

Role of Carotid Intima Media Thickness As A Surrogate Marker of Cardiovascular Events

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ABSTRACT

Introduction: Cardiovascular events are acquiring important dimensions. Atherosclerosis is the main cause of reduction in regional blood flow. Screening modalities to evaluate subclinical atherosclerosis are significant for preventing cardiovascular events. Study aimed to evaluate role of carotid intima - media thickness (CIMT) as a surrogate marker of cardiovascular events. Objectives: To measure common carotid artery intima - media thickness (IMT) and internal carotid artery intima - media thickness (CIMT).

Material and Methods: Carotid B - mode ultrasonography (USG) was done prospectively in 200 individuals. Of them 100 cases were patients with complaint of chest pain with positive electrocardiogram (ECG) findings or elevated cardiac enzymes or both. 100 cases were patients with no present or past history of chest pain with positive electrocardiogram (ECG) findings or elevated cardiac enzymes or both.

Results: In this study, Carotid intima - media thickness (CIMT) was measured in both cases and control groups bilaterally. The mean levels of common carotid artery (CCA) were 0.12 mm in cases and 0.05 mm in control and the mean levels of internal carotid artery (ICA) were 0.12 mm in cases and 0.06 mm in controls.

Conclusion: The study significantly shows the correlation between increased CIMT and cardiovascular events. CIMT can act as surrogate marker in CVS events as it assesses degree of subclinical atherosclerosis. It is highly effective due to its non invasive nature, low economic cost and easy availability.

Keywords: Atherosclerosis, Cardiovascular Events, Coronary Artery Disease (CAD), CIMT, CCA, ICA.

atherosclerosis¹⁰. IMT is the distance from the lumen-intima interface to the media-adventitia interface of artery wall as measured on non-invasively acquired ultrasonographic images of the carotid arteries¹¹. Grossly visible plaques (Figure-1) should not be included in the measurement of IMT.

B-mode (bright-mode) USG is a safe, non-invasive, and cost-effective method to measure CIMT. B mode vascular USG precisely defines CIMT as the double-line pattern formed by two parallel echogenic lines representing junction of the vessel lumen with intima and media-adventitia interface¹². Increased IMT of the CCA represents a form of atherosclerosis; the amount of lesion in CCA has been reported to correlate to extent of atherosclerotic lesions elsewhere in the body².

As CIMT is easily reproducible, it will be the ideal choice for evaluation of subclinical atherosclerosis and as a reliable marker for cardiovascular events. It is highly effective in Indian population due to its economical and reasonable cost.

MATERIAL AND METHODS

Carotid B - mode USG using Philips 650 Clear vue with 5 to 12 MHz linear probe was done prospectively in 200 individuals, of them 100 cases were patients who presented with complaint of chest pain with positive ECG findings or elevated cardiac enzymes or both. 100 cases were patients with no present or past history of chest pain with positive ECG findings or elevated cardiac enzymes or both. Comparative study with cases and controls was done in Department of Radiodiagnosis and Imaging, Muzaffarnagar

INTRODUCTION

The burden of CAD continues to rise globally, as developing nations, including India, are adopting to lifestyle changes with predisposition to cardiovascular diseases (CVD)¹. In India, incidences of CAD have doubled over the last three decades. Atherosclerosis is observed to be present more or less equally in coronary, cerebral and carotid arteries and keeps progressing insidiously without symptoms afflicting large sections of arterial tree including carotid and coronary arteries². Screening modalities to evaluate, subclinical atherosclerosis is significant for prevention of CAD, stroke and peripheral vascular diseases.

CIMT is a surrogate measure of atherosclerosis³ associated with cardiovascular risk factors⁴ and with cardiovascular outcomes⁵⁻⁹. Increase in CIMT may result from hypertrophy of intimal or medial layers or both because cellular molecular mechanisms that increase CIMT are also the factors responsible for development and progression of

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Medical College and Hospital, Muzaffarnagar. A detailed medical history, ECG findings and biochemical data were obtained.

