Original Article

Correlation of Carotid Intima Media Thickness by B Mode Ultrasonography with Extent of Coronary Artery Disease

Geeta[1], Prakrati[2], Sohel Solanki[3]

[1]Associate Professor, Department of Anatomy, S.P. Medical College, Bikaner, Rajasthan, India. [2]Assistant Professor, RUHS College of Medical Sciences, Jaipur, Rajasthan, India. [3]Assistant Professor, Department of Anatomy, Government Medical College, Barmer, Rajasthan, India

Abstract

Background: Owing to its non-invasive character and easy applicability, quantitative carotid B-mode Ultrasonography has emerged as one of the methods of choice for determining the anatomic extent of atherosclerosis and its progression, and for assessing cardiovascular risk. The purpose of study was to investigate the thickness of Intima-Media Thickness (IMT) of Common Carotid Artery (CCA), Internal Carotid Artery (ICA), Carotid bifurcation and relation of IMT with extent of the coronary arteries disease. **Material and Methods:** A total of 200 subjects, 158 males and 42 females (age ranging from 21year to 80 years) who had admitted for coronary angiography in cardiology hospital, included in this study. Coronary Angiography was performed by standard technique. The mean value of six measurement of IMT of far wall of the CCA, ICA, and carotid bifurcation was calculated in each patient. **Results:** According to the results, the mean IMT for the proximal implicated in CCA Right, middle and distal segment was 0.758mm, 0.724mm and 0.698mm respectively.. The magnitude of mean IMT in ICA Right for proximal, middle and distal segments was 0.699mm, 0.622mm and 0.621mm respectively. The mean IMT of right bulb for respective segments was as 0.767mm, 0.783mm and 0.742mm. When mean IMT were compared for number of obstructed coronary arteries, these values were significantly (p=0.000) higher for the triple vessel disease as comparison to single and double vessel coronary disease. **Conclusion:** In present study the IMT of carotid arteries were significantly correlated with the no. of the diseased vessels (p=0.000). Present study suggested that noninvasive B-mode ultrasonography measurement of IMT can be used for early detection of atherosclerosis and can be considered for patients who cannot undergo coronary angiography.

Keywords: Intima-Media Thickness (IMT), Common Carotid Artery (CCA), Internal Carotid Artery (ICA), Carotid Bifurcation, Carotid Ultrasound, Coronary Artery Disease (CAD), Atherosclerosis, Noninvasive Imaging, Cardiovascular Risk Assessment

Received: 20 June 2025 **Revised: 10 July 2025** **Accepted: 30 August 2025** **Published: 25 September 2025**

Introduction

The coronary circulation, which feeds the heart's many components by encircling its whole surface, is the heart's special blood supply, provided by two coronary arteries. The right and left coronary artery presents proximal, middle and distal segments.

The condition known as coronary artery disease (CAD) or coronary heart disease (CHD) arises when the arteries of the heart that provide blood and oxygen to the heart are narrowed or even completely blocked. Narrowing of arteries occur because of buildup of plaque, on the inner wall, which is known as atherosclerosis. Thickening of the intima-media is commonly recognized as the initial stage in the development of atherosclerosis. Various non-invasive markers of early arterial wall alteration are currently available, such as arterial wall thickening and stiffening, endothelial dysfunction and coronary artery calcification. Of them, intima-media thickness (IMT) of large peripheral arteries, especially carotid, can be assessed by B-mode ultrasound relatively in a simple way. Ultrasound imaging may easily assess a widespread increase in the common carotid artery's (CCA) intima-media thickness (IMT), which often occurs in the early stages of the atherosclerotic process.[1]

Owing to its non-invasive nature, simplicity of use, and quantified carotid B-mode One of the most popular techniques for evaluating cardiovascular risk and figuring out the anatomic extent of atherosclerosis and its progression is ultrasonography.[2] It enables the precise measurement of the intima-media thickness (IMT), which is the distance between the luminal-intima and media-adventitia contact of the artery wall.[3] Paolo pignoli originally proposed and confirmed ultrasound IMT measures in vitro in Milan who contrasted B mode real-time imaging of the same specimens with direct measures of artery wall thickness using both microscopic and gross inspection.

