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PROGNOSTIC VALUE OF LEFT ATRIAL VOLUME INDEX IN PATIENTS WITH ACUTE ST ELEVATION MYOCARDIAL INFARCTION

Cardiology

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ABSTRACT

After acute myocardial infarction (AMI), diastolic function assessed by Doppler echocardiography provides important prognostic information that is incremental to systolic function. However, these variables reflect the beat-to-beat interaction of LV filling pressures and ventricular compliance, making them sensitive to rapid alternations in ventricular preload and afterload. However, in contrast to other Doppler variables of LV diastolic function, which are affected by acute hemodynamic changes, LA volume is a more stable parameter, integrating the effects of elevated LV filling pressures from preexisting cardiovascular conditions as well as acute disease. This study was carried out in the period of January 2018 to June 2019 in the Department of cardiology, SCB Medical College & Hospital, Cuttack. 200 consecutive patients presenting to ICCU with first episode of acute ST elevation myocardial infarction (STEMI) were enrolled in this study. The LA volume was corrected for body surface area, and the population was divided according to LA volume index of 32 mL/m2 (2 SDs above normal). LA volume index was >32 mL/m2 in 70 (35%) patients. The primary study end point was all-cause mortality. During follow-up of 12 months, 31 patients (15.5%) died. LA volume index was a powerful predictor of mortality and remained an independent predictor of major adverse cardiovascular events even after adjustment for clinical factors, LV systolic function, and Doppler-derivedparameters of diastolic function.

KEYWORDS

Myocardial infarction, Echocardiography, Diastolic dysfunction, Left atrial volume index

INTRODUCTION

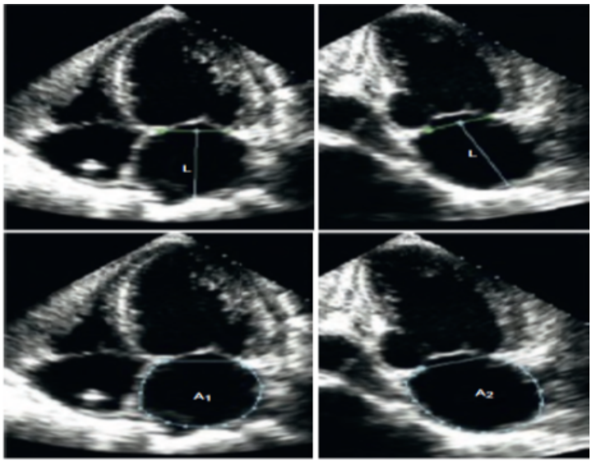
Echocardiography is very useful in assessing the prognosis for patients at risk for recurrent ischemia and heart failure and overall risk for morbidity and mortality after STEMI.[1] Left ventricular ejection fraction (LVEF) is one of the most important predictors of overall morbidity and mortality after acute STEMI[2]. Recently, left ventricular diastolic dysfunction is increasingly gaining importance as an useful marker for risk stratification of patients with acute MI[3]. Multiple echocardiographic variables may be used to assess left ventricular (LV) diastolic function.[4] However, these variables reflect the beat-to-beat interaction of LV filling pressures and ventricular compliance, making them sensitive to rapid alternations in ventricular preload and afterload[5]. However, in contrast to other Doppler variables of LV diastolic function, which are affected by acute hemodynamic changes, LA volume is a more stable parameter, integrating the effects of elevated LV filling pressures from preexisting cardiovascular conditions as well as acute disease[6-9]. Left ventricular diastolic dysfunction progresses due to progressive left ventricular remodeling after AMI and leads to a rise in LVEDP. Persistently raised LVEDP leads to left atrial hypertrophy and fibrosis. Therefore, LA will be relatively unaffected by transient changes in LA pressure.[10] Because of this relative insensitivity to transient changes in filling pressures, LA size can be considered a biomarker of sustained elevations in LV filling pressures[11]. Due to rapid hemodynamic changes associated with acute MI due to disease progression, complications or treatment response and relative insensitivity of chronically dilated LA to transient changes in LV filling pressure, it is hypothesized that LA volume would predict long-term outcome after acute MI and might be superior in this respect to conventional doppler indices of diastolic dysfunction[13-15]. This study is designed to assess the prognostic efficacy of left atrial volume index in patients of first episode of STEMI, its correlation with clinical characteristics , risk factors, complications & comparison with other echocardiographic variables and cardiac biomarkers used for risk stratification.

