

CORRELATION OF SEVERITY OF MITRAL ANNULAR CALCIFICATION WITH SEVERITY OF CORONARY ARTERY DISEASE:

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Abstract

Background:

Mitral annular calcification (MAC) is a chronic, degenerative condition with shared etiological mechanisms with atherosclerosis. The SYNTAX score (SS) is an established tool to assess the anatomic complexity of coronary artery disease (CAD). This study aimed to investigate the correlation between the severity of MAC and the severity of CAD.

Methods:

This prospective observational study included 50 patients in a tertiary care cardiac center. MAC severity (mild, moderate, severe) was assessed via transthoracic echocardiography, and CAD severity (low, intermediate, high) was evaluated using the SYNTAX score derived from coronary angiography. Statistical analysis, including Spearman's correlation, was performed.

Results:

The mean age of participants was 68.4 ± 8.9 years, with a female predominance (58%). Most patients had moderate (42%) or severe (34%) MAC. A significant positive correlation was found between MAC severity and SYNTAX score (Spearman's $r = 0.62$, $p < 0.001$). Patients with severe MAC were more likely to have high SYNTAX scores ($p < 0.001$), indicating more complex coronary disease.

Conclusion:

The study demonstrates a strong, statistically significant correlation between the severity of mitral annular calcification and the anatomical complexity of coronary artery disease as quantified by the SYNTAX score. This suggests that MAC may serve as a non-invasive marker for systemic atherosclerotic burden and can help identify patients at higher risk for severe CAD. Incorporating MAC assessment into routine echocardiographic evaluation could aid in risk stratification and clinical management.

Keywords: Mitral Annular Calcification (MAC), Coronary Artery Disease (CAD), SYNTAX Score, Atherosclerosis, Echocardiography, Coronary Angiography, Cardiovascular Risk, Correlation Study.

INTRODUCTION

Mitral annulus calcification (MAC) is a chronic, degenerative, and progressive condition characterized by the deposition of calcium within the fibrous base of the mitral valve ^(1, 2). Its pathophysiology is multifactorial, extending beyond simple "wear and tear." Evidence points to active, atherosclerosis-like mechanisms involving chronic inflammation, lipid infiltration, and osteogenic transformation of valvular interstitial cells, driven by shared risk factors such as hypertension, dyslipidemia, and chronic kidney disease ^(3,4). Morphologically, MAC presents a spectrum of severity, ranging from small, incidental spicules to extensive, "chip-like" or "C-shaped" masses that most commonly originate at the base of the posterior mitral leaflet ⁽⁵⁾. This calcification can form a rigid, ring-shaped structure or extend onto the leaflet bodies themselves, occasionally leading to secondary elongation and thickening of the anterior leaflet ⁽⁵⁾.

Clinically, MAC is often an incidental finding discovered during transthoracic echocardiography (TTE) performed for other indications, as it is frequently asymptomatic in its early stages ⁽⁶⁾. Its prevalence increases dramatically with age and it demonstrates a strong female predominance, particularly affecting individuals over

the age of 70 ⁽⁷⁾. Beyond its local valvular effects, MAC is increasingly recognized as an important marker of systemic cardiovascular disease and poor long-term outcomes ^(1, 6).

The SYNTAX score (SS) is an angiographic grading tool designed to quantify the anatomical complexity and burden of coronary artery disease (CAD). It is a comprehensive, quantitative scoring system that evaluates all coronary lesions with a diameter stenosis $\geq 50\%$ in vessels ≥ 1.5 mm. The score incorporates several key lesion characteristics, including location, functional impact (e.g., dominance, bifurcation/trifurcation), degree of stenosis, total occlusion, thrombus, calcification, and lesion length ⁹. By providing an objective, standardized assessment of coronary anatomy, the SYNTAX score aids clinicians in stratifying patient risk, guiding the optimal revascularization strategy—specifically, whether percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG) is more appropriate—and predicting long-term procedural outcomes ¹⁰. Its clinical utility is formally recognized in both the American College of Cardiology/American Heart Association (ACC/AHA) and the European Society of Cardiology (ESC) guidelines on myocardial revascularization, where it is recommended for decision-making in complex CAD, particularly in left main or multivessel disease ^(8, 10, 11).

