ORIGINAL ARTICLE

SONOGRAPHIC NORMATIVE VALUES OF CAROTID INTIMA-MEDIA THICKNESS IN AN ADULT NIGERIAN POPULATION

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ABSTRACT

BACKGROUND: The thickness of the intima-media complex of the Common carotid artery (CCA) has been advanced as a reliable measurement of the degree of atherosclerosis in the CCA and the coronary artery. We set out to determine the baseline values of this complex in a Nigerian population so as to determine standards for abnormalities.

METHOD: This prospective study was conducted on 100 normal patients aged 21years and above. The CCAs were scanned using GE Logic 5 color Doppler scanner (2007) with 7.5MHz linear probe. Two measurements of the carotid intima-media thickness (CIMT) were obtained at 1cm proximal to the right and left carotid bulbs and the mean value of the two measurements was recorded. The mean values were then analyzed with Statistical Package for Social Sciences (SPSS) version 20.0.

RESULTS: The age range of participants was 21-70 years with a mean age of 45.26 ±12.95 years. We observed the mean CIMT of 0.61±0.12mm with the overall right and left mean CIMT of 0.61±0.12mm and 0.61±0.13mm respectively. No significant difference was seen between the two sides. CIMT in the study population increased with age, with a maximal value of 0.82±0.05mm recorded among the 61-70 year age group. Male subjects had higher CIMT values than females. CIMT values were higher in overweight, compared to underweight, subjects.

CONCLUSION: This study showed different values of CIMT according to age and gender variations. However, the values obtained were slightly different from previous values from other African and Caucasian populations.

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INTRODUCTION

High frequency B-mode Ultrasonography is a non invasive, simple, safe, inexpensive, precise, available and easily reproducible method of examining and evaluating the walls of common carotid arteries for arterial wall thickening and atherosclerotic progression. This technique permits us to accurately quantify the carotid intima media thickness (CIMT) which is an early marker of atherosclerosis associated with Hypertension, Diabetes Mellitus, smoking, Ischaemic stroke as well as Myocardial Infarction[1]. It is a promising noninvasive measure of cardiovascular disease burden in its pre-occlusive phase[2].

The limitation to global use of CIMT to quantify atherosclerosis lies in its inter-racial and geographic variability[3]. The main aim of this work was to measure the CIMT of normal patients and establish baseline values in the study environment.

METHODOLOGY

This cross-sectional study involved 100 participants, and was carried out at the department of Radiology, Jos University Teaching Hospital, Jos, Plateau State. Healthy adult patients, aged 21 to 70 years, were recruited consecutively into the study after obtaining an informed consent.

Excluded are

1. Patients with cardiovascular risk factors such as diabetes, hypertension, obesity, smoking, history of excessive alcohol intake.
2. Patients with obvious cardiovascular conditions or stroke, TIA, myocardial infarction
3. Pregnant patients

After obtaining the informed consent, the carotid IMT was evaluated using GE Logic 5 color Doppler scanner (2007) with 7.5MHz linear probe. With the subject in supine position, the neck was extended and head turned 45* away from the side being scanned. Measurements of CIMT were obtained in the longitudinal plane at a point 1cm proximal to the carotid sinus. The IMT is the distance between the inner echogenic line of the intima-blood interface and the outer echogenic line of the adventitia-media junction. The average of two measurements was taken and recorded on each side. All the patients were scanned by the first author to avoid inter-observer variation.

Figure 1: Thickened Carotid intima media complex (0.14cm) denoted by a double head arrow.