METHODS:

Patient selection: This study was carried out in the period of January 2018 to June 2019 in the Department of cardiology, SCB Medical College & Hospital, Cuttack. 200 consecutive Patients presenting to ICCU with first episode of acute ST elevation myocardial infarction (STEMI) were enrolled in this study. The diagnosis of ST Elevated Myocardial Infarction was based on typical chest pain and ECG changes. Patients with previous history of myocardial infarction or Unstable angina, previous history of Percutaneous Coronary Intervention or Coronary Artery Bypasses Graft, valvular diseases, arrhythmias, cardiomyopathies and pericardial diseases were excludedfrom the study**.** This is a prospective observational study of all newly diagnosed first episode acute ST elevation myocardial infarction patients. Following information was obtained at the time of admission - Detailed history recording, thorough physical examination, serial ECG, routine blood investigations, 2D Echocardiography and doppler , BNP and HS TROP T level, Major Adverse Cardiovascular Events (MACE = Death, LV systolic dysfunction, hospitalization for heart failure, reinfarction, arrhythmias, mechanical complications and Cardiogenic shock). Complete patient characteristics, treatment details, thrombolysis, inotropic therapy were recorded for further analysis.

2D Echocardiography: 2D Echocardiography was performed within 24 hours of admission using PHILLIPS CX 50 equipped with color Doppler, pulsed Doppler and tissue Doppler imaging. LV systolic function was assessed by Simpson method and Wall motion score index. Left ventricular diastolic function was assessed from mitral inflow pattern, mitral deceleration time, peak mitral annular velocity in early diastole and left atrial volume index. For Left atrial volume index (LAVI) , the Biplane area- length method was used which measure LA area from two orthogonal apical views (A1 and A2) and LA length (L) in end systole, from which LA volume was calculated as (0.85 x A1 x A2)/L (Figure 1). When LA length is measured from two apical views, the shorter value is used to calculate LA volume. Then the LA volume is divided with body surface area to obtain left atrial volume index. The normal value of indexed LA volume has been reported to be 20 ± 6 ml/m^2. Patients were therefore divided according to the mean value plus 2 SD corresponding to 32 ml/m^2.

Figure 1: Echocardiographic Measurement Of Left Atrial Volume



Apical Four Chamber View **Apical Two Chamber View**

Statistical Analysis: The data are expressed as Mean ± SD for quantitative data. Qualitative data are expressed as frequency and percentage. The probability value less than 0.05 was considered significant by using SPSS software (V.26.0). Pearson chi square test was used to compare LA volume index with all the parameters including complications. Multivariate logistic regression analysis was used to find out the independent predictors of MACE.

RESULTS:

