Original Article

Carotid Doppler Screening in Type 2 Diabetes Mellitus with Risk Factors

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ABSTRACT

Objective: To find out usefulness of screening by Carotid Doppler in type 2 Diabetes Mellitus with the four major modifiable risk factors i.e. smoking, hypertension, obesity and lipid profile by evaluating for the presence & extent of atherosclerotic carotid artery disease in asymptomatic Type 2 diabetics, by Carotid artery Doppler Ultrasonography.

Methods: This study, conducted in a tertiary care hospital of South Gujarat, enrolled 50 subjects who were known cases of type 2 DM with risk factors for accelerated atherosclerosis.

Result: The target population constituted 60% males and 40% females. There was a positive correlation of increase CIMT with duration of diabetes mellitus, HbA1c, LDL, TG and diabetic retinopathy.

Conclusion: The routine use of carotid Doppler screening of the type 2 DM with risk factors can be recommended in patient with longer duration of DM (>7 years), HbA1c (>7.5%), and altered lipid profile or patient having any end organ damage.

Key words: carotid intima-media thickness, type 2 diabetes mellitus

INTRODUCTION

India has been proposed as the diabetic capital of the world with the number of patients expected to rise from 40.9 to 101 million by 2030.[1]

As atherosclerosis is accelerated in patients of diabetes, the risk of coronary disorders and stroke in diabetic patients is three times that in individuals without this condition.[2,3,4] Stroke is one of the leading cause of morbidity and mortality in our country. Carotid artery stenosis, usually secondary to atherosclerosis, is one of the main causes of stroke. Intima-media thickness (IMT) of common carotid artery is an excellent non-invasive measure of generalized atherosclerosis. It also serves as a surrogate marker of coronary artery disease (CAD)[5] and correlates strongly with future development of stroke and CAD.[6]

At present, carotid ultrasound is recommended in diabetic patients with cerebrovascular symptoms. Since the prevalence of diabetes is increasing constantly, it could be recommended for diabetic patients with at least one or more risk factors for accelerated atherosclerosis and for diabetic patients above 50 years of age.[7,8]

METHODS

The study was conducted amongst outdoor & indoor patients of the Surat municipal Institute of Medical education and research (SMIMER). OPD/Indoor patients at SMIMER, known case of type 2 diabetes mellitus with any of the following risk factors: Smoking, Hypertension, Obesity (BMI > 30kg/m^2), High blood cholesterol (Total Cholesterol > 240 mg/dl) and willing to participate in the study were enrolled in the study. Patient of extremes of age (< 18 years or > 60 years), patient with other type of diabetes and patient with any evidence of cerebrovascular disease were excluded from the study.

Subjects were examined in the supine position, with the head turned 45° away from the side being scanned. The ultrasound system used was a VOLUSON S8 (GE Healthcare), equipped with a 5-10 MHz linear array transducer. The left and right common carotid arteries were examined in anterolateral, posterolateral, and mediolateral direction. The IMT of the carotid artery was measured as the distance from the leading edge of the first echogenic line, corresponding to the lumen-intimal interface, to that of the second echogenic line, corresponding to the collagen-contained upper layer of tunic adventitia[12], as shown in figure below:

Figure 1: Intima media thickness

The measurement of IMT was made in a 1-cm segment proximal to the dilation of the carotid bulb and always in plaque-free segments. The artery was then searched for the presence of plaques. Plaque was defined as the presence of a focal lesion measuring at least twice the thickness of the IMT. The normal value of IMT in carotid vessels is <0.8 mm. While increased in IMT were divided in mild-0.8-1.2 mm, moderate- >1.2 – 1.6 mm and severe >1.6 mm. The raised IMT is a surrogate marker of accelerated atherosclerosis.