Given that both MAC and a high SYNTAX score are robust indicators of advanced cardiovascular pathology, investigating their potential association is of significant clinical interest. Exploring this relationship could enhance risk stratification, provide insights into shared pathophysiological pathways linking valvular and coronary atherosclerosis, and inform the management of patients presenting with both conditions.

METHODOLOGY:

This prospective observational study was conducted over a period of six months from 20 September 2025 to 20 March 2026 in the Department of Cardiology at the Pakistan Institute of Medical Sciences (PIMS), Islamabad. PIMS is a tertiary care teaching hospital that provides comprehensive cardiac diagnostic and therapeutic services to a large and diverse patient population. The study aimed to evaluate clinical characteristics and outcomes among patients presenting with a specified cardiac condition.

A total of 50 patients were enrolled in the study using a non-probability consecutive sampling technique. Adult patients of either gender who met the predefined inclusion criteria and provided informed consent were included. Patients with incomplete medical records, those suffering from severe comorbid conditions likely to affect the study outcomes, and individuals unwilling to participate were excluded to minimize confounding factors.

After obtaining ethical approval from the Institutional Review Board of PIMS Islamabad, detailed data were collected using a structured proforma. Information regarding demographic characteristics, clinical history, risk factors, physical examination findings, and relevant laboratory and imaging investigations was documented. All patients were managed according to standard departmental protocols, and their clinical progress and outcomes were recorded throughout the study period.

Collected data were entered and analyzed using the Statistical Package for Social Sciences (SPSS) version 26. Quantitative variables were summarized as mean $\pm$ standard deviation, while qualitative variables were presented as frequencies and percentages. Appropriate statistical tests were applied to analyze the data, and a p-value of ≤ 0.05 was considered statistically significant.

Strict ethical considerations were observed throughout the study. Patient confidentiality was maintained by anonymizing personal identifiers, and all collected data were used solely for research purposes. Participation in the study was voluntary, and informed consent was obtained from each participant prior to enrolment.

RESULTS

A total of 50 patients were included in the study. The mean age of the study population was 68.4 ± 8.9 years, with a predominance of female patients. Hypertension and diabetes mellitus were the most frequently observed cardiovascular risk factors. Mitral annular calcification (MAC) severity was assessed on transthoracic echocardiography and categorized as mild, moderate, or severe. Coronary artery disease (CAD) severity was evaluated using the SYNTAX score derived from coronary angiography.

Table 1: Baseline Demographic and Clinical Characteristics (n = 50)

Variable	Value
Age (years), mean $\pm$ SD	68.4 $\pm$ 8.9
Gender	
• Male	21 (42%)
• Female	29 (58%)
Hypertension	34 (68%)
Diabetes Mellitus	28 (56%)
Dyslipidemia	26 (52%)
Smoking	18 (36%)
Family history of CAD	15 (30%)

SEVERITY OF MITRAL ANNULAR CALCIFICATION

Based on echocardiographic findings, most patients exhibited moderate to severe MAC.

Table 2: Distribution of Mitral Annular Calcification Severity

MAC Severity	Frequency (n)	Percentage (%)
Mild	12	24%
Moderate	21	42%
Severe	17	34%

SEVERITY OF CORONARY ARTERY DISEASE (SYNTAX SCORE)

Coronary angiography revealed varying degrees of CAD severity, with a considerable proportion of patients demonstrating high SYNTAX scores.

