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Original Article

Left Atrial Volume Index as a Predicting Factor for the Severity of Acute Coronary Syndrome

Ahmed I. Bedier[1], MD; Mohamed Taher[2], MS; Ensaf Bassam[1], MD; Mohammed Hamza Kabil[3], MD; Sally M. Teima[1*], MD

ABSTRACT

Background: Coronary artery disease (CAD) is a predominant contributor to global mortality. The left atrial volume index (LAVI) is a recognized marker of chronic diastolic dysfunction and has been linked to unfavorable outcomes in patients with acute coronary syndrome (ACS). This study explored the association between echocardiographic parameters and the angiographic complexity of CAD in patients presenting with ACS.

Methods: This prospective cohort study enrolled 52 patients diagnosed with ACS who were treated with percutaneous coronary intervention. Each participant underwent a comprehensive echocardiographic evaluation, including measurement of LAVI, and coronary angiography with SYNTAX score calculation.

Results: The majority of patients (n = 52) were male (94.2%) with a mean age of 57.3 ± 9.0 years. Single-vessel disease was detected in 78.8%, and low SYNTAX scores (>22) in 86.5%. LAVI correlated positively with age (r = 0.333; P = 0.016), left anterior descending artery diameter (r = 0.840; P < 0.001), left atrial volume A2 (r = 0.904; P < 0.001), left atrial volume A4 (r = 0.913; P < 0.001), and SYNTAX categories (r = 0.337; P = 0.015). Two-vessel disease (adjusted odds ratio, 15.4 [95% CI, 1.4 to 165.3]; P = 0.024) and age greater than 68 years (AOR, 24.0 [95% CI, 1.2 to 489.6]; P = 0.039) independently predicted more severe CAD.

Conclusions: LAVI correlates with coronary complexity in ACS. Age and multivessel disease predict more severe CAD, supporting the prognostic value of echocardiographic assessment. ***(Iranian Heart Journal 2025; 26(4): 46-56)***

KEYWORDS: Acute coronary syndrome; Left atrial volume index; Coronary artery disease; SYNTAX score; Echocardiography

[1] Cardiology Department, Faculty of Medicine, Mansoura University, Mansoura, Egypt.
[2] Cardiology Department, Faculty of Medicine, Damietta University, Damietta, Egypt.
[3] Cardiology Department, Faculty of Medicine, Suez University, Suez, Egypt.

***Corresponding Author:** Sally M. Teima, MD; Cardiology Department, Faculty of Medicine, Mansoura University, Mansoura, Egypt.
Email: sally88@mans.edu.eg **Tel:** +201012770015

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Ischemic heart disease continues to rank among the leading causes of death globally. Despite advances in the management of prior acute coronary syndromes (ACS), the persistent prevalence of cardiovascular risk factors contributes to the rising incidence of subsequent acute coronary events.[1] Clinically, coronary artery disease (CAD) may present as stable angina, acute coronary syndrome, heart failure, or sudden cardiac death. The spectrum of ACS includes both ST-segment elevation myocardial infarction (STEMI) and non–ST-segment elevation acute coronary syndromes (NSTE-ACS), the latter comprising non–ST-segment elevation myocardial infarction (NSTEMI) and unstable angina.[2] Epidemiological data indicate that approximately two-thirds of ACS presentations are classified as NSTE-ACS, whereas STEMI accounts for approximately one-third of cases.[3] Left atrial (LA) enlargement often arises as a consequence of both systolic and diastolic cardiac dysfunction. Current guidelines from the American Society of Echocardiography endorse the use of the left atrial volume index (LAVI)—determined by dividing the LA volume by the body surface area—as the preferred metric for evaluating LA size.[4] Elevated LAVI levels have been associated with increased mortality following acute MI; nonetheless, the prognostic value of varying degrees of LA enlargement remains insufficiently clarified, particularly in ambulatory populations with CAD.[5] Additionally, LA enlargement serves as an indicator of elevated left ventricular (LV) filling pressures and is recognized as a marker of poorer clinical outcomes, notably in patients experiencing heart failure due to diastolic dysfunction. Compared with traditional anteroposterior diameter measurements, the assessment of LA volume is now considered the most accurate echocardiographic approach to determining atrial size.[6] During diastole, as the mitral valve opens, LV filling pressures are transmitted to the left atrium, rendering it highly sensitive to the presence of diastolic dysfunction. Emerging evidence emphasizes that LA expansion is strongly predictive of adverse cardiovascular outcomes, particularly among elderly individuals and those with hypertension.[7]

