Carotid Plaque Burden in Patient who Underwent Coronary Angiogram at Dhulikhel Hospital

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Citation

Humagain S, Pathak SR, Koju RP. Carotid Plaque Burden in Patient who Underwent Coronary Angiogram at Dhulikhel Hospital. *Kathmandu Univ Med J.* 2023;82(2):170-4.

ABSTRACT

Background

Coronary artery disease (CAD) is a leading cause of death worldwide and is primarily caused by atherosclerosis. Carotid plaque and coronary artery disease share a common pathogenesis and risk factor. Carotid arteries are accessible through non-invasive imaging method. By characterizing the carotid arteries, it becomes possible to estimate the total burden of atherosclerosis, including that of coronary artery disease. According European Society of Cardiology (ESC) ultrasound of the carotid arteries should be considered, and be performed to detect plaque in patients with suspected chronic coronary syndrome.

Objective

To establish a relationship between coronary artery disease and carotid plaque.

Method

It is a cross sectional analytical study. Patients who underwent coronary angiogram at Dhulikhel Hospital from 1st April 2022 till 31st March 2023 were assessed for carotid plaque using carotid ultrasound. Chi square test was done to find the relationship between presence of carotid plaque and coronary artery stenosis of more than 50%. Positive predictive value and negative predictive value was calculated.

Result

Total number patient was 254 and the mean age was 61± 4.7 years. Out of which 85(33.5) had normal coronary artery, 143(56.3) had ≥ 50% stenosis and 120 (47.2) had ≥ 70% stenosis. Eight patients also had significant left main disease with ≥ 50 % stenosis. Carotid plaque was present in 121(47.6) patients. Out of 143 patients who had ≥ 50% stenosis in coronary angiogram, 104(72.7) patients also had carotid plaque which is statistically significant as $p < 0.05$. Positive predictive value (PPV) was 72.7% and negative predictive value was 84.7%.

Conclusion

This study establishes a relationship between coronary artery disease and carotid plaque, suggesting that the presence of carotid plaque may serve as an indicator of underlying coronary artery disease.

KEY WORDS

Atherosclerosis, Carotid plaque, Coronary artery disease, Stenosis

INTRODUCTION

Coronary artery disease (CAD) is a leading cause of death worldwide and is primarily caused by atherosclerosis.[1] The development of atherosclerosis is influenced by common risk factors such as hypertension, dyslipidemia, diabetes mellitus and smoking. This means that carotid plaque and CAD share a common pathogenesis and risk factors.[2] Patients with carotid plaque often have concomitant coronary artery lesions. In predicting the risk of CAD, both carotid intima-media thickness (CIMT) and carotid plaque can be useful, but carotid plaque is considered a better indicator.[3]

By characterizing the carotid arteries, it becomes possible to estimate the total burden of CAD.[4,5] The presence of atherosclerotic plaques in carotid serve as indicators of atherosclerosis in other vascular territories.[6] The superficial location of the carotid arteries makes their imaging less challenging compared to the coronary circulation, further justifying their use in assessing atherosclerotic burden and guiding appropriate management strategies. Overall, the evaluation of carotid arteries in CAD and vice versa has become an important aspect of clinical practice, facilitating the identification of high-risk patients who require intensive preventive measures and targeted treatment interventions.[7,8]

According European Society of Cardiology (ESC) ultrasound of the carotid arteries should be considered, and be performed to detect plaque in patients with suspected chronic coronary syndrome.[9] Though we have limited study in our country, one of the study done shows that carotid plaque was seen in 63% of patients with coronary artery disease.[10]

From this study we aim to establish a relationship between CAD and carotid plaque.

METHODS

It is a cross sectional analytical study. Any patient who was indicated for coronary angiogram at Dhulikhel Hospital from 1st April 2022 till 31st March 2023 were included in the study.

Sample size was derived using from formula $n= Z^2 P(1-P)/ D^2$.[11]

Where n is the sample size, Z is the statistic corresponding to level of confidence, P is expected prevalence and d is precision.

Z value is taken as 1.96 for 95% confidence level

P is taken as 5%.[12]

Margin of error taken as 3%

N=(1.96x1.96) x 0.05(1-0.05)/0.03x0.03

=3.8416x 0.05x 0.95/0.0009

=203

Sample size calculated was approximately as 203. Ethical clearance was taken from Kathmandu University School of Medical Sciences Institutional Review Committee. Informed written consent was taken by the principal author.