The relationship between carotid IMT and subsequent coronary events was first demonstrated by Salonen and Salonen (Kuoppio Ischemic Heart Disease study).[4] In Kuopio Ischemic Heart

Address for correspondence: Dr. Geeta,
Associate Professor, Anatomy, S.P. Medical College Bikaner, India
E-ail: g79geeta@gmail.com

DOI:
10.21276/amit.2025.v12.i3.88

How to cite this article: Geeta, Prakrati, Solanki S. Correlation of Carotid Intima Media Thickness by B Mode Ultrasonography with Extent of Coronary Artery Disease. Acta Med Int. 2025;12(3):323-326.

Disease Risk Factor Study (KIHD),[5] Salonen and Salonen reported that, for every 0.1-mm increment of CIMT, the risk of future myocardial infarction increased by 11%.

The present study also worked in this direction to see: the relationship of carotid IMT to the extent of the coronary artery disease, the value of CCA IMT, ICA IMT and bulb IMT in predicting cardiovascular disease, measurement of carotid IMT by B-mode ultrasound, but the present study also focus on the matter that which coronary segment (proximal, middle and distal) mostly affected or obstructed in coronary artery disease, which was not reported by previous studies.

Materials and Methods

This study incorporated 200 subjects, 158 males and 42 females (age ranging from 21year to 80 years) who had admitted for coronary angiography in cardiology hospital. Prior to coronary angiography each patient underwent for B-mode ultrasound scanning of the carotid arteries using a 7-10 MHz linear transducer by a Philips envisor-c ultrasound machine. In order to analyze changes in frequency within an ultrasound signal that indicate mobility inside a tissue, such as when evaluating carotid arteries, a B-mode scan combines a "real time" duplex scan in two dimensions.

The common carotid arteries' distal 10 mm were seen in order to do ultrasonography, carotid bulb and the internal carotid arteries' proximal 10 mm. A reliable measure of the intimal medial complex's thickness was obtained by measuring the distance between two lines representing the blood-intima and media-adventitia interfaces. The highest IMT was measured three times at the internal carotid arteries, the carotid bifurcation, and the far wall of the common carotid artery's plaque-free section. The results were then averaged.

Coronary Angiography was carried out using normal procedure. Patients were categorized into the following groups based on the angiography report: Based on the lesion Patients in Group 2 members had coronary artery disease (lesion > 50%), but Group 1 members had normal coronary arteries (lesion < 50%). Based on the number of impacted coronary artery disease: Group1) patient with normal vessels; group 2- patients with 1-vessel disease (single vessel disease); group 3- patients with 2-vessel disease (double vessel disease); group 4- patients with 3-vessel disease (triple vessel disease); According to the diseased segment of coronary artery it was classified as: proximal, middle and distal stenosed segment of coronary arteries.