LA volume has gained recognition as a significant prognostic indicator across a spectrum of cardiovascular disorders, such as acute MI, LV dysfunction, mitral valve regurgitation, cardiomyopathies, and atrial fibrillation.[8] Importantly, an increase in LA volume reflects the presence of longstanding diastolic dysfunction and has been linked to unfavorable clinical outcomes, regardless of the status of systolic function. The objective of the present study was to evaluate the association between echocardiographic measures—including LAVI—and the angiographic characteristics of CAD in patients presenting with ACS.

METHODS

Study Design and Population

This prospective cohort study was conducted at a single center within the catheterization unit of Mansoura Medical Specialized Hospital in Mansoura, Egypt. Consecutive patients diagnosed with ACS were recruited from the inpatient wards and outpatient clinics of the Cardiovascular Department at Mansoura University Hospital from November 2022 through May 2023.

Written informed consent was obtained from all participants before enrollment. The study protocol was approved by the Institutional Review Board (IRB) of Mansoura University (approval code MS.22.04.1953).

Eligibility Criteria

The study included adults older than 18 years who presented with ACS and were candidates for percutaneous coronary intervention. The ACS spectrum encompassed STEMI, NSTEMI, and unstable angina, as defined by the 2023 European Society of Cardiology (ESC) guidelines.[9] Patients were excluded if they had atrial flutter, atrial fibrillation, valvular heart disease, congenital heart disease, mechanical complications, contraindications to percutaneous coronary intervention, poor echocardiographic windows, hypertrophic cardiomyopathy, restrictive cardiomyopathy, or non-ischemic dilated cardiomyopathy.

Clinical Assessments and Procedures

All patients underwent a comprehensive clinical evaluation that included a detailed history (demographic characteristics, cardiovascular risk factors, and relevant past medical history) and a complete general and cardiovascular physical examination. Laboratory investigations included a complete blood cell (CBC) count, serum creatinine level, cardiac enzyme levels, and international normalized ratio (INR). A standard 12-lead surface ECG was obtained for all participants, and ischemic localization was determined according to the infarct territory.

Doppler echocardiographic assessments were performed using a GE LOGIQ e ultrasound system equipped with a 4S transducer, with patients positioned in the left lateral decubitus position. Standard measurements included LV end-diastolic and end-systolic diameters, LV mass index, and relative wall thickness. Systolic function was evaluated by fractional shortening, derived from M-mode echocardiography in the parasternal long-axis view. Diastolic function was assessed using pulsed-wave Doppler analysis of mitral inflow to measure early (E wave) and late (A wave) diastolic velocities, the E/A ratio, and the E-wave deceleration time, complemented by tissue Doppler imaging to determine medial and lateral E/e′ ratios. LA volume was estimated via 2D planimetry from apical four- and two-chamber views at end-systole and was subsequently indexed to the body surface area to calculate LAVI. All participants underwent coronary angiography to evaluate coronary artery lesions, based on the segmentation model proposed by the American Heart Association (AHA). The anatomical complexity and severity of coronary artery disease were quantified using the SYNTAX score, which was calculated via the official online SYNTAX score calculator (http://www.syntaxscore.org/) according to established protocols.[10] This calculation incorporated lesion-specific features, including bifurcations, trifurcations, vessel tortuosity, calcific burden, chronic total occlusions, thrombus presence, and lesion length.[11, 12]

Follow-Up and Outcomes

The primary outcome was the relationship between LAVI and the angiographic severity of CAD, as quantified by the SYNTAX score. Secondary outcomes included the association between various echocardiographic parameters and the severity of coronary lesions, and the predictive value of LAVI for identifying severe coronary disease.

