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Clinical and Demographic Factors Associated with Left Ventricular Diastolic Dysfunction in Acute ST-Elevation Myocardial Infarction.

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Abstract

Background: Left ventricular diastolic dysfunction (LVDD) can occur during acute ST-elevation myocardial infarction (STEMI) and may provide information about cardiac involvement beyond systolic function. Aim: To assess LVDD and its association with clinical and demographic factors in patients with acute STEMI. ***Methods***: This hospital-based observational cross-sectional study included 100 patients with acute STEMI. Demographic and clinical data were collected, and transthoracic echocardiography was performed during the index admission. LVDD and its grade were recorded from the echocardiography reports. Associations were assessed using the chi-square test; $p<0.05$ was considered statistically significant. ***Results***: Mean age was 59.45 ± 13.71 years, and 63% of participants were male. LVDD was present in 65% (95% CI: 55.3-73.6%). Grade I dysfunction was most common (43%), followed by Grade II (21%) and Grade III (1%). LVDD was associated with age group ($\chi^2=16.63$, $p=0.0008$) and sex; prevalence was 81.1% in women and 55.6% in men (OR=3.43, 95% CI: 1.31-8.96; $p=0.010$). Associations were also observed with alcohol consumption (OR=2.83, $p=0.040$), smoking (OR=3.97, $p=0.015$), and Killip class ($\chi^2=54.36$, $p<0.001$). Associations with diabetes and hypertension were not statistically significant. ***Conclusion***: LVDD was common among patients with acute STEMI. Age group, sex, selected personal habits, and Killip class were associated with its presence in unadjusted analyses. Larger studies with standardized echocardiographic criteria and multivariable analysis are needed.

Keywords: Acute myocardial infarction; diastolic dysfunction; echocardiography.

INTRODUCTION

Coronary artery disease remains a major cause of illness and death worldwide. Acute myocardial infarction (AMI), a serious manifestation of coronary artery disease, occurs when myocardial blood supply is interrupted. ST-elevation myocardial infarction (STEMI) is generally associated with acute coronary artery occlusion and requires prompt diagnosis and treatment to limit myocardial injury. Despite advances in reperfusion and medical therapy, patients may develop ventricular dysfunction and other complications after STEMI.[1,2]

Evaluation after STEMI often focuses on left ventricular ejection fraction (LVEF), but myocardial ischemia can also impair relaxation and filling. This may lead to left ventricular diastolic dysfunction (LVDD), which can occur even when systolic function is relatively preserved. LVDD may raise cardiac filling pressures and contribute to pulmonary congestion, heart failure symptoms, and adverse outcomes.[3,4]

Echocardiography is a non-invasive and widely available method for assessing cardiac function. Alongside LVEF and regional wall motion, it provides information about left ventricular diastolic function and can support clinical assessment during the acute phase of STEMI.[3] The occurrence and severity of LVDD may vary with demographic and clinical factors, including age, sex, diabetes, hypertension, smoking, alcohol use, infarct location, and clinical condition at presentation. Examining these factors may help identify patients who need closer assessment and follow-up.

AIM

To assess left ventricular diastolic dysfunction and its association with clinical and demographic factors in patients with acute ST-elevation myocardial infarction.

OBJECTIVES

1. To determine the prevalence and grades of left ventricular diastolic dysfunction among patients with acute STEMI using echocardiography.
2. To assess the association of demographic factors, including age and sex, with left ventricular diastolic dysfunction.
3. To assess the association of selected clinical factors, including comorbidities, personal habits, Killip class, infarct location, and thrombolysis status, with left ventricular diastolic dysfunction.

MATERIALS AND METHODS

Source of data

Data were obtained from adult patients diagnosed with acute STEMI and admitted to the Medicine ward or intensive cardiac care unit (ICCU) of the study hospital. Information was collected through patient interviews, clinical examination, investigation reports, echocardiography reports, and relevant medical records.

Study design

The study was a hospital-based observational cross-sectional study.

Study location

The study was conducted in the Department of Medicine at a tertiary-care teaching hospital.

Study duration

The study was conducted over 18 months after approval from the Institutional Ethics Committee.

