Innovative Journal of Medical and Health Science

IJMHS 10 (05), 882–886 (2020) ISSN (O) 2277:4939 | (P) 2589:9341

"CAROTID INTIMA MEDIA THICKNESS - A PREDICTOR OF CORONARY ARTERY DISEASE: RETROSPECTIVE ANALYSIS"

DR. ASHISH SINGHAL[⋆,†,1], DR. SURBHI GUPTA[2], DR. ANKUR SINGHAL[3], DR. AASHIMA ARON[4]

[1]*DEPARTMENT OF CARDIOLOGY, OXYGEN HOSPITAL ROHTAK, HARYANA, INDIA*
[2]*DEPARTMENT OF OBSTETRICS AND GYNECOLOGY, PGIMS, ROHTAK, HARYANA, INDIA*
[3]*DEPARTMENT OF UROLOGY, PBM HOSPITAL, BIKANER, RAJASTHAN, INDIA*
[4]*DEPARTMENT OF OBSTETRICS AND GYNECOLOGY, PBM HOSPITAL, BIKANER*

DOI: https://doi.org/10.15520/ijmhs.v10i03.282

Accepted 20/05/2020; Received 02/05/2020; Publish Online 28/05/2020

Reviewed By: Dr Daniel V.
Department: Medical

ABSTRACT

BACKGROUND

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. The aim of the study is to find the individual predictor role of CIMT in CAD (Coronary artery disease) patients. 100 Cases selected from CAD patients who underwent PTCA and 100 Controls selected with no history of CAD and stroke. CIMT measurements done in all at common carotid artery level.

RESULTS

Baseline characteristics like mean age, male sex, obesity, dyslipidemia, diabetes, hypertension, smoking and family history were comparable in cases and controls. The mean CIMT was 1.11 mm in the case and 0.87mm in control (P<0.0001). ROC analysis gave us a got optimal cut-off value of 1.0 mm above for which sensitivity, specificity, and positive and negative predictive values for predicting CAD was 73%, 73%, 73%, and 73%, respectively. Linear regression analysis showed a significant correlation between CIMT and presence of CAD with the $R = 0.582$ ($P \leq 0.001$). Multiple logistic regression analysis showed only CIMT correlated (coefficient 8.03) significantly with presence of CAD.

CONCLUSION

CIMT independently can predict presence of CAD whether traditional atherosclerotic risk factors are present or not. Deploying CIMT evaluation in low and intermediate risk individual(s) to detect subclinical CAD will be a good strategy in resource limited setting specially where invasive modalities are not easily available.

Key words: CIMT–CAD

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] The aim of the study is to find the individual predictor role of CIMT in CAD patients.

⋆ Corresponding author.
† Email: singhalashis@gmail.com

2 MATERIALS & METHODS:

Study participants:

Two groups of cases and controls were formed. 100 cases and 100 controls were selected based upon the crtieria given below.

Inclusion criteria:

Case:

1. Confirmed CAD based upon coronary angiography who underwent percutaneous transluminal coronary angioplasty (PTCA)

Control:

1. General patients with no history of any atherosclerotic event (Stroke & ischemic cardiac event).

Exclusion criteria (same for both Cases & Controls):

1. Hemodynamically unstable patient.
2. Any history of congenital pro-atherosclerotic condition like: familial hypertriglyceridemia etc.
3. Drugs increasing atherosclerotic risk: anti-retrovirals, chemotherapy for cancers, systemic steroids etc.
4. Patient who did not give consent for the study

Study Methodology:

The study was conducted over a period of one year at Oxygen Hospital Rohtak from March 2019 to February 2020. After proper written informed consent detailed history and baseline characteristics were obtained including age, gender, hypertension (blood pressure >140/90 mm hg And/or those already taking treatment for hypertension), Diabetes mellitus (fasting blood glucose >126 mg/dl and/or Postprandial blood glucose >200 mg/dl and those who were On treatment for diabetes mellitus), smoking status, and dyslipidemia; Total cholesterol ≥200 mg/dl (5.16 mmol/l) or low-density Lipoprotein >130 mg/dl (3.38 mmol/l) or High density Lipoprotein cholesterol <40 mg/dl (1.03 mmol/l) or Triglycerides ≥150 mg/dl (3.87 mmol/l) and Obesity (Body mass index>25.0 kg/m^2).