OBSERVATIONS AND DISCUSSION

This study, conducted in a tertiary care hospital of South Gujarat, enrolled 50 subjects who were known cases of type 2 DM with risk factors for accelerated atherosclerosis and the observation of study is as below:

The age range of the study subjects were 35 to 60 years, with a mean of 52 ± 6.6 years. 32 of our patients (64%) were between the age ranges of 51 to 60 years. Similarly results of other variables according to stratification have been shown in Table-1. The mean IMT in >50 years age group was higher than ≤50 years age group, with a positive correlation and a statistically significant difference between the two groups. There were 30 male subjects in study and different parameter of blood investigation with mean value is stated in table number 2. There was no statistically difference in blood investigation according to gender. Correlation of various factors with carotid IMA is depicted in table 3. As the age progresses IMT was increased in diabetic patients which was also seen in study conducted by Bashir F et al[13] and Taniguchi et al[14]; however, in another study conducted by Mujeeb-ur-Rehman et al[15] no significant association was found between the two. This was due to accumulation of various stress factors over period of time. Though there was no difference in IMT between gender of subjects but Kong et al[16] found that CCA-IMT was closely associated with male sex, age and smoking.

The mean IMT was higher in subjects who had duration DM for >7 years, HbA1c > 7.5 %. Similar results were seen in a study conducted by Bashir F et al [13], and Wagen knecht LE [17]; however, in other studies conducted by Mujeeb-ur-Rehman et al [15] and Taniguchi et al [14] no significant association was found between the two. However, when the duration of diabetes was reduced to 6 years or 5 years, the difference in the mean IMT was not statistically significant. Chronic hyperglycemia leads to change in vasculature leads to accelerated atherosclerosis and can be independent risk factor for it. [14]

The mean IMT was higher in subjects whose BMI >30 kg/m^2 but the difference was statistically not significant. Taniguchi et al [14] found a strong association of age, duration of DM and raised non esterified free fatty acids while no correlation was seen with BMI and raised cholesterol or triglyceride levels. Ciccone M et al [18] found that CCA-IMT was correlated with smoking and body mass index. In contrast to our study, Ciccone et al [18] found that BMI is strongly and independently associated with the IMT of common carotid artery. Their results suggest that central fat accumulation may accelerate the development of earlier clinically silent stages of atherosclerosis, thus possibly explaining the higher prevalence of cardiovascular diseases in patients with abdominal obesity.

The mean IMT was higher in subjects who had Diabetic Retinopathy. The ARIC study found that the severity of retinopathy correlated positively with carotid artery intima media wall thickness.[19]

The mean IMT was higher in subjects who had altered lipid profile. Similar results were seen in a study conducted by Bashir F et al [13] and Wagen knecht LE[17]. Though it is well established that in non-diabetics, age, gender, total cholesterol and smoking are independent determinants of CCA-IMT.[20]

Table 1: Demographic characteristics of the population

Parameters	Subjects (%)
Age (years)	
≤ 50	18 (36)
>50	32 (64)
Gender	
male	30 (60)
female	20 (40)
Duration (years)	
≤5	21 (42)
>5	29 (58)
Target organ damage	
Diabetic retinopathy	27 (54)
Diabetic neuropathy	17 (34)
Peripheral Arterial disease	10 (20)
Nephropathy	10 (20)
Cardiac complication	20 (40)
Risk factors	
Hypertension	27 (54)
Obesity	15 (30)
Smoking	15 (30)
Altered lipid profile	30 (60)
Number of risk factors	
≤2	43 (86)
>2	7 (14)
Stenosed vessel present	6 (12)

Table 2: Comparison of Investigation profile of study group according to their gender

Investigation	Mean Values ± SD		P value
	Male	Female	
FBS (mg/dl)	162.53 ± 56.68	143.25 ± 34.17	0.1794
PP2BS (mg/dl)	243.1 ± 74.38	233.7 ± 53.38	0.6285
HbA1c (%)	7.54 ± 0.84	7.25 ± 0.71	0.2103
TGs(mg/dl)	200.13 ± 90.98	152.35 ± 45.92	0.03
LDL (mg/dl)	140.43 ± 65.55	134.15 ± 59.24	0.7319

Table 3: Correlation of Risk Factors with Common Carotid Intimal- Medial Thickness

