Evaluation of Carotid Intimal Thickness in Type 2 Diabetic Individuals by Colour Doppler Ultrasonography in a Teaching Hospital in Hyderabad, Telanaga, India

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ABSTRACT

BACKGROUND

Diabetes mellitus is a common chronic condition in our country and is an established modifiable risk factor for cardiovascular diseases and ischemic stroke. Carotid Doppler ultrasonography is a popular tool for evaluating atherosclerosis of the carotid artery. Its two-dimensional grayscale can be used for measuring the intima-media thickness, which is a very good biomarker for atherosclerosis and can aid in plaque characterisation. We intend to evaluate carotid intimal thickness by colour Doppler ultrasonography in type 2 diabetic individuals in a teaching hospital.

METHODS

A prospective study was done among 70 cases of diabetes mellitus in whom ultrasonography (USG) was done in the Department of General Medicine, Maheshwara Medical College, Patancheru, Hyderabad, Telangana.

RESULTS

In the present study, study participants were in the age group of 20 - 70 years. Majority of the cases was in the 41 - 50 years age group with a slight male predominance and the male to female ratio was 1.8:1. In this study, intimal medial thickness (IMT) change of 0.07 mm was observed. Within the observation period of eight months, the IMT of diabetic patients increased by an average of 0.06 mm.

CONCLUSIONS

Colour Doppler ultrasonography of carotid is an important imaging modality for early detection of carotid artery stenosis in diabetic patients who are at risk for developing carotid atherosclerosis. It should be a routine practice to screen diabetic patients for carotid atherosclerosis.

KEYWORDS

Colour Doppler USG, Intima-Media Thickness, Type 2 Diabetes, Atherosclerosis

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BACKGROUND

Diabetes mellitus (DM) is a well-known modifiable risk factor for cardiovascular[1,2,3] diseases and ischaemic strokes. Diabetic patients have 2 to 5 fold increased risk for stroke compared with those without diabetes,[4] and the main underlying cause of stroke is carotid atherosclerosis leading to carotid stenosis with most changes affecting the carotid bifurcation.[5,6] Carotid intima media thickness (cIMT) is widely used as a measure of atherosclerosis, considered to be an important pathogenic mechanism of thrombotic stroke.[7]

Increased cIMT is associated with a higher prevalence of coronary artery disease (CAD) and correlates with future development of myocardial infarction and stroke.[8] Atherosclerosis risk in community (ARIC) study reported that when compared with internal carotid artery, IMT of common carotid artery (CCA) was found to be a stronger marker of future stroke.[9] The B-mode ultrasonography is widely recommended for evaluation of cIMT.[10] The intima-medial thickness has been widely used as one of the parameters of atherosclerosis.[11,12]

The IMT is measured on a two-dimensional (2D) grayscale image. The optimal grayscale image of the longitudinal scan of the carotid artery, which passes by the centre of the carotid artery, shows two bright interfaces along the artery wall. In the far wall, the upper bright line is the interface between the blood and intima, and the lower bright line is the interface between the media layer and adventitia layer.

Carotid arteries are the major vessels that transport oxygenated blood to the brain. Carotid duplex ultrasound (CDUS) is a non-invasive, safe and relatively inexpensive technique for evaluating the carotid arteries. (11) CDUS uses B-mode ultrasound imaging and Doppler ultrasound to detect carotid intima of 11 - 13 media thickness.

Carotid ultrasonography, measuring both the presence of stenosis and IMT, has provided a powerful non-invasive technique (16) to determine atherosclerosis and carotid IMT has been extensively used as an outcome measure in clinical trials.[13] We intend to evaluate carotid intimal thickness by colour Doppler ultrasonography in type 2 diabetic individuals in a teaching hospital

METHODS

This was a prospective observational study done in the Department of General Medicine and Department of Radiology at Maheshwara Medical College, Patancheru, Hyderabad, Telangana, over a period of eight months from January 2020 to September 2020. The study did not have any ethical issues. Written informed consent was obtained from the all the cases included in the study.