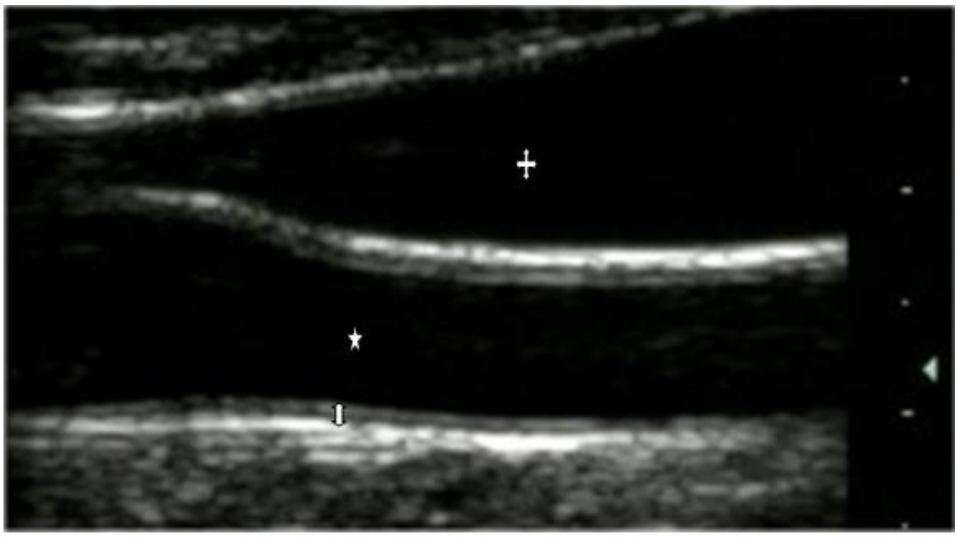

Figure 2: A gray scale image of a common carotid artery (☆) with a normal intima-media complex (⇳) and an internal jugular vein above it (✣)

RESULTS

A total of 100 subjects participated in the study. Subjects were between 21 and 70 years with mean age of 45.26±12.95 years made up of 32 males and 68 females, giving approximate male-to-female ratio of 1:2. The predominant age group was 41-50 years accounting for 31% (Table 1). The overall mean CIMT was 0.61±0.12mm. The overall right and left mean CIMT were 0.61±0.12mm and 0.61±0.13mm respectively. No statistically significant difference existed between the two sides. Mean CIMT for age group 21-30 and 61-70 were 0.49±0.09mm and 0.82±0.05mm, with statistically significant increase in CIMT with age (p=0.001). Age has a strong correlation with CIMT (correlation co-efficient= 0.581) (Table 2). The overall mean CIMT for male and female were 0.66±0.12mm and 0.58±0.11mm. The difference was statistically significant (p= 0.002, Table 3). Mean CIMT in underweight (BMI < 18.5Kg/m2), normoweight (BMI= 18.6-24.9Kg/m2) and overweight (BMI= 25.0-29.9Kg/m2) subjects respectively were 0.47±0.08mm, 0.59±0.12mm and 0.63±0.11mm. There was significant difference in the CIMT values across the BMI grouping (p= 0.003, Table 4).

Table 1: Relationship between age and CIMT

Age group	Frequency (%)	Right CIMT(mm) Mean±SD*	Left CIMT(mm) Mean±SD**	Mean±SD ***
21-30	8(8.0)	0.50±0.08a	0.49±0.10a	0.490.09a
31-40	28(28.0)	0.53±0.08a	0.53±0.08a	0.530.08a
41-50	31(31.0)	0.60±0.08b	0.59±0.08b	0.590.07b
51-60	17(17.0)	0.61±0.08b	0.61±0.08b	0.610.07b
61-70	16(16.0)	0.81±0.06c	0.83±0.04c	0.820.05c
Total	100(00.0)	0.61±0.12	0.61±0.13	0.610.12 p= 0.933
F-test* = 35.770		P* = 0.001	F-test** = 45.363	P** = 0.001
F-test*** = 47.555		P*** = 0.001		

Table 2: Correlation between age and CIMT

Parameter		Age	CIMT
Age	Pearson Correlation	1	0.581
	P		0.001
	N	200	200
CIMT	Pearson Correlation	0.581	1
	P	0.001	
	N	200	200

Table 3: Relationship between gender and CIMT

Gender	Frequency (%)	Right CIMT(mm) Mean±SD*	Left CIMT(mm) Mean±SD**	Mean±SD***
Male	32(32.0)	0.67±0.12	0.65±0.13	0.660.12
Female	68(68.0)	0.58±0.11	0.58±0.12	0.580.11
Total	100(100.0)	0.61±0.12	0.61±0.13	0.610.12

t-test* = 3.503, p* = 0.001 t-test** = 2.648, p** =0.009

t-test*** = 3.157, p*** = 0.002

Table 4: Relationship between BMI and CIMT

BMI	Frequency (%)	Right CIMT(mm) Mean±SD*	Left CIMT(mm) Mean±SD**	Mean±SD***
Underweight	6(6.0)	0.47±0.10a	0.47±0.07a	0.470.08a
Normal	44(44.0)	0.60±0.12b	0.56±0.13b	0.590.12b
Overweight	50(50.0)	0.63±0.12b	0.63±0.12b	0.630.11b
Total	100(100.0)	0.61±0.12	0.61±0.13	0.610.12

