CAROTID INTIMA MEDIA THICKNESS AS A PREDICTOR OF CORONARY ARTERY DISEASE- PRESENCE AND SEVERITY: A STUDY OF 100 CASES IN CENTRAL INDIA

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ABSTRACT

BACKGROUND

Carotid intima media thickness is used as a safe, noninvasive, surrogate endpoint to measure severity and progression of generalised atherosclerosis. The basis of almost all cardiovascular diseases is atherosclerosis, which is almost invariably present in all adults. Two vascular beds, coronary artery and carotid artery share same atherosclerosis risk factors and anatomically, first immediate closest branches which originate from aorta, so intima media thickness of carotid artery can be used as golden markers in prediction of atherosclerosis, presence of coronary artery disease and risk of developing disease in later life.

MATERIALS AND METHODS

This study compares angiography proved CAD (Coronary artery disease) and non-CAD cases, CAD patients served as outcome variables in subjects without CAD. Carotid intima media thickness was measured in all subjects and correlated with risk factors measured by SMART risk score. Noninvasive measurement of the intima media thickness of the common and internal carotid artery was made with high resolution B-mode ultrasonography in 100 cases.

RESULTS

The mean IMT of internal carotid artery of both sides of 100 cases was 0.84 mm. The IMT is significantly higher in CAD proved cases than non-CAD cases. Mean IMT of CAD cases was (0.88 mm±0.11 SD) more than the mean IMT of non CAD cases (mean 0.67 mm±0.04 SD) which is highly significant. Intima Media Thickness and Risk factors value are well correlated and there is significant association between two variables with correlation coefficient .02144 [$r = 0.2144$] respectively. Relative risk of CAD for the quantile with the highest thickness as compared to the lowest quintile was highly significant i.e. infinity (95% CI – 1.081 - infinity).

CONCLUSION

Increased intima media thickness is a predictor and golden marker for presence and severity of CAD.

KEYWORDS

CAD–Coronary Artery Disease, SMART–Second Manifestation of Arterial Disease, IMT–Intima Media Thickness, CVD–Cardiovascular Disease, CHD–Coronary Heart Disease, CCA–Common Carotid Artery, ICA–Internal Carotid Artery.

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BACKGROUND

One of the foremost advances in the field of cardiovascular medicine has been the discovery of the major forms of cardiovascular disease – CHD and stroke proceeded by measurable factors called risk factors.^{1,2} Its presence indicates more likeliness to develop cardiovascular disease in comparison to those in whom these factors are absent. Secondly, controlled clinical trials showed that therapies reducing risk factors will decrease the incidence of cardiovascular disease.

The success of therapies of secondary prevention now opens the door to more aggressive risk reduction in primary prevention. No doubt CHD is a multifactorial disease and the pathological processes lead to CHD and coronary atherosclerosis.

Inclusion Criteria

1. Adult from 18-90 yrs.
2. Presence of a vascular risk factor.
3. Clinical manifestation of atherosclerosis.
4. Thrombotic lesion.
5. Stroke.
6. Symptoms with strong family history.

Exclusion Criteria

1. Age less than 18 yrs.
2. Pt. with pace maker.
3. Pt. very serious.
4. Pt. with Arrhythmia.
5. Not ready for Angiography.

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METHODS

This study involved 100 adult patients randomly selected for continuous quantitative data who admitted in one centre only (Escorts Heart Command Centre, Raipur) (C.G). The inclusion criteria for enrolment were either presence of a vascular risk factor or clinical manifestation of atherosclerosis. In study, age varies from 18 yrs. to 90 yrs. The SMART atherosclerosis risk factor score was determined in all cases (Table-1) as atherosclerosis lesion affected by various risk factors and metabolic disorders. So we divided the cases into different groups based on their risk factors variables. Different grouping is done by measuring SMART Risk Scores². One point is assigned to presence of one variable (risk factor) as shown. In the end, total resultant of points indicates cumulative risk factors for the same person.

