Ultrasonographic assessment of carotid artery intima media thickness and its predictivity of coronary artery disease and its relation with age and gender

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ABSTRACT

Introduction: IMT of carotid artery, can be assessed by B-mode ultrasound in a simple way, because of its superficial location, runs parallel to the surface of the neck, serve it as a suitable diagnosing method for coronary atherosclerosis. The purpose of this study was to investigate the predictive value of IMT of CCA, ICA, carotid bifurcation for CAD and relation of IMT with age and gender of patients.

Methods: Two hundred patients (age from 30 ye80 y) who were subjected to coronary angiography in Haldiram Moolchand Cardiology Hospital, Bikaner (Rajasthan), also sub-jected for B-mode ultrasound scan of carotid. The mean value of six measurements of IMT of far wall of the CCA, ICA, carotid bifurcation was calculated in each patient.

Result: R2 value by regression analysis was significantly (p-0.000) higher for collectively all four arterial segments in significant CAD. R2 value for club model (CCA, ICA, Carotid bifurcation) was found 0.549 whereas for individual segment it was 0.422. Mean IMT of arteries significantly increasing with age and greater for men (0.686 ± 0.261) as comparison to women (0.594 ± 0.253).

Conclusion: present study that the IMT of carotid arteries which were taken in this study as different parameters were significantly correlated not only to CAD but also its severity. An increase in IMT of CCA and its arterial segments were found associated with age and gender of the patients.

KEYWORDS

Introduction

The heart has its own unique blood supply, more commonly known as the coronary circulation, which encircles the entire surface of the heart to supply its different regions. The coronary arteries supply oxygenated and nutrient filled blood to the heart muscles. Coronary Artery Disease happens when the arteries that supply blood to heart muscles, become hardened and narrowed. This is due to the buildup of cholesterol and other material, called plaque, on their inner walls. This build-up is called atherosclerosis. Atherosclerosis is a major cause of coronary artery disease, so it must be necessary that atherosclerosis can be detected at an early stage. A generalized increase in intima media thickness (IMT) of common carotid artery (CCA) is mostly occur in an early stage of the atherosclerotic process and is readily measured by ultrasound imaging.[1] Ultrasound IMT measurements have been first proposed and in vitro validated in Milan by Paolo Pignoli[2] who compared direct measurements of arterial wall thickness by gross and microscopic examination with B-mode real-times imaging of those same specimens. Due to non-invasive character and easy applicability, quantitative carotid B-mode. Ultrasonography has emerged as one of the methods of choice for determining the atherosclerosis and its progression, and for assessing cardiovascular risk.[3] It allows the accurate measurement of the distance between luminaleintima and media-adventitia interfaces of the arterial wall, which is defined as intima media thickness (IMT).[4] The aim of present study was to define the predictive value of IMT in cardiovascular complications.

Material and method

Two hundred patients (age from 30 ye80 y) with mean of 57.22 ± 9.93 undergoing coronary angiography in the Haldiram Moolchand Cardiology Hospital and associated group of hos-pital, Bikaner (Raj.) for suspected CAD, were included in this study. All patients who went for angiography also went for B-mode Ultrasound scan of carotid . Angi-ogra-phy of patients was performed by standard technique. On the basis of angiography report patients were divided into different groups as:

According to the lesion: Group 1) patients with normal coronary arteries (lesion <50%), group 2) patients with coronary artery disease (lesion >50%). According to the number of affected coronary arteries: Group 1) patients with normal coronary artery group 2) patients with single vessel disease, group 3) patients with double vessel disease and group 4) patients with triple vessel disease. Severity of disease considered as without coronary artery disease (<50%), with non-significant coronary artery disease (lesion 50e70%) and with significant coronary artery disease (>70%) thus classified accordingly.

B-mode scan is "real time" two dimensional scan combined with duplex scan allowing analysis of frequency shifts in an ultrasonographic signal, reflecting motion within a tissue eg. for evaluation of carotid arteries.