Complete patient characteristics is shown in table 1 and echocardiographic and biomarker variables in table 2. Among 200 patients 133 (66.5%) were male and 67 (33.5%) were female, 64.5% were below 60 years of age and 35.5% were above 60 years and mean age of the study population was 59 years. 117 (58.5%) patients had AWMI whereas 83 (41.5%) patients had IWMI. Various risk factors in the study population were, family history (10.5%), Obesity (19%), Smoking (33.5%), hypertension (33%), diabetes (27.5%), dyslipidemia (26%).70.5% patients were in Killip class I, 15% were in Killip Class II, 10.5% were in Killip Class III and 4% were in Killip Class IV. 53.5% had grade I, 30% had grade II and 11% had grade III diastolic dysfunction. 130 Patients (65%) had LA Volume Index < 32 ml / m^2 and 70 patients (35%) had LA Volume Index > 32 ml / m^2. Major adverse cardiovascular events were death (15.5%), LV systolic dysfunction (54.5%), heart failure (27.5%), reinfarction (6.5%), arrhythmias (26.5%), significant MR (16%), mechanical Complications (2%) and cardiogenic shock (4%) and their distribution in two LAVI group is shown in figure 2. More number of patients in LAVI >32ml/m^2 group had diabetes (37.14% vs 22.31%, p = 0.028), hypertension (44.28% vs 26.92%, P = 0.017), smoking (28.46% vs 42.86%, p= 0.032) and higher killip class (45.71% vs 20.76%, P = 0.000) whereas age, location of infarction, obesity and dyslipidemia didn't differ between two groups. LV systolic dysfunction and Wall motion score index>1.5 was more common in LAVI > 32 ml/m^2 group (68.57% vs 46.92% in LAVI≤32 group, P = 0.01). Larger LA Volume Index group had more patients with DT <140 ms (21.43% vs 1.54%, p = 0.004), E/e'>15 (18.57% vs 1.54%, p = 0.007) and diastolic dysfunction ≥2 (60% vs 32.31%). Larger LAVI group had more patients with BNP value above the median value (87 pg/ml) [61.43% vs 38.46% in LAVI≤32 group, P = 0.011] & HS-TROP T value above the median value (132 pg/ml) [60% vs 43.85% in LAVI≤32 group, P = 0.023]. Heart failure occurred in 45.71% patients in LAVI >32 group and 17.69% patients in LAVI ≤32 group (p= 0.001). Significant MR occurred in 25.71% of patients in larger LA Volume Index group compared to 10.77 % in smaller LA Volume Index group (p = 0.014). Reinfarction occurred more commonly in the LA volume index > 32 ml/m^2 which was 15.71% while it was only 1.54% in the LAVI ≤ 32 ml/m^2 group (p= 0.003). Recurrent arrhythmia occurred in 37.14% of patients in larger LA Volume Index group compared to 20.77% in smaller LAVI group (p = 0.025). Mechanical complications occurred in very few patients (2%). More deaths (38.57%) occurred in LA volume index > 32 ml/m^2 group as compared to 3.07% in LAVI≤32 group (p= 0.000). In multivariate analysis (Table 3), only left ventricular ejection fraction (P = 0.041) and left atrial volume index more than 32 (p = 0.024) were independent predictors of major adverse cardiovascular events.

Table 1: Complete Patient Characteristics

Characteristics	LAVI≤32 ml/m^2	LAVI>32ml/m^2	P
Male	85 (65.38%)	48(68.57%)	0.853
Age>60yr	43 (33.08%)	28 (40%)	0.516
Smoking	37(28.46%)	30(42.86%)	0.032
Hypertension	35 (26.92%)	31 (44.28%)	0.017
Diabetes	29 (22.31%)	26 (37.14%)	0.028
obesity	21 (16.15%	17 (24.28%)	0.692
Hyperlipidemia	31 (23.85%)	21 (30%)	0.657
AWSTEMI	75 (57.69%)	42 (60%)	0.742
Killip class ≥2	27 (20.76%)	32 (45.71%)	0.000
Arrhythmia	27 (20.77%)	26 (37.14%)	0.025
Heart failure	23 (17.69%)	32 (45.71%)	0.001
Reinfarction	02 (1.54%)	11 (15.71%)	0.003
Death	4 (3.07%)	27 (38.57%)	0.000

Table 2: Echocardiographic Characteristics And Biomarker Values

Characteristics	LAVI≤32ml/m^2	LAVI>32ml/m^2	P
LVEF	61 (46.92%)	48 (68.57%)	0.01
LVEF <40%	32 (24.61%)	29 (41.43%)	0.018
WMSI>1.5	61 (46.92%)	48 (68.57%)	0.01
DD ≥2	42 (32.31%)	42 (60%)	0.000
DT	2 (1.54%)	15(21.43%)	0.004
E/e/	2 (1.54%)	13 (18.57%)	0.001
Significant MR	14 (10.77%)	18 (25.71%)	0.014
HS TROP T>132	57 (43.85%)	42 (60%)	0.023
BNP >87	50 (38.46%)	43 (61.43%)	0.011