Risk factors	Common carotid artery Mean IMT (mm)		P value
	Right	Left	
Age			
≤50 y (n=18)	0.73 ± 0.40	0.79 ± 0.30	0.00012
>50 y (n=32)	1.24 ± 0.41	1.20 ± 0.35	0.00012
Gender			
Male(n=30)	1.15 ± 0.45	1.12 ± 0.40	0.1087
Female(n=20)	0.93 ± 0.49	0.95 ± 0.35	0.1287
Duration			
≤7 y (n=30)	0.91 ± 0.43	0.95 ± 0.37	0.00650
>7 y (n=20)	1.28 ± 0.48	1.21 ± 0.36	0.0175
Hypertension			
present	1.11 ± 0.52	1.08 ± 0.41	0.4241
absent	1.00 ± 0.43	1.02 ± 0.36	0.5882
BMI (kg/m^2)			
<30 (n=37)	1.02 ± 0.44	1.06 ± 0.40	0.3690
≥30 (n=13)	1.16 ± 0.58	1.03 ± 0.34	0.8105
HbA1C (%)			
≤7.5% (n=26)	0.86 ± 0.43	0.94 ± 0.38	0.00049
>7.5% (n=24)	1.31 ± 0.42	1.20 ± 0.35	0.01550
Retinopathy			
Normal fundus (n=23)	0.77 ± 0.37	0.85 ± 0.32	0.00002
Retinopathy (n=27)	1.30 ± 0.42	1.23 ± 0.35	0.00023
Smoking			
Present (n=15)	1.25 ± 0.45	1.26 ± 0.34	0.065
Absent (n=35)	0.98 ± 0.47	0.97 ± 0.37	0.072
Altered lipid profile			
TC > 240mg/dl (n=30)	1.00 ± 0.50	1.02 ± 0.40	0.2816
TC ≤ 240mg/dl (n=20)	1.15 ± 0.44	1.11 ± 0.37	0.4261
TG(mg/dl)			
≤200 (n=26)	0.90 ± 0.41	0.96 ± 0.36	0.004
>200 (n=24)	1.26 ±0.47	1.15 ±0.39	0.047
HDL(mg/dl)			
≤60 (n=24)	1.13 ± 0.45	1.17 ± 0.41	0.3047
>60 (n=26)	0.99 ± 0.50	0.95 ± 0.33	0.07122
LDL(mg/dl)			
≤160 (n=23)	0.86 ± 0.43	0.92 ±0.37	0.004
>160 (n=27)	1.23 ±0.45	1.17 ±0.36	0.019

Irrespective of well-known risk factors of atherosclerosis Geroulakos G et al [21] and Kanters SD[22] were unable to find any statistically significant correlation between CCA-IMT with age, gender, duration of DM, serum total cholesterol and triglyceride levels in patients with type 2 diabetes mellitus.

Naya et al [23] found smokers with high body mass index, high fasting serum insulin, or high systolic blood pressure to have larger CCA-IMT values than would be predicted by consideration solely of the individual risk factors but in our study, we could not find such an association. They also found that Diabetes mellitus status itself and even impaired glucose tolerance as compared to normal glucose tolerance is a strong predictor of CCA-IMT. It is probably explained by the fact that diabetes itself is of crucial importance for the development of atherosclerosis because of clustering of multiple interrelated metabolic disturbances that it over shadows the contribution of other risk factors. In our study also majority of patients had other risk factors in addition to diabetes mellitus.

CONCLUSION

On the basis of our study, it can be recommended that Carotid Doppler scanning must be done on Diabetic patients, if - Duration of DM > 7 years, HbA1c > 7.5 %, LDL > 160 mg/dl and TG > 200 mg/dl, Diabetic Retinopathy, BMI >30 Kg/m^2 and/or Hypertension

In conclusion, our data shows that CCA-IMT is directly associated with, duration of DM, LDL, TG, HbA1c and diabetic retinopathy. This study therefore suggests that the carotid intima-media thickness may be clinically useful in the monitoring of vascular changes in the management of type 2 diabetics. Considering the conflicting outcomes of different studies, it is suggested that further research is required in larger number of patients to find out the interrelationship and contribution of various risk factors of carotid atherosclerosis in diabetic patients. Our preliminary study paves way for further randomized studies including large number of patients from multiple centers with longer follow-up,

which would assess the role of CIMT in predicting the development of various complications and how the various available treatment strategies could be incorporated to influence the outcome.

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