Ultrasonography was performed by visualizing the distal 10 mm of the common carotid arteries, carotid bulbs and proximal 10 mm of internal carotid arteries. Distance between 2 lines, blood-intima and media-adventitia interfaces was measured, which give a reliable index of the thickness of the intimalemedial complex (Figs. 1 and 2). The maximum IMT was measured at the far wall at plaque free area of the common carotid artery, at carotid bifurcation, the internal carotid arteries each for 3 times and then expressed as a mean value. The data were analyzed using SPSS 19.0 version.

Result and discussion

In the present study, out of 200 cases 158 were males and 42 females and out of 158 males significant lesion was diagnosed in 110 males. 27 patients diagnosed without coronary disease, 39 patients were diagnosed with non-significant CAD

(50%e 70% lesion), whereas 139 patients had significant CAD (>70% lesion). The Intima media thickness of all arteries was significantly increased with age as shown in Table 1. A significant association was also found between IMT and gender, intima media thickness was found greater in males than female patients as shown in Table 2.

According to Table 1 differences of mean IMT of all arterial segments (common carotid artery, internal carotid artery, carotid bifurcation) were found significant in different age groups. When mean IMT of right CCA was compared in different age groups it was 0.430 mm, 0.519 mm, 0.627 mm & 0.790 mm respectively for below 30 y, 31e45 y, 46e60 y & above 60 years age group. In present study it was observed that mean IMT of CCA significantly increasing with age. Similar trend was also found for carotid bifurcation, ICA . Tiong K. Lim,Eric Lim[5] found in their study that Carotid IMT in both CCA and its bifurcation increased significantly with age. The upper limits of IMT at CCA for participants age 35e39, 40e49, 50e59, and 60 years or older were 0.60, 0.64, 0.71, and 0.81 mm, respectively, whereas for that at bifurcation were 0.83, 0.77, 0.85, and 1.05 mm, respectively. Daniel H. O'Leary et al[6] observed that the prev-alence and severity of carotid atherosclerosis continued to increase with age even in the late decades of life.

Difference of mean intima-media thickness in two groups male and females among arterial segments (CCA, ICA and carotid bifurcation) were found to be significant but in case of femoral artery it was non-significant as shown in Table 2 and Fig. 3. When means IMT of CCA Right was compared in two genders it was 0.686 mm and 0.594 mm respectively for male and females and difference of two groups was found signifi-cant. In ICA Right the mean IMT values for two groups was 0.621 mm, and 0.544 mm respectively. The mean IMT values for bulb right was 0.727 mm, 0.594 mm respectively for male and females and the difference was found to be significant.

Burke et al[7] showed in their study that the coronary risk was almost two fold greater in men with mean carotid IMT >1 mm. Marco Matteo Ciccone[8] found in the Italian population that carotid IMT changes always higher in men than in women. In a other study by Cheng et al[9] it was reported that both the carotid and femoral IMT increases significantly with age and the IMT was greater in men compared with women, they have also been stated that mean values of carotid IMT was 0.61 ± 0.15 mm (mean ± S.D.) for men and 0.58 ± 0.14 mm for women and there was a significant difference between the two genders (P < 0.01). However a study by Bots ML et al[10] no significant differences were found in carotid thickness for men and women.

Mean IMT of carotid were significantly higher for significant CAD, compared to non-significant CAD and for without CAD as shown in Table 3 and Fig. 4. This was illustrated by the fact that in CCA Right the mean IMT for non-diseased coronary arteries, non-significant CAD and signifi-cant CAD was 0.400 mm, 0.514 mm, 0.765 mm and the dif-ference of mean IMT

was found significant in three groups. Similarly for ICA right the mean IMT for severity of disease was found 0.362 mm, 0.503 mm and 0.683 respectively and it was observed that mean IMT was greater for significant CAD than non-signif-icant CAD and disease free coronary arteries. Similar trends were also seen for carotid bifurcation . Observations of present study has also confirmed by previous studies, although methods used in some of them to measure IMT differ with the present study (concern to near or far wall and inclusion of the plaque area as well). Kablak Ziembicka[1] found a strong correlation between carotid IMT and coronary artery stenosis >50% luminal narrowing. According to them if mean IMT was more than 1.15 mm, patients had a 94% probability of having sig-nificant CAD. Tarzamni et al[11] also observed that, the IMT values of common carotid artery was significantly (p < 0.005) higher in patients with coronary artery disease (CAD) compared with non-CAD patients, as well as in patients with significant CAD compared to non-significant CAD in both genders as reported in present study. A study by Alexandros Kafetzakis et al[12] has shown that both carotid were signifi-cantly associated with severity of coro-nary artery disease.

