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Carotid Atherosclerosis in Diabetic Patients and Associated Risk Factors

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ABSTRACT

Objective: To determine the frequency of carotid atherosclerosis in diabetic patients and find out its association with various risk factors.

Study Design: Cross-sectional analytical study.

Place and Duration of Study: Department of Medicine, Combined Military Hospital, Nowshera Pakistan, from May to Jul 2022.

Methodology: Patients, from both genders, were included in this study. Demographic information was obtained from all patients. Patients fulfilling the inclusion and exclusion criteria underwent carotid Doppler ultrasound after giving informed consent. High-resolution 7.5 MHz probe B mode ultrasonography and atherosclerosis was classified on the basis of grey-scale imaging.

Results: A total of 100 patients were included in the study, out of which 74 were males and 26 were females. Among diabetics, 54% occurrence of atherosclerosis was seen, with a major share of 24% involvement of the left carotid artery, followed by 18% bilaterally, and 12% right carotid artery involvement. Carotid intimal media thickness increased with advancing age, with variable severity of mild in 32%, moderate in 14%, and severe stenosis in 3% of positive cases.

Conclusion: There was a high association of carotid atherosclerosis with diabetes mellitus, having significant association with older age, hypertension, hyperlipidemia, and smoking.

Keywords: Atherosclerosis, Carotid Doppler, Diabetes Mellitus

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INTRODUCTION

Carotid artery narrowing is a manifestation of atherosclerosis, which results in plaque formation in arteries, leading to significant stenosis of arterial vessels with any causative factor for atherosclerosis resulting in cerebrovascular events with smoking, dyslipidemia, male sex, age, and sedentary lifestyle as primary risk factors for atherosclerosis .[1] Uncontrolled diabetes mellitus (DM) is associated with the progression of atherosclerosis. Carotid artery intima-media thickness (CIMT) can be assessed through carotid Doppler.[2] as early diagnosis of stenosis will decrease the incidence of transient ischemic attacks or strokes through appropriate timely management, decreasing morbidity and mortality.[3] However, Doppler ultrasound is operator-dependent and calcification limits its use with certain vulnerable features of plaque such as intraplaque hemorrhage, lipid-rich necrotic core, fibrous cap, calcification, and even neovascularization that are only identified on MRI and CT scans.[4] Apart from the carotid artery, this disease may occur anywhere in any medium vessel with aneurysm formation.[5] which can worsen in the presence of risk factors like poor dietary habits, increased Body Mass Index (BMI) and sedentary lifestyle[6] as the more severe the carotid stenosis, the more the risk of embolization from carotid plaques and hemodynamic instability.[7] Calcified plaques at multiple sites may lead to pathogenic lipid-rich necrotic core and intraplaque hemorrhage.[8] Early identification of increased carotid intima-media thickness and artery stiffness are biomarkers of carotid atherosclerosis and these parameters can be assessed through carotid Doppler ultrasound.[9,10] Routine ultrasound investigation of the carotid arteries might be a valuable prognostic tool for screening of patients with diabetes mellitus. This study was planned to determine such ultrasound-diagnosed carotid atherosclerosis in diabetic patients.

METHODOLOGY

This analytical cross-sectional study was carried out at the Department of Medicine, Combined Military Hospital (CMH), Nowshera, Pakistan, from May to July 2022. After obtaining formal approval from the Ethics Committee (ERC# 03/2020), the first 100 patients diagnosed with diabetes mellitus and who

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were admitted to the inpatient ward, were enrolled in this study, after taking written, informed consent. The small sample size was kept due to the constraint of resources, as only one radiologist was available for interpretation of all the imaging data from the entire hospital. Sampling was done via non-probability consecutive sampling.

Inclusion Criteria: All diabetic patients, more than 12 years old, of either gender, and were otherwise asymptomatic.

Exclusion Criteria: Patients having current infections, inflammatory diseases or active malignancies, recent or past CVA, past history of carotid stent implantation, history of Myocardial Infarction, and peripheral vascular surgery.

Patient age, gender, duration of diabetes, social status, and history of co-morbid and risk factors was recorded in predesigned proforma. Carotid Doppler ultrasound was done with high resolution 7.5 MHz probe, B mode ultrasonography was used for detection of intima-media thickness and detection of plaques. Carotid atherosclerosis was recorded on specially designed proforma. The severity of carotid stenosis was based on greyscale imaging with < 30% stenosis as normal, 30-50% as mild, 50-70% as moderate, and >70% as severe stenosis. Data was analyzed with Statistical Package for Social Sciences (SPSS) ver 20.0. Frequencies and percentages were computed for qualitative variables while Mean±Sd was presented for quantitative variables. Carotid atherosclerosis was stratified among age, gender, hypertension, smoking, and hyperlipidemia. Chi-square test was applied and p ≤0.05 was considered statistically significant.

