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ORIGINAL ARTICLE

Correlation of carotid intima medial thickness with triple vessel coronary artery disease

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ABSTRACT

Background: Coronary artery disease (CAD) is a leading cause of morbidity and mortality, with triple vessel disease (TVD) representing a severe and complex form. Carotid Intima-media thickness (CIMT) is a non-invasive marker of subclinical atherosclerosis and has been associated with cardiovascular risk. The aim of our study was to investigate the correlation between CIMT and TVD in patients at Lady Reading Hospital, assessing CIMT as a potential predictor for TVD.

Methods: A cross-sectional study was conducted at the Department of Cardiology, MTI/Lady Reading Hospital, from June 1, 2023, to December 1, 2023. Seventy-four patients aged 30 to 70 years with a confirmed diagnosis of TVD were included using non-probability consecutive sampling. IMT was measured via B-mode ultrasound at six carotid artery sites. Pearson's correlation coefficient was used to assess the relationship between CIMT and TVD, with stratification by age, gender, BMI, and disease duration.

Results: The mean age of participants was 52.15 ± 5.617 years, with 74.3% males. TVD correlation was present in 62.2% of patients. Abnormal CIMT (>1 mm) was observed in 75.7% of participants. There was a significant positive correlation between CIMT and TVD ($r = 0.312$, $p < 0.05$), with stronger associations in older patients ($r = 0.367$) and females ($r = 0.406$).

Conclusion: Increased CIMT is significantly correlated with the presence of TVD, suggesting its potential role in risk stratification for severe CAD particularly in older patients. These findings highlight the utility of CIMT as a non-invasive predictor for TVD, emphasizing the need for early screening and the targeted interventions for high-risk patients.

Keywords: Atherosclerosis, Carotid Ultrasound, Coronary Artery Disease, Cardiovascular Risk

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Introduction

Cardiovascular disease remains a leading cause of morbidity and mortality worldwide(1). The coronary artery disease is major threat in cardiovascular disease, with triple vessel disease representing a severe and complex form(2). The characteristic features of triple vessel disease are significant stenosis in all three major coronary arteries,

and an increased risk of major adverse cardiac events. Its effective management is very crucial and risk stratification and early detection are crucial for improved patient outcomes(3).

Intima-media thickness is non-invasive procedure for the measurement of the thickness of the arterial wall(4). It is a valuable marker for cardiovascular risk assessment and atherosclerosis. In early stage of atherosclerosis structural changes occurs in arterial walls intima and media and its thickness are measured(5).

All of these changes occur even before the development of significant luminal narrowing. Many of the studies have shown that there is strong association between the intima medial thickness and major cardiovascular events(6).

The relationship between the presence of cardiovascular events and carotid intimal medial thickness have been studied the very specific correlation between triple vessel disease and intimal medial thickness needs further exploration(7). By understanding this correlation there will be enhanced and early risk stratification for triple vessel disease, it will allow earlier and targeted interventions for better cardiovascular outcome (8).

The relationship between CIMT and the presence of CAD has been studied and explored by various studies. A meta-analysis showed that there is a strong positive correlation between CIMT and presence of coronary atherosclerosis(9). Similar other recent studies have has also investigated and showed that CIMT can predict the occurrence of major adverse cardiovascular events and the progression of coronary artery disease. For the specific correlation further research is needed(10). While some studies have suggested that there is a link between multivessel coronary disease and CIMT(11). However, the relationship with TVD specifically has not been fully investigated.

The aim of our study is to investigate the correlation between CIMT and the presence of TVD in patients at Lady Reading Hospital. By examining this relationship within a specific patient population group, our aim is to contribute valuable insights into the role of CIMT as a potential predictor of TVD and its implications for clinical practice and better outcome. The study will add to the existing body of literature by focusing on the relationship between IMT and TVD, which could have important implications for clinical decision-making and patient management.

Methods

This cross-sectional study was conducted at the Department of Cardiology, MTI/Lady Reading Hospital, Peshawar, from June 1, 2023, to December 1, 2023. A sample size of 74 participants was calculated using the WHO sample size formula, based on an anticipated correlation coefficient (r) of 0.322, a power of 80%, and a confidence level of 95%. Non-probability consecutive sampling was employed. Patients aged 30 to 70 years with diagnosis of triple vessel disease were included. Patients with diabetes, vasculitis, haemochromatosis, Cushing's syndrome, glucagonoma, hyperthyroidism and hypothyroidism were excluded. Drug history those taking medications known to elevate blood glucose levels (glucocorticoids, thyroid hormones, diazoxide, diuretics, beta-adrenergic agonists, nicotinic acid). Patients with history of coronary artery bypass grafting, carotid surgery, endarterectomy, cerebrovascular accidents, pancreatectomy, pancreatitis or peripheral vascular disease were excluded to minimize confounding and potential bias.

