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Original Article

Evaluation of Carotid Artery Intima-media Thickness in Patients of Type 2 Diabetes Mellitus

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Abstract

Introduction: Majority of diabetic patients suffer from intense atherosclerosis. Out of all the sonographic parameters, carotid intima-media thickness (CIMT) has been established as the most effective prognosticator.

Aims and objectives: The aim of the study was to compare the CIMT in diabetics and non-diabetics and correlation with age, sex, body mass index (BMI), and lipid profile.

Materials and Methods: The present study was cross-sectional analytical study done in Medicine ward, Lata Mangeshkar Hospital, Nagpur.

Results: CIMT was increased in diabetics as compared to non-diabetics. Statistically significant difference was found in CIMT in cases and controls in correlation to age, sex, increased BMI, dyslipidemia in the form of increased triglycerides, and decreased high-density lipoprotein.

Conclusion: CIMT might serve as an effective prognosticator for atherosclerosis in high-risk diabetic patients.

Key words: Atherosclerosis, Body mass index, Carotid intima-media thickness, Diabetes, Dyslipidemia

INTRODUCTION

Globally, diabetes mellitus (DM) acts as a major culprit for its contribution to morbidity and mortality related to cardiovascular health. International Diabetes Federation estimates on prevalence of diabetes indicate a massive increasing trend.[1,2] Global prevalence of DM is around 382 million, which is estimated to rise close to 600 million by 2035.[3] Majority of diabetic patients suffer from intense atherosclerosis.[4] This has been corroborated by findings of Framingham Heart Study, which found that diabetic patients had increased incidence of atherosclerosis and its after effects such as coronary artery disease (CAD), cerebrovascular disease, and peripheral vascular disease.[5] Furthermore, it was found in the global registry of acute coronary events registry that one-quarter of patients suffering from CAD and its sequelae were diabetics.[6]

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Conventionally, coronary angiography (CA) has been established as an investigation of choice for assessing coronary atherosclerosis. However, due to factors such as invasiveness of the procedure, increased cost, and need for sophisticated setup the practice of CA on a large scale is not feasible, especially in developing countries like India. Alternatively, ultrasonographic evaluation of easily accessible arteries has been advocated as surrogate marker for comparatively remote arterial system like cerebral arteries. Various advantages of ultrasonography have been documented over CA such as non-invasiveness, less expensive, and procurement of vital information such as carotid intima media thickness (CIMT), type and localization of plaque, calcification, and arterial diameter and thus the extent of atherosclerosis helps in gauging the risk of cardiovascular events.[7] In other words, it can

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be used to identify patients of DM, who are at increased risk of CAD.

Out of all the sonographic parameters, CIMT has been established as the most effective prognosticator. Greater the CIMT value, greater is the risk of cardiovascular morbidity and mortality. It has been found that CIMT values are greater in diabetics as compared to non-diabetics which reflect in increased cardiovascular morbidity and mortality in diabetic patients.[8,9] This holds true even in case of patients with borderline oral glucose tolerance test results/prediabetes. Thus, CIMT values show an increasing trend as we move from non-diabetic, prediabetes to diabetes. These changes in CIMT appear to be more pronounced in internal carotid artery as compared to common carotid artery.[10] Thus, measurement of CIMT at baseline and after an intervention can also serve as an important target in the management of high-risk diabetics.[11]

It has been seen in Indian diabetic patients that CIMT serves as an autonomous prognosticator for cardiovascular morbidity and mortality.[12] Thus, we planned this study to measure CIMT in diabetics, with, or without CAD.

Aims and Objectives

The present study was planned with the following aims and objectives:

1. To determine and compare the CIMT in type 2 DM patients with age- and sex-matched controls.
2. To correlate the CIMT in type 2 DM patients with age, sex, body mass index (BMI), and lipid profile.

MATERIALS AND METHODS

Study Design

This was a cross-sectional observational analytical study.

Sample Size

The sample size was 120 (60 patients and 60 controls).

Study Site

This study was conducted at Medicine ward, Lata Mangeshkar Hospital, Nagpur, India.

Study Duration

The study duration was from July 2007 to December 2009.