RESULTS

A total of 100 patients were included in the study. The mean age in our study was 49.85±12.91 years.. The study population was categorized into two groups based on age, Group A comprised patients up to 4 years of age, and consisted of 39 % of patients, while Group B comprised patients above 45 years of age and consisted of 61% of participants. The distribution of carotid atherosclerosis is shown in Figure. The distribution of artery involvement was noted as, 24% in the left carotid artery, 18% in bilateral carotids, and 12% in the right carotid artery. Table shows that statistically significant association of carotid atherosclerosis was seen with advancing age, hypertension, smoking and hyperlipidemia (*p* value: < 0.001). In individuals with a longer duration of diabetes, an increase in carotid intimal medial thickness was observed, with 32% of patients exhibited mild stenosis, 14% had moderate stenosis and 3% had severe stenosis.

Table: Baseline Characteristics of Study Participants (n=100)

Baseline characteristics	Study Groups		*p*-value
Age	Group A	Group B	<0.001
	(<45 yrs)	(>45 yrs)	
	39(39%)	61(61 %)	
Gender			
Male = 74 (74%) Female = 26 (26%)	32(82.05%) 7(17.94%)	42(68.85%) 19(31.14%)	0.142
Hyperlipidemia			
Yes= 21(21%) No=79(79%)	2(5.12%) 37(94.87%)	19(31.14%) (68.85%)	0.002
Hypertension			
Yes=49 (49%) No=51(51%)	7(17.94%) 32(82.05%)	42(68.85%) 19(31.14%)	<0.001
Smoking			
Yes=31(31%) No=69(69%)	5(12.82%) 34(87.17%)	26(42.62%) 35(57.37%)	0.002

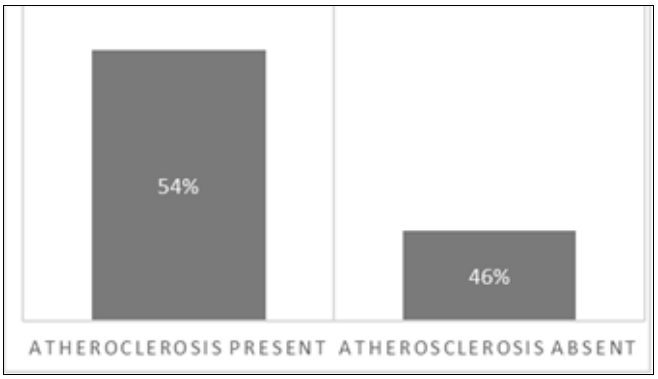

Figure: Carotid Atherosclerosis (n=100)

DISCUSSION

A global study published in 2020 demonstrated a 25% worldwide prevalence of atherosclerosis, with increased carotid intimal thickness, especially in adults aged above 30 years, among whom more than 800 million individuals had carotid plaque formation and carotid stenosis.[11] Our study found a strong association of plaques with elderly age, similar to a study which reported more advanced plaque formation in uncontrolled diabetes mellitus and older age.[12] While our sample population consisted of 74 % males, we did not find significant gender-specific correspondence of carotid artery atherosclerosis in diabetic patients but one study reported that the overall detection rate of extracranial carotid plaque in older people (> 60 years' age) had been more than 40%

in females and 50% % in males, and in middle-aged adults, the rates were significantly higher in females.[13] We found that there was a statistically significant association ($p<0.05$) of carotid atherosclerosis with hypercholesterolemia, similar to another study, which also found that the effects of LDL/HDL cholesterol ratio and BMI on carotid intimal thickness were more profound in males [14]. This association becomes even stronger if high blood pressure is accompanied by risk factors like advanced age (>45 years), smoking, drinking, increased BMI, high blood cholesterol, and creatinine levels where, as compared to men, women have a lower risk of carotid atherosclerosis.[15] Studies have also shown that men with low levels of HDL cholesterol had a very high incidence of ultrasound-guided carotid artery atherosclerosis [16, 17]. Our study demonstrated that the prevalence of unilateral plaques is more common in the left carotid artery than in the right carotid artery and the predominance of intraplaque hemorrhage in left-sided carotid plaques showed a greater vulnerability as opposed to right-sided plaques, which are more calcified and considered stable.[18]

CONCLUSION

There was a high association of carotid atherosclerosis with diabetes mellitus, having significant association with older age, hypertension, hyperlipidemia, and smoking.

Conflict of Interest: None.

Authors Contribution

Following authors have made substantial contributions to the manuscript as under:

MF & MF: Conception, study design, drafting the manuscript, approval of the final version to be published.

NM & AS: Data acquisition, data analysis, data interpretation, critical review, approval of the final version to be published.

AAS: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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