

**SONOGRAPHIC ASSESSMENT OF COMMON AND INTERNAL CAROTID ARTERIES
IN TYPE 2 DIABETIC PATIENTS****Hassan. A. Hamed^{1*}, Abdelmoneim. A. Sulieman², Hosman³, Mustafa Z Mahmoud²**¹College of Medical Radiologic Science – Sudan University of Science and Technology²Sattam bin Abdulaziz University, Alkharj, Saudi Arabia.³Taif University. College of Applied Medical Science P.O.Box 2425 KSA**Corresponding Author: Hassan. A. Hamed**

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ABSTRACT

Background: Diabetes Mellitus is one of risk factors that cause carotid arteries atherosclerosis which occurs when lipoprotein accumulates in the intima of the artery. As atherosclerosis progresses it may completely occlude the artery lumen or plaque may rupture sending thrombus more distal, resulting in Transient Ischemic Attack or stroke.

Aim: The aim of this study was to assess the Common Carotid Arteries and Internal Carotid Arteries in adult Sudanese patients with Type 2 Diabetes Mellitus. **Materials and methods:** 92 participants were enrolled in the study; they were scanned with linear probe of (7-10 MHz). Intima-Media-Thickness (IMT), Caliper, peak Systolic Velocity (PSV), End Diastolic Velocity (EDV) and Resistive Indices (RI) were measured. **Results:** Maximum value of IMT in CAs increased with age and duration of type 2 DM, in Rt CCA it begins at 1.2 mm in first age group and ended in 1.9 mm for age and duration in last age group, while for Lt CCA from 1.4mm to 2mm for age and 1.4mm to 2.1mm for duration, the external calipers like IMT increased with increased in age and duration while there is no correlation with PSV, EDV and RI. **Conclusion:** In conclusion, statistically IMT and carotid calipers showed strong positive correlation with age and type 2 DM duration and they consider as a good marker of subclinical for atherosclerosis. IMT values and diameter of carotid arteries tends to be larger in Lt side of the neck than the Rt neck. While there is no correlation between PSV, EDV and RI with age and duration.

KEYWORDS: Common Carotid Artery, Diabetes Mellitus, Intima Media Thickness, Peak Systolic Velocity, End Diastolic Velocity, Resistive Index.

INTRODUCTION

Diabetes is one of risk factors that cause carotid arteries atherosclerosis which occurs when lipoprotein accumulates in the intima of the artery and is oxidatively modified and cytokine released which leads to monocyte deposition in the artery wall then transform into foam cells causing smooth muscle cells to migrate to intima and form the plaques. These plaques tend to occur at arterial branches points and bifurcations. As atherosclerosis progresses it may completely occlude the artery lumen or plaque may rupture sending thrombus more distal, resulting in Transient Ischemic Attack (TIA) or stroke (Sharrett et al., 1994).

Ultrasound assessment of carotid arteries plaque and stenosis has become the first choice for carotid scanning; it is easily, a noninvasive, inexpensive, sensitive and permitting the evaluation of both the macroscopic appearance of plaques as well as flow characteristic in carotid arteries (Stein et al., 2008). High-resolution carotid ultrasonography can determine the presence or extent of atherosclerosis *in situ*. Carotid artery intima-media thickness (CIMT) independently predicts the risk

of cardiac (myocardial infarction, angina pectoris, coronary intervention) and cerebrovascular events (stroke or transient ischemic attack) (Lorenz et al., 2006), the involvement of other arterial beds with atherosclerosis and is well suited for use in large-scale population studies as a marker of subclinical disease due to the relative simplicity and noninvasive nature of the technique (Naghavi et al., 2003).

In this study Doppler ultrasound was used to assess Common and Internal Carotid Artery in both side of neck in patients with type 2 diabetes mellitus, considering age of patients and duration of diabetes, Intima-Media-Thickness (IMT), Caliper in mm, peak Systolic Velocity (PSV), End Diastolic Velocity (EDV) and Resistive Indices (RI) were obtained as variables for assessment.

MATERIALS AND METHODS**Subjects**

92 participants with type 1 diabetes mellitus (male = 51 and female = 41) who admitted at National Ribat Hospital. The sample selection and negligence depend on two criterions, the included subjects are patients with

Type 2 Diabetes Mellitus and excluded are patients with Type 1 Diabetes Mellitus, Hypertension, Smokers and patients with previous history of carotid artery surgery.