Inclusion Criteria

The following criteria were included in the study:

- Known or newly detected type 2 DM patients
- Age >40 years but <60 years
- Willing to give informed consent

Exclusion Criteria

The following criteria were excluded from the study:

- Patients with a history of hypertension
- Patients with a history of ischemic heart disease or cerebrovascular accident
- Chronic smoker and/chronic alcoholism
- Patients with acute or chronic liver or kidney disease
- Patients with thyroid disorders
- Patients taking beta-blockers, estrogen, or statins
- Patients with overt malignancy
- Not willing to give consent.

Methodology

The methodology process adopted for the present study is depicted in Figure 1.

Ethical Approval

The ethical approval was taken before start of the study from the Institutional Ethics Committee.

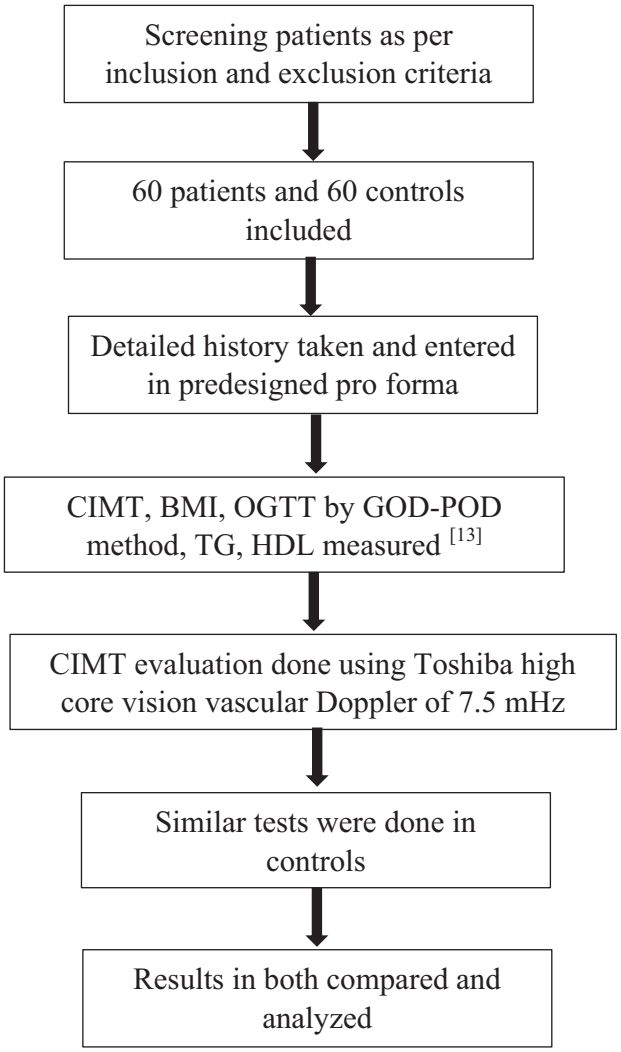

Figure 1: Showing methodology adopted for the present study

Statistical Analysis

Data were analyzed using an unpaired *t*-test, wherein $P < 0.05$ was considered as statistically significant and $P < 0.01$ was considered as highly significant.

RESULTS

In the present study, 60 cases and an equal number of age- and sex-matched controls were included in the study. Patients comprised 30 males and 30 females. An equal number of patients were found in age groups 40–50 years and 50–60 years, i.e., 30 in each group. Majority of the patients had duration of DM >5 years, i.e., 40 patients (67%) had DM >5years [Table 1].

BMI >25–29.9, i.e., overweight was found in 51 patients (85%), while 2 patients had BMI > 30 i.e., obese. Serum triglycerides (TG)> 150 mg/dl was found in 51 patients (85%). Serum high-density lipoprotein (HDL) was decreased < 40 mg/dl in 45 patients (75%) [Table 2].

Comparison of CIMT findings between cases and controls is shown in Table 3. Increased CIMT >0.90 was found in 32 patients (53%) as compared to none in controls.