Sample size

A total of 100 patients were included. The sample size was justified using the single-population proportion formula:

$$n=(Z_{(1-\alpha/2)}^2 \times p \times q)/d^2$$

Where:

- n= required sample size
- $Z_{(1-\alpha/2)}$= 1.96 for a 95% confidence level
- p= anticipated prevalence; 50% was used because a reliable local estimate was not specified
- q=1-p=50%
- d= absolute precision of 10%

$$n=((1.96)^2 \times 50 \times 50)/(10)^2 = 96.04$$

The calculated sample size was approximately 96. It was rounded up to 100 participants.

Inclusion criteria

Patients were included if they:

- Had a diagnosis of acute STEMI.
- Were aged over 18 years.
- Were of either sex.
- Provided written informed consent.

Exclusion criteria

Patients were excluded if they:

- Were aged under 18 years.
- Had congenital heart disease or significant valvular heart disease.
- Had hypertrophic or infiltrative cardiomyopathy.
- Had a history of previous myocardial infarction.
- Had atrial fibrillation or a pacemaker.
- Were pregnant.
- Had an inadequate echocardiographic window.

Procedure and methodology

After Institutional Ethics Committee approval, eligible patients were enrolled consecutively during the study period. Written informed consent was obtained before enrolment. A detailed history was recorded, including age, sex, residence,

presenting complaints, medical history, comorbidities, smoking, alcohol consumption, and thrombolysis status. A general and systemic examination was performed, vital parameters were recorded, and Killip class was assessed.

Acute STEMI was diagnosed on the basis of symptoms suggestive of acute myocardial ischemia, ECG evidence of persistent ST-segment elevation in anatomically contiguous leads, and evidence of acute myocardial injury, including a rise and/or fall in cardiac troponin with at least one value above the 99th-percentile upper reference limit. The ECG lead-specific ST-elevation thresholds described in the study protocol were applied.

Routine investigations included complete blood count, blood glucose, lipid profile, renal and liver function tests, and urine routine examination. Other relevant investigations were recorded from the clinical file.

Transthoracic echocardiography was performed during the hospital stay, usually within 24-72 hours of admission. Findings recorded from the documented echocardiography report included LVEF, regional wall motion abnormalities, presence and grade of LVDD, valvular abnormalities, and pericardial effusion. LVDD was classified according to the interpretation documented in the report and standard echocardiographic criteria. Patients were monitored during their index hospitalization; no formal long-term follow-up was undertaken.

Sample processing

No biological specimens were collected or processed specifically for this study. Laboratory values from routine clinical investigations were transcribed from the patients' records. Clinical, investigation, and echocardiographic information was reviewed for completeness, coded, and entered into the study dataset.

Statistical methods

Data were entered and analysed using Microsoft Excel. Continuous variables, such as age, LVEF, and duration of hospital stay, were summarized as mean and standard deviation, as appropriate. Categorical variables were summarized as frequencies and percentages. Associations between LVDD and categorical variables were assessed using the chi-square test or Fisher's exact test, as appropriate. A p-value below 0.05 was considered statistically significant.

Data collection

Data were collected using a structured case record form. The form included demographic details; presenting symptoms; past medical history and comorbidities; smoking and alcohol history; physical examination, vital parameters and Killip class; STEMI diagnostic findings; routine laboratory investigations; thrombolysis status; and echocardiographic findings. The completed forms were checked for missing or inconsistent entries before data entry.

RESULTS

Table 1. Sociodemographic and clinical profile of patients with acute STEMI (N=100)