Figure 2: Major Adverse Cardiovascular Events

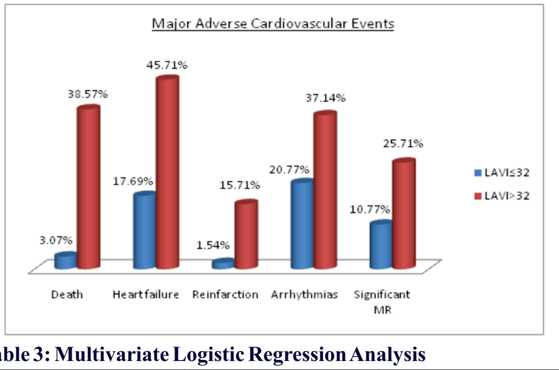


Table 3: Multivariate Logistic Regression Analysis

VARIABLES	P VALUE	HR (95% CI)
AGE>60YR	0.411	1.993 (0.743-1.235)
DIABETES	0.313	2.183 (0.652- 2.760)
HYPERTENSION	0.587	2.364 (0.747-3.548)
KILLIP≥2	0.16	1.872 (0.68 -1.232)
LVEF	0.041	0.192 (0.037 – 0.856)
DT<140ms	0.195	1.217 (0.562 -1.354)
E/e/>15	0.078	1.738(0.824-1.437)
LAVI>32ml/m2	0.034	2.259 (0.052 – 0.695)
HS TROP T>132pg/ml	0.072	2.375 (0.732-1.314)
BNP>87pg/ml	0.085	1.973 (0.658-1.465)

DISCUSSION

In our study, more number of patients in higher LAVI group have diabetes, hypertension and smoking and higher LAVI was associated with increased incidence of significant MR, lower LV ejection fraction, advanced diastolic dysfunction, heart failure, reinfarction and death. In the article by Teresa S M Sang et al,[11] Moller et[16] and Beinert et al[17], left atrial volume was found to correlate positively with history of systemic hypertension, diabetes mellitus and smoking. Higher LA volume index was associated with severe MR, heart failure lower ejection fraction and advanced diastolic dysfunction and increased mortality but only LVEF and LAVI were independently associated with all cause mortality in patients with a first STEMI in the study by Beinert et al.[17] Moller et al[16] found killip class,LAVI and restrictive filling pattern as independent predictors of mortality. Saeed S et al[12] have suggested in their study that increased LA volume due to left atrial remodeling post STEMI is associated with increased incidence of atrial fibrillation. LAVI was independently associated with composite end point of death, reinfarction and heart failure in the study by Prasad et al[20]. LAVI was independent predictor of heart failure and death in the study by Reistow et al[19] and Sakaguchi et al[18].

LIMITATIONS

This study was a single center study. Sample size was small. Patients with previous history of myocardial infarction were excluded but subclinical coronary artery disease which was undiagnosed could have affected the diastolic function of the heart. LAVI cannot be applied in the presence of severe mitral valve disease or AF. LA is a complex three-dimensional structure and the geometric algorithm used only estimates its volume. Hence Real time 3 D Imaging (RT – 3DE) and CMR may be a more accurate method of assessing LA volume and function.

CONCLUSION

The present study demonstrates that LA enlargement implies a poor prognosis in patients with STEMI. It has been proved as an independent predictor of mortality and other major adverse cardiovascular events in patients with first STEMI. LA Volume index provides prognostic information incremental to clinical data, standard echocardiographic predictors of outcome including LV systolic function and Doppler indicators of diastolic function and cardiac biomarkers.

