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Original Research Article

SONOGRAPHIC MEASUREMENT OF COMMON CAROTID ARTERY INTIMA MEDIA THICKNESS AMONG HEALTHY ADULTS IN JOS, NIGERIA

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Abstract: The intima media thickness (IMT) has been established as an early predictor of general arteriosclerosis in patients. B-mode ultrasonography is a noninvasive method for examining thewalls of peripheral arteries. It provides a measure of intima-mediathickness (IMT) and the presence of stenosis and plaques. However, to date, there is paucity of information on IMT of common carotid artery in healthy patients in study area. **Objective:** The aim of this study is to sonographically measure common carotid artery intima media thickness among healthy adults in Jos, Nigeria. **Methodology:** The common carotid artery (CCA) was scanned using an ALOKA SSD-3500 ultrasound scanner with Doppler facility and a 7.5MHz linear transducer. Three measurements of the CIMT were obtained at 1cm proximal to the right and left carotid bulb and the mean value of the three measurements was recorded. **Results**: The overall mean CIMT 0.61mm±0.10. CIMT values increased progressively with increasing age from 21-70 years and with increasing BMI. CIMT correlated positively with age and BMI. Mean CIMT value was higher in male (0.62±0.09mm) compared to female (0.61±0.09mm). The overall right and left mean CIMT value was 0.61± 0.10 and 0.60 ± 0.10 respectively. There was no significant difference between the two sides. **Conclusion:** The CIMT value obtained in this study is slightly higher than those among Caucasians confirming the need for establishing normal values for each region. The study has shown that age, sex, BMI have significant effect on CIMT and should be taken into consideration when reporting CIMT of normal subjects.

Keywords: Ultrasound, CIMT, normal subjects.

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Introduction

The IMT corresponds to the intima-media complex, which comprises endothelial cells, connective tissue, and smooth muscle and is the site of lipid deposition in plaque formation. The IMT of the carotid artery is an established sonographic marker for early atherosclerosis,

and thickening of the intima-media complex reflects generalized atherosclerosis[1] and assessment of CIMT (carotid intima thickness) has been proposed as a noninvasive measure of cardiovascular disease burden in adults[2].

It is imperative to shift the focus to disease prevention rather than palliation. Prevention requires early identification of individuals at risk of developing cardiovascular disease but still clinically asymptomatic, so that intensive preventive measures may be instituted to arrest the progression of the disease. The various diagnostic modalities used currently (exercise electrocardiography, stress echocardiography, thallium scanning, coronary angiography) can detect atherosclerotic disease only when it becomes well advanced and occlusive[3]. Assessment of subclinical and clinical target organ damage is a key element in the management of patients with cardiovascular risk factor. Carotid intima-mediathickness (CIMT) measurement is a promising tool for detecting atherosclerosis in its pre-occlusive phase[3].Several studies have shown an association between increased CIMT and myocardial infarction or stroke in elderly and middle-aged subjects.[1] Increased common carotid artery IMT has been reported under various conditions, including hypertension, dyslipidemia, obesity, diabetes, smoking, and cardiovascular disease, including ischemic stroke[1].

High resolution B-mode Ultrasonography is a non-invasive, simple, safe, inexpensive, precise and reproducible method of examining and evaluating the walls of common carotid arteries for arterial wall thickening and atherosclerotic progression and regression. It also provides a measure of CIMT and detects presence of stenosis and plaques in patients.

Aim: The aim of this study is to sonographically measure common carotid artery intima media thickness among healthy adults in Jos, Nigeria

Methodology

Study background

This was a cross – sectional study involving 400 hundred (400) subjects, was conducted at the Department of Radiology, Jos University Teaching Hospital, Jos Plateau state.

Study population

Consecutive healthy adult patients with no history or clinical evidence of cardiovascular risk factors or disease were recruited into the study with informed consent.