Predictive powers of different IMT variables were shown as R^2 value in the form of five different models. Highest R^2 values has been shown for a model which included all three; common carotid, internal carotid, carotid bifurcation and R^2 value for this model was 0.549 (p ¼ 0.000) whereas R^2 value for individual segment as carotid bulb was 0.422. In present study it was observed that measurement of increased IMT of all three arterial segments as CCA, ICA and carotid bifurcation have shown a much better strong association with coronary artery disease than individual segment. Daniel H O'Leary et al[6] also found in their study that R^2 values (regression value) provide a strong association of the coronary disease and myocardial infarction with the ultrasound measurements of carotid arteries, with larger values of carotid IMT imply a greater association. Lorenz et al[13] worked on eight observational studies, meta-analysis of these eight observational studies showed that carotid IMT to be a strong predictor of future cardiovascular events.

Conclusion
Over all it has been observed in the previous attempts as well as the present attempt that to assess the IMT as a marker for the CAD has shown promising results with greater values of significance. It can be concluded from the present study that an increase in IMT of the common carotid artery, internal ca-rotid artery and carotid bifurcation measured at the sites of the plaque free area are collectively more predictable for cor-onary artery disease rather than individual arterial segment. Femoral artery also plays a separate roll for prediction of coro-nary artery disease but less sensitive than carotid artery. An in-crease in IMT of CCA and other arterial segments were found associated with age and gender of the patients. Because of increased IMT of carotid artery predict a high probability of coronary artery disease and its roll in early detection of ather-osclerosis, routine ultrasound scan of carotid artery advisable for those patients who undergoing for angiography.

Table 1 – Mean intima media thickness of following arteries for different age groups.

Age group	No. of patients	CCA right	CCA left	ICA right	ICA left	Bulb right	Bulb left	Femoral right	Femoral left
<30	2	0.430 ± 0.056	0.320 ± 0.028	0.325 ± 0.035	0.305 ± 0.007	0.610 ± 0.084	0.480 ± 0.042	0.685 ± 0.049	1.040 ± 0.226
31–45	26	0.519 ± 0.202	0.481 ± 0.188	0.482 ± 0.195	0.503 ± 0.213	0.570 ± 0.224	0.593 ± 0.204	0.685 ± 0.049	0.646 ± 0.186
46–60	103	0.627 ± 0.237	0.616 ± 0.189	0.578 ± 0.178	0.612 ± 0.220	0.684 ± 0.242	0.706 ± 0.243	0.702 ± 0.215	0.721 ± 0.200
>60	69	0.790 ± 0.271	0.747 ± 0.159	0.700 ± 0.245	0.721 ± 0.227	0.774 ± 0.199	0.833 ± 0.221	0.771 ± 0.233	0.833 ± 0.189
p-values	200	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000

Table 2 – Mean intima media thickness of following arteries in male and female

Sex	No. of patients	CCA right	CCA left	ICA right	ICA left	Bulb right	Bulb left
Female	42	0.594±0.253	0.552±0.206	0.544±0.260	0.609±0.250	0.594±0.205	0.632±0.235
Male	158	0.686±0.261	0.664±0.192	0.621±0.204	0.639±0.229	0.727±0.232	0.760±0.239
P value	200	0.043	0.001	0.042	0.461	0.001	0.002

Table 3 – Mean intima media thickness of following arteries for severity of disease

Severity of disease	No. of patients	CCA right	CCA left	ICA right	ICA left	Bulb right	Bulb left
Normal coronary arteries	27	0.400±0.118	0.389±0.114	0.362±0.150	0.391±0.134	0.455±0.153	0.429±0.120
Non significant CAD	39	0.514±0.119	0.525±0.144	0.503±0.133	0.499±0.154	0.565±0.154	0.570±0.131
Significant CAD	134	0.765±0.255	0.725±0.166	0.683±0.202	0.720±0.215	0.788±0.211	0.842±0.206
P values	200	0.000	0.000	0.000	0.000	0.000	0.000

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