Characteristic	Value, n (%) or mean (SD)	95% CI
Age, years	59.45 (13.71)	56.73-62.17*
Age ≤30 years	3 (3.0%)	1.0-8.5%
Age 31-50 years	25 (25.0%)	17.5-34.3%
Age 51-70 years	53 (53.0%)	43.3-62.5%
Age >70 years	19 (19.0%)	12.5-27.8%
Male	63 (63.0%)	53.2-71.8%
Female	37 (37.0%)	28.2-46.8%
Urban residence	52 (52.0%)	42.3-61.5%
Rural residence	48 (48.0%)	38.5-57.7%
Any comorbidity	58 (58.0%)	48.2-67.2%
Hypertension	42 (42.0%)	32.8-51.8%
Diabetes mellitus	22 (22.0%)	15.0-31.1%
Any reported personal habit/addiction	58 (58.0%)	48.2-67.2%
Alcohol consumption	30 (30.0%)	21.9-39.6%
Other habits, including tobacco/cannabis	29 (29.0%)	21.0-38.5%
Smoking	26 (26.0%)	18.4-35.4%
Killip class I	42 (42.0%)	32.8-51.8%
Killip class II	38 (38.0%)	29.1-47.8%
Killip class III	6 (6.0%)	2.8-12.5%
Killip class IV	14 (14.0%)	8.5-22.1%
Anterior infarct territory†	50 (50.0%)	40.4-59.6%

Inferior infarct territory†	48 (48.0%)	38.5-57.7%
Lateral infarct territory†	23 (23.0%)	15.8-32.2%
Posterior infarct territory†	20 (20.0%)	13.3-28.9%
Right ventricular involvement†	11 (11.0%)	6.3-18.6%

*95% CI for the mean age. †Infarct territories could overlap; percentages therefore do not sum to 100%. The thesis did not report an overall association test for this descriptive table.

Among 100 patients with acute STEMI, mean age was 59.45 ± 13.71 years (95% CI: 56.73-62.17). The largest age group was 51-70 years (53.0%). Most participants were male (63.0%), while urban and rural residence was nearly evenly distributed (52.0% and 48.0%, respectively). Comorbidities and personal habits or addictions were each reported in 58.0% of patients. Hypertension was the most common listed comorbidity (42.0%), and alcohol consumption was the most frequently reported personal habit (30.0%). Killip class I was observed in 42.0%, followed by class II in 38.0%. Anterior and inferior infarct territories were the most common, affecting 50.0% and 48.0%, respectively; territories could overlap. This was a descriptive table, so no overall significance test was applicable.

Table 2. Prevalence and grades of left ventricular diastolic dysfunction on echocardiography (N=100)

Echocardiographic finding	n (%) of total sample	95% CI
LVDD present	65 (65.0%)	55.3-73.6%
Normal diastolic function (Grade 0)	35 (35.0%)	26.4-44.8%
Grade I LVDD	43 (43.0%)	33.7-52.8%
Grade II LVDD	21 (21.0%)	14.2-30.0%
Grade III LVDD	1 (1.0%)	0.2-5.5%

Echocardiography identified LVDD in 65 patients (65.0%; 95% CI: 55.3-73.6%), while 35 (35.0%; 95% CI: 26.4-44.8%) had normal diastolic function. Grade I was the most frequent finding, present in 43.0% of the full cohort (95% CI: 33.7-52.8%), followed by Grade II in 21.0% (95% CI: 14.2-30.0%). Grade III was uncommon, affecting one patient (1.0%; 95% CI: 0.2-5.5%). These are descriptive estimates; no significance test was reported.

Table 3. Association of demographic factors with LVDD (N=100)

Demographic factor	LVDD present, n/N (%)	95% CI for prevalence	Test statistic	Effect estimate (95% CI)	p value
Age group			Pearson χ^2=16.63, df=3		0.0008
≤30 years	0/3 (0.0%)	0.0-56.2%			
31-50 years	10/25 (40.0%)	23.4-59.3%			
51-70 years	41/53 (77.4%)	64.5-86.6%			
71-90 years	14/19 (73.7%)	51.2-88.2%			
Sex			Pearson χ^2=6.68, df=1	OR, female vs male: 3.43 (1.31-8.96)	0.010
Female	30/37 (81.1%)	65.8-90.5%			
Male	35/63 (55.6%)	43.3-67.2%		Reference	

LVDD prevalence differed significantly across age groups (Pearson χ^2=16.63, df=3, p=0.0008). It was observed in 40.0% of patients aged 31-50 years, 77.4% of those aged 51-70 years, and 73.7% of those aged 71-90 years; none of the three patients aged 30 years or younger had LVDD. The small number in the youngest group produced a wide confidence interval. LVDD was also more common among women than men (81.1% vs 55.6%). The association with sex was statistically significant (χ^2=6.68, df=1, p=0.010); the crude odds of LVDD in women were 3.43 times those in men (95% CI: 1.31-8.96).