Patients were followed up throughout their hospitalization until all clinical, echocardiographic, and angiographic evaluations were completed. Long-term follow-up was not part of the study protocol.

Statistical Analysis

Data management and statistical analyses were conducted using IBM SPSS Statistics for Windows, Version 27.0 (IBM Corp) and MedCalc Statistical Software, version 20.215 (MedCalc Software Ltd). Categorical variables were summarized as frequencies and percentages. Continuous variables were assessed for normality using the Shapiro-Wilk test, with a P-value greater than 0.05 indicating a normal distribution. Normally distributed continuous data were reported as mean (SD), and non-normally distributed data were presented as median (IQR). Categorical variable comparisons were performed using the χ^2 or Fisher exact test, as appropriate. The Fisher-Freeman-Halton exact test was employed for larger contingency tables. The Mann-Whitney *U* test was drawn upon for comparisons of continuous variables.

Associations between continuous variables were explored using the Spearman rank correlation coefficient. Binary logistic regression analysis was used to identify predictors of binary outcomes. Univariate logistic regression provided crude odds ratios (ORs) with corresponding 95% CIs, and multivariate logistic regression was used to obtain adjusted ORs after controlling for potential confounding factors. A *P*-value of less than or equal to 0.05 defined statistical significance.

RESULTS

Among the 52 studied cases, most were men (94.2%), and 55.8% were younger than 60 years. The mean age was 57.3 ± 9.0 years, and the mean body mass index was 26.2 ± 2.3 kg/m². Most patients were overweight (75.0%), 21.2% had a normal weight, and 3.8% were obese. Risk factors included current smoking in 67.3%, hypertension in 51.9%, diabetes mellitus in 38.5%, and dyslipidemia in 36.5%. Regarding acute coronary syndrome presentation, inferior ST-segment elevation myocardial infarction was most common (42.3%), followed by anterior STEMI (30.8%), NSTEMI (13.5%), unstable angina (9.6%), and lateral STEMI (3.8%) (Table 1).

Table 1. Demographic characteristics, medical history, and ACS presentation of the studied cases

Characteristic	*P*
Sex	
Male	49 (94.2%)
Female	3 (5.8%)
Age group	
< 60 years	29 (55.8%)
≥ 60 years	23 (44.2%)
BMI category	
Normal weight	11 (21.2%)
Overweight	39 (75.0%)
Obese	2 (3.8%)
Age (years)	57.3 ± 9.0
BMI (kg/m²)	26.2 ± 2.3
Current smoking	35 (67.3%)
Hypertension	27 (51.9%)
Diabetes mellitus	20 (38.5%)
Dyslipidemia	19 (36.5%)
STEMI – Anterior	16 (30.8%)
STEMI – Inferior	22 (42.3%)
STEMI – Lateral	2 (3.8%)
NSTEMI	7 (13.5%)
Unstable angina	5 (9.6%)

Regarding echocardiographic findings, 26.9% of patients had impaired ejection fraction (EF) (<50%), while 73.1% had normal EF. Most patients (76.9%) had an E/e′ ratio of less than 10, 19.2% had values between 10 and 14, and 3.8% had values greater than 14. Diastolic dysfunction, defined as an E/A ratio of 0.8 or less, was observed in 59.6% of cases, whereas 40.4% had normal or pseudonormal filling patterns (E/A >0.8). An enlarged LA diameter (≥4 cm) was present in 40.4%.

