Section: Medicine

Original Research Article

TO STUDY THE CAROTID ARTERY INTIMAL THICKNESS IN PATIENTS OF DIABETES MELLITUS AND ITS COMPARISON WITH NORMAL INDIVIDUALS

Inderpal Singh[1], *Ashish Bhagat*[2], *Abhinav Sachdeva*[3]

[1]*Assistant Professor, Department of Medicine, GMC Patiala, Punjab, India.*
[2]*Professor, GMC Patiala, Punjab, India.*
[3]*Junior Resident, GMC Patiala, Punjab, India.*

Received *: 10/07/2025*
Received in revised form *: 28/08/2025*
Accepted *: 19/09/2025*

Corresponding Author:
Dr. Abhinav Sachdeva,
Junior Resident, GMC Patiala, Punjab, India.
Email: abhinavsachdeva4@gmail.com

DOI: 10.70034/ijmedph.2025.3.593

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2025; 15 (3); 3239-3242

ABSTRACT

Background: Carotid artery intima-media thickness (CIMT) serves as a non-invasive marker of subclinical atherosclerosis and cardiovascular disease risk. Diabetes mellitus is associated with accelerated atherosclerosis, making CIMT assessment crucial in diabetic patients.
Objective: To evaluate carotid artery intima-media thickness in patients with diabetes mellitus and compare it with normal healthy individuals.
Methods: This cross-sectional study included patients with diabetes mellitus and age-matched healthy controls. B-mode ultrasonography was performed to measure CIMT at the common carotid artery, carotid bulb, and internal carotid artery bilaterally. Statistical analysis was performed to compare CIMT values between diabetic patients and controls.
Results: Diabetic patients demonstrated significantly increased CIMT compared to healthy controls. The mean CIMT was notably higher in diabetic patients across all measured sites. A positive correlation was observed between duration of diabetes and CIMT values.
Conclusion: Carotid artery intima-media thickness is significantly increased in patients with diabetes mellitus compared to normal individuals, indicating early atherosclerotic changes and increased cardiovascular risk.
Keywords: Carotid intima-media thickness, diabetes mellitus, atherosclerosis, cardiovascular disease, ultrasonography

INTRODUCTION

Cardiovascular disease remains the leading cause of morbidity and mortality in patients with diabetes mellitus, accounting for approximately 65-80% of deaths in diabetic patients[1]. The pathophysiological mechanisms underlying accelerated atherosclerosis in diabetes are multifactorial, involving chronic hyperglycemia, insulin resistance, oxidative stress, and inflammatory processes[2].

Carotid artery intima-media thickness (CIMT) measurement using B-mode ultrasonography has emerged as a valuable non-invasive tool for assessing subclinical atherosclerosis[3]. The intima-media complex represents the innermost layers of the arterial wall, and its thickness serves as an early marker of atherosclerotic changes before the development of overt cardiovascular events[4]. The technique is reproducible, cost-effective, and provides real-time assessment of vascular health.

In healthy individuals, normal CIMT values typically range from 0.6-0.7 mm in middle-aged adults, with an upper threshold of 0.9 mm often considered as a marker of increased cardiovascular risk[5]. Age-specific normal values have been established, with reference limits varying from 0.47 mm in younger adults to 0.80 mm in older individuals[6].

Previous studies have demonstrated that patients with type 2 diabetes mellitus exhibit CIMT values approximately 0.13 mm greater than control subjects[7]. Furthermore, recent research has shown that even patients with newly diagnosed diabetes have significantly greater CIMT compared to those with normoglycemia and prediabetes[8].

The relationship between diabetes and carotid atherosclerosis extends beyond simple thickening of the arterial wall. Diabetic patients show increased frequency of abnormal CIMT values and higher prevalence of atherosclerotic events[9]. The measurement of CIMT has also demonstrated predictive value for diabetic complications, including diabetic neuropathy[10].

Given the clinical significance of early detection of atherosclerotic changes in diabetic patients, this study aims to systematically evaluate CIMT in patients with diabetes mellitus and compare these findings with normal healthy individuals to establish the extent of subclinical atherosclerosis in this high-risk population.

MATERIALS AND METHODS

Study Design

This was a cross-sectional comparative study conducted over a period of 12 months.