CIMT measurement was conducted in supine position on scan bed with head of the patient resting comfortably, and neck slightly hyper-extended and rotated in direction opposite to the probe. A pillow was kept under shoulder blades for better visualization. Optimization of images was done by adjusting patient's neck position especially in anterior scanning planes, and rolled towels were placed under neck and legs for patient's comfort. Height and location of ultrasound system keyboard and monitor, examination bed, and chair were adjusted accordingly to avoid any musculoskeletal injuries to patients. The IMT of CCA and ICAs was measured bilaterally. The 6 values of IMT (3 on each side) of all cases and controls were obtained and averaged to get mean IMT

RESULT

Normal IMT is less than 0.07 cm in both CCA and ICA. IMT increases with age; a thickness of 0.08 to 0.1cm was considered indeterminate. A thickness greater than 0.1cm was considered as abnormal value. The IMT in CCA and ICA was higher in cases as compared to controls. It was noted that mean IMT in both CCA and ICA was almost equal



Figure-1: Longitudinal and transverse view of calcified plaque left CCA

on respective sides (R and L) in both cases and controls. Mean value of right CCA in control group was 0.05 cm and in cases 0.12 cm. The mean value of left CCA in control and cases was 0.05 cm and 0.12 cm (Table-1). The mean value of right ICA in control and cases was 0.06 cm and 0.12 cm and the mean value of left ICA in control group was 0.06 cm and in cases 0.12 cm. (Table: 2)

DISCUSSION

Chronic non-communicable diseases are acquiring important dimension in both developing and developed countries. Cardiovascular events include conditions in which there is an inadequate blood supply to part of myocardium, it mainly occurs due to imbalance between myocardial oxygen supply and demand. Atherosclerosis diseases are present in both urban and rural populations. There is increase in incidence of cardiovascular events in both population but is steeper in urban compared to rural population mainly corresponding to their lifestyle and habits. Artherosclerosis remains the pioneer cause of regional reduction of blood flow causing inadequate perfusion of involved myocardium.

In the present study, we found significantly increased right and left CCA and ICA thickness in cases as compared to control (Figure-2). Artherosclerosis may manifest as cardiovascular events, cerebrovascular disease or peripheral vascular disease. Cardiovascular events are more important because of subsequent morbidity and mortality. The likelihood

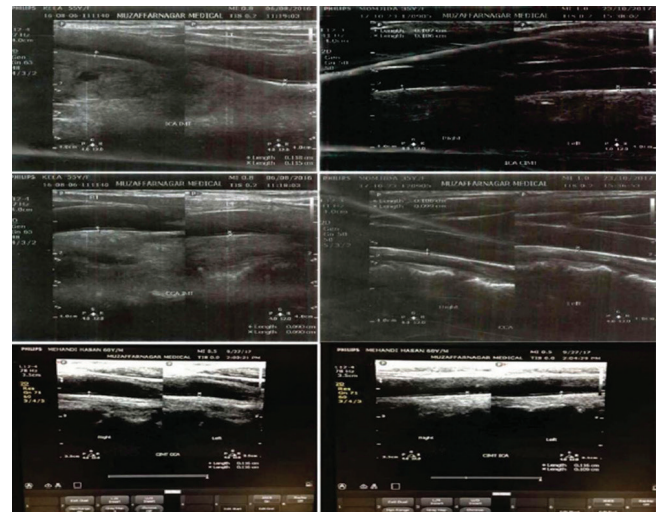


Figure-2: Increased intima media thickness of common carotid and internal carotid artery in cases

CCA					
Right CCA (cm)			Left CCA (cm)		
Cases	Control	p-Value	Cases	Control	p-Value
0.12 ± .0082	0.05 ± 0.00949	< 0.05	0.12 ± .00917	0.05 ± 0.00906	< 0.05

Table-1 Showed IMT of right and left CCA.