The median E/A ratio was 0.79 (IQR, 0.64–0.91), E/e′ ratio was 8.15 (IQR, 6.70–9.88), and EF was 0.52 (IQR, 0.47–0.58). The median LA diameter was 3.90 cm (IQR, 3.70–4.20 cm), LA volume in the apical two-chamber view (LAV A2) was 40.0 mm² (IQR, 30.0–48.0), LA volume in the apical four-chamber view (LAV A4) was 40.5 mm² (IQR, 32.0–49.5), and the median LAVI was 20.75 mL/m² (IQR, 16.0–26.0) (Table 2).

Table 2. Echocardiographic and coronary angiography findings of the studied cases

Characteristics	*P*
Ejection Fraction %	
Impaired	14 (26.9%)
Normal	38 (73.1%)
E/e′ Ratio	
E/e′ < 10	40 (76.9%)
E/e′ 10–14	10 (19.2%)

E/e′ > 14	2 (3.8%)
Diastolic Dysfunction (E/A Ratio)	
Normal/Pseudonormal (E/A > 0.8)	21 (40.4%)
Impaired (E/A ≤ 0.8)	31 (59.6%)
Left Atrial Diameter (LAD, cm)	
Normal (< 4 cm)	31 (59.6%)
Enlarged (≥ 4 cm)	21 (40.4%)
E/A Ratio	0.79 (0.64–0.91)
E/e′ Ratio	8.15 (6.70–9.88)
EF (%)	0.52 (0.47–0.58)
Interventricular Septal Thickness in Diastole (IVSd, cm)	1.10 (1.00–1.10)
PWDd (cm)	1.10 (1.00–1.10)
Left Atrial Diameter (LAD, cm)	3.90 (3.70–4.20)
Left Atrial Area in Apical 2-Chamber View (LAV A2, mm²)	40.0 (30.0–48.0)
Left Atrial Area in Apical 4-Chamber View (LAV A4, mm²)	40.5 (32.0–49.5)
LAVI, mL/m²	20.75 (16.0–26.0)
Characteristic	Value
Vessel Involvement	
Single-vessel disease	41 (78.8%)
Two-vessel disease	11 (21.2%)
Artery Affected	
Left Anterior Descending (LAD) artery	32 (61.5%)
LCX artery	12 (23.1%)
RCA	19 (36.5%)
SYNTAX Score Categories	
Low (<22)	45 (86.5%)
Intermediate (22–32)	6 (11.5%)
High (>32)	1 (1.9%)
SYNTAX Score	15.00 (8.00–19.00)

As for coronary angiography findings, single-vessel disease was observed in 78.8% of patients, and two-vessel disease in 21.2%. The left anterior descending (LAD) artery was the most commonly affected vessel (61.5%), followed by the right coronary artery in 36.5% and the left circumflex artery in 23.1%. Most patients (86.5%) had a low SYNTAX score (<22), 11.5% had an intermediate score (22–32), and 1.9% had a high score (>32). The median SYNTAX score was 15.00 (IQR, 8.00–19.00) (Table 2). Regarding correlations with LAVI, a significant positive correlation was found with age (*r* = 0.333, *P* = 0.016), LAD diameter (*r* = 0.840, *P* < 0.001), LAV area in the apical two-chamber view (*r* = 0.904, *P* < 0.001), and LAV area in the apical four-chamber view (*r* = 0.913, *P* < 0.001). In addition, LAVI was significantly correlated with age category (<60 vs. ≥60 years) (*r* = 0.323, *P* = 0.019) and with SYNTAX score categories (*r* = 0.337, *P* = 0.015) (Table 3).