Following approval from the hospital's research review board (ref number 615/LRH/MTI dated 30 dec 2022), patients with inclusion criteria were enrolled from the inpatient department. Informed consent was obtained from all participants, ensuring confidentiality and explaining the absence of any study-related risks. Baseline data, including age, gender, BMI, and disease duration were recorded. Exclusion criteria were strictly adhered to in order to minimize potential bias. B-mode ultrasound images of the left and right carotid arteries were performed by a single radiologist using a 7 MHz linear array transducer, adhering to a standardized operating procedure. Three segments of each carotid artery were assessed: the distal 1.0 cm of the common carotid artery proximal to the bifurcation, the carotid bulb, and the proximal 1.0 cm of the internal carotid artery. The average carotid intima-media thickness was calculated as the mean of these six measurements. Data were recorded on a specifically designed proforma.

Data were analyzed using IBM SPSS Statistics version 24. Descriptive statistics were calculated for all variables. For continuous variables, including age, BMI, disease duration, and intima-media thickness, mean and standard deviation were computed. For categorical variables, including gender and abnormal intima-media thickness (defined as [specify the cutoff value used]), frequencies and percentages were calculated. Pearson's correlation coefficient (r) was used to assess the correlation between intima-media thickness and the presence of triple vessel disease, with the following interpretation of strength: r = 0.1 to 0.3 indicating a mild correlation, r = 0.4 to 0.5 indicating a moderate correlation, and r > 0.5 indicating a strong correlation. The correlation analysis was stratified by age, gender, BMI, and disease duration to explore potential effect modification.

Results

Total 74 patients were recruited in the study, with ages ranging from 30 to 70 years. The mean age was 52.15 ± 5.617 years; mean weight was 70.66 ± 6.422 kg**.** Mean BMI was 23.81 ± 2.77 kg/m² (Table 1).Among the participants, 86.5% (n = 64) were older than 45 years, while 13.5% (n = 10) were 45 years or younger (Table 2). The majority of the patients were male (74.3%, n = 55), whereas 25.7% (n = 19) were female. Based on BMI classification, 43.2% (n = 32) had a BMI ≤ 23.0 kg/m², while 56.8% (n = 42) had a BMI > 23.0 kg/m² (Table 4).Regarding disease duration, 24.3% (n = 18) had a disease duration of ≤6 months, while **75.7%** (n = 56) had a duration of more than 6 months.

Triple Vessel Disease (TVD) observed in 62.2% (n = 46) of patients, while 37.8% (n = 28) did not have TVD (Table 6). Intima-Medial Thickness (IMT) was categorized into normal (≤1 mm) and abnormal (>1 mm), with **75.7%** (n = 56) of patients having an abnormal IMT, while 24.3% (n = 18) had a normal IMT.

A significant correlation was found between TVD and IMT (Pearson r = 0.312). Among patients with normal IMT (≤1 mm), 88.9% (n = 16) did not have TVD, while 11.1% (n = 2) had TVD. In contrast, among patients with abnormal IMT (>1 mm)**,** 53.6% (n = 30) did not have TVD, while 46.4% (n = 26) had TVD. Pearson correlation: r = 0.312

Patients aged ≤45 years showed no significant correlation between IMT and TVD (r = -0.048), whereas those aged >45 years demonstrated a positive correlation (r = 0.367), indicating that abnormal IMT was more strongly associated with TVD in older

patients. In male patients, the correlation between IMT and TVD was moderate (r = 0.269), with 48.8% (n = 21) of males with abnormal IMT having TVD. In females, the correlation was stronger (r = 0.406), though the sample size was smaller.

Patients with BMI ≤23.0 kg/m² showed a higher correlation (r = 0.372) compared to those with BMI >23.0 kg/m² (r = 0.279), indicating that increased IMT was more predictive of TVD in patients with lower BMI. Patients with a disease duration ≤6 months had a weaker correlation (r = 0.239) compared to those with a duration >6 months (r = 0.353). Among patients with longer disease duration, 54.8% (n = 23) of those with abnormal CIMT had TVD, compared to only 14.3% (n = 2) of those with normal IMT

To contextualize the following data, we present the stratification of correlation with respect to age, gender, BMI, and disease duration (Table 1).