CIMT measurements were obtained in all participants of case and control group. CIMT measurement was obtained with the patient lying in the supine position and the neck rotated to opposite side. After transversely scanning the common carotid artery from the base of the neck to the carotid bulb, longitudinal images were taken to obtain the best lumen-intima interface. CIMT was the distance between the leading edges of lumen-intima interface and media-adventitia Interface measured in the far wall of the common carotid artery around 1 cm below the carotid bulb using electronic calipers manually. It was done in plaque-free region according to the guidelines recommendations at end diastole corresponding to the peak of r wave in Electrocardiogram. Carotid plaque is defined as a localized thickening of more than 1.5 mm in the intima of the artery. The measurements were done Using b-mode GE Voluson ultrasound machine with a 5–10 Mhz Linear phase array transducer. CIMT was assessed on both Sides of the neck and six values of CIMT (three on each side) are obtained and averaged to get mean CIMT.

Statistical analysis

The groups were compared regarding risk factors and CIMT. Values were expressed as means and standard deviation. Data obtained then analysed using SPSS 20.0 software. Proper statistical tests were done including chi-square, Mann-Whitney U test, one way and multifactorial Analysis of variance, and multifactorial logistic regression analysis. P value <0.05 was taken as significant.

3 RESULTS:

The baseline characteristics and demographic data obtained from the study population i.e. cases and controls are shown in Table 1. All the characteristics are comparable in both cases and controls and doesn't have any significant difference as shown clearly by p-values.

Table 1. BASELINE CHARACTERISTICS OF STUDY POPULATION

CHARACTERISTIC	CASES (N=100)	CONTROLS (N=100)	P-VALUE
MEAN AGE (IN YEARS)	60.35	57.52	0.30
MALE (N)	66	51	0.189
OBESITY (N)	36	41	0.46
SMOKING (N)	54	48	0.39
FAMILY HISTORY (N)	46	57	0.11
DYSLIPIDEMIA (N)	47	55	0.25
HYPERTENSION (N)	42	45	0.66

*N=NUMBER

The mean CIMT values are shown in Table 2 along with their P-values.

Table 2. MEAN CIMT IN STUDY POPULATION

MEAN CIMT (in mm)	CASES	CONTROLS	P-VALUE
Mean CIMT	1.11	0.87	<0.00001

The correlation of various atherosclerotic risk factors along with CIMT in determining the presence of CAD is shown in Table 3 in the form of multiple logistic regression analysis.

Table 3. Multiple logistic regression analysis showing correlation of various attributes in determining the presence of coronary artery disease

VARIABLE	COEFFICIENT	STANDARD ERROR	P-VALUE
1.MALE SEX	-0.1660	0.4396	0.7057
2.MEAN AGE	0.0021	0.0113	0.8516
3.OBESITY	-0.0134	0.4397	0.9756
4.SMOKING	-0.6411	0.4497	0.1540
5.FAMILY HISTORY	-0.1710	0.4424	0.6992
6.DYSLIPIDEMIA	-0.2982	0.4501	0.5077
7.HYPERTENSION	-0.0326	0.4451	0.9416
8. MEAN CIMT	8.0306	1.3597	<0.00001

4 DISCUSSION:

Limited studies available where a direct comparison of CIMT values has been done among the diagnosed CAD patients and general population with comparable baseline characteristics; this study is a modest attempt in doing the same.

In our study the distribution of the various atherosclerotic risk factors corroborates very well with the previous literature which reiterates the relative frequency of these risk factors in the CAD patients in our country. [3,4] However, as far as the presence of risk factors in the Control groups are concerned these individuals were selected as per their criteria some of them were relatives of these CAD patients and some belonging to other ailments like skin and dental diseases etc.

