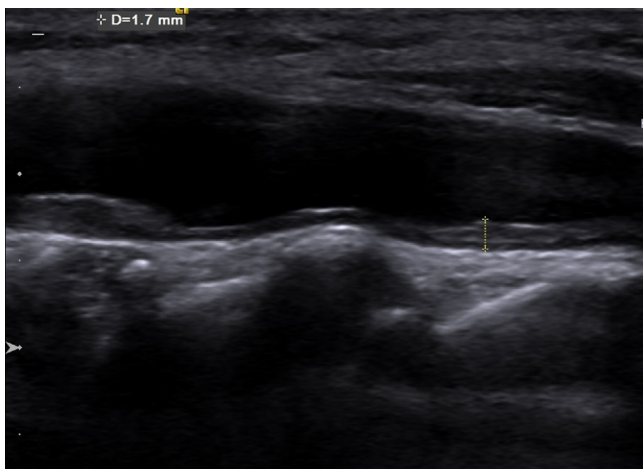**Fig. 1.** Manual measurement of carotid intima-media thickness.

Table 1
Demographic and Clinical Characteristics of Patients.

Variables	M ± SD/N (%)
Age(years)	58.99 ± 9.86
Sex (male)	82(82%)
DM	30(30%)
DLP	54(54%)
HTN	51(51%)
FH	33(33%)
Smoking	33(33%)
Diseased culprit vessel	
single vessel	31(31%)
2 vessels	28(28%)
3 vessels	41(41%)
Right CIMT(mm)	0.86 ± 0.29
Left CIMT(mm)	0.83 ± 0.24

DM: diabetes mellitus, DLP: dyslipidemia, HTN: Hypertension, FH: family history, CIMT: carotid intima–media thickness in millimeters.

Table 2
The relationship between CIMT and clinical Characteristics.

	CIMT (mm)	p-value
Sex		
male(n = 82)	0.85 ± 0.20	0.16
female(n = 18)	0.80 ± 0.2.	
Diseased Culprit Vessel		
1 vessel(n = 31)	0.80 ± 0.18	0.15
2 vessels(n = 28)	0.82 ± 0.23	
3 vessels(n = 41)	0.88 ± 0.19	
DM		
yes(n = 32)	0.89 ± 0.28	0.04
no(n = 68)	0.80 ± 0.21	
HTN		
yes(n = 53)	0.87 ± 0.19	0.01
no(n = 47)	0.81 ± 0.21	
DLP		
yes(n = 55)	0.85 ± 0.21	0.75
no(n = 45)	0.83 ± 0.19	
FH		
yes(n = 31)	0.80 ± 0.18	0.11
no(n = 69)	0.86 ± 0.21	
Smoking		
yes(n = 33)	0.89 ± 0.23	0.12
no(n = 67)	0.82 ± 0.18	

DM: diabetes mellitus, DLP: dyslipidemia, HTN: Hypertension, FH: family history, CIMT: carotid intima–media thickness.

No significant relationships between demographic and clinical data including age (r: 0.13, P: 0.19) and SYNTAX score was found (Table 3).

We also did not find a statistically significant correlation between the SYNTAX score and CIMT (r: 0.10, P: 0.30) (Table 4).

In multivariate model, after adjustment by baseline, CIMT remained not associated with the SYNTAX score (P: 0.35) (Table 5). There was also no significant relationship between mean of left and right CIMT and Syntax score (r: 0.103, P: 0.30).

4. Discussion

Our main findings of this study were: 1) the complexity of coronary lesions as assessed by SYNTAX score does not correlate with CIMT; (2) Presence of hypertension and diabetes mellitus could be related to increased CIMT.

Although several studies have suggested a relationship between CIMT and the prevalence or severity of CAD, our results did not prove it. In the other words, SYNTAX scoring system as a CAD complexity marker had no significant relationship with CIMT. It should also be contemplated that some parameters that influence the SYNTAX score including vessel tortuosity, angle at bifurcation lesions, age of total occlusion, right or left dominancy

Table 3
The relationship between SYNTAX score and clinical Characteristics.

	SYNTAX score	p-value
Sex		
male	15.71 ± 4.76	0.81
female	16.00 ± 5.25	
DM		
yes	16.33 ± 4.54	0.43
no	15.51 ± 4.95	
HTN		
yes	15.82 ± 4.69	0.89
no	15.69 ± 5.00	
DLP		
yes	16.4 ± 4.29	0.60
no	15.43 ± 5.41	
FH		
yes	16.12 ± 4.42	0.60
no	15.58 ± 5.03	
Smoking		
yes	16.45 ± 5.36	0.31
no	15.42 ± 4.54	

DM: diabetes mellitus, DLP: dyslipidemia, HTN: Hypertension, FH: family history.

Table 4
Correlation between SYNTAX score and CIMT.

	r	p-value
CIMT	0.103	0.30

Table 5
Multivariate Analysis of Total CIMT Score and Variables.

	coefficients	Beta	p-value
sex	0.02	0.37	0.72
age	0.03	0.16	0.12
CS	0.03	0.08	0.48
HTN	4.81	0.30	0.007
DLP	2.41	0.15	0.13
DM	0.11	0.27	0.02
FH	0.01	0.03	0.78
SYNTAX	−0.51	−0.01	0.89

DM: diabetes mellitus, DLP: dyslipidemia, HTN: Hypertension, FH: family history, CIMT: carotid intima–media thickness.

but might not have a direct relationship with atherosclerosis burden.[3]

As we enrolled patients not only with 3-vessel disease but also with single and two vessels coronary disease that might have led to lower calculated SYNTAX score than other trials. Comparing our results with previous studies indicates some differences and similarities. Ikeda et al has reported overall SYNTAX score 8.1 ± 14.4 and CIMT: 0.86 ± 0.23. Although their SYNTAX score was lower than SYNTAX score that we reported, they found significant relationship between SYNTAX score and CIMT.[4]

Kato et al. reported significant association between positive carotid artery remodeling and complex CAD.[9] Lomborda et al reported that stenosis in carotid arteries were much more common in patients with unstable angina than in those with chronic stable angina.[10] Kablak-Ziembicka et al showed CIMT increases with advancing CAD and patients with mean IMT over 1.15 mm have a 94% likelihood of having CAD.[11] Costanzo et al, in line with our results, found high prevalence of carotid lesion in patients with complex CAD. However, SYNTAX score does not seem to correlate with carotid atherosclerosis.[1]

A limitation of our study was a rather small sample size and not including patients without CAD. Despite our findings regarding the relation between SYNTAX score and CIMT, we demonstrated associations between some common risk factors and mean CIMT in accordance with other studies. Many studies found that increased carotid intima-media thickness is associated with age, sex, hypertension, diabetes mellitus, dyslipidemia, and other cardio-vascular risk factors.[12] We found hypertension and diabetes mellitus to independently predict increased carotid intima-media thickness.

5. Conclusion

In conclusion, we found no relationship between CIMT and SYNTAX score in patients who underwent elective coronary angiography. In multivariate analysis, diabetes mellitus and hypertension are independent predictors of increased carotid intima-media thickness.

Conflict of interest

None.

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