Table 1: Stratification of Correlation with Respect To Age, Gender, BMI, and Disease Duration

Category	Subgroup	TVD No	TVD Yes	Total	Pearson r
Age ≤45 yrs	IMT ≤1mm	2	1	3	-0.048
Age ≤45 yrs	IMT >1mm	5	2	7	-0.048
Age >45 yrs	IMT ≤1mm	14	1	15	0.367
Age >45 yrs	IMT >1mm	25	24	49	0.367
Gender Male	IMT ≤1mm	10	2	12	0.269
Gender Male	IMT >1mm	22	21	43	0.269
Gender Female	IMT ≤1mm	6	0	6	0.406
Gender Female	IMT >1mm	8	5	13	0.406
BMI ≤23.0	IMT ≤1mm	6	0	6	0.372
BMI ≤23.0	IMT >1mm	14	12	26	0.372
BMI >23.0	IMT ≤1mm	10	2	12	0.279
BMI >23.0	IMT >1mm	16	14	30	0.279
Duration ≤6m	IMT ≤1mm	4	0	4	0.239
Duration ≤6m	IMT >1mm	11	3	14	0.239
Duration >6m	IMT ≤1mm	12	2	14	0.353
Duration >6m	IMT >1mm	19	23	42	0.353

Discussion

The Carotid Intima Media Thickness (CIMT) is well-established marker of early atherosclerotic disease and serves as a reliable indicator for detecting cardiovascular disease in its early subclinical stages(12). The present study utilized the average CIMT for analysis, as it provides a stable representation of disease progression. Our results are inconsistent with the previous research which demonstrated a strong association between CIMT and various cardiovascular risk factors(13).

B-mode ultrasound, a non-invasive imaging procedure was used to quantify atherosclerotic changes within the carotid arterial system(14). The B-mode ultrasound visualizes atherosclerotic changes within the arterial wall and it is clinical significant for the early detection of the disease, it is also utilized in many clinical trials and epidemiological studies which underscores its reliability(15).

The results and findings are also in consistent with the study which demonstrated the Atherosclerosis Risk In Communities (ARIC)

, showing similar trends in CIMT values and CAD prevalence(16), which further enhances the reliability and comparative analysis. Study reported increased CIMT values in individuals having cardiovascular disease as compared to the healthy controls(17). Similarly, our study also revealed that there is a significant relationship between carotid atherosclerosis, measured via CIMT, and the coronary artery disease (CAD) and confirmed via angiography. The Multivariate analysis also showed that there is statistically significant associations ($p<0.001$) between CIMT and classical cardiovascular risk factors such as diabetes mellitus, hypertension, dyslipidemia and smoking.

In our study the CIMT was a stronger predictor of CAD presence than individual risk factors. Among participants having triple-vessel disease, 35.3% showed carotid plaques, which suggest a substantial atherosclerotic burden. These findings are in agreement with a study which reported a 4.15-fold increased risk of myocardial infarction in individuals with carotid plaques (18). So, carotid ultrasound not only facilitates risk stratification but also helps in timely diagnosis and preventive interventions.

Another study observed a significant linear relationship between the number of stenosed coronary artery and the CIMT ($r=0.54$, $p<0.001$) in a patient group of 75 participants undergoing coronary angiography (19). Similarly, another research by Kpil et al. reported significantly higher CIMT values in patients with CAD (1.45±0.95 mm) as compared to controls (0.87±0.1 mm; $p<0.005$) (20). Our results are similar to these findings, reinforcing the utilization of CIMT as a marker for coronary atherosclerosis.

In conclusion, CIMT, measured via B-mode ultrasound, serves as a robust, non-invasive marker for identification of individuals at elevated risk for CAD. Early detection through CIMT-based screening may facilitate timely lifestyle interventions and pharmacological treatments, potentially relieving adverse cardiovascular outcomes.

Conclusion

Increased CIMT is significantly correlated with the presence of TVD, suggesting its potential role in risk stratification for severe CAD particularly in older patients. These findings highlight the utility of CIMT as a non-invasive predictor for TVD, emphasizing the need for early screening and the targeted interventions for high-risk patients.

Conflict of Interest: Nil
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All the authors agree to take responsibility for every facet of the work, making sure that any concerns about its integrity or veracity are thoroughly examined and addressed.