In a study by Kasliwal *et al.*,[5] mean CIMT in the Indian population was found to be 0.608 ± 0.12 mm in men versus 0.579 ± 0.11 mm in women, which is lower than our study population. This is expected as our study population

included 100 patients with significant CAD whereas Kasliwal *et al.*[5] have calculated mean CIMT in the general Indian population without significant CAD. However, in our study, in non-CAD group mean CIMT was 0.87, which is also higher than study by Kasliwal *et al.*[5] probably because most of Control patients had positive family history of CAD. In our study, the mean maximum IMT value of 1.10 mm in CAD group was found to be significantly higher than mean maximum CIMT (0.87 mm) in non-CAD group ($P < 0.001$). In a similar study population of suspected CAD, Hansa *et al.*,[6] Tarzamni, *et al.*,[7] and Granér *et al.*,[8] and in their respective studies, found similar significantly higher mean maximum CIMT in CAD group compared to non-CAD group. Furthermore, in South Indian study by Ezhumalai *et al.*,[9] mean CIMT was higher in CAD group (0.74 mm) than non-CAD group (0.45 mm).

In our study, we analysed our CIMT data by ROC (receiver operating characteristic) curve (Fig. 1) to find a cut-off with optimal predictive values in our study population. We got optimal cut-off value of 1.00 mm above which sensitivity, specificity, and positive and negative predictive values for predicting CAD was 73%, 73%, 73%, and 73%, respectively. If we see the Djaberi *et al.*,[10] in their study, obtained on optimal sensitivity and specificity of 85% and 72%, respectively, at a cut-off of 0.67 mm by ROC curve analysis. Matsushima *et al.*[11] in their study, obtained a sensitivity of 70% and specificity 69% while taking a higher cut-off of 1.2mm according to the ROC curve analysis. In few studies such as Coskun *et al.*[12] and Jadhav *et al.*,[13] arbitrary cut-off values of 1 mm and 0.8 mm were taken, respectively. The variability in the cut-off value of CIMT in different studies may also be related to the ethnically and geographically different populations studied. Hence, the value obtained in our study could be more appropriate for the Indian population studied.

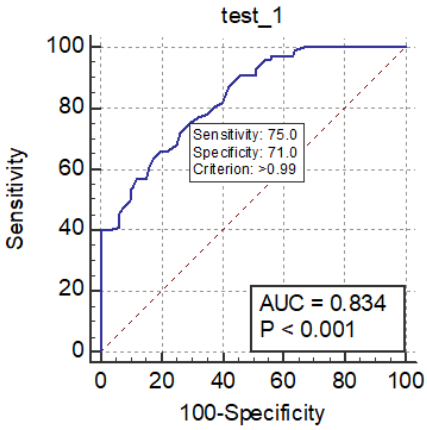

Figure 1. ROC curve for CIMT & presence of CAD

Linear regression analysis showed a significant correlation between CIMT and presence of CAD with the $R = 0.582$ ($P \leq 0.001$) in our study Fig. 2. By linear regression analysis, Hansa *et al.*[6] and Matsushima *et al.*[11] also found similar correlation of mean maximum CIMT with CAD ($R = 0.28$ and $R = 0.411$, respectively). Even Kablak-Ziembicka *et al.*[14] and Granér *et al.*[8] also found a significant linear correlation between CIMT and advancing CAD, while Adams *et al.*[15] showed a weak correlation.