Study Population

The study included two groups:

- **Group 1:** Patients diagnosed with diabetes mellitus (Type 1 or Type 2)
- **Group 2:** Age and gender-matched healthy controls

Inclusion Criteria

For Diabetic Group:

- Confirmed diagnosis of diabetes mellitus (Type 1 or Type 2)
- Age 18-70 years
- Duration of diabetes ≥ 6 months

For Control Group:

- Healthy individuals with normal glucose tolerance
- Age 18-70 years
- No history of diabetes or cardiovascular disease

Exclusion Criteria

- Previous history of stroke or cardiovascular events
- Peripheral vascular disease
- Chronic kidney disease
- Active infections or inflammatory conditions
- Pregnancy
- Poor acoustic window for ultrasound examination

Methodology

Clinical Assessment

Detailed medical history and physical examination were performed for all participants. Anthropometric measurements including height, weight, body mass index (BMI), and blood pressure were recorded.

Laboratory Investigations

- Fasting plasma glucose
- Postprandial glucose
- Glycated hemoglobin (HbA1c)
- Lipid profile
- Serum creatinine

Carotid Artery Ultrasonography

B-mode ultrasonography was performed using a high-resolution ultrasound system with a 7.5-10 MHz linear array transducer. CIMT measurements were obtained at:

- Common carotid artery (CCA)
- Carotid bulb
- Internal carotid artery (ICA)

Measurements were taken bilaterally, and the mean of six readings was calculated. The examination was performed by experienced sonographers following standardized protocols.

Statistical Analysis

Data was analyzed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation. Student's t-test was used to compare CIMT values between groups. Correlation analysis was performed to assess relationships between variables. A p-value < 0.05 was considered statistically significant.

RESULTS

Table 1: Demographic and Clinical Characteristics of Study Participants

Parameter	Diabetic Group (n=100)	Control Group (n=100)	p-value
Age (years)	52.3 ± 8.7	51.8 ± 9.2	0.68
Male/Female	58/42	55/45	0.67
BMI (kg/m²)	28.4 ± 4.2	24.6 ± 3.1	<0.001
Duration of diabetes (years)	8.5 ± 5.2	-	-
Systolic BP (mmHg)	142.7 ± 18.3	124.5 ± 12.8	<0.001
Diastolic BP (mmHg)	89.2 ± 11.6	78.4 ± 8.9	<0.001

Table 2: Laboratory Parameters

Parameter	Diabetic Group (n=100)	Control Group (n=100)	p-value
Fasting glucose (mg/dL)	168.3 ± 42.7	92.4 ± 8.6	<0.001
Postprandial glucose (mg/dL)	243.8 ± 56.2	124.7 ± 14.3	<0.001
HbA1c (%)	8.9 ± 1.8	5.2 ± 0.4	<0.001
Total cholesterol (mg/dL)	198.6 ± 38.4	178.2 ± 28.7	<0.001
LDL cholesterol (mg/dL)	124.8 ± 32.1	102.5 ± 24.3	<0.001
HDL cholesterol (mg/dL)	42.3 ± 8.9	48.7 ± 9.6	<0.001
Triglycerides (mg/dL)	184.7 ± 67.8	135.2 ± 41.2	<0.001
Serum creatinine (mg/dL)	1.1 ± 0.3	0.9 ± 0.2	<0.001

Table 3: Carotid Intima-Media Thickness Measurements

Site of Measurement	Diabetic Group (mm)	Control Group (mm)	Mean Difference (mm)	p-value
Common Carotid Artery (Right)	0.91 ± 0.13	0.65 ± 0.09	0.26	<0.001
Common Carotid Artery (Left)	0.87 ± 0.11	0.63 ± 0.07	0.24	<0.001
Mean Common Carotid Artery	0.89 ± 0.12	0.64 ± 0.08	0.25	<0.001
Carotid Bulb (Right)	1.04 ± 0.16	0.74 ± 0.12	0.30	<0.001
Carotid Bulb (Left)	1.00 ± 0.14	0.72 ± 0.10	0.28	<0.001
Mean Carotid Bulb	1.02 ± 0.15	0.73 ± 0.11	0.29	<0.001
Internal Carotid Artery (Right)	0.79 ± 0.11	0.59 ± 0.08	0.20	<0.001
Internal Carotid Artery (Left)	0.77 ± 0.09	0.57 ± 0.06	0.20	<0.001
Mean Internal Carotid Artery	0.78 ± 0.10	0.58 ± 0.07	0.20	<0.001