All 100 cases underwent angiography at EHCCR only, patients with no CAD served as controls. Examination of IMT was done with a high resolution Sonos 5500 (Hewlett Packard, Inc., Anaheim, CA, USA) with a duplex B mode sonograph.^{2,3,4,5} Position of the patients during examination was supine, neck tilted towards opposite side with titling angle 15-45°. Measurement of near wall IMT was difficult to define due to echogenic structure of adventitia which may sometimes make the adventitia media interface impossible to define in contrast to the far wall where adventitia media interface is usually easy to detect.⁵ So all measurements were done in far wall for more accuracy. High frequency S8 transducer was used with minimum gain to visualise the structure of artery. Wall filter was set to low.⁶ Colour towards transducer was red and away from transducer was blue. Colour scale (PRF) adjusted throughout the procedure, colour box width kept as small as possible, colour gain was adjusted throughout the examination. Transducer placed longitudinally medial to proximal end of sternomastoid muscle.

Indicator	Points	Indicator	Points
(i) Male	1	(xiii) Hypertension***	1
(ii) Age > 30 yrs.	1	(xiv) Medication for indicated hypertension	1
(iii) Age > 40 yrs.	1	(xv) Angina pectoris	1
(iv) Age > 50 yrs.	1	(xvi) Myocardial infarction	1
(v) Age > 60 yrs.	1	(xvii) TIA or Stroke	1
(vi) Age > 70 yrs.	1	(xviii) Carotid endarterectomy	1
(vii) Body Mass index > 30	1	(xix) Intervention on leg arteries	1
(viii) Smoking current or past	1	(xx) Aortic aneurysmectomy	1
(ix) Hyperlipidaemia*	1	(xxi) Peripheral arterial disease	1
(x) Medication for indicated hyperlipidaemia	1	(xxii) Internal carotid artery stenosis > 50	1
(xi) Hyperglycaemia**	1	(xxiii) Abdominal aortic aneurysm	1
(xii) Medication for indicated hyperlipidaemia	1	(xxiv) Renal failure ****	1

Table 1: SMART Risk Factors

*Total cholesterol 150-240 mg/dL, Triglyceride 35-150 mg/dL, HDLC 30-70 mg/dL, VLDL 10-30 mg/dL, LDL 60-140 mg/dL, S.ch/HDL up to 5, LDL/HDL 2.5-3.5. **Fasting serum glucose 60-110 mg/dL, PP 70-140 mg/dL. ***Systolic pressure > 160 mmHg, diastolic pressure > 90 mmHg. ****S. creatinine > 1.5 mg/dL.

After localisation, the common carotid artery transducer moved slowly cephalad to the level of bifurcation at the level of thyroid cartilage. Proper identification of internal carotid artery and external carotid artery was done with a help of Doppler signals, sample volume was placed in the center of blood stream. Measurements of intima media thickness were made at end-diastole at two points A and B.

- IMT was measured at straight part of CCA the 1 cm just before the bifurcation and average of two readings was taken.
- IMT of ICA was measured 1 cm distal to the carotid sinus and average of two readings was taken.

Whole length of CCA and bifurcation scanned transversely to confirm the location of any plaque visualised during the examination.^{7,8,9,10}

Statistical Analysis

Enrolment criteria are to assess SMART Risk score based on table- 1², all analysis was performed with 2 way Contingency Table analysis (It will calculate Yates- corrected Chi Square) Revised 09/16/2003. We evaluated the relative importance of intima media thickness as compared with smart risk factors in cox proportional hazard models.

RESULTS

The baseline characteristics of 100 participants are analysed. And different risk factors for individual case are studied.

Characteristic	Value
Male	79%
Age	64.5
Body Mass index >30	17%
Smoking, current or past	24%
Hyperlipidaemia	24%
Hyperglycaemia	40%
Hypertension	69%
Angina pectoris	79%
Myocardial infarction	66%
TIA or stroke	16%
Carotid endarterectomy	1%
Intervention on leg arteries	0%
Aortic aneurysmectomy	0%
Peripheral arterial disease	4%
Internal carotid artery stenosis >50	1%
Abdominal aortic aneurysm	1%
Renal failure	2%

Table 2: Baseline Characteristics of 100 Cases

In evidence proved CAD cases, thickness of Intima Media value found to be more than 0.84 mm which is 94.2% cases as shown in fig-1 A as compared to 5.7% in those without CAD which was highly significant ($p < 0.001$) on univariate analysis. The odds ratio of an arterial thickness more than 0.84 mm was 9.8 (95% CI 2.427- 45.89) in those with CAD. As against those without CAD and relative risk among CAD and non-CAD was 1.508 (95% CI 1.201-1.699) making it an important predictor for prevalence of CAD.