On analyzing age-wise distribution of CIMT in cases and controls, it was found that mean CIMT in cases was 0.989 ± 0.233 as compared to 0.687 ± 0.058 in controls in age group 41–50 years, and 0.931 ± 0.147 in cases as compared to 0.699 ± 0.06 in controls in the age group 51–60 years; difference in both age groups between cases and controls was highly statistically significant ($P < 0.0001$) [Figure 2].

Mean CIMT in males was 1.02 ± 0.243 and 0.89 ± 0.412 in females which was statistically significant ($P < 0.01$) [Figure 3].

The difference in mean CIMT in males and females in controls was not statistically significant. On analysis of correlation of BMI with mean CIMT in cases and controls, it was found that mean CIMT in BMI 18.5–24.9 was 0.71 ± 0.03 in cases and 0.98 ± 0.18 in cases with BMI >25. Differences in mean CIMT between cases and controls in both groups were highly statistically significant [Table 4].

Mean serum TG in cases was 168.63 ± 13.99 mg% and CIMT was 0.960 ± 0.206 mm, while mean HDL was 42.83 ± 5.43. Difference between cases and controls was highly statistically significant [Table 5].

DISCUSSION

Atherosclerosis is a multifactorial disease associated with a variety of risk factors such as DM, hypertension, obesity,

Table 1: Sociodemographic details in cases

Sociodemographic details	
Particulars	**Number**
Age	
40–50	30
50–60	30
Sex	
Male	30
Female	30
Duration of DM (years)	
≤5	20 (33%)
>5	40 (67%)

DM: Diabetes mellitus

Table 2: Laboratory investigations in patients

Laboratory parameters	
Particulars	***n* (%)**
BMI	
18.5–24.9	7 (12)
25–29.9	51 (85)
>30	2 (3)
Serum TG	
≤150	9 (15)
>150	51 (85)
Serum HDL	
≤40	45 (75)
>40	15 (25)

TG: Triglycerides, HDL: High-density lipoprotein, BMI: Body mass index

Table 3: CIMT findings in patients and controls

CIMT findings		
CIMT (in mm)	***n* (%)**	
	Patients	**Control**
0.70–0.79	13 (22)	23 (38)
0.80–0.89	15 (25)	6 (10)
0.90–0.99	10 (17)	0
>1	22 (36)	0

CIMT: Carotid intima-media thickness

Table 4: Correlation of BMI and mean CIMT values

BMI	Cases (mm) in mean±SD	Controls (mm) in mean±SD	*P* value
18.5–24.9	0.71±0.03	0.63±0.03	<0.0001
25–29.9	0.98±0.18	0.72±0.04	<0.0001

CIMT: Carotid intima-media thickness, BMI: Body mass index, SD: Standard deviation

Table 5: Correlation of lipid profile and mean CIMT values

Correlation of CIMT with lipid profile				
Participant	**Item**		**Mean CIMT**	***P* value**
	HDL	**Mean TG**		
Patient	36.96±4.94	168.63±13.99	0.960±0.206	<0.0001
Control	42.83±5.43	134.73±16.78	0.693±0.06	>0.05

CIMT: Carotid intima-media thickness, TG: Triglycerides, HDL: High-density lipoprotein

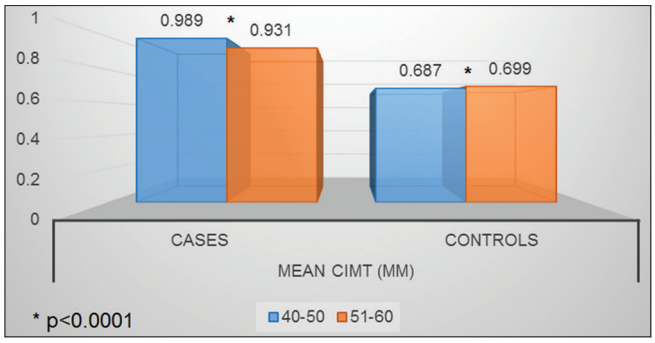

Figure 2: Age-wise distribution of carotid intima-media thickness in case and controls