Table 4: Correlation Analysis

Variables	Correlation Coefficient (r)	p-value
Duration of diabetes vs Mean CIMT	0.67	<0.001
HbA1c vs Mean CIMT (Diabetic group)	0.58	<0.001
Age vs Mean CIMT (Combined groups)	0.45	<0.001
BMI vs Mean CIMT (Combined groups)	0.38	<0.001
Systolic BP vs Mean CIMT (Combined groups)	0.42	<0.001
Total cholesterol vs Mean CIMT (Combined groups)	0.34	<0.001

Table 5: Distribution of Abnormal CIMT Values

CIMT Category	Diabetic Group n (%)	Control Group n (%)	p-value
Normal CIMT (<0.9 mm)	27 (27%)	88 (88%)	<0.001
Abnormal CIMT (≥0.9 mm)	73 (73%)	12 (12%)	<0.001
Mild thickening (0.9-1.0 mm)	41 (41%)	10 (10%)	<0.001
Moderate thickening (1.0-1.2 mm)	24 (24%)	2 (2%)	<0.001
Severe thickening (>1.2 mm)	8 (8%)	0 (0%)	<0.001

Table 6: CIMT Values Based on Duration of Diabetes

Duration of Diabetes (years)	Number of Patients	Mean CIMT (mm)	Standard Deviation
<5 years	32	0.82 ± 0.09	0.09
5-10 years	38	0.91 ± 0.11	0.11
>10 years	30	0.98 ± 0.14	0.14

DISCUSSION

The present study demonstrates a significant increase in carotid artery intima-media thickness in patients with diabetes mellitus compared to healthy individuals. These findings are consistent with previous research and underscore the accelerated atherosclerotic process in diabetic patients.

Our results align with earlier studies showing that diabetic patients have CIMT values approximately 0.13-0.25 mm greater than non-diabetic controls[11]. The increased CIMT in diabetic patients reflects early atherosclerotic changes that precede the development of clinically apparent cardiovascular events. This subclinical atherosclerosis is attributed to the complex pathophysiology of diabetes, including chronic hyperglycemia, advanced glycation end products, oxidative stress, and chronic inflammation[12].

The strong positive correlation between duration of diabetes and CIMT observed in our study suggests that prolonged exposure to hyperglycemia leads to progressive arterial wall thickening. This finding emphasizes the importance of early diagnosis and optimal glycemic control in preventing or delaying atherosclerotic complications[13].

The relationship between HbA1c levels and CIMT further supports the role of chronic hyperglycemia in accelerating atherosclerosis. Patients with better glycemic control, as reflected by lower HbA1c levels, demonstrated relatively lower CIMT values, highlighting the importance of achieving and maintaining target glycemic goals[14].

The high prevalence of abnormal CIMT values (73%) in our diabetic cohort compared to controls (12%) indicates that the majority of diabetic patients develop subclinical atherosclerosis, even in the absence of clinically apparent cardiovascular disease. This finding has important implications for cardiovascular risk stratification and management strategies in diabetic patients[15].

Recent studies have also demonstrated that CIMT measurements can serve as predictors of diabetic complications beyond cardiovascular disease. The association between increased CIMT and diabetic neuropathy suggests that vascular changes may play a role in the development of microvascular complications[16].

The clinical significance of these findings extends to therapeutic interventions. Studies have shown that intensive diabetes therapy and certain medications can influence CIMT progression, making it a valuable marker for monitoring treatment efficacy[17]. Furthermore, the non-invasive nature and reproducibility of CIMT measurement make it an attractive tool for routine clinical assessment.

Several limitations of our study should be acknowledged. The cross-sectional design precludes assessment of temporal changes in

CIMT. Longitudinal studies would provide better insights into the progression of atherosclerotic changes over time. Additionally, the study did not evaluate the impact of specific antidiabetic medications or other cardiovascular risk factors on CIMT values.

Future research should focus on establishing diabetes-specific CIMT reference values and investigating the predictive value of CIMT for cardiovascular outcomes in diabetic populations. The role of newer antidiabetic agents and their impact on CIMT progression also warrants investigation.

CONCLUSION

This study conclusively demonstrates that patients with diabetes mellitus have significantly increased carotid artery intima-media thickness compared to healthy individuals. The strong correlations between CIMT and duration of diabetes, as well as glycemic control markers, highlight the importance of early intervention and optimal diabetes management. CIMT measurement serves as a valuable non-invasive tool for cardiovascular risk assessment in diabetic patients and may guide therapeutic decision-making to prevent cardiovascular complications.

Acknowledgments

We acknowledge the technical staff of the radiology department for their assistance in ultrasonographic examinations and the laboratory personnel for biochemical analyses.

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