Table 3. Correlations between LAVI and study parameters

Parameters	Correlation Coefficient (rs)	*P*
Numerical Variables		
Age (years)	0.333	0.016 *
BMI (kg/m²)	-0.039	0.785
BSA (m²)	-0.199	0.157
EF (%)	-0.153	0.278
IVSd (cm)	-0.037	0.794
PWDd (cm)	0.046	0.747
LAD (cm)	0.840	<0.001*
LAV A2 (mm²)	0.904	<0.001*
LAV A4 (mm²)	0.913	<0.001*
SYNTAX score	0.225	0.108
Vessel number	0.119	0.399
Categorical Variables		
Age category (<60 vs ≥60 years)	0.323	0.019*
Current smoking	0.164	0.245
Diabetes mellitus	-0.149	0.293
Hypertension	-0.131	0.356
Dyslipidemia	-0.085	0.551
Diastolic dysfunction (E/A)	0.123	0.387
Diastolic dysfunction (E/e′)	0.181	0.198
STEMI	-0.057	0.686
NSTEMI	0.039	0.784
UA	0.108	0.445
LAD artery affection	0.077	0.587
LCX artery affection	0.111	0.435
RCA artery affection	-0.093	0.513
SYNTAX score categories	0.337	0.015

LAVI: left atrial volume index; BMI: body mass index; BSA: body surface area; EF: ejection fraction; IVSd: interventricular septal end-diastolic thickness; PWDd: posterior wall end-diastolic thickness; LAD: left anterior descending (coronary) artery; LAV A2: left atrial volume in apical two-chamber view; LAV A4: left atrial volume in apical four-chamber view; STEMI: ST-segment elevation myocardial infarction; NSTEMI: non–ST-segment elevation myocardial infarction; UA: unstable angina; LCX: left circumflex (coronary) artery; RCA: right coronary artery

Analysis of SYNTAX score categories showed a significant positive correlation with vessel number (*r* = 0.337, *P* = 0.015), LAD diameter (*r* = 0.315, *P* = 0.023), LAV A2 area (*r* = 0.283, *P* = 0.042), and LAVI (*r* = 0.284, *P* = 0.041). Regarding the continuous SYNTAX score, significant negative correlations were observed with E/A ratio (*r* = –0.328, *P* = 0.018), E/e′ ratio (*r* = –0.290, *P* = 0.037), and EF (*r* = –0.650, *P* < 0.001) (Table 4).
Comparison between low and intermediate–high SYNTAX score categories revealed that diastolic dysfunction, based on E/A ratio, was significantly more frequent in the intermediate–high SYNTAX group (*P* = 0.033). Patients with intermediate–high SYNTAX scores also had a higher frequency of LAVI greater than 23 mL/m² (*P* = 0.041), two-vessel disease (*P* = 0.029), and LAD artery involvement (*P* = 0.035).

Vis-à-vis continuous variables, the intermediate–high SYNTAX group had significantly lower EF (*P* = 0.011), lower E/A ratio (*P* = 0.046), larger LAD diameter (*P* = 0.026), higher LAV A2 area (*P* = 0.046), and higher LAVI (*P* = 0.046) compared with the low SYNTAX group (Table 5).
In univariable logistic regression analysis, a LAVI greater than 23 mL/m² (crude odds ratio [COR], 6.2; 95% CI, 1.1 to 35.8; *P* = 0.043), two-vessel disease (COR, 7.2; 95% CI, 1.3 to 39.6; *P* = 0.023), and age greater than 68 years (COR, 16.1; 95% CI, 2.1 to 126.7; *P* = 0.008) were identified as significant predictors of intermediate–high SYNTAX scores and more severe coronary artery disease.
In multivariable analysis, two-vessel disease (adjusted odds ratio [AOR], 15.4; 95% CI, 1.4 to 165.3; *P* = 0.024) and age greater than 68 years (AOR, 24.0; 95% CI, 1.2 to 489.6; *P* = 0.039) remained independent significant predictors, whereas LAVI greater than 23 mL/m² was no longer statistically significant (*P* = 0.511) (Table 6).