REFERENCES

1. Mollema SA, Nucifora G, Bax JJ. Prognostic value of echocardiography after acute myocardial infarction. Heart. 2009;95:1732.
2. Moller JE, Egstrup K, Kober L, Poulsen SH, Nyvad O, Torp-Pedersen C. Prognostic importance of systolic and diastolic function after acute myocardial infarction. Am Heart J. 2003;145:147–153.
3. Moller JE, PellikkaPA,Hillis GS, Oh JK. Prognostic Importance of Diastolic Function and Filling Pressure in Patients With Acute Myocardial Infarction. Circulation. 2006;114:438-444.
4. Nagueh et al. Recommendations for the Evaluation of Left Ventricular Diastolic Function by Echocardiography: An Update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am SocEchocardiogr 2016;29:277-314.
5. Choong CY, Hermann HC, Weymann AE, Fifer MA. Preload dependence of Doppler-derived indexes of left ventricular diastolic function in humans. J Am CollCardiol. 1987;10(4):800-8.
6. Gonzalez-Vilchez F, Ayuela J, Ares M, Mata NS, Gonzalez AG, Duran RM. Comparison of Doppler echocardiography, color M-mode Doppler, and Doppler tissue imaging for the estimation of pulmonary capillary wedge pressure. J Am SocEchocardiogr. 2002;15:1245–1250.
7. Vieira MJ, Teixeira R, Gonçalves L, Gersh BJ. 2014. Left atrial mechanics: echocardiographic assessment and clinical implications. Journal of the American Society of Echocardiography.2014; 27: 463–478
8. Tsang TSM, Abhayaratna WP, Barnes ME, et al: Prediction of cardiovascular outcomes with left atrial size: is volume superior to area or diameter? J Am CollCardiol 47(5):1018–1023, 2006.
9. Hoit BD. Left atrial size and function . J Am CollCardiol 2014;63:493–505
10. Abhayaratna WP, Seward JB, Appleton CP, et al. Left atrial size: physiologic determinants and clinical applications. J Am CollCardiol. 2006;47:2357---63.
11. Tsang TS, Barnes ME, Gersh BJ, Bailey KR, Seward JB. Left atrial volume as a morphophysiologic expression of left ventricular diastolic dysfunction and relation to cardiovascular risk burden. Am J Cardiol 2002;90:1284–9.
12. Saeed S,Gerdts E. Incremental prognostic value of left atrial function indices in the prediction of incident atrial fibrillation in patients with ST-elevation myocardial infarction. Int J Cardiol.2018;263:7-8
13. Kyhl K et al. Predictors and prognostic value of left atrial remodeling after acute myocardial infarction.Open Heart BMJ.2015;2:e000223
14. Wierzbowska-Drabik K, Krzemińska-Pakula M, Drozdz J, Plewka M, Trzos E, Kurpesa M, Rechciński T, Rózga A, Plońska-Gościniak E, Kasprzak JD. Enlarged left atrium is a simple and strong predictor of poor prognosis in patients after myocardial infarction. Echocardiography2008; 25: 27-35.
15. Meris A, Amigoni M, Uno H, Thune JJ, Verma A, Køber L, Bourgoun M, McMurray JJ, Velazquez EJ, Maggioni AP, Ghali J, Arnold JM, Zelenkofske S, Pfeffer MA, Solomon SD. Left atrial remodeling in patients withmyocardial infarction complicated by heart failure, left ventriclular dysfunction,or both: the VALIANT Echo Study. Eur Heart J 2009; 30: 56-65.
16. Moller JE, Hillis GS, Oh JK, Seward JB, Reeder GS, Wright RS, Park SW, Bailey KR, Pellikka PA. Left atrial volume: a powerful predictor of survivalafter acute myocardial infarction. Circulation 2003; 107: 2207-12.
17. Beinart et al. Long-Term Prognostic Significance of Left Atrial Volume in Acute Myocardial Infarction. J Am CollCardiol 2004;44:327–34.
18. Sakaguchi et al. Prognostic value of left atrial volume index in patents with first acute myocardial infarction. European Journal of Echocardiography (2011) 12, 440–444.
19. Reistow et al. Usefulness of Left Atrial Volume Index to Predict Heart Failure Hospitalization and Mortality in Ambulatory Patients With Coronary Heart Disease and Comparison to Left Ventricular Ejection Fraction (from the Heart and Soul Study)Am J Cardiol. 2008 July 1; 102(1): 70–76.
20. Prasad et al. Diastolic dysfunction assessed using contemporary guidelines and prognosis following myocardial infarction. J Am Soc Echocardiogr.2018;05:016-37.