Table 4. Association of clinical factors with LVDD (N=100)

Clinical factor	LVDD present, n/N (%)	95% CI for prevalence	Test statistic	Effect estimate (95% CI)	p value
Diabetes mellitus			Pearson χ^2=0.13, df=1	OR, diabetes vs no diabetes: 1.20 (0.44-3.29)	0.723
Present	15/22 (68.2%)	47.3-83.6%			
Absent	50/78 (64.1%)	53.0-73.9%		Reference	
Hypertension			Pearson χ^2=1.97, df=1	OR, hypertension vs no hypertension: 0.55 (0.24-1.27)	0.161
Present	24/42 (57.1%)	42.2-70.9%			

Absent	41/58 (70.7%)	58.0-80.8%		Reference	
Alcohol consumption			Pearson χ^2=4.24, df=1	OR, alcohol use vs no use: 2.83 (1.03-7.79)	0.040
Present	24/30 (80.0%)	62.7-90.5%			
Absent	41/70 (58.6%)	46.9-69.4%		Reference	
Smoking			Pearson χ^2=5.94, df=1	OR, smoking vs no smoking: 3.97 (1.24-12.66)	0.015
Present	22/26 (84.6%)	66.5-93.9%			
Absent	43/74 (58.1%)	46.7-68.7%		Reference	
Killip class			Pearson χ^2=54.36, df=3		<0.001
I	10/42 (23.8%)	13.5-38.5%			
II	35/38 (92.1%)	79.2-97.3%			
III	6/6 (100.0%)	61.0-100.0%			
IV	14/14 (100.0%)	78.5-100.0%			
Infarct location	Cross-tabulation by LVDD not reported		Not available	Not calculable from reported summary data	
Thrombolysis status	Cross-tabulation by LVDD not reported		Not available	Not calculable from reported summary data	

LVDD prevalence was similar among patients with and without diabetes (68.2% vs 64.1%; OR=1.20, 95% CI: 0.44-3.29; χ^2=0.13, p=0.723) and was not significantly associated with hypertension (57.1% vs 70.7%; OR=0.55, 95% CI: 0.24-1.27; χ^2=1.97, p=0.161). LVDD was more frequent among patients reporting alcohol consumption (80.0% vs 58.6%; OR=2.83, 95% CI: 1.03-7.79; χ^2=4.24, p=0.040) and smoking (84.6% vs 58.1%; OR=3.97, 95% CI: 1.24-12.66; χ^2=5.94, p=0.015). Prevalence increased across Killip classes, from 23.8% in class I to 92.1% in class II and 100% in classes III and IV; the overall association was significant (χ^2=54.36, df=3, p<0.001). The thesis did not provide LVDD cross-tabulations for infarct location or thrombolysis status, so their associations could not be described or tested from the reported summary data.

DISCUSSION

In this hospital-based study of 100 patients with acute STEMI, the mean age was 59.45 ± 13.71 years, and most patients were male. This pattern is broadly consistent with the adult STEMI populations described in clinical reviews and Indian guidance.[1,2] Although men made up most of this cohort, LVDD was more prevalent among women, a finding that resembles the female-sex association reported in a primary-PCI STEMI cohort.[3] Differences in patient selection, age, risk-factor burden, reperfusion access, and echocardiographic assessment may affect comparisons between studies.