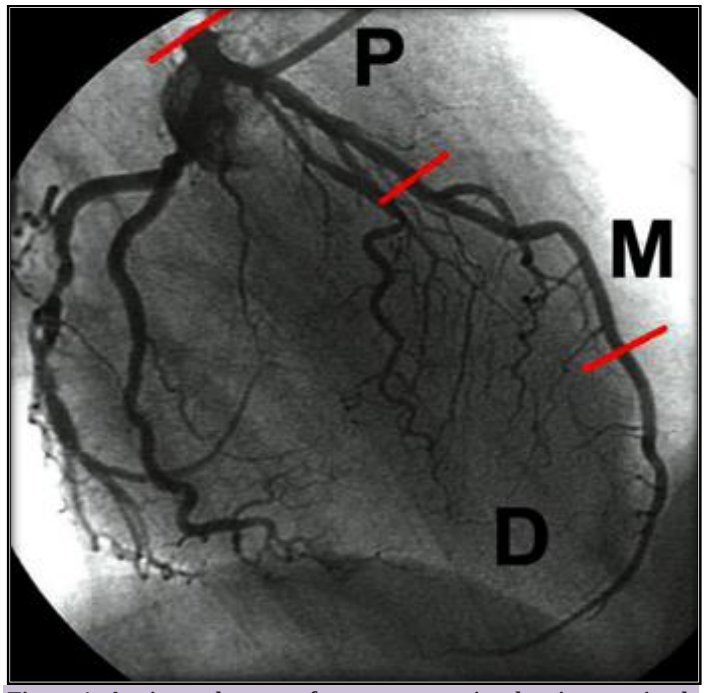

Figure 1: Angiography scan of coronary arteries showing proximal, middle and distal segments of coronary artery.

Results & Discussion

With a mean age of 57.22 ± 9.93, 200 participants in the current study underwent coronary angiography and carotid artery ultrasound scanning; 158 of the 200 cases were male and 42 were female. Out of 200 cases 134 were diagnosed with significant lesion (>70%) in coronary arteries, 39 with non-significant lesion whereas 27 cases were diagnosed with normal coronary arteries.

Table 1: shows the mean values (mm) of intima-media thickness of different arteries for different segments (proximal, middle, and distal) of coronary arteries which showed lesion.

Segment involved	CCA Right	CCA Left	ICA Right	ICA Left	Bulb Right	Bulb Left
Not at segment level	0.446± 0.128	0.440± 0.135	0.418± 0.143	0.439± 0.148	0.492± 0.149	0.500± 0.146
Distal	0.698± 0.208	0.700± 0.181	0.621± 0.185	0.721± 0.228	0.742± 0.147	0.764± 0.142
Middle	0.724± 0.201	0.703± 0.156	0.622± 0.148	0.690± 0.164	0.783± 0.196	0.855± 0.232
Proximal	0.758± 0.385	0.708± 0.180	0.699± 0.227	0.696± 0.245	0.767± 0.234	0.797± 0.222
P-values	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*

Mean ± SD * Significant at 0.05 level

For every artery, the intima medium thickness was considerably higher for the affected proximal segment of coronary artery. According to [Table 1 and figure 1] perusal of data reveals that the magnitude of IMT of arteries significantly greater for affected proximal segment than middle or distal segment of coronary arteries. The proximal, middle, and distal segments implicated in CCA Right had mean IMTs of 0.758mm, 0.724mm, and 0.698mm, respectively, which demonstrated this. For ICA Right, the mean IMT magnitudes were 0.699mm, 0.622mm, and 0.621mm, in that order. The mean IMT of right bulb for respective segments was as 0.767mm, 0.783mm and 0.742mm. There are limited studies which have shown the association between carotid IMT and obstructed segment of coronary arteries. Graner et al,[6] observed that carotid IMT was correlated with quantitative angiographic indexes for mid and distal segments but not with the proximal segments of coronary vessels. According to them carotid IMT seems to

be a weaker predictor of coronary atherosclerosis in the proximal parts of the coronary tree than in the mid and distal parts. Whereas in present study mean IMT values were greater for affected proximal segment compared to middle and distal segments.

Table 2: Shows the mean values (mm) of intima-media thickness of different arteries according to the advancing coronary artery disease (CAD) or number of the obstructed coronary arteries.