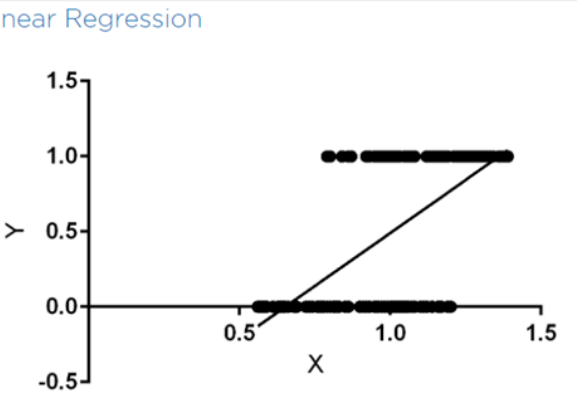

Figure 2. Linear regression analysis between mean CIMT and CAD

In our study, CIMT was the strongest factor which independently predicted CAD ($P \leq$ 0.001). Other factors such as age, gender, diabetes mellitus, hypertension, dyslipidemia, or smoking did not independently predict CAD. Among studies done on CIMT to predict CAD, the study by Hansa *et al.*,[6] only maximum CIMT was found to be the independent predictor of CAD,

while no other risk factor had independent predictive value. The study by Djaberi *et al.*[10] and Coskun *et al.*[12] also showed CIMT to be an independent predictor of CAD by multivariate analysis.

We established the association of CIMT with presence of CAD both in linear regression and as well as in multiple logistic regression analysis. The p-values came out very significant and also the correlation coefficient was >8.0 suggestive of very strong linkage between the two. This is in correlation of various studies done in the past.[16–17]

5 CONCLUSION:

In patients with suspected CAD; CIMT is simple and non-invasive tool to predict the presence of CAD. CIMT significantly correlated with the presence of CAD. CIMT alone in absence of traditional atherosclerotic risk factors can fairly predict the presence of obstructive CAD. Hence, deploying CIMT evaluation in low and intermediate risk individual to detect subclinical CAD will be a good strategy in resource limited setting where invasive and higher modalities like Coronary Calcium scoring or invasive coronary angiography is not easily available. Whether Elevated CIMT values lead to more severe Coronary artery disease need further larger studies though the evidence available is small but favours its association.

LIMITATIONS:

1. Small sample size

2. Non correlation with cardiac risk scores in the study population

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest. [1–17]

REFERENCES

[1] Krishnan MN, Zachariah G, Venugopal K, Mohanan PP, Harikrishnan S, Sanjay G, et al. Prevalence of coronary artery disease and its risk factors in Kerala, South India: a community-based cross-sectional study. BMC Cardiovascular Disorders. 2016;16(1):12–12. Available from: https://dx.doi.org/10.1186/s12872-016-0189-3.

[2] Kasliwal RR, Bansal M, Desai N, Kotak B, Raza A, Vasnawala H, et al. A Study to derive distribution of carotid intima media thickness and to determine its COrrelation with cardiovascular Risk factors in asymptomatic nationwidE Indian population (SCORE-India). Indian Heart Journal. 2016;68(6):821–827. Available from: https://dx.doi.org/10.1016/j.ihj.2016.04.009.

[3] Costanzo L, Campisano MB, Capodanno D, Sole A, Grasso C, Ragusa M, et al. The SYNTAX score does not predict presence of carotid disease in a multivessel coronary disease population. Catheterization and Cardiovascular Interventions. 2014;83(7):1169–1175. Available from: https://dx.doi.org/10.1002/ccd.25320.

[4] Coskun U, Yildiz A, Esen OB, Baskurt M, Cakar MA, Kilickesmez KO, et al. Relationship between carotid intima-media thickness and coronary angiographic findings: a prospective study. Cardiovascular Ultrasound. 2009;7(1):59–59. Available from: https://dx.doi.org/10.1186/1476-7120-7-59.

[5] Matsushima Y, Kawano H, Koide Y, Baba T, Toda G, Seto S, et al. Relationship of carotid intima-media thickness, pulse wave velocity, and ankle brachial index to the severity of coronary artery atherosclerosis. Clinical Cardiology. 2004;27(11):629–634. Available from: https://dx.doi.org/10.1002/clc.4960271110.

[6] Chambless LE, Heiss G, Folsom AR, Rosamond W, Szklo M, Sharrett AR, et al. Association of Coronary Heart Disease Incidence with Carotid Arterial Wall Thickness and Major Risk Factors: The Atherosclerosis Risk in Communities (ARIC) Study, 1987-1993. American Journal of Epidemiology. 1997;146(6):483–494. Available from: https://dx.doi.org/10.1093/oxfordjournals.aje.a009302.