Coronary angiogram (CAG) was done and reported by one of the author. Demographic profile of the patient was recorded. CAG was reported on the basis of involvement of major coronary arteries or its first-degree branches which are more than 2.0 mm in size. Normal (if no plaque or minor plaque seen), less than 50% stenosis, 50-69% stenosis, more than or equal to 70% stenosis (70-99%) and Total occlusion (100%) in any epicardial vessel and its major branches which are at least 2.0 mm in size. Any plaque with more or equal to 50 % stenosis is divided into single vessel disease (SVD), double vessel disease(DVD) or triple vessel disease(TVD) in standard protocol.[13-15] The carotid plaque screening was done by the principal author using carotid ultrasound (Philipis Epiq 7) machine available at cardiac out-patient department of Dhulikhel hospital. Screening was done one or two days prior to CAG or within seven days after CAG when the patients visited for follow up. Carotid ultrasound screening was reported as either presence of plaque or absence of plaque.

Any patient undergoing CAG at Dhulikhel Hospital cathlab during study period were included. Those who were not willing to undergo carotid ultrasound screening and not giving consent were excluded from the study.

A total of 254 data was analyzed. Statistical analysis was done using SPSS 28.0. Paired t test and chi square test was applied wherever applicable.

RESULTS

Total of 268 patients underwent CAG from 1st April 2022 till 31st March 2023. Out of which all required information was available for 254 patients as 14 patients either did not give consent or did not undergo carotid ultrasound screening for plaque. Age range was from 31 years to 87 years with maximum number in the age group 50-59 years (36.2%). The mean age was 61±4.7 years. Normal coronary artery was found in 85 (33.5%) of patient. A total of 143(56.3%) had ≥ 50% stenosis and 120 (47.2%) had ≥ 70% stenosis. Eight patients also had significant left main disease with ≥ 50% stenosis. A total of 72 patients were indicated for angioplasty, out of which 62 patients underwent the procedure. Patients referred for coronary artery bypass graft (CABG) in other center were 26 but only 12 underwent the procedure.

Out of 254 who underwent carotid ultrasound screening 121 (47.6%) had carotid plaque. The distribution of patients with presence and absence of carotid plaque and patients with presence and absence of ≥ 50% stenosis in CAG is shown in table 1.0. Out of 143 patients who had ≥ 50% stenosis in CAG, 104 (72.7%) patients also had carotid plaque which is statistically significant as $p < 0.05$ ($p=0.008$). The positive predictive value (PPV) was 72.7% and the negative predictive value was 84.7%.

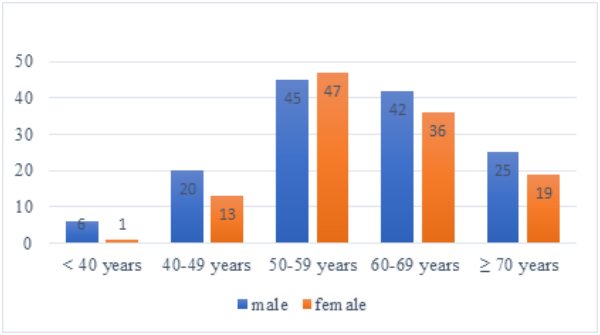

Figure 1. Age and Sex Distribution of patients

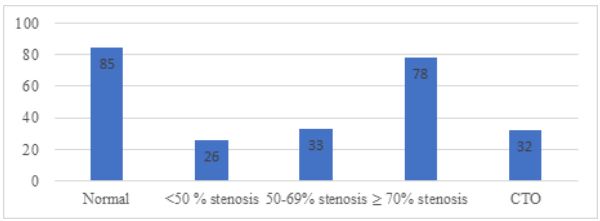

Figure 2. Distribution of patients according to coronary artery lesion, CTO (Chronic total occlusion).

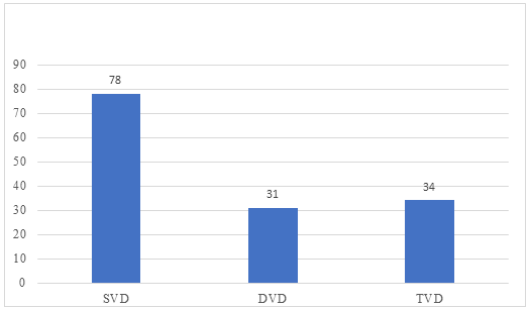

Figure 3. Distribution of patient according to number of vessel having ≥ 50% stenosis, SVD (single vessel disease), DVD (double vessel disease, TVD (triple vessel disease).

Table 1. The distribution of patients with presence and absence of carotid plaque and patients with presence and absence of ≥ 50% stenosis in CAG (coronary angiogram).