Machine used

Ultrasound scan for CCA was performed using a higher resolution Siemens Ultrasound medical system, Sonoline G 60S, equipped with a linear probe frequency 7-10 MHz Printing facility issued through the ultrasound digital graphic printer.

Methods

Common Carotid (CC) and Internal Carotid (IC) arteries were scanned to visualize IMT, calipers, PSV and RI, which consider as dependent variables and correlation with age and duration of type 2 diabetes mellitus as independent variables. Patient lay in supine position with knee support and examiner seated toward the patient’s head, the neck scanning was enhanced by tilting and rotating the head away from the side being examined. Several transducer positions were used in this research to examine CC and IC arteries in long-axis (longitudinal) planes and short-axis (transverse), the views of the carotid arteries were obtained from anterior, lateral and posterior-lateral approach depending on which best shows the vessels. Image for CCA were obtained in longitudinal plane at the point along a 1cm distal from bulb of carotid artery to measure IMT which was proved to be a simple and reproducible method for assessing IMT of CCA for routine practice. B-mode image of arterial wall composed of two parallel echogenic lines separated by a hypoechoic space, calculation of carotid IMT is arguably the most widely used noninvasive measure of atherosclerosis currently employed by clinicians and clinical investigators, both to quantify the extent of subclinical disease and to monitor change over times (Stein *et al.*, 2004). For the far (posterior) wall of the carotid artery, this index can be easily measured by ultrasound as the distance between the leading edge of the luminal echo (first bright line) and the leading edge

of the media-adventitia echo (second bright line). For the near (anterior) wall, IMT is measured as the distance between the trailing edge of the first bright line and the trailing edge of the second bright line (del Sol *et al.*, 2001).

In CCA and ICA color Doppler ultrasound imaged the arteries as completely as possible with caudal angulation of transducer in supraclavicular area and cephalic angulation at the level of the mandible. Pulsed Wave Doppler ultrasound (PWD) is used to provide Doppler parameters of CCA and ICA after positioning the sample volume of the beam in the middle of the vessels using an insonation angle 60 degree, between ultrasound beam and longitudinal axis of the carotid segment, thus PSV and EDV were assessed and RI was automatically calculated by sonographic machine using the following formula (Laurent *et al.*, 1990).

$$RI = \frac{PSV - EDV}{PSV}$$

Informed Consent

The research protocol was approval from the both the College of Medical Radiologic Science (CMRS), Sudan University for Science and Technology (SUST) and Ultrasound Department in Ribat Hospital. Beside we obtained written informed consent from all patients prior to each Common Carotid Artery and Internal Carotid Artery ultrasound scan.

RESULTS

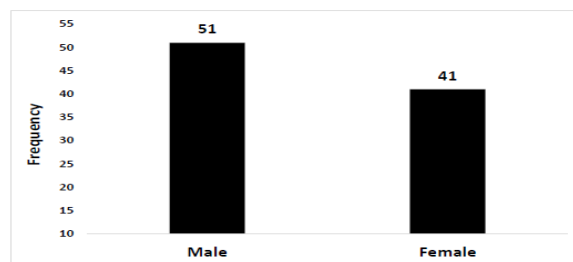


Figure 3.1 Gender distribution

Table 3.1: the Descriptive Statistics of Right Common Carotid Artery indices

	Mean	Std. Deviation	Std. Error Mean	
RT CCA Caliper		7.397	1.12	0.117
RT CCA IMT		1.184	1.94	0.202
RT CCA PSV		78.02	15.43	1.609
RT CCA RI		0.680	0.932	0.097
RT CCA PI		1.983	0.307	0.032

Table 3.2: Descriptive Statistics of Left Common Carotid Artery indices

	Mean	Std. Deviation	Std. Error Mean
LT CCA PSV	74.45	13.2647	1.3829
LT CCA RI	.6802	.5846	.00609
LT CCA PI	2.0103	.27261	.02842
LT ICA Caliper	7.699	1.0392	.1083
LT CCA IMT	2.114	1.0552	.11

Table 3.3: Descriptive Statistics of Right Internal Carotid artery indices

	Mean	Std. Deviation	Std. Error Mean
RT ICA Caliper	5.935	0.99	.103
RT ICA PSV	67.96	11.79	1.23
RT ICA EDV	22.64	4.65	0.49
RT ICA RI	0.69	0.05	0.005
RT ICA PI	1.98	0.32	0.033