Inclusion Criteria

Patients willing to participate in the study. Age group range from 20 years to 70 years. Presence of history of diabetes mellitus. Diabetic patients with fasting blood glucose (FBG) level of ≥ 7.0 mmol / L.

Exclusion Criteria

Pregnant women with gestational diabetes mellitus. Patients with known systemic vascular disease other than diabetes mellitus. Patients with stroke or past history of cerebrovascular disease.

Collection of Data

The study protocols were explained to the patients. A total of 70 cases who attended general medicine outpatient department (OPD) with history of type 2 diabetes were included and all the cases were selected randomly. A general and detailed clinical examination was done. Routine investigations such as complete blood picture (CBP), random blood sugar (RBS), fasting blood sugar (FBS), post lunch blood sugar (PLBS), liver function tests (LFT) were done. The patients were referred to the radiology department where ultrasound examination of the carotid arteries was performed.

USG Procedure

The examination was performed using a high-resolution real-time Doppler ultrasound scanner (GE machine) equipped with 7.5 and 10 MHz linear-array transducer. The high frequency transducer provides greater resolution for superficial structures such as the carotid artery. All the carotids were assessed: right common carotid artery (RCC), left common carotid artery (LCCA), right internal carotid artery (RICA), left internal carotid artery (LICA). The degree of carotid artery narrowing was obtained according to 6 categories, corresponding to North American Symptomatic Carotid Endarterectomy Trial (NASCET) angiographic graduation.[14]

Statistical Analysis

Data was recorded and analysed using the Statistical Package for the Social Sciences software version 11. Results are presented using descriptive statistics and percentages

RESULTS

A total of 70 cases were studied. Among them 45 (64.2 %) were males and 25 (35.7 %) were female patients and the male to female ratio was 1.8:1.

Age (in Years)	Males	Females	Total No. of Cases	(%)
20 - 30	00	01	01	1.4 %
31- 40	03	03	06	8.5 %
41 - 50	25	10	35	50 %
51 - 60	15	09	24	34.2 %
61 - 70	02	02	04	5.7 %
Total	**45**	**25**	**70**	**100 %**

Table 1. Age and Gender Distribution

In the present study the age distribution ranged from 20 - 70 years. Majority of cases were in the 41 - 50 years age group. [Table 1]

Duration of Diabetes

Based on history of the patients, the duration of diabetes mellitus was 2 - 5 years in 10 (14.2 %) cases, 6 - 10 years in 26 (37.1 %) cases and 11 - 15 years in 34 (48.5 %) cases.

	Percentage Degree of Stenosis	Normal (0 %)	< 50 %	50 - 69 %	> 70 %
RCCA	Males	30 (42.8 %)	15 (21.4 %)	-	-
	Females	15 (21.4 %)	10 (14.2 %)	-	-
LCCA	Males	29 (41.4 %)	16 (22.8 %)	-	-
	Females	14 (20 %)	11 (15.7 %)	-	-
RICA	Males	29 (41.4 %)	10 (14.2 %)	06 (8.5 %)	-
	Females	14 (20 %)	06 (8.5 %)	05 (7.1 %)	-
LICA	Males	30 (42.8 %)	10 (14.2 %)	03 (4.2 %)	02 (2.8 %)
	Females	16 (22.8 %)	05 (7.1 %)	04 (5.7 %)	-

Table 2. Sonographic Evaluation of Percentage Degree of Stenosis

RCCA: Right common carotid artery, LCCA: Left common carotid artery, RICA: Right internal carotid artery, ICA: Left internal carotid artery.

For RCCA: 45 patients (64.2 %) showed no stenosis, 25 patients (34.6 %) showed < 50 % stenosis.
For LCCA: 43 patients (61.4 %) showed no stenosis, 27 patients (38.5 %) showed < 50 % stenosis.
For RICA: 43 patients (61.4 %) had no stenosis, 16 patients (22.75 %) showed < 50 % stenosis and 11 patients (15.6 %) showed 50 - 69 % stenosis.
For LICA: 46 patients (75.6 %) had no stenosis, 15 patients (21.3 %) showed < 50 % stenosis and 07 patients (9.7 %) showed 50 - 69 % stenosis, 02 (2.8 %) showed > 70 stenosis.