Table 4. Correlations between the SYNTAX score and study parameters

Parameters	SYNTAX Categories (rs)	*P*	SYNTAX Score (rs)	*P*
BMI category	0.035	0.807	-0.157	0.267
Diastolic dysfunction (E/e′)	0.089	0.529	0.149	0.292
LAV category	0.209	0.136	0.095	0.501
Vessel number	0.337	0.015*	0.223	0.112
Age (years)	0.189	0.180	0.003	0.981
BMI (kg/m²)	0.017	0.907	0.020	0.886
BSA (m²)	-0.135	0.341	-0.241	0.085
E/A ratio	-0.271	0.052	-0.328	0.018*
E/e′ ratio	0.023	0.874	-0.290	0.037*
EF (%)	-0.343	0.013*	-0.650	<0.001*
IVSd (cm)	0.026	0.856	0.030	0.834
LAD (mm)	0.315	0.023*	0.203	0.149
LAV A2 (mm²)	0.283	0.042*	0.223	0.112
LAV A4 (mm²)	0.217	0.122	0.105	0.459
LAVI (mL/m²)	0.284	0.041*	0.225	0.108
PWDd (cm)	0.082	0.562	0.037	0.792

Table 5. Comparisons of low vs. intermediate to high SYNTAX score

Characteristic	Low SYNTAX	Intermediate–High SYNTAX	P-value
Age category (< 60 years)	26 (57.8%)	3 (42.9%)	0.686
Age category (≥ 60 years)	19 (42.2%)	4 (57.1%)	
Sex (Male)	42 (93.3%)	7 (100%)	1.000
Sex (Female)	3 (6.7%)	0 (0.0%)	
BMI category (Normal weight)	10 (22.2%)	1 (14.3%)	1.000
BMI category (Overweight)	33 (73.3%)	6 (85.7%)	
BMI category (Obese)	2 (4.4%)	0 (0.0%)	
Current smoking	29 (64.4%)	6 (85.7%)	0.404
Diabetes mellitus	17 (37.8%)	3 (42.9%)	1.000
Diastolic dysfunction (E/A > 0.8)	21 (46.7%)	0 (0.0%)	0.033*
Diastolic dysfunction (E/A ≤ 0.8)	24 (53.3%)	7 (100%)	
Diastolic dysfunction (E/e′ < 10)	34 (75.6%)	6 (85.7%)	0.675
Diastolic dysfunction (E/e′ > 10)	11 (24.4%)	1 (14.3%)	
Dyslipidemia	16 (35.6%)	3 (42.9%)	0.697
EF category (Impaired)	10 (22.2%)	4 (57.1%)	0.075
EF category (Normal)	35 (77.8%)	3 (42.9%)	
Hypertension	21 (46.7%)	6 (85.7%)	0.101
LAD category (Normal < 4 cm)	29 (64.4%)	2 (28.6%)	0.104
LAD category (Enlarged ≥ 4 cm)	16 (35.6%)	5 (71.4%)	
LAVI > 23 mL/m²	13 (28.9%)	5 (71.4%)	0.041*
STEMI (Anterior)	12 (26.7%)	4 (57.1%)	0.245
STEMI (Inferior)	21 (46.7%)	1 (14.3%)	
STEMI (Lateral)	2 (4.4%)	0 (0.0%)	
NSTEMI	6 (13.3%)	1 (14.3%)	1.000
Unstable angina	4 (8.9%)	1 (14.3%)	0.530
Vessel involvement (Single-vessel disease)	38 (84.4%)	3 (42.9%)	0.029*
Vessel involvement (Two-vessel disease)	7 (15.6%)	4 (57.1%)	
LAD artery affection	25 (55.6%)	7 (100%)	0.035*
LCX artery affection	9 (20.0%)	3 (42.9%)	0.331
RCA artery affection	18 (40.0%)	1 (14.3%)	0.242
Age (years)	57 (49.5–62)	64 (51–71)	0.203
BMI (kg/m²)	26 (25–28)	26 (26–27)	0.937
BSA (m²)	2.0 (2.0–2.1)	2.0 (1.8–2.1)	0.445
E/A ratio	0.80 (0.67–0.93)	0.64 (0.54–0.80)	0.046*
E/e′ ratio	8.2 (6.65–9.9)	8.0 (7.0–9.9)	0.854
EF (%)	0.54 (0.505–0.58)	0.47 (0.38–0.51)	0.011*
IVSd (cm)	1.1 (1.0–1.1)	1.1 (1.0–1.1)	0.896
PWDd (cm)	1.1 (1.0–1.1)	1.0 (1.0–1.1)	0.528
LAD (cm)	3.9 (3.7–4.2)	4.2 (3.9–4.5)	0.026*
LAV A2 (mm²)	38 (30–45)	48 (40–52)	0.046*
LAV A4 (mm²)	40 (31.5–47.5)	52 (38–60)	0.136
LAVI (mL/m²)	20 (16–26)	26 (21–37.6)	0.046*