Exclusion criteria:

I. Patients <21years or >70years of age;
II. Patients with clinical evidence of cardiovascular disease or stroke.
III. Patients with other associated cardiovascular risk factors such as hypertension, diabetes, smoking hypercholesterolemia and family history of cardiovascular risk factor.
IV. Detection of plaques or lesion in the longitudinal B mode of the common carotid arteries were also excluded from the study.
V. Unwillingness to participate.
VI. Pregnant women because of physiological changes and accompanying dilation of CCA.
VII. Subjects in whom imaging circumstances were very poor, with limited boundary visualization of CCA or where there is anatomical constraint either a high carotid artery bifurcation or a short neck.

The body mass index (BMI) was calculated as ratio of measured weight to square of the measured height (Kg/m^2). BMI was classified using WHO classification as underweight (BMI<18.5); normal (BMI 18.5-24.9); overweight (BMI 25.0-29.9); obese (BMI $\geq$30)[4].

The examination of the CIMT was performed using the 7.5 MHz linear transducer ALOKA SSD-3500 ultrasound scanner equipped with Doppler facility. Measurements of CIMT were obtained in the longitudinal plane at the point of maximal thickness on the far wall of both CCA 1cm proximal to the carotid bulb, where it is

clear of plaques. The IMT is the distance between the inner echogenic line representing the intima -blood interface and the outer echogenic line representing the adventitia media junction (Figure 1). Measurements were repeated thrice on each side, unfreezing on each occasion and relocating the position of maximal IMT.