	IMT Mean ± SD (mm)	Normal (0 %)	< 50 %	50 - 69 %	> 70 %
RCCA (N = 45)	Males	0.78 mm ± 0.07	0.92 mm ± 0.08	-	-
	Females	0.66 mm ± 0.06	0.88 mm ± 0.07	-	-
LCCA (N = 43)	Males	0.77 mm ± 0.07	0.92 mm ± 0.08	-	-
	Females	0.65 mm ± 0.06	0.83 mm ± 0.07	-	-
	Total (RCCA + LCCA)(N)	45 + 43 = 88	25 + 27 = 52		
RICA	Males	0.78 mm ± 0.07	0.84 mm ± 0.07	1.18 mm ± 0.17	-
	Females	0.66 mm ± 0.06	0.73 mm ± 0.06	1.15 mm ± 0.12	-
LICA	Males	0.75 mm ± 0.07	0.82 mm ± 0.07	1.11 mm ± 0.11	1.5 ± 0.17 mm
	Females	0.65 mm ± 0.06	0.72 mm ± 0.06	1.06 mm ± 0.11	-
	Total (RICA + LICA) (N)	43 + 46 = 89	16+15 = 31	11 + 07 = 17	0 + 2 = 02

Table 3. Means in Intima-Media Thickness (IMT) and Percentage Degree Stenosis in the Carotid Arteries of Diabetic Patients

RCCA: Right common carotid artery, LCCA: Left common carotid artery, RICA: Right internal carotid artery, LICA: Left internal carotid artery.

Personal History

Based on personal history, the habit of only smoking was seen in 10 (14.2 %) cases, only alcohol intake was seen in 15 (21.4 %) cases, both smoking and alcohol intake were seen in 35 (50 %) cases and the habit of tobacco chewing was present in 10 (14.2 %) cases.

In this study, IMT change of 0.07 mm was observed. Thus, within the observation period of eight months in 80 patients IMT of diabetics increased by an average of 0.06 mm.

DISCUSSION

In the present study the total sample size was of 70 patients. Hoke et al.[15] in a similar study had a large sample size of 1065 patients.

Comparative Studies Based on Age Distribution

In the present study, the age distribution was 20 - 70 years and majority of the cases i.e. 50 % were in the 41 - 50 years age group followed by 34.2 % cases in the 51 - 60 years age group. In the study by Hoke et al.[15] the median age of the patients was 69 years. In the study by Ahmadu et al.[16] the age range was 20 - 78 years with a mean of 50.03 ± 11.4 years. The predominant age group in both genders was 40 - 49 years. In the study by Kota SK et al.[17] majority of their subjects were distributed in the age group of 61 - 70 years.

Comparative Studies Based on Gender Distribution

In our study there was a slight male predominance with the male to female ratio being 1.8:1 as there were 45 (64.2 %) male and 25 (35.7 %) female patients. In the studies by Ahmadu et al.[16] and Yamasaki et al.[18] there were 72 (60 %) male and 48 (40 %) female patients and 124 male and 163 female patients respectively. Kota SK et al.[17] also observed a male predominance with 19 (76 %) male and 6 (24 %) female patients.

Comparative Studies Based on Personal History

n the present study, 50 % patients had history of both smoking and alcohol and 14.2 % cases had history of smoking and tobacco chewing each and 21.4 % cases had history of alcohol. Bernard et al.[19] in their study observed that overall, 23 % were current smokers, 48 % had hypertension, and 24 % had microalbuminuria. Glycemic control as assessed by HbA1c was poor in their study.

Comparative Studies Based on Diabetes Mellitus and Degree of Carotid Stenosis

In our study, 15.6 % patients had unilateral carotid artery narrowing of 50 - 69 %. Hoke et al.[15] observed 35.4 % of their study group had unilateral or bilateral carotid artery narrowing of ≥ 50 % at enrolment.