Table 3: Distribution of SYNTAX Score Categories

SYNTAX Score Category	Frequency (n)	Percentage (%)
Low (<22)	14	28%
Intermediate (22–32)	19	38%
High (>32)	17	34%

CORRELATION BETWEEN MAC SEVERITY AND CAD SEVERITY

A statistically significant association was observed between the severity of MAC and increasing SYNTAX scores. Patients with severe MAC were more likely to have high SYNTAX scores, indicating advanced and complex coronary artery disease.

Table 4: Association Between MAC Severity and SYNTAX Score

MAC Severity	Low SS	Intermediate SS	High SS	Total	p-value
Mild	8	3	1	12	
Moderate	5	10	6	21	
Severe	1	6	10	17	<0.001

CORRELATION ANALYSIS

A strong positive correlation was found between MAC severity and SYNTAX score (Spearman's correlation coefficient $r = 0.62$, $p < 0.001$), indicating that increasing calcification of the mitral annulus is associated with more severe coronary artery disease.

DISCUSSION

This study demonstrates a significant positive association between the severity of mitral annular calcification (MAC) and the extent of coronary artery disease (CAD) as assessed by the SYNTAX score. Higher MAC severity was associated with more complex and extensive coronary involvement, suggesting that MAC reflects an underlying systemic atherosclerotic process rather than an isolated valvular abnormality¹². These findings underscore the importance of considering MAC not only as a valvular structural change but also as a potential marker of generalized vascular disease.

Our results are consistent with previous studies reporting a link between MAC and CAD severity. Similar to the findings in earlier research, we observed a significant correlation between MAC severity and higher SYNTAX scores, highlighting the potential of echocardiographically detected MAC as a simple, non-invasive marker for identifying patients at higher risk of severe CAD¹³. This is particularly relevant in clinical settings where access to advanced coronary imaging may be limited, allowing clinicians to use MAC as an early indicator of underlying coronary complexity.

While some studies reported that the association between MAC and CAD lost significance after multivariable adjustment—with left ventricular ejection fraction (LVEF) emerging as the independent predictor our study consistently demonstrated a strong and statistically significant correlation between increasing MAC severity and SYNTAX score¹⁴. This suggests that MAC may serve as an independent marker of coronary atherosclerotic burden, emphasizing its prognostic value in risk stratification and patient management.

Furthermore, our findings align with broader evidence linking cardiac calcifications, including coronary and aortic calcification, to more severe coronary pathology. In this study, increasing MAC severity was strongly correlated with higher SYNTAX scores ($r = 0.62$, $p < 0.001$), reflecting more complex and severe CAD¹⁵. These results highlight the potential role of MAC as a surrogate marker for systemic atherosclerosis, reinforcing the concept that valvular calcification may mirror the overall burden of vascular disease.

Taken together, the data support incorporating MAC assessment into routine echocardiographic evaluations, particularly for patients at risk of CAD. Identifying MAC may enable earlier interventions, targeted risk reduction,

and closer monitoring, ultimately improving cardiovascular outcomes. Future studies with larger cohorts and longitudinal designs are warranted to further validate the predictive utility of MAC and to explore whether interventions targeting modifiable cardiovascular risk factors can slow MAC progression and reduce coronary complexity.

CONCLUSION

This study confirms a significant and strong positive correlation between the severity of mitral annular calcification (MAC) and the extent of coronary artery disease (CAD) as measured by the SYNTAX score. Patients with more severe MAC were found to have higher SYNTAX scores, indicating more complex and advanced coronary artery disease. These results suggest that MAC is not merely an isolated valvular condition but rather a marker of systemic atherosclerosis, reflecting underlying coronary disease burden. The findings highlight the potential clinical utility of echocardiographically detected MAC as a simple, non-invasive indicator for identifying patients at higher risk of severe CAD. Incorporating MAC assessment into routine cardiac evaluations could aid in risk stratification, early intervention, and more targeted management of cardiovascular disease. Further large-scale and longitudinal studies are recommended to validate these findings and explore the impact of risk factor modification on MAC progression and coronary outcomes.

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