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Correlation of Mitral E- Point Septal Separation with Left Ventricular Ejection Fraction in Patients of Acute Coronary Syndrome

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Abstract: **Background:** Acute Coronary Syndrome (ACS) is a major cause of morbidity and mortality worldwide and requires rapid assessment of left ventricular (LV) function for risk stratification. Left Ventricular Ejection Fraction (LVEF) is a key prognostic indicator but may not always be quickly measurable in emergency settings. E-point septal separation (EPSS), a simple M-mode echocardiographic parameter, has emerged as a rapid bedside surrogate for assessing LV systolic function. **Aim:** To determine the correlation between mitral E-point septal separation (EPSS) and left ventricular ejection fraction (LVEF) in patients with ACS. **Methods:** This observational study was conducted on 100 patients diagnosed with ACS at Sri Guru Ram Das Institute of Medical Sciences and Research, Amritsar, between July 2024 and January 2026. EPSS was measured using M-mode echocardiography in the parasternal long-axis view, and LVEF was assessed using standard echocardiographic methods. Statistical analysis was performed to evaluate the correlation between EPSS and LVEF. **Results:** The majority of patients were males (71%) and aged 61–80 years (49%). STEMI was the most common presentation (48%). EPSS >7 mm was observed in 84% of patients. Most patients had moderately reduced LVEF (51%). A statistically significant inverse correlation was found between EPSS and LVEF ($r = -0.602$, $p < 0.001$), indicating that higher EPSS values are associated with lower LVEF. Additionally, EPSS showed significant association with BNP levels ($p = 0.0477$), reflecting its utility in assessing cardiac dysfunction. **Conclusion:** EPSS is a simple, rapid, and reliable bedside echocardiographic parameter that correlates significantly with LVEF in ACS patients. It can serve as a useful screening tool for early identification of LV systolic dysfunction, especially in emergency settings where quick decision-making is essential.

Keywords: Acute Coronary Syndrome, E-point Septal Separation, Left Ventricular Ejection Fraction, Echocardiography, LV Dysfunction.

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INTRODUCTION

Acute Coronary Syndrome (ACS) comprises a spectrum of clinical conditions resulting from acute myocardial ischemia due to sudden reduction in coronary blood flow. It includes ST-elevation myocardial infarction (STEMI), non-ST elevation myocardial infarction (NSTEMI), and unstable angina (UA) [1]. ACS remains one of the leading causes of morbidity and mortality worldwide and continues to pose a major public health challenge, particularly in developing countries [2]. Despite significant advances in interventional cardiology and pharmacological management, early identification of patients at risk of left ventricular dysfunction remains essential for improving outcomes [3].

The underlying pathophysiology of ACS commonly involves rupture or erosion of an atherosclerotic plaque followed by platelet aggregation and thrombus formation within the coronary arteries, resulting in partial or complete obstruction of coronary blood flow [1]. Early diagnosis and prompt evaluation of cardiac function are crucial because left ventricular systolic dysfunction is strongly associated with increased morbidity, mortality, and adverse cardiovascular outcomes [4,5].

Left Ventricular Ejection Fraction (LVEF) is considered one of the most important prognostic indicators in patients with myocardial infarction and

heart failure. It plays a major role in risk stratification, therapeutic planning, and long-term prognostic assessment.[5,6] Echocardiography remains the most widely used non-invasive imaging modality for assessment of left ventricular systolic function. Conventional assessment of LVEF is performed using M-mode echocardiography, two-dimensional echocardiography, and Doppler examination [4].

In recent years, Point-of-Care Ultrasound (POCUS) has emerged as a valuable bedside tool in emergency and critical care settings for rapid cardiovascular evaluation [4]. Among various echocardiographic parameters, Mitral E-Point Septal Separation (EPSS) has gained importance as a simple and rapid method for estimating left ventricular systolic function [7]. EPSS refers to the minimum distance between the anterior mitral valve leaflet and the interventricular septum during early diastole. Normally, the anterior mitral leaflet closely approaches the interventricular septum during ventricular filling; however, in patients with impaired left ventricular systolic function, this distance increases because of reduced ventricular emptying and ventricular dilatation [8].

Several studies have demonstrated a significant inverse relationship between EPSS and LVEF, suggesting that increasing EPSS values are associated with worsening left ventricular systolic dysfunction.[8,9] EPSS measurement is simple, reproducible, inexpensive, and can be rapidly performed at the bedside without requiring advanced echocardiographic expertise. Therefore, it may serve as a useful screening tool for rapid assessment of left ventricular systolic function, especially in emergency departments and resource-limited settings [7].

Although EPSS has shown promising utility in rapid bedside assessment of left ventricular function, limited studies have specifically evaluated its correlation with LVEF in patients presenting with Acute Coronary Syndrome in the Indian population. Hence, the present study was undertaken to evaluate the correlation between Mitral E-Point Septal Separation and Left Ventricular Ejection Fraction in patients with Acute Coronary Syndrome.

MATERIALS AND METHODS

Study Design

The present observational study was conducted to evaluate the correlation between Mitral E-Point Septal Separation (EPSS) and Left Ventricular Ejection Fraction (LVEF) in patients presenting with Acute Coronary Syndrome (ACS).