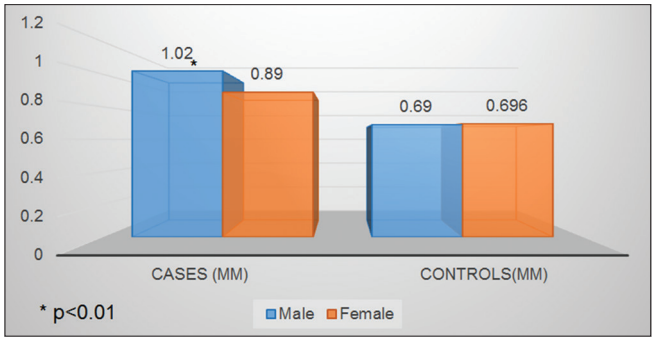

Figure 3: Sex-wise distribution of carotid intima-media thickness in case and controls

sedentary lifestyle, and dyslipidemia. Atherosclerotic plaques affect peculiar arterial systems and produce a plethora of clinical symptoms depending on the arterial system involved. Atherosclerosis has been implicated as a causative factor for grave diseases such as CAD, cerebrovascular disease, and also peripheral vascular disease.[14]

The mean CIMT in the present study was 0.96 mm, which is similar to that of other study findings.[7,15] Females had lower values of CIMT as compared to males. Such low CIMT values in females were reported by Gayathri *et al.* low CIMT values in the present study may be attributed to two facts; one being the protective effect of female hormones on lipid profile and second due to male sex as a risk factor. In the present study, CIMT increased with advancing age and this association was highly statistically significant. This is in contrast to that of findings of one study;[7] however, Doruk *et al.* reported high male preponderance.[16]

Intimal thickness processes and advancement are postulated to be similar to that of atherosclerotic plaque, while hypertrophy of tunica media layer is believed to be due to persistently increased blood pressure.[17,18] The intimal layer of carotid arteries is thin as compared to other muscular arteries, thus increased CIMT may be related to increased media thickness rather than increased intimal thickness.[19] Some authors attribute this to altered baroreceptor function in response to atherosclerotic plaque in the carotid plaque.[20]

Out of the major risk factors, dyslipidemia and DM are most commonly implicated in atherosclerosis. In the present study, dyslipidemia was found in almost 75–85% of the patients with 75% with decreased HDL and 85% with increased TG. These findings are in contrast to that of other such studies wherein dyslipidemia was reported to be 22–52%.[21,22] These differences may be due to the fact that cut off level of hypertriglyceridemia was variable in different studies. CIMT was increased by 36% of the patients with dyslipidemia. Furthermore, it was found in a study that obesity and dyslipidemia are associated with increased levels of adipokines such as adiponectin and leptin which are implicated in initiating and progression of atherosclerotic plaque, which is reflected as increased CIMT.[23] Thus, it can be implied that it is better to screen diabetic patients with dyslipidemia for presence or absence of atherosclerosis by measuring CIMT.

The mean BMI of patients in the present study was in the overweight range, which further increased spectrum of diabetic patients to be screened routinely for increased CIMT. Similar findings were found in other study by Temelkova-Kurktschiev *et al.*[8] Majority of patients in the present study had CIMT >1 which is taken as the cutoff for atherosclerosis. On analyzing these values for their correlation with age, it was found that CIMT was more in both age groups. A similar trend was reported by Mohan *et al.*[15] It is a well-established fact that vasculature of advancing age is more prone to atherosclerotic changes.[14] CIMT values in the present study were more in males as compared to females. This was corroborated by findings of other such study conducted in western countries.[24] In the same study, investigators found that advancing age was major risk factor in both sexes. Increased BMI is associated with increased circulating levels of free fatty acids, which are implicated to play an important role in oxidative damage, leading to the formation of oxidized low-density lipoprotein which is a triggering point for the formation of atherosclerotic plaque.[25]

One limitation of the present study was that the progression of CIMT was not studied in relation to the said risk factors.

CONCLUSION

The present study showed that CIMT was significantly higher in diabetic patients, especially in relation to advancing age, male sex, dyslipidemia, and increased BMI. Thus, it can be concluded that CIMT may serve as an effective screening

tool for atherosclerosis in diabetic patients with risk factors such as increased BMI, dyslipidemia in pursuit of limiting the development, and progression of atherosclerosis.

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