		CAG showing ≥ 50 % stenosis		
		Yes	No	Total
Carotid plaque present	Yes	104	17	121
	No	39	94	133
	Total	143	111	254

DISCUSSION

Coronary artery disease (CAD) is a leading cause of death worldwide and is primarily caused by atherosclerosis, a systemic process that affects multiple arteries in the body Carotid plaque, which refers to the accumulation of fatty deposits in the carotid arteries, is not only an indicator of local vessel wall disease but also signifies the presence of systemic atherosclerotic disease.[1] Atherosclerotic plaques initially start as focal thickenings of the arterial wall's intimal layers and progress with lipid deposition.[2] The presence of atherosclerotic plaques and the measurement of carotid intima-media thickness serve as indicators of atherosclerosis in other vascular territories, providing valuable information for identifying patients at risk of myocardial infarction or stroke.[6] We have very limited data from our country regarding comparison of carotid plaque and CAD.

In our study we found that 85 (33.5%) of patient had normal coronary artery. A total of 143 (56.3%) had ≥ 50% stenosis and 120 (47.2%) had ≥ 70% stenosis. Eight patients also had significant left main disease with ≥ 50 % stenosis. We also found that 121 (47.6%) had carotid plaque. Out of 143 patients who had ≥ 50% stenosis in CAG, 104 (72.7%) patients also had carotid plaque which is statistically significant as $p < 0.05$. Positive predictive value (PPV) of 72.7% and negative predictive value of 84.7% was found in our study. In one of the study done in Nepal by Limbu et al. they found 64.8% had single vessel disease, 26% had double vessel disease and 9.2% had triple vessel disease whereas this study showed 54.5% had single vessel disease, 21.7% had double vessel disease and 23.7% had triple vessel disease. However carotid plaque was present in 63% of the patient with positive CAG finding.[10] This finding is similar to our study with PPV of 72.7% and we had larger number of study population.

In a systemic review and meta-analysis done by Bytyci et al. who included Eighty-nine papers with 22683 patients comparing carotid and coronary atherosclerosis found that carotid plaque was less prevalent in non-significant CAD (35.9%) and was found in 65.1 % in patients with significant CAD.[16] They found moderate correlation between carotid and coronary stenosis. This study aligns with our finding with PPV of 72.7%.[16] The study by Sahadevan et al. in the Malaysian population found a prevalence of carotid plaque (74.8%) in patients with established CAD, which is consistent with our finding.[17]

On the other hand, the study in the Russian population reported a higher prevalence of carotid plaques (91.8%) in young and middle-aged males with angiographically proven CAD, which contradicts our findings.[18] Differences in patient populations and study methodologies may have contributed to these variations. The study by Adkartas et al., which selected patients with more than 50% carotid stenosis, did not find a significant association between carotid and coronary atherosclerosis.[19] This discrepancy might be due to differences in patient selection criteria.

The study from Taiwan that investigated significant carotid stenosis and CAD found a 68% concurrence.[20] However, it's important to note that our study focused on carotid plaque instead of stenosis. Carotid plaque has been suggested

as an alternate marker for coronary artery disease. And carotid plaque are strong predictors for myocardial infarction.[21] The Three City Study done by Plichart et al. showed that in multivariate analysis, carotid plaques were independent predictors of CAD.[22] The study in the Japanese population by Tanimoto et al. focused on carotid artery stenosis of more than 50% and found a lower prevalence rate of 25.4%.[23] The differences in methodology and patient selection could explain the discrepancy between their findings and ours.[23] In one of the study done in India by Alai et. al found 53.3 % patients had SVD, 15.6 had DVD and 31.1% had TVD which is similar to our finding of 54.5% SVD, 21.7% DVD and 23.7% TVD.[24]

Overall, our study's findings align with many other studies suggesting that carotid plaque is present in patients with CAD. These findings support the inclusion of carotid plaque evaluation as part of CAD risk assessment and the initiation of preventive measures before the development of symptomatic CAD. The ESC guidelines on chronic coronary syndrome also recommend the evaluation of carotid plaque as a risk factor for CAD.[9]

The study did not look into the association carotid plaque and the coronary artery which had less than 50% stenosis which is important to identify for future prevention of atherosclerotic cardiovascular disease.

CONCLUSION

From this study we can conclude that carotid plaque has good positive predictive as well as negative predictive value for detection of CAD. This study also establishes a relationship between CAD and carotid plaque, suggesting that the presence of carotid plaque may serve as an indicator of underlying CAD. As carotid plaque assessment is non-invasive test, it could be used as a part of risk assessment for CAD in selected patients.

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