Table 3.4: Descriptive Statistics of Left Internal Carotid artery indices

	Mean	Std. Deviation	Std. Error Mean
LT ICA Caliper	5.9804	0.91618	0.9552
LT ICA PSV	65.72	14.7846	1.5414
LT ICA EDV	22.15	5.9153	0.6167
LT ICA RI	0.67	0.0505	0.005
LT ICA PI	2.01	0.305	0.032

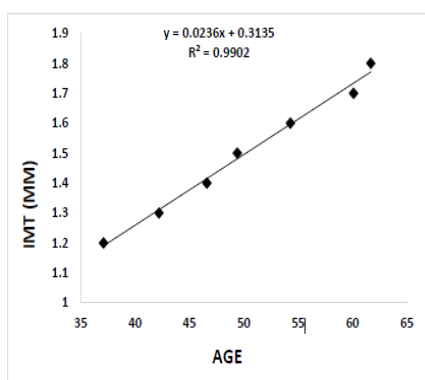


Figure 3.2 Correlation between IMT and Age in Rt CCA.

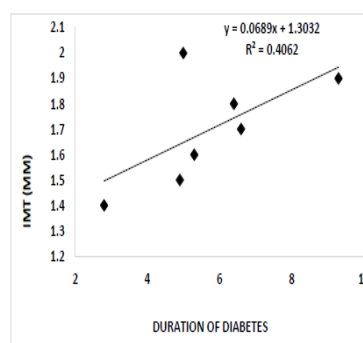


Figure 3.5 Correlation between IMT and Duration of Diabetes in Lt CCA

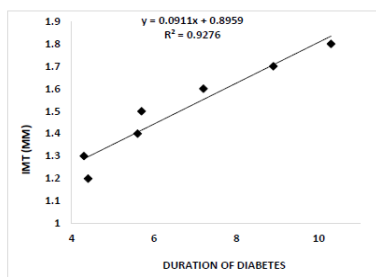


Figure 3.3 Correlation between IMT and Duration of Diabetes in Rt CCA.

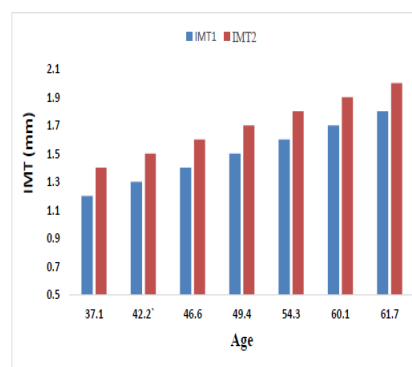


Figure 3.6 Compare IMT between Rt CCA (IMT1) and Lt CCA (IMT2) in age group

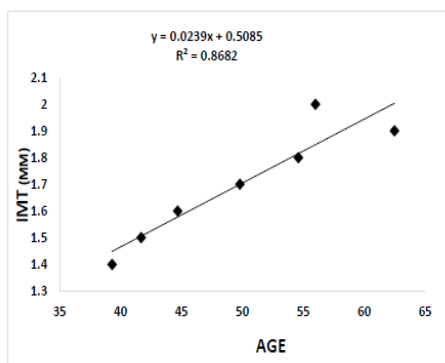


Figure 3.4 Correlation between IMT and Age in Lt CCA.

