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Original Research Article

RELATIONSHIP BETWEEN CAROTID ARTERY DISEASE EVALUATED BY ULTRASOUND AND CORONARY ARTERY DISEASE EVALUATED BY CORONARY COMPUTED TOMOGRAPHY

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Abstract: *The prospective study was conducted in the Department of Cardiology, Nishtar Medical & Institute of Cardiology Hospital from June 2022 to June 2023 to evaluate the association between the severity of CAD and carotid IMT through multi-slice computed tomography (MSCT) scan in symptomatic or asymptomatic patients. Patients with dyspnea, chest pain, or asymptomatic patients with low to moderate pre-test probability of CAD detected by MSCT were included in the study. Mean IMT, presence or absence of plaque, CACS, and any evidence of atherosclerosis were recorded. Of 250 patients, 8% had dyspnea, 14.8% had chest pain, 10.8% had dizziness, 6.4% had palpitations, and 62% were asymptomatic. Corid plaque and higher CAC score (P<0 .0001) had a significant association. 48% (50 of 105) patients with CACS 0 had carotid plaque, while 87.5% (127 of 145) patients with CACS >0 had carotid plaque, which shows the association between higher CACS and carotid plaque (P=0.0001). Similarly, 52.3% (55 of 105) patients without atherosclerosis had carotid plaque, and 85% (119 of 140) patients with atherosclerosis had carotid plaque (P < 0.0001). It is concluded that plaque and carotid IMT are associated with the degree and presence of coronary disease and calcification on CTA. Due to modest correlation, imaging modality should be selected based on the pattern of atherosclerosis and methodological considerations.*

Keywords: Intima Medium Thickness, Coronary Artery Disease, Carotid Vessels, CT Angiography

Introduction

Atherosclerosis is a vascular disorder having a common underlying mechanism in coronary and carotid arteries (Al-Bayati et al., 2021). Atherosclerosis-related cerebrovascular and cardiovascular disease is the major cause of morbidity in developing countries (Tsao et al., 2022). There is an established association between coronary artery disease (CAD) and carotid atherosclerosis, with an 8% co-existence rate (Wei et al., 2022). Etiologically, atherosclerosis in various arterial vasculature may have common risk factors. Coronary and carotid atherosclerosis have common risk factors, including smoking, older age, dyslipidemia, hypertension, and diabetes mellitus (Mazzolai et al., 2022). The involvement of different arterial vascular beds in the body signifies a significant disease burden, even if the person is clinically asymptomatic. Studies reveal that atherosclerosis may coexist in carotid and coronary arteries (Vlajinac et al., 2019). Polyvascular atherosclerosis is associated with a worse prognosis in patients with clinical symptoms (Musiałek et al., 2019). Structural alteration in arteries and cardiovascular risk can be detected early through B-mode ultrasonography, which determines large arteries' intima medium thickness (IMT) (O'Leary et al., 1992). Moreover, studies show that IMT of the carotid artery is useful for CAD screening; increased IMT is associated with an increased risk of stroke and CAD. This study aims to evaluate the association between the severity of CAD and carotid IMT through multi-slice computed tomography (MSCT) scans in symptomatic or asymptomatic patients.

Methodology

The prospective study was conducted in the Department of Cardiology, Nishtar Medical & Institute of Cardiology Hospital from June 2022 to June 2023. Patients with dyspnea, chest pain, or asymptomatic patients with low to moderate pre-test probability of CAD detected by MSCT were included in the study. Patients with a history of percutaneous coronary intervention or coronary artery bypass graft, recent myocardial infarction, atrial fibrillation, dye allergy, and renal insufficiency were excluded. The study was conducted on a total of 250 patients. Informed consent of the participants was taken. The ethical board of the hospital approved the study.

Mean IMT, the average reading measured at two or more points, of the right and left common carotid artery was measured. The plaque was identified based on the following criteria (at least 2): change in the surface contour of the carotid wall, focal change in echogenicity of the carotid wall, or IMT >1.5 mm. Coronary Artery Calcium Score (CACS) sum was categorized into 0, mild (1-100), moderate (101- 400), and high (>400).

A maximum of four vessels, including the right coronary artery, circumflex coronary artery, left main coronary artery and left anterior descending artery, were counted for any evidence of atherosclerosis.

SPSS version 23.0 was used for data analysis. Descriptive variables were represented as frequency. The chi-square test was used to determine the association between categorical data. Pearson correlation was used to determine the

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association between continuous data. The association between categorical and continuous variables was assessed by Spearman's test. P value < 0.05 was considered statistically significant.

Results

Of 250 patients, 95 were symptomatic, and 155 were asymptomatic. Asymptomatic patients and those referred for screening were less hypertensive, diabetic, and younger than symptomatic patients or those diagnosed with CAD. There were 163 (65.2%) males and 87 (35%) females. 77 (31%) patients were smokers, 12 (4.8%) were ex-smokers, 126 (50.4%) were hypertensive, and 78 (31.2%) were diabetic. 7 (17.5%) had a history of peripheral vascular disease, and 60 (24%) had a history of CAD. The mean cholesterol level in symptomatic patients was 191.8±40.4 mg/dl, and in asymptomatic patients was 186.6±41.8 mg/dl. The mean triglyceride level in symptomatic and asymptomatic patients was 126±31.8 and 110.4±30.1, respectively. Of 250 patients, 8% had dyspnea, 14.8% had chest pain, 10.8% had dizziness, 6.4% had palpitations, and 62% were asymptomatic Table 1.