BMI: body mass index; EF: ejection fraction; LAD: left anterior descending; LAVI: left atrial volume index; STEMI: ST-segment elevation myocardial infarction; LCX: left circumflex; STEMI: non–ST-segment elevation myocardial infarction, BSA: body surface area; LAV A2: left atrial volume in the two-chamber view; LAV A4: left atrial volume in the four-chamber view; IVSd: interventricular septal end-diastolic thickness; PWDd: posterior wall end-diastolic thickness; E/A ratio: early to late diastolic mitral inflow velocity ratio; E/e′ ratio: early mitral inflow to early diastolic mitral annular velocity ratio

Table 6. Predictors of the likelihood of intermediate-to-high SYNTAX scores and more severe CAD

	Univariable			Multivariable		
	P	COR	95%CI	*P*	AOR	95% CI
Impaired ejection fraction (<50%)	.068	4.7	.89-24.4	-	-	-
Hypertension	.086	6.9	.76-61.7	-	-	-
Enlarged left anterior descending (≥4)	.091	4.5	.79-26.1	-	-	-
Left atrial volume index > 23	.043*	6.2	1.1-35.8	.511	2.2	.22-21.3
Two-vessel disease	.023*	7.2	1.3-39.6	.024*	15.4	1.4-165.3
Age > 68 years	.008*	16.1	2.1-126.7	.039*	24	1.2-489.6

DISCUSSION

CAD results from plaque formation and occlusion of the coronary arteries, leading to impaired myocardial oxygen supply; it remains a leading cause of death worldwide.[13–15] ACS, including STEMI, NSTEMI, and unstable angina, represents a critical presentation of CAD.[16] LV function is a key prognostic marker in ACS, as both impaired and subclinical dysfunction are associated with worse outcomes, highlighting the need for early detection and intervention.[17–19] Echocardiographic assessment of diastolic function, particularly through LAVI, offers prognostic insights because LAVI reflects the chronic diastolic burden and predicts adverse outcomes. Although LAVI has been extensively studied in acute MI, its role in unstable angina is less clear.[20] Therefore, this study aimed to evaluate the association between echocardiographic measures—including LAVI—and the angiographic characteristics of CAD in patients presenting with ACS.

In our study, LAVI showed significant positive correlations with age, diastolic dysfunction, LAD diameter, LAV A2, LAV A4, and SYNTAX categories.

In agreement with our findings, Truong et al.[21] reported that LA volumes were associated with age and cardiovascular comorbidities but were not notably influenced by sex, β-blocker use, or sublingual nitroglycerin administration. Similarly, Hsiao et al.[4] found that LA distensibility was strongly associated with LV filling pressure independently of coronary status and EF, highlighting the prognostic utility of LA parameters over E/e′ alone. Secundo Junior et al.[18] also supported the importance of LAVI, demonstrating that patients with increased LAVI had worse outcomes, including higher rates of acute pulmonary edema and major adverse cardiac events (MACE), independent of traditional risk factors. In line with these results, Ahmeti et al.[22] showed through a meta-analysis that elevated LAVI was strongly associated with increased risks of MACE, mortality, and hospitalization among patients with ACS.