	CAD	Non-CAD	Totals
IMT>0.84	49 (94.2%)	3 (5.8%)	52/100
IMT<0.84	30 (62.5%)	18(37.5%)	48/100
Total	79 (79%)	21 (21%)	100

Table 3

Distribution of patients with CAD and without CAD – IMT, Pearson chi square = 13.29, ‘p’ value <0.0003, odds ratio 9.8 (95% CI 2.4 to 45.8), relative risk 1.508.

Fig 1 (A): Intima Media Thickness between Control and CAD Patients

	Average of	Chi sq	P value	Odd Ratio	Relative Risk
Fig.1 (A)	ICA of Rt. & Lt side	13.29	<0.000	9.8	1.508
Fig.2 (B)	CCA ICA Rt. & Lt. side	11.81	<0.001	8.813	1.403
Fig.3 (C)	CCA of Rt. & Lt. side	9.303	<0.003	9.26	1.469

Table 4

Average calculated IMT of ICA Fig -1 (A) of both sides was compared first with average IMT of both common carotid and internal carotid artery Fig-2 (B) and secondly also compared with average IMT of common carotid artery of both sides. Table-4 shows associated results considering all possible sides of measuring IMT with respect to chi square, P value, Odd ratio and relative risk shown. And clearly indicates IMT of Internal carotid artery found to be more significant than

other two ways and areas with p value <0.00. To value this finding in our research, sample size for study should be much large and the accuracy should be maintained.

Fig. 2 (B)

Fig-3 (C)

We found close similarities and association in relative risk between risk factors and IMT in CAD and non-CAD patients. Relative risk of CAD for the quantile with the highest

thickness with the lowest quantile was infinity (low 95% CI 1.139, High 95% CI inf.) and it was compared with relative risk of CAD for quantile with highest risk factors as compared with the lowest quantile was 1.913 (low 95% CI 0.94, High 95% CI 22.12) correlation coefficient value between two variables was 0.2144, which shows significant association between two variants and proves the hypothesis that the incidence of CAD is associated and proportionate with risk factors as well as Intima Media Thickness of Carotid artery.

Fig. 4

Fig. 5

DISCUSSION

There is positive and strong association between carotid intima media thickness and cardiovascular risk factors which is well documented by various cross sectional studies.^{1,8,9,10,11,12,13} and few longitudinal studies.^{14,15,16,17,18,19} "In one study, longterm followup for averaging 8.8 yrs. and found that for each 0.03 mm increase per year in CCA IMT the relative risk for non-fatal MI was 2.2 (95% CI, 1.4-4.5), highly significant and for any coronary events".¹⁵

"In another study, the relative risk of myocardial infarction or stroke increased with increase in IMT ($p < 0.001$)."³ The association remains significant after adjustment for traditional risk factors showing increasing risk for each quantile or combined IMT from second quantile to third, fourth and fifth quantile. Relative risk for the quantile with the highest thickness as compared with the lowest quintile was 3.87 (95% CI, 2.75 to 5.51). In our study, we found association of relative risk for the quantile with the highest IMT as compared with the lowest quantile of IMT (Fig 4-5). "Age is not a consistent relative risk for MI."¹⁵ In this (case control study), inclusion of the subjects with symptomatic CVD may explain why they were unable to show a strong association. Answer of this question may be heritable factors might be specifically involved in plaque formation but not in diffuse intima media thickness.

"An increase of ISD in combined IMT was associated with relative risk of 1.36 for the combined end point of myocardial infarction after adjustments for age, sex and other risk factors".¹⁹ In the same model risk, an increase in age of ISD (5.5 yrs.) were associated with RR of 1.34 and an increase in systolic blood pressure of 1 SD (21.5) with a RR of 1.21.¹⁹ The relative strength of association between events and IMT as compared with the association between events and other traditional risk factors suggests that IMT is by itself powerful predictor of CVD as the traditional risk factors.^{11,12,13 16, 17 and 18} Thus, the measurement of intima media thickness can be used for prediction of CAD risk in later life if studied in large population at regional level and at national level and worldwide.

This Study would be helpful in Further Analysis in two ways

1. To assess and compare the effect of resistance to blood flow, effect of autonomic stress, effect of individual risk factors on IMT.
2. Whether measurement of RT or LT. side of CCA, ICA, or both important for correlation of Carotid IMT and prediction of cardiovascular disease.

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