ICA					
Right ICA (cm)			Left ICA (cm)		
Cases	Control	p-Value	Cases	Control	p-Value
0.12 ± .0072	0.06 ± 0.00954	< 0.05	0.12 ± .0071	0.06 ± 0.00894	< 0.05

Table-2: Showed IMT of right and left ICA.

of atherosclerosis is determined by the combination of acquired and inherited risk factors. Major risk factors for atherosclerosis are non-modifiable (constitutional) are genetic abnormalities, family history, age and sex and modifiable hyperlipidemia, hypertension, cigarette smoking, diabetes and inflammation¹³.

Hansa et al¹⁴ reported association of CIMT with CAD and cardiovascular (CV) risk factors in the Indian population. CIMT, as measured at three predefined sites (carotid bifurcation, CCA, and ICA) on each side, was significantly higher in the coronary disease group compared to the controls. The results of this study indicated that increased values of average and maximum CIMT were significantly associated with the presence of CAD and this association was independent on the presence of other conventional CV risk factors.

Polak et al¹⁵ took a step toward refining carotid IMT measurements as an appropriate tool both by the use of normative carotid IMT scores and in finding most benefit from a combined score of the common and internal carotid IMT. Measuring carotid IMT is safe, non-invasive and although it requires some experience, has quite high reproducibility in addition, the normative values calculated from this Multi ethnic study of Atherosclerosis (MESA) cohort are not universal, and efforts to generate appropriate normative values in other populations should be encouraged. Further efforts should also include individuals younger than 45 years, where the potential for primary prevention could be even greater. And although the improved prediction of Coronary heart disease (CHD) achieved by carotid IMT measurements in this study is promising, these findings need to be replicated for validation.

Prati P et al¹⁶ in their study showed a positive significant association between the severity of carotid atherosclerotic lesions (plaques and stenosis) and age, systolic blood pressure, cigarette smoking, and highdensity lipoprotein cholesterol. It emphasizes the value of USG in the detection of early atherosclerotic lesions.

According to Takashi W et al¹⁷ increased IMT and plaque development in the extracranial carotid arteries reportedly correlate well with the prevalence of CAD. IMT of at least 0.7 mm in the middle-age group and at least 1.0mm in the old-age group was specific and positively predictive of CAD. The location of these atherosclerotic lesions in the carotid artery varies with age in patients with coronary artery atherosclerosis. Increased IMT thickness (>1.0 mm) and calcification were more significant in patients than in controls.

The Chennai Urban Rural Epidemiology Study (CURES-2)¹⁸, an epidemiological study reported association of CIMT and arterial stiffness with retinopathy in Asian Indians who were at a high-risk group for diabetes and CAD. The data from this study showed an association between early atherosclerosis and diabetic retinopathy in urban South Indian population.

Agarwal et al¹⁹ reported higher CIMT in diabetics who had CAD, even when the CAD was not clinically overt, and suggested that the CIMT was a reliable surrogate marker for

subclinical CAD in diabetic patients.

Mattson et al²⁰ in their cross-sectional study reported that Apo B and MS were independently associated with increased CIMT (defined as CIMT more than 90th percentile and/or plaque), and CIMT was attenuated by ~40% after adjustment with Apo B.

Costan G. Magnussen et al²¹ concluded that measurement of CIMT is elevated amongst those with hypertensive heart disease. Although individuals with a higher CIMT are at increased risk of clinical cardiovascular outcomes, the prognostic utility of CIMT differs by application and whether or not other risk factors are considered in the prediction.

CONCLUSION

The study significantly shows the correlation between increased CIMT and cardiovascular events. We can conclude that cardiovascular events are mainly the outcome of atherosclerosis which is more or less equally distributed in the vasculature. It insidiously progresses without any significant symptom. Therefore, increased CIMT pathogenesis is same as that of atherosclerosis elsewhere in the body. CIMT can act as surrogate marker in CVS events as it assess degree of atherosclerosis which help to assess the risk factors and related cardiovascular events. As CIMT is easily reproducible, it will be the ideal choice for evaluation of subclinical atherosclerosis and as a reliable marker for cardiovascular events. It is highly effective in Indian population due to its economical cost and easy availability.

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