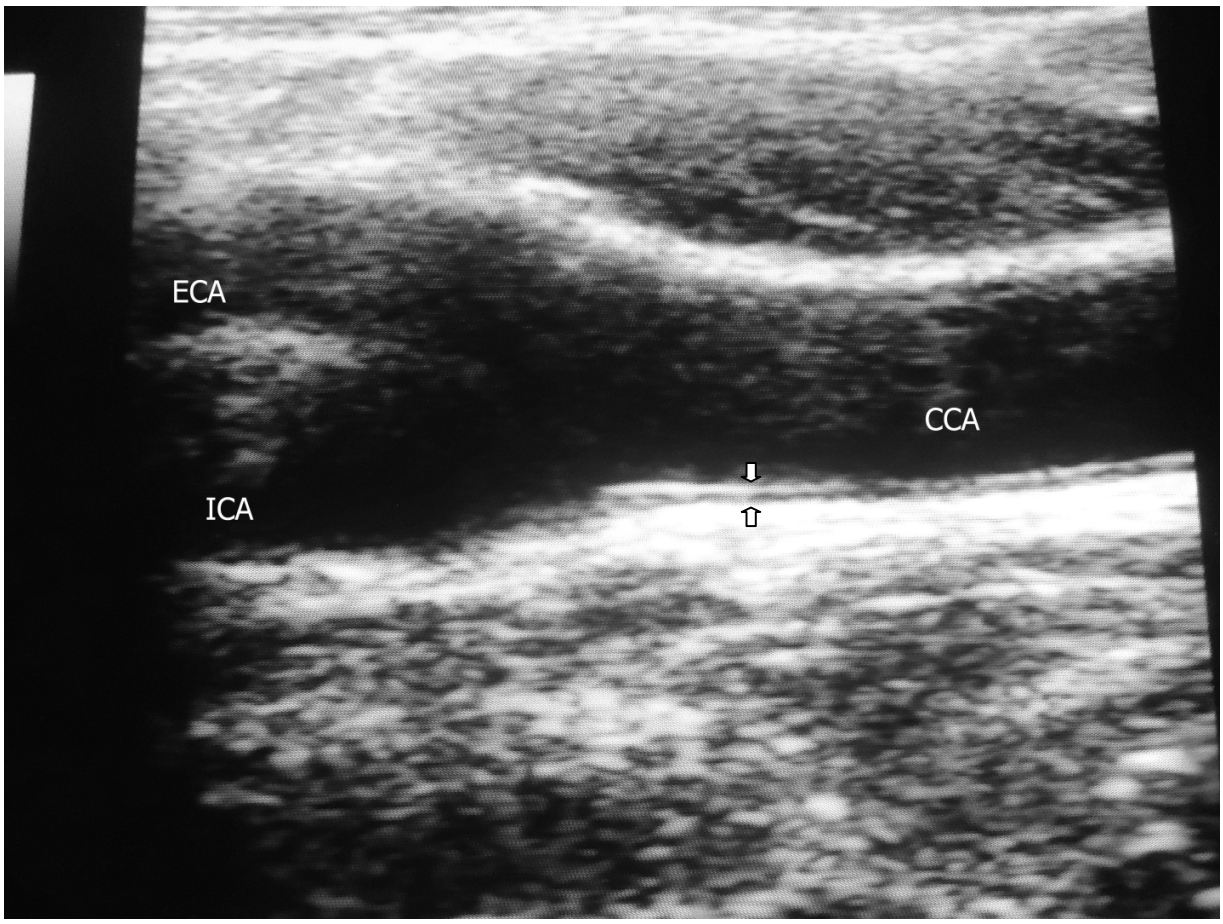

Figure 1: Longitudinal sonogram showing the measurement of common carotid intima media thickness (arrows). Common carotid artery (CCA), external carotid artery (ECA), and internal carotid artery (ICA).

Data Analysis

Data were analyzed using SPSS 19.0 software. The chi square-test and Fischer exact test was used to perform and establish any statistical difference. Probability values of <0.05 was considered as statistically significant.

Result

A total of 400 normal subjects participated in the study comprising of 244 (61%) females and 156 (39%) males. The mean age of the subjects was 38.49 ±11.85 years.The predominant age group (Table 1) was age group 31-40 years accounting for 39 (39%). The overall mean CIMT in the study was 0.62± 0.10mm.The overall right and left mean CIMT value was 0.61±0.10mm and 0.62±0.10mm respectively. There was no statistically significance different between the two sides (p=0.018).

The overallmean CIMT for males and females was 0.62±0.09mm and 0.61±0.09mm respectively. Male CIMT values were higher than female. However gender difference in CIMT was not statistically significant. (p= 0.70) (Table 2).The right mean CIMT for males and females were 0.61mm and 0.61mm respectively. Thiswas not statistically

significantly. The left mean CIMT for males was 0.63mm and left mean CIMT for female was 0.61mm. This indicates that the left mean CIMT for males is higher than females. This was not statistically significant (p=0.90).

Mean CIMT for age group 21- 30 and 61-70 was 0.52mm and 0.83mm respectively (Table 1). The CIMT progressively increased with age. This increase was statistically significant (p=0.000). Age has a strong correlation with CIMT (Pearson correlation= 0.88). The mean BMI was 26.58± 6.17. The CIMT values increases with each BMI grouping (p=0.000, Table 3). BMI has a positive correlation with CIMT (Pearson correlation= 0.22). This correlations were however not statistically significant (p=0.24).

Table 1: Age and mean CIMT among normal adult in Jos.

Age group (Years)	Frequency (%)	Percent mm	RCIMT mm	LCIMT mm	Mean CIMT
21 – 30	4 1.0	0.51	0.52	0.52	
31 – 40	156	39.0	0.60	0.61	0.61
41 – 50	84	21.0	0.65	0.66	0.66
51 – 60	88	22.5	0.76	0.77	0.77
61 – 70	68	17.0	0.82	0.83	0.83

P =0.000

Table 2: Gender and mean CIMT in normal adult in Jos.

Gender	Frequency (%)	Percent (mm)	RCIMT (mm)	LCIMT (mm)	Mean CIMT
Male	156	39.0	0.61	0.63	0.62
Female	244	61.0	0.61	0.61	0.61
Total	**400**	**100.0**			

Table 3: BMI with mean CIMT among normal adult in Jos.

BMI	Frequency (mm)	RCIMT (mm)	LCIMT (mm)	Mean CIMT
< 18.5	8	0.50	0.53	0.52
18.5 – 24.9	140	0.58	0.61	0.60
25.0 – 29.9	172	0.61	0.61	0.61
≥ 30	80	0.68	0.66	0.67
	400			

Discussion

The aim of this study was to document normal baseline values of CIMT in healthy adults in this environment with special attention on the effect of age, sex and BMI on the CIMT.