F-test* = 5.796 P* = 0.004 F-test** = 5.810 P** = 0.004

F-test*** = 6.178 P*** = 0.003

DISCUSSION

The main objective of this study was to measure the CIMT and determine its baseline values in the study environment across age, gender and BMI status. The overall mean CIMT in this study was 0.61mm. This was similar to 0.62mm Kolade *et al* obtained in Jos, but lower than what was obtained in other parts on Nigeria.[4] While Dambatta et al got 0.725mm in Kano, Umeh *et al* arrived at 0.65mm in Ibadan, using same research methods.[5,6] This suggests significant ethnic variation in CIMT values. Within the African continent, a value of 0.66mm is regarded as cut-off in South Africa.[7] A Kenyan study recorded higher values in males (0.97mm) and females (0.77mm)[8]. Inter-ethnic variation in the values of CIMT was observed among Sudanese of North Africa where Mahmoud obtained a range of 0.4 to 0.7mm, with the southern Sudanese having lower IMT.[3] Compared with values obtained among the Caucasians, the mean CIMT in this study was lower than 0.69mm obtained by Manuel *et al*[9] but higher than 0.51mm and 0.54mm recorded by Honzikova *et al* and Plavnik *et al* respectively[10,11]. These showed inter-racial and geographical variations in CIMT values.[3]

Inter-racial differences may be explained by differences in lifestyle, diet and social habit. For instance, it has been established that chronic intake of potato chips is associated with higher CIMT values as the chips is known to induce pro-inflammatory state which is a risk factor for atherosclerosis.[12] Also implicated are racial differences in aortic wall stiffness and diameter as well as the genetic and environmental contributions to atherosclerosis.[13] There is a conflict as to the role of infections such as hepatitis and human immunodeficiency virus infection in increased CIMT. It is suggested that these infections elaborate pro-inflammatory cells which are risk factors in atherogenesis[7,14,15]. If proven, these infections might have influenced the results of these previous studies, according to the respective geographic prevalence.

In this study, sex variation in CIMT is established with male gender having significantly higher mean values (0.66mm vs 0.58mm, p=0.002) and on both sides. This was supported by most of the reviewed articles[4,16,17]. Mahmoud however found higher but insignificant values among females in south Sudan, explaining this away by unknown genetic and environmentalcontributions to atherosclerosis[3]. Males have a higher chance of developing atherosclerosis more often than women, 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 [18].

There was a progressive increase in CIMT from age 21 to 70 years. Age has a strong positive association with CIMT. The reviewed articles support this finding. [4,19,20] The increase in mean CIMT with age in normal healthy subjects could probably be due to specific effects of aging on the arterial wall, as a vascular component of the normal degenerative process of aging or probably be due to exposure to risk factor not measured or captured in this work.

In spite of the fact that obesity is an exclusion criterion in this work, a statistically significant progressive increase in BMI is recorded from underweight to overweight subjects. Eduado *et al* observed that apart from age, BMI is the most influential independent determinant of increased IMT of both right and left carotid arteries. [21] Kolade noticed a sharp increase in CIMT from overweight to obesity (0.61mm vs 0.67mm). [4] The pathogenetic mechanism of

increased CIMT and plaque formation in an obese patient is deposition of esterified cholesterol following arterial wall injury. [22] This process probably follows progressive weight gain, only accentuated by obesity.

CONCLUSION

This study showed respective CIMT values across gender, age and BMI variations in the study environment. It demonstrated steady increase in CIMT with age and BMI. No difference on the right and left sides. Mean values were higher in males than females. In comparison with previous works, significant inter-racial differences in CIMT values were noted affirming the fact that normal values for each region should be established and considered before deciding a thickened intima-media thickness in these regions.