In the present study, SYNTAX categories (low vs. intermediate–high) showed significant positive correlations with the number of affected vessels, LAV A2, LAVI, and LAD diameter, whereas a significant negative correlation was found with EF. Further, the SYNTAX score was negatively correlated with E/A ratio, E/e′ ratio, and EF. Consistent with our findings, Nabati et al.[23] demonstrated that a higher E/(e′s′) ratio, larger LVAI, and positive troponin levels were independently associated with increased SYNTAX scores, further supporting the role of diastolic dysfunction and LA enlargement in coronary disease severity. Similarly, Saklecha et al.[24] found a significant positive correlation between LAVI and the SYNTAX score, reinforcing the prognostic importance of atrial structural remodeling in patients with ACS.

In our study, comparisons between mild and moderate-to-severe CAD showed that the latter was associated with significantly lower E/A ratio and EF, and higher prevalence of enlarged LAVI, two-vessel disease, LAD artery affection, LAD size, and higher LAV A2 and LAVI scores.

Chiming with our findings, Truong et al.[21] demonstrated that patients with ACS had significantly larger LA volumes and indices than non-ACS patients, with higher quartiles of LAV and LAVI associated with an increased risk of ACS. Similarly, Ahmeti et al.[22] and Gunasekaran et al.[25] confirmed that increased LAVI served as an independent predictor of adverse outcomes and MACE post-ACS, reinforcing the prognostic value of LA remodeling.

In the present study, binary logistic regression analysis identified two-vessel disease and age greater than 68 years as independent predictors of moderate-to-severe CAD severity, while LAVI of greater than 23 was significant only on univariate analysis. These findings highlight the combined role of clinical burden and structural cardiac remodeling in predicting CAD complexity.

Concordant with our results, Truong et al.[21] demonstrated that age, history of LV dysfunction, and diabetes were independent predictors of increased LA volumes, which in turn added incremental prognostic value for predicting ACS beyond coronary plaque burden. Similarly, Hsiao et al.[4] found that maximal LAVI was a significant independent predictor of 1-year hard cardiovascular events, with an adjusted hazard ratio of 2.266 for patients with LAVI 34 mL/m² or greater, further emphasizing the prognostic relevance of LA size in CAD outcomes.

In our study, most patients exhibited mild diastolic dysfunction based on E/e′, and a notable proportion had impaired diastolic function on E/A ratio assessment. Impaired EF and enlarged LAD were present in a substantial subset, with inferior STEMI being the most common ACS presentation. Most patients had single-vessel disease affecting primarily the LAD artery, and the majority had a low SYNTAX score.

Consistent with our findings, Truong et al.[21] demonstrated that ACS patients had larger LA volumes and indices than non-ACS patients, and that higher LA volumes were associated with an increased risk of ACS. Similarly, Li et al.[26] found that higher LAVI and impaired LA strain parameters were associated with higher GRACE scores and worse short-term outcomes in ACS patients, although traditional LV structure and function parameters showed no significant differences between risk groups. Moreover, Saklecha et al.[24] showed that increased LAVI was common among ACS patients and correlated with more extensive CAD and higher SYNTAX scores, reinforcing the association between LA enlargement and the severity of coronary atherosclerosis.

Limitations

Several limitations should be acknowledged in this study. First, it was conducted at a single institution with a relatively limited sample size, potentially affecting the broader applicability of the results. The absence of a dedicated control group further restricts the ability to perform direct comparative analyses. Moreover, the lack of long-term follow-up precludes evaluation of the prognostic significance of the investigated echocardiographic parameters over an extended duration.

CONCLUSIONS

Among patients presenting with ACS, elevated LAVI demonstrated a significant association with the severity of coronary artery lesions. Additionally, the presence of two-vessel disease and older age emerged as strong independent predictors of more complex coronary pathology, highlighting the importance of echocardiographic markers in facilitating early risk stratification.

Conflict of Interest

None to declare.

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