The overall CIMT value in normal subjects in this study was 0.61mm. However, this was

lower than 0.69mm obtained in study by Lemne*et al*[5] but higher than 0.51mm and 0.54mm recorded by Honzikova[6] and Plavnik[7] respectively. The differences in CIMT observed in various studies could be due to sampling methods, sampling size, and racial differences. The sample size in this study was comparably larger than in other studies[5-7]. Differences in life styles, diet and social habits, for instance high alcohol intake as well as chronic intake of potato chips in the study environment (Jos) is known to induce a pro-inflammatory state which is a risk factor for atherosclerosis[8] and may be responsible for the higher mean CIMT valueobserved in this study and other studies[6,7]. In this study, the method used at arriving at CIMT value involved taking three measurements 1cmproximal to right and left carotid bulb and the mean value of the three measurements were recorded for each side; this was different from the method employed in some other studies[5,7]. This method is simple, reliable, and reproducible. There is minimal inter and intra observer error. Using this method allows rapid identification of the target area and ensures that an identical area is assessed on follow up. Certain infections such has viral hepatitis and human immunodeficiency virus infection have been shown to be associated with increased CIMT probably due to presence of pro-inflammatory cells which are risk factor in artherogenesis[8,9]. However, the subjects were not screened for above factors.

The mean CIMT value obtained in the study was 0.62mm in males and 0.61 in females. Males have a higher CIMT value than females. This relationship was not statistically significant (P=0.70). This finding was consistent with other studies[9,10,11] and may be explained by the sex variation in the development of artherosclerosis. Males have a higher chance of developing artherosclerosis more often than females[11,12], although the reasons are not known but may be due to the fact that males are more prone to psychological and environmental stress than females[8,11].

The overall mean CIMT value was 0.62mm±10 on the left and 0.61mm±10 on the right. The left CIMT value was higher than right. Although, this findings was not statistically significant (P=0.18). This result was consistent with the study by Sharma[13-15]but contrary to findings in other studies [10,16]. The reason for such differences between IMT of right and left common carotid artery sides are unknown. However, the left common carotid is a direct branch of the aorta while right common carotid results from division of brachiocephalic trunk. Therefore it is possible that dissimilarities have existed in the arterial growth between both arteries and/or that flow mediated mechanical forces applied to carotid wall differ between the two sides[17].

There was progressive increase in CIMT values from age 21 years to 70 years. Most of the studies reviewed also consistently showed increased CIMT with age[6,7,9,10,14]. This study also showed that age has a strong correlation with CIMT values recorded (Pearson correlation=0.88). The increase in mean CIMT with age in normal healthy subjects could probably be due to specific effect of aging on the arterial wall or probably be due to exposure to risk factor not measured or captured in this study.

There was also progressive increase in mean CIMT values with BMI. This was statistically significant. Mean CIMT correlated positively with BMI. Similar finding was demonstrated in the studies by Honzikova and Planvik[6,7].BMI has been shown to influence the CIMT but the role of BMI in arterial wall thickening is poorly understood and its influence is probably independent of age[18].

Studies conducted in many countries have shown that IMT values may differ between distinct ethnic groups,thus indicating the need for regional investigations[7]. A previous study indicated that the IMT of the common carotid artery in blacks were thicker than that of white; and males in eastern Europe were also found to have thicker IMT than males in the west[7]. A

study though among children, revealed normal IMT of Brazilian children from 10 to 18 years old to be different from that of Beijing children[7]. Unlike the previous studies, the subjects in the present study were native Nigerians, and therefore establishing normogram for each specific region may be needed.

Conclusion: This study has shown that the mean CIMT values increase steady with increase in age from 21-70 year old subject and with increase BMI. Mean CIMT value in males was higher than that of females in Jos, Nigeria. The CIMT value in Jos, Nigeria is slightly higher than that of Caucasians further affirming the fact that normal values for each region be estimated separately due to geographic and racial differences and that whenever interpreting values of CIMT factors such as age, sex and BMI should be taken in to account before arriving at a conclusion.

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