Table 1 Demographic characteristics of the study

Characteristic	Total (N=250)	Symptomatic (N=95)	Asymptomatic (N=155)
Gender			
- Males	163 (65.2%)	68 (71.6%)	95 (61.3%)
- Females	87 (34.8%)	27 (28.4%)	60 (38.7%)
Smoking Status			
- Current Smokers	77 (31%)	42 (44.2%)	35 (22.6%)
- Ex-Smokers	12 (4.8%)	8 (8.4%)	4 (2.6%)
Hypertension			
- Hypertensive	126 (50.4%)	76 (80%)	50 (32.3%)
Diabetes			
- Diabetic	78 (31.2%)	52 (54.7%)	26 (16.8%)
History of Peripheral Vascular Disease			
- Yes	7 (17.5%)	5 (5.3%)	2 (1.3%)
History of CAD			
- Yes	60 (24%)	60 (63.2%)	0 (0%)
Cholesterol Level (mg/dl)			
- Mean (± SD) in Symptomatic		191.8 ± 40.4	186.6 ± 41.8
Triglycerides Level (mg/dl)			
- Mean (± SD) in Symptomatic		126 ± 31.8	110.4 ± 30.1
Symptoms			
- Dyspnea	20 (8%)	14 (14.8%)	6 (3.9%)
- Chest Pain	37 (14.8%)	37 (38.9%)	0 (0%)
- Dizziness	27 (10.8%)	27 (28.4%)	0 (0%)
- Palpitations	16 (6.4%)	16 (16.8%)	0 (0%)
- Asymptomatic	155 (62%)	1 (1.1%)	154 (99.4%)

Table II shows the CAC score in patients. 1 and 2 vessel disease had similar carotid findings, so their data was merged. There was a significant association between carotid plaque and higher CAC score (P< .0001). 48% (50 of 105) patients with CACS 0 had a carotid plaque, while 87.5% (127 of 145) patients with CACS >0 had a carotid plaque, which shows an association between higher CACS and carotid plaque (P=0.0001).

Table II Differences in Presence of Plaque and Carotid IMT according to Number of Vessels Involved and Coronary Artery Calcium Score

CACS				
	0	**1-99**	**100-399**	**400+**
Maximal IMT	1.62 ±.79	2.09±.88	2.49±.92	2.65±1.07
The mean of 6 segment IMT	0.72 ±.18	0.78±.21	0.84±.16	0.88±0.14
Plaque Present	48% (50/105)	85.4% (47/55)	90% (36/40)	91% (41/45)
Number of coronary arteries involved				
	0	**1-2**	**3**	**4**
Maximal IMT	1.61±.75	2.19±0.93	2.42±0.96	2.99±1.14
The mean of 6 segment IMT	0.73±0.17	0.81±0.17	0.87±0.16	0.9±0.13
Plaque Present	52.3% (55/105)	82.8% (58/70)	88.8% (40/45)	92% (23/25)

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Similarly, 52.3% (55 of 105) patients without atherosclerosis had carotid plaque, and 85% (119 of 140) patients with atherosclerosis had carotid plaque ($P < 0.0001$).The presence of carotid plaque or carotid IMT ≥1.5 mm predicted coronary artery disease and had a positive predictive value of 68% and 70%, respectively, for 1 vessel disease. Absence of carotid plaque and IMT <1.5 mm had negative predictive of 78% and 67% for no vessel involvement.

Discussion

Atherosclerosis is a vascular disease with a common underlying mechanism in coronary and carotid arteries. B-mode ultrasonography is preferably used to detect structural alteration in arterial walls early and predict cardiovascular risk(Poredos and Jezovnik, 2021). Carotid IMT is a significant predictor of MI in a population older than 55 (Joh and Cho, 2020). The current study reported a higher incidence of carotid plaque (70%) than a previous study, which reported that 26% of patients had carotid plaque(Drosos et al., 2021). In the current study, asymptomatic and symptomatic patients significantly differed regarding risk factors like smoking, DM, hypertension, and gender. Patients with higher IMT and carotid plaque were at increased risk of CAD compared to those with lower IMT and no carotid plaque. These findings are consistent with the results of the previous study, which reported that patients with non-significant CAD have a lower prevalence of carotid plaque than significant CAD (Rasheed et al., 2022). In this study, carotid IMT in different numbers of vessels involved was compared, and it was found that coronary artery and carotid artery disease had a similar and significant relationship irrespective of how they are defined (by CAC score, mean IMT, number of vessels involved on CTA or presence of plaque) or measured. Our study reported a modest correlation between CAC and IMT, similar to the previous study (Jeevarethinam et al., 2018). IMT ≥1.5 mm and carotid plaque were independent predictors of CAD independent of sex and age. A previous study reported that coronary risks were 19.1% and 23.1% in patients with no carotid atherosclerosis and with atherosclerosis, respectively (Li et al., 2021). Another study reported association between cardiac events and carotid plaques, and that the patients with carotid plaque are at 5 times increased risk of cardiac event(Rios, 2021). The association between CAD and carotid IMT show the systematic nature of atherosclerosis. However, moderate correlation show heterogeneous distribution of atherosclerosis. This correlation can be impacted by the risk factors. A study suggested that carotid IMT was associated with diabetes while CAC was with hypertension(Hennig et al., 2020).

Conclusion

Plaque and carotid IMT are associated with the degree and presence of coronary disease and calcification on CTA. Due to modest correlation, imaging modality should be selected based on the pattern of atherosclerosis and methodological considerations.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department Concerned.
Consent for publication
Approved
Funding
Not applicable

Conflict of interest

The authors declared absence of conflict of interest.

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