Number of affected vessels	CCA Right	CCA Left	ICA Right	ICA Left	Bulb Right	Bulb Left
0	0.465± 0.144	0.451± 0.154	0.428± 0.173	0.442± 0.154	0.503± 0.158	0.499± 0.158
1	0.580± 0.160	0.586± 0.149	0.548± 0.146	0.569± 0.194	0.634± 0.159	0.673± 0.202
2	0.718± 0.206	0.714± 0.159	0.654± 0.170	0.713± 0.197	0.774± 0.168	0.836± 0.180
3	0.934± 0.301	0.816± 0.147	0.803± 0.228	0.809± 0.222	0.895± 0.268	0.818± 0.034
P-values	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*

Mean ± SD * Significant at 0.05 level

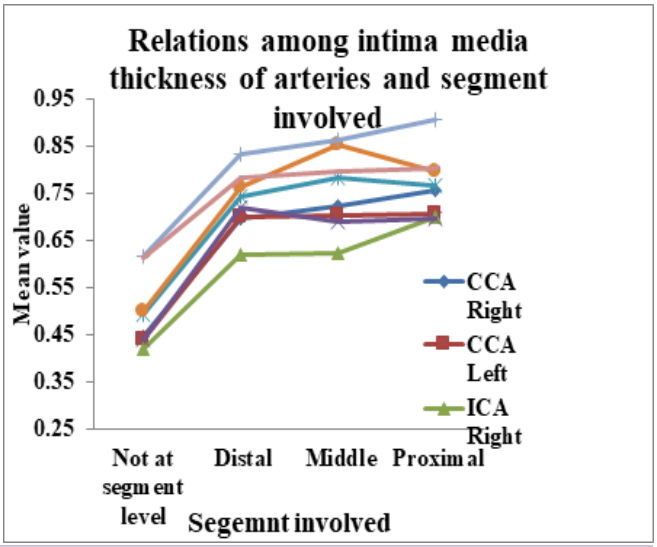

Figure 2: showing the mean artery IMT trend for several coronary artery segments.

A strong association between mean IMT of different arterial segments and advancing coronary artery disease or number of obstructed coronary arteries was observed in present study. In [Table 2] CCA Right the mean IMT for single, double and triple vessel disease was 0.580± 0.160 mm, 0.718 ± 0.206 mm and 0.934 ± 0.301 mm respectively, as compared to mean IMT for normal coronary arteries (0.465 ± 0.144 mm)., For ICA right, the average IMT was 0.428 ± 0.173 mm. 0.548 ± 0.146 mm, 0.654 ± 0.170 mm and 0.803 ± 0.228 mm respectively for the normal coronary arteries and number of obstructed coronary arteries. For 0, 1, 2, and 3 vessels involved, the right bulb's IMT was 0.503 ± 0.158 mm, 0.634 ± 0.159 mm, 0.774 ± 0.168 mm, and 0.895 ± 0.268 mm, respectively. A study by Ziembicka et al,[7] found that the mean value of IMT of CCA for patients with normal coronary arteries was lower than one vessel CAD (1.15mm), with two vessels CAD (1.26mm) and with three vessels CAD (1.47mm) when compared. They found a significant, nearly linear correlation between IMT and advancing CAD (p= 0.0001). In a North Indian study by Tiwari et al,[8] reported the mean carotid intima medial thicknesses in patients with triple vessel, double vessel and single vessel disease as 0.96±0.12 mm, 0.84±0.11 mm and 0.78±0.13 mm, respectively (p=0.05). Langroodi et al,[9] observed the same trends in Iranian population. Overall, the present study demonstrates a significant association between increased carotid intima-media thickness (IMT) and the severity of coronary artery disease (CAD). Specifically, the IMT of all measured arterial segments was higher in the proximal segments of affected coronary arteries compared to the middle and distal segments, suggesting that carotid IMT may reflect the burden of atherosclerosis in these critical regions. These findings are consistent with previous studies showing a positive correlation between carotid IMT and the number of obstructed coronary arteries, although some prior studies suggested weaker correlations in proximal segments. The progressive increase in mean IMT values from patients with normal coronary arteries to those with single-, double-, and triple-vessel disease reinforces the utility of carotid IMT as a noninvasive marker for CAD severity. Therefore, assessment of carotid IMT could serve as a valuable tool in early detection and risk stratification of patients with coronary artery disease across diverse populations.