	Percent Degree of Stenosis	Ahmadu et al. Study [16] Normal (0 %)	< 50 %	50 - 69 %	> 70 %	Present Study Normal (0 %)	< 50 %	50 - 69 %	> 70 %
RCCA	Males	45 (37.5 %)	27 (22.5 %)	-	-	30 (42.8 %)	15 (21.4 %)	-	-
	Females	31 (25.8 %)	17 (14.2 %)	-	-	15 (21.4 %)	10 (14.2 %)	-	-
LCCA	Males	44 (36.7 %)	28 (23.3 %)	-	-	29 (41.4 %)	16 (22.8 %)	-	-
	Females	30 (25 %)	18 (15 %)	-	-	14 (20 %)	11 (15.7 %)	-	-
RICA	Males	44 (36.7 %)	18 (15 %)	10 (8.3 %)	-	29 (41.4 %)	10 (14.2 %)	06 (8.5 %)	-
	Females	30 (25 %)	10 (8.3 %)	8 (6.7 %)	-	14 (20 %)	06 (8.5 %)	05 (7.1 %)	-
LICA	Males	45 (37.5 %)	15 (12.5 %)	11 (9.2 %)	1 (0.8 %)	30 (42.8 %)	10 (14.2 %)	03 (4.2 %)	02 (2.8 %)
	Females	32 (26.7 %)	13 (10.8 %)	3 (2.5 %)	-	16 (22.8 %)	05 (7.1 %)	04 (5.7 %)	-

Table 4. Comparative Studies Based on Sonographic Evaluation of Degree of Stenosis of Carotid

Comparative Studies Based on Diabetes Mellitus and IMT

In the present study IMT change of 0.07 mm was observed. Thus, within the observation period of eight months the IMT of diabetic patients increased by an average of 0.06 mm.

In Yamasaki et al study.[18] 287 diabetic subjects showed an IMT change of 0.040 ± 0.004 mm / year. They reported that in the study period of 3 years, the IMT of diabetic patients increased by an average of 0.120 mm.

In the study by Ahmadu et al.[16] the mean intima-media thickness (mm) for normal (non-stenotic) carotid arteries on the right and left were (CCA = 0.71 ± 0.09 and 0.70 ± 0.08; ICA = 0.71 ± 0.08 and 0.69 ± 0.09) and abnormal (stenotic) on the right and left were (CCA = 0.84 ± 0.17 and 0.83 ± 0.19; ICA = 0.98 ± 0.10 and 1.03 ± 0.10) respectively.

In the study by Kota SK et al.[17] they observed that type 2 diabetes mellitus patients with or without ischemic stroke had a significantly higher prevalence of increased cIMT and a value greater than 0.8 mm was associated with the occurrence of stroke. The mean carotid IMT of the group as a whole was 0.840 ± 0.2 mm. Naomi et al.[20] also reported that carotid artery IMT was significantly greater in diabetic patients than in non-diabetic patients.

Comparative Studies Based on Complications

In the present study, 8.5 % (6 / 70) patients showed diabetic retinopathy. Intima-media thickness was higher in patients with diabetic retinopathy (0.13 ± 0.07 mm). In the study by Nejad et al.[21] diabetic retinopathy was found in 50 % (50) patients. Intima-media thickness was higher in patients with diabetic retinopathy than in those without retinopathy (0.77 ± 0.17 mm vs. 0.71 ± 0.2 mm, respectively, P = 0.041). Razzaq et al. used carotid duplex ultrasound in 45 diabetic patients diagnosed of stroke and observed that carotid artery stenosis was greater than 50 %.

In our study, the prevalence of carotid stenosis was found to be 5.8 % of the total population whereas, Nejad et al.[21] observed prevalence of carotid stenosis was around 37.5 % of the total study population.

CONCLUSIONS

Colour Doppler ultrasonography of carotid is an important imaging modality for early detection of carotid artery stenosis in diabetic patients who are at risk of developing carotid atherosclerosis. It should be a routine practice to screen diabetic patients for carotid atherosclerosis.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.
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