LVDD was present in 65% of patients. Grade I dysfunction was most common (43% of the cohort), followed by Grade II (21%); Grade III was rare (1%). The prevalence is comparable in broad terms with other post-STEMI studies, although the estimates are not directly interchangeable because the populations, timing of echocardiography, and diagnostic criteria differed. Chen et al.(2017)[7] reported abnormal filling patterns in about 80% of a post-reperfusion STEMI cohort, while Subramaniyan et al.(2018)[8] found diastolic dysfunction in more than half of patients with anterior STEMI after primary PCI. In a separate prospective STEMI cohort, 62% had diastolic dysfunction, and its presence was associated with greater myocardial injury and poorer myocardial salvage.[6]

Age group was significantly associated with LVDD (χ^2=16.63, p=0.0008). Prevalence was 40.0% among patients aged 31-50 years and 77.4% among those aged 51-70 years. It was 73.7% in the 71-90-year group, so the observed pattern was not a strictly increasing gradient across every age category. The finding is consistent with the reported association between older age and LVDD after STEMI; Wang et al.(2015)[3] identified age ≥65 years as an independent risk factor in patients undergoing primary PCI. The youngest age group in the present study contained only three patients, so its estimate is imprecise and should be interpreted cautiously.

Women had a higher prevalence of LVDD than men (81.1% vs 55.6%; crude OR=3.43, 95% CI: 1.31-8.96; p=0.010). This agrees with Wang et al.(2015)[3], who reported female sex as an independent risk factor for LVDD in a STEMI cohort. The present estimate was unadjusted, however, and may reflect differences in age, comorbidities, infarct characteristics, or other factors. A larger study with multivariable analysis would be needed to determine whether sex was independently associated with LVDD in this population.

Among the clinical factors examined, LVDD was significantly associated with alcohol consumption (p=0.040), smoking (p=0.015), and Killip class (p<0.001). The increasing prevalence across Killip classes was consistent with the association

of higher Killip class with LVDD reported by Wang et al.(2015)[3]. In contrast, diabetes and hypertension were not significantly associated with LVDD in this sample. These non-significant findings do not rule out an association: the subgroups were small, and no adjusted analysis was reported. Associations with smoking and alcohol should also be viewed as exploratory because habit history was recorded clinically and could be affected by recall or classification.

Infarct-location and thrombolysis-status associations could not be discussed because the study results did not provide LVDD cross-tabulations for these factors. Other studies have linked diastolic impairment or elevated filling pressure after STEMI with infarct burden, reperfusion timing, and subsequent outcomes.[5-7,9,10] These results support the clinical relevance of assessing diastolic function, but they do not establish that the same relationships occurred in this cohort. The present cross-sectional study did not assess long-term outcomes.

Echocardiographic assessment is central to evaluating LV diastolic function, but diagnostic estimates depend on the parameters and criteria used. Recommendations emphasize a structured assessment using Doppler and other echocardiographic measures; the British Society of Echocardiography guidance also notes the need to consider LV systolic function and rhythm when interpreting diastolic function.[4,11,12] In this study, LVDD and its grade were taken from the final echocardiography reports. The results therefore describe the documented clinical classification and may not be fully comparable with studies that applied a uniform research protocol with specified Doppler thresholds.

CONCLUSION

LVDD was present in 65% of patients with acute STEMI, with Grade I dysfunction being the most frequent grade. Age group, female sex, alcohol consumption, smoking, and Killip class were significantly associated with LVDD in the unadjusted analyses. Diabetes and hypertension were not statistically significant factors in this sample. Because the study was single-centre, cross-sectional, and based on 100 patients, these associations should be interpreted as descriptive and hypothesis-generating rather than causal or independently predictive. Larger studies using standardized echocardiographic criteria and adjusted analyses are needed.

Limitations

- The study was conducted at a single tertiary-care hospital and included only 100 patients, which limits generalizability and precision.
- Its cross-sectional design did not establish temporal or causal relationships and did not assess long-term cardiovascular outcomes.
- LVDD classification was taken from echocardiography reports; the results do not provide a uniform set of Doppler measurements or document inter-observer agreement.
- Analyses were unadjusted. Potential confounding by age, sex, comorbidities, infarct severity, and treatment was not addressed.
- Some subgroups were small, particularly the youngest age group and patients with Grade III dysfunction, yielding imprecise estimates.
- Associations by infarct location and thrombolysis status were not reported in the available results.
- Smoking and alcohol histories may have been affected by recall or reporting bias.
- Multiple associations were tested, and the significant findings should therefore be interpreted cautiously.

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