REFERENCES

1. Lee EJ, Kim HJ, Bee JM. Relevance of common Carotid Intima Media Thickness and Carotiproof@myesr.orgd Plaque as Risk factors for Ischaemic Stroke in Patients with type 2 Diabetes Mellitus. *America J of Neuroradiology* 2007;28:916-919
2. Hanza G, Bhargava K, Bansal M, Tandan S, Kashwal R. Carotid intima-Media Thickness and Coronary Artery Disease: An Indian Perspective. Asian cardiovascThorac Ann 2003;11:217-221.
3. Mahmoud Z Mustafa. Sonography of Common Carotid Artery Intima-media Thickness in the Normal Adult Population in Sudan. N Am J Med 2013: 2(2):88-94
4. Kolade-Yunusa HO, Haruna AS. Sonographic Measurement of Common Carotid Artery intima media thickness among healthy Adults in Jos, Nigeria. *J. Harmoniz. Res. Med. And Hlth. Sci*. 2015;2(4):156-162
5. Dambatta AH, Tabari AM, Isyaku K, Idris SK, Suwaid MK, Sale A. B-Mode Ultrasonographic Measurement of Common Carotid Artery Intima-Media Thickness in Kano, Nigeria. West Afri J of Ultr. 2008;9: 1.
6. Umeh EO, Agunloye AM, Adekanmi AO, Adeyinka. Ultrasound Evaluation of Intima-media Thickness of Carotid Arteries in Adults with Primary Hypertension at Ibadan, Nigeria.W/A J of Med. 2013; 32: 1
7. Woodiwiss AJ, Norton GR, Michel F, Booysens HL, Majane OHI, et al. (2012) Carotid IMT in African Patients with Critical Lower Limb Ischaemia Infected with the Human Immunodeficiency Virus. J AIDS Clinic Res 3: 167. Doi: 10.4172/2155-6113.1000167
8. Ongeti K, Saidi H, Ogeng'o J. Common Carotid Intima-media Thickness in a Kenyan Population. Anat J Afri 2014; 3:3
9. Manuel AG, José IR, Emiliano RS, Maria CP, Rosa M, *et al*. Carotid Intima-Media Thickness in Diabetics and Hypertensive Patients. *Rev Esp Cardiol*. 2011;64(7):622-625
10. Honzikova N, Labrova R, Fiser B, Maderova E, Novakova Z, *et al*. Influence of age, body mass index, and blood pressure on the carotid intima-media thickness in normotensive and hypertensive patients. *Biomed Tech* (Berl). 2006;51:159-162
11. Plavnik FL, Ajzen S, Kohlmann Jr O, Tavares A, Zanella MT, *et al*. Intima-media thickness evaluation by B-mode ultrasound. Correlation with blood pressure levels and cardiac structures *Braz J Med Biol Res*, 2000;33:55-64
12. Naruszemicz M, Zapolska-Downar D, Kosmidient A. "Chronic intake of potato chips in humans increases the production of reactive oxygen radicals by leucocytes and increases

plasma C-reactive protein: a pilot study," *The American Journal of Clinical Nutrition*.2009;89:773-777
13. Wong ND and Ridker PM, "Thrombosis, inflammation and infection" in Preventive Cardiology. A Practical Approach, N. D. Wong, H. R. Black, and J. M. Gardin, Eds, McGraw-Hill, New York, USA, 2nd edition, 2005;321–337
14. Pacheco AG, Grinsztejn B, Fonseca M, Griep RH, Lotufo P, et al. (2016) HIV Infection is not Associated with Carotid Intima-media Thickness in Brazil: A Cross-Sectional Analysis from the INI/ELSA-Brazil Study. PLOS ONE 11(7): e0158999. Doi: 10.1371/journal.pone.0158999
15. Olumide EA, "The distribution of hepatitis B surface antigen in Africa and the tropics: report of a population study in Nigeria," *International Journal of Epidemiology*, 1976;5(3):279-289
16. Stensland-Bugge E, Bønaa KH, Joakimsen O, Diamond J. Sex Differences in the Relationship of Risk Factors to Subclinical Carotid Atherosclerosis Measured 15 Years Later. *Stroke* 2000;31:574
17. Hedblad B, Nilsson P, Janzon L, Berglund G. Relation between insulin resistance and carotid intima-media thickness and stenosis in non-diabetic subjects. Results from a cross-sectional study in Malmo, Sweden. *Diabet Med* 2000*;* 17*:* 299–307
18. Troxel WM, Matthews KA, Bromberger JT, Sutton-Tyrrell K. "Chronic stress burden, discrimination, and subclinical carotid artery disease in African American and Caucasian women," *Health Psychology*, 2003;22(3):300-309.
19. O' Leary D.H, Polark J.F, Richard A.K. Carotid Artery Intima Media Thickness as a Risk Factor for Myocardial Infarction and Stroke in Older Adult. *N Engl J Med* 1999; 340:14-22
20. El-Barghouti N, Elkeles R, Nicolaides A, Geroulakos G, Dhanjil S, et al. The ultrasonic evaluation of the carotid intima-media thickness and its relation to risk factors of atherosclerosis in normal and diabetic population. *Int Angiol* 1997*;* 16*:* 50–54
21. Eduado V, Maria C, Francesco P, Todd JA. Common Carotid Artery Intima Media Thickness Determinants in a Population Study. *J Ultrasound Med* 2007;26:427-432.
22. John AC, Maria-Lopez V, Perry VH. Pathogenesis of Atherosclerosis in Diabetes Mellitus. *Diabetes Care* 1981; 4:121-133.