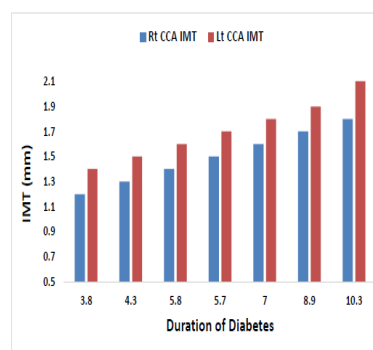


Figure 3.7 Compare IMT between Rt CCA (IMT1) and Lt CCA (IMT2) in Duration group

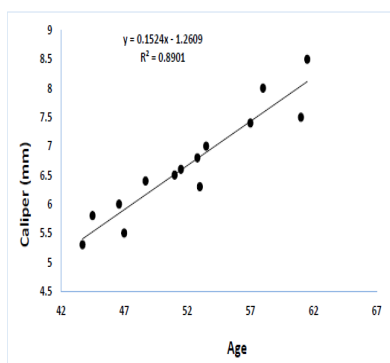


Figure 3.8 Correlation between Caliper and Age in Rt CCA

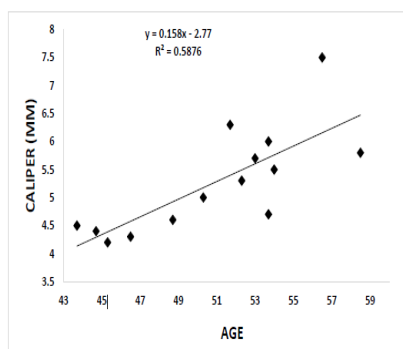


Figure 3.9 Correlation between Caliper and Age in Rt ICA

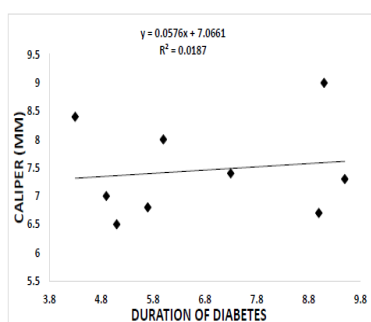


Figure 3.10 Correlation between Caliper and Duration in Lt LCA

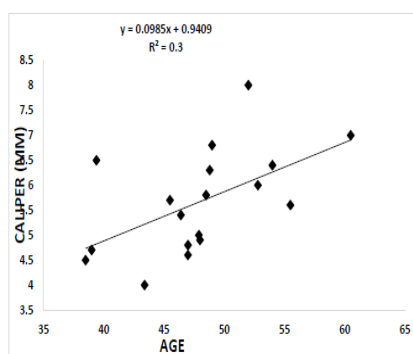


Figure 3.11 Correlations between Caliper and Age in Lt ICA

to assess Common Carotid (CA) and Internal Carotid (IC) artery in both side of neck in patients with type 2 DM using Doppler ultrasonography.

Changes in both structural and functional aspects of arteries have been a research interest for several years as they are considered risk factors for cardiovascular events. As diabetes is one of the most common causes of cardiovascular disease, IMT was changed due to impaired glucose level. Many published studies of normative IMT reported that the diagnostic values of carotid arteries ultrasound using B-mode in evaluating IMT in patients with type 2 DM (Lim *et al.*, 2008), in this study IMT found to be increased than the normal range. Furthermore, IMT is significantly correlated to age and duration of diabetes. this result totally consistent with(Kamile.), study which reveal that in patients with type 2 DM CIMT is higher than in the control group and each increment in its value is related with diabetes microvascular complications and duration of diabetes (Gul *et al.*, 2010)(Sharief *et al* 2015), and due to adherence of circulating monocytes to the endothelium then immigration into the sub-endothelium and subsequent formation of foam cells which are principle initial events in an increase IMT value in type 2DM patients (Eigenbrodt *et al.*, 2007). From obtained data observed that IMT for the Lt CCA is greater than in the Rt CCA which is based on the basic thickness of Lt CCA that usually thicker than the Rt CCA and this is approved by previous study which showed that the value of IMT for Lt CCA has been greater than the Rt CCA (Vicenzini *et al.*, 2007).

The study showed that the calipers positively correlated with patient's age and duration of type 2 DM. This results consistent with (Schmit A, *et al*, 1999), study showed that arterial wall enlarged with age and (Marsh L, *et al*, 2007), in his study found that CAs diameter complemented IMT for discrimination of risk factors of carotid events and both IMT and diameter are so effective in men but in women diameter is stronger than IMT. This prove that the CAs diameter can be a good marker as IMT in assessment early progression of carotid plaques, because arterial diameter occurs early in atherosclerosis (Landy A, *et al*. 2004) and exaggerated in the presence of vulnerable plaques (Kichel S, *et al*, 1999) and (Merono P, *et al*, 2002).

Calipers data revealed that the caliper for the Lt CCA is greater than in the Rt CCA which is based on the basic thickness of the Lt CCA that is usually thicker than the Rt CCA as has been stated by (Edoardo *et al*, 2007), in their study in which they found that the Lt CCA thickness is greater than in the Rt CCA.

Regarding PSV, EDV and RI the results showed that, there is no correlation with age and type 2 DM as appearance in scatters plots of PSV, EDV and RI.

DISCUSSION

The study has been carried out in Ribat Hospital affiliated to National Ribat University with general aim

CONCLUSION

In conclusion, statistically IMT and carotid calipers showed strong positive correlation with age and type 2 DM duration and they consider as a good marker of subclinical for atherosclerosis. IMT values and caliper of carotid arteries tends to be larger in Lt side of the neck than the Rt neck. While there is no correlation between PSV, EDV and RI with age and duration.

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