[7] Holland Z. Carotid intima-media thickness is a predictor of coronary artery disease in South African black patients. Cardiovascular journal of africa africa • . 2009;20(4).

[8] Hansa G, Bhargava K, Bansal M, Tandon S, Kasliwal RR. Carotid Intima-Media Thickness and Coronary Artery Disease: An Indian Perspective. Asian Cardiovascular and Thoracic Annals. 2003;11(3):217–221. Available from: https://dx.doi.org/10.1177/021849230301100308.

[9] Jadhav UM, Kadam NN. Carotid intima-media thickness as an independent predictor of coronary artery disease. Indian Heart J. 2001;53:458–62.

[10] Kablak-Ziembicka A. Association of increased carotid intima-media thickness with the extent of coronary artery disease. Heart. 2004;90(11):1286–1290. Available from: https://dx.doi.org/10.1136/hrt.2003.025080.

[11] Granér M, Varpula M, Kahri J, Salonen RM, Nyyssönen K, Nieminen MS, et al. Association of Carotid Intima-Media Thickness With Angiographic Severity and Extent of Coronary Artery Disease. The American Journal of Cardiology. 2006;97(5):624–629. Available from: https://dx.doi.org/10.1016/j.amjcard.2005.09.098.

[12] Tarzamni MK, Salehi R, Givian F, Farhang S. Association of carotid intima-media thickness with the presence and severity of coronary artery disease. Neurosciences (Riyadh). 2006;11:308–319.

[13] Adams MR, Nakagomi A, Keech A, Robinson J, McCredie R, Bailey BP, et al. Carotid Intima-Media Thickness Is Only Weakly Correlated With the Extent and Severity of Coronary Artery Disease. Circulation. 1995;92(8):2127–2134. Available from: https://dx.doi.org/10.1161/01.cir.92.8.2127.

[14] Sekhri T, Kanwar RS, Wilfred R, Chugh P, Chhillar M, Aggarwal R, et al. Prevalence of risk factors for coronary artery disease in an urban Indian population. BMJ Open. 2014;4(12):e005346–e005346. Available from: https://dx.doi.org/10.1136/bmjopen-2014-005346.

[15] Ezhumalai B, Krishnasuri SD, Jayaraman B. Comparison of diagnostic utilities of ankle–brachial index and Carotid

intima-media thickness as surrogate markers of significant coronary atherosclerosis in Indians. Indian Heart Journal. 2013;65(2):137–141. Available from: https://dx.doi.org/10.1016/j.ihj.2013.02.011.

[16] Alipour M, Masri D, Mofazzali A, Chitsazan M. Carotid Artery Intima-Media Thickness in Patients Undergoing Coronary Artery Bypass Graft Surgery. Archives of Cardiovascular Imaging. 2013;1(1):27–31. Available from: https://dx.doi.org/10.5812/acvi.12490.

[17] Djaberi R, Schuijf JD, de Koning EJ, Rabelink TJ, Smit JW, Kroft LJM, et al. Usefulness of Carotid Intima-Media Thickness in Patients With Diabetes Mellitus as a Predictor of Coronary Artery Disease. The American Journal of Cardiology. 2009;104(8):1041–1046. Available from: https://dx.doi.org/10.1016/j.amjcard.2009.06.004.

AUTHOR BIOGRAPHY

DR. ASHISH SINGHAL DEPARTMENT OF CARDIOLOGY, OXYGEN HOSPITAL ROHTAK, HARYANA, INDIA

DR. SURBHI GUPTA DEPARTMENT OF OBSTETRICS AND GYNECOLOGY, PGIMS, ROHTAK, HARYANA, INDIA

DR. ANKUR SINGHAL DEPARTMENT OF UROLOGY, PBM HOSPITAL, BIKANER, RAJASTHAN, INDIA

DR. AASHIMA ARON DEPARTMENT OF OBSTETRICS AND GYNECOLOGY, PBM HOSPITAL, BIKANER