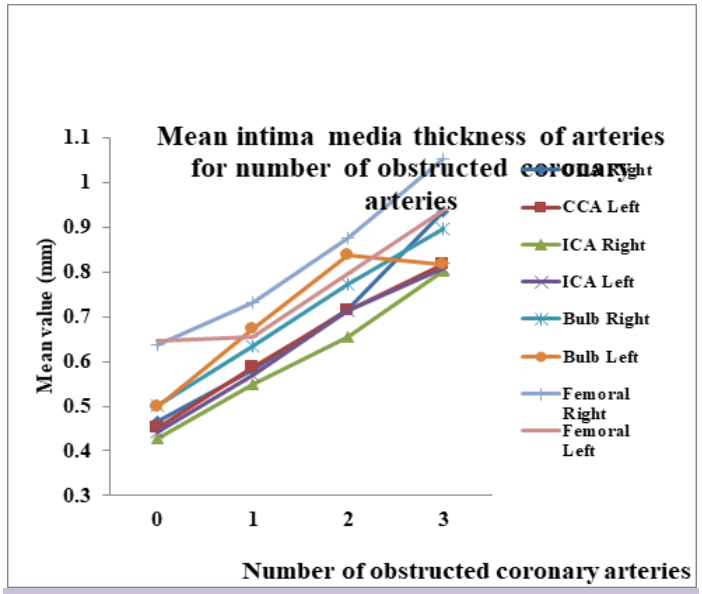

Figure 3: displaying the mean artery IMT trend for the number of coronary artery blockages.

Conclusion

The present study demonstrates that non-invasive B-mode ultrasonography of intima-media thickness (IMT) is a reliable

method for the early detection of atherosclerosis. Our findings suggests that patients with increased IMT values tend to have a greater number of coronary vessels affected. Given that elevated carotid IMT is a strong predictor of CAD and can aid in the early identification of atherosclerotic changes, routine ultra-sonographic assessment of the carotid arteries is recommended for patients undergoing coronary angiography.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Ziembicka AK, Tracz W, Przewlocki T, Pieniazek P, Sokolowski A. Association of increased carotid intima-media thickness with the extent of coronary artery disease. Heart. 2004;90:1286–90
2. Poredos P. Intima-media thickness: indicator of cardiovascular risk and measure of the extent of atherosclerosis Vascular Medicine. 2004;9: 46-54.
3. Amato M, Montorsi P, Ravani1 A, Oldani E. Carotid intima-media thickness by B-mode ultrasound as surrogate of coronary atherosclerosis: correlation with quantitative coronary angiography and coronary intravascular ultrasound findings. European Heart Journal. 2007;28:2094–101.
4. Pignoli P, Tremoli E, Poli A, Oreste P, Paoletti R. Intimal plus medial thickness of the arterial wall: a direct measurement with ultrasound imaging. Circulation. 1986;74(6):1399-406
5. Salonen JT, Salonen R. Kuoppio Ischaemic Heart Disease study Ultrasonographically assessed carotid morphology and risk of coronary heart disease. Arterioscler Thromb. 1991;11:1245-49.
6. Granér M, Varpula M, Kahri J, Salonen RM, Nyyssönen K. Association of carotid intima-media thickness with angiographic severity and extent of coronary artery disease. Am J Cardiol. 2006;97(5): 624-9.
7. Ziembicka AK, Tracz W, Przewlocki T, Pieniazek P, Sokolowski A. Association of increased carotid intima-media thickness with the extent of coronary artery disease. Heart 2004;90:1286–90.
8. Tewari S, Garg N, Kapoor A, Jain A, Singh U. Association of Common Carotid Intima - Media Thickness and Lipoprotein(a) with Coronary Artery Disease, Indian Heart J. 2004;56:642–5.
9. Langroodi RM, Kheirkhah J, Barzegar A. Prediction of Coronary Artery Disease by B-Mode Sonography. Iranian Cardiovascular Research Journal. 2010;4 (3):131-3.