Study Setting and Participants

The study was conducted in the Department of Medicine at Sri Guru Ram Das Institute of Medical Sciences and Research, Amritsar, Punjab, India. Patients admitted to the Indoor Patient Department (IPD) and Emergency Department with a diagnosis of Acute Coronary Syndrome was enrolled in the study.

Duration of Study

The study was conducted from July 2024 to January 2026.

Sample Size

A total of 100 patients were included in the study.

Sampling Technique

Convenience sampling method was used for patient selection.

Ethical Considerations

The study was conducted after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants prior to enrolment in the study.

Inclusion Criteria

- Patients aged more than 18 years
- Patients diagnosed with Acute Coronary Syndrome
- Patients willing to participate in the study

Exclusion Criteria

- Patients with valvular heart disease
- Patients with congenital heart disease
- Patients with rheumatic heart disease
- Patients with left bundle branch block
- Patients with asymmetric septal hypertrophy/hypertrophic obstructive cardiomyopathy (HOCM)

METHODOLOGY

Clinical Evaluation

A detailed clinical history and thorough physical examination were performed in all patients at the time of admission.

Diagnosis of Acute Coronary Syndrome was established based on clinical presentation, electrocardiographic findings, and serum cardiac biomarkers.

Electrocardiographic Criteria

ST-Elevation Myocardial Infarction (STEMI)

- New ST elevation at the J point in leads V2–V3 of ≥2.5 mm in men aged <40 years, ≥2 mm in men aged >40 years, or ≥1.5 mm in women
- New ST elevation of ≥1 mm in at least two contiguous leads other than V2–V3

Non-ST Elevation Myocardial Infarction (NSTEMI)

- Horizontal or downsloping ST depression ≥0.5 mm in at least two contiguous leads
- Dynamic T-wave inversion ≥1 mm in two or more contiguous leads

Unstable Angina (UA)
Chest discomfort suggestive of unstable angina included:

1. Occurrence at rest or minimal exertion lasting >10 minutes
2. Recent onset within the previous two weeks
3. Crescendo pattern with increasing severity or frequency

Cardiac Biomarkers

- Elevated Creatine Kinase-MB (CK-MB)
- Elevated Troponin-I levels

Rise in Troponin-I was defined as elevation above the 99th percentile reference value on at least one occasion during the first 24 hours after the clinical event.

Echocardiographic Evaluation
Echocardiographic examination was performed using a harmonic transducer. M-mode, two-dimensional (2D) echocardiography, and Doppler examination were performed in all patients.

Mitral E-Point Septal Separation (EPSS) was measured in the parasternal long-axis view using M-mode echocardiography as the minimum distance between the anterior mitral valve leaflet and the interventricular septum during early diastole.

Left Ventricular Ejection Fraction (LVEF) was assessed using standard two-dimensional echocardiographic methods.

Patients were categorized according to EPSS measurements, and the corresponding LVEF values were evaluated and correlated statistically.

E-Point Septal Separation (EPSS)
<7 mm
7–10 mm
11–15 mm
>15 mm

Statistical Analysis
Data were entered into Microsoft Excel and analyzed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation, while categorical variables were expressed as frequencies and percentages. Association between EPSS categories and LVEF was assessed using Chi-square test. Correlation between EPSS and LVEF was evaluated using Pearson's correlation coefficient. A p-value <0.05 was considered statistically significant.

RESULTS
A total of 100 patients diagnosed with Acute Coronary Syndrome (ACS) were included in the present study. The demographic profile, echocardiographic findings, and correlation between Mitral E-point Septal Separation (EPSS) and Left Ventricular Ejection Fraction (LVEF) were analyzed.
The study population showed a male predominance. Out of 100 patients, 71 (71.0%) were males and 29 (29.0%) were females.

Table-1: Distribution of Patients According to Gender

Gender	Number (n)	Percentage (%)
Males	71	71.0
Females	29	29.0
Total	100	100

The majority of patients belonged to the 61–80 years age group (49%), followed by the 41–60 years age group (42%). Only 6% of patients were below 40 years of age, while 3% were older than 80 years.

Table-2: Distribution of Patients According to Age Group

Age Group (Years)	Number (n)	Percentage (%)
<40	6	6
41–60	42	42
61–80	49	49
>80	3	3
Total	100	100

Assessment of EPSS revealed that the majority of patients had EPSS values greater than 7 mm. Out of 100 patients, 92 (92%) had EPSS >7 mm, whereas only 8 (8%) patients had EPSS <7 mm.

Table-3: Distribution of Patients According to EPSS Category

EPSS Category	Number (n)	Percentage (%)
<7 mm	8	8
>7 mm	92	92
Total	100	100

Further categorization of EPSS severity demonstrated that 57 patients (57%) had EPSS values between 11–15 mm, followed by 26 patients (26%) with EPSS values between 7–10 mm. Nine patients (9%) had EPSS values >15 mm, while only 8 patients (8%) had EPSS values <7 mm.

Table-4: Distribution of Severity of EPSS

EPSS Range	Number (n)	Percentage (%)
<7 mm	8	8.0
7–10 mm	26	26.0
11–15 mm	57	57.0
>15 mm	9	9.0
Total	100	100

Evaluation of Left Ventricular Ejection Fraction showed that most patients had moderately reduced systolic function. Moderately reduced LVEF (30–44%) was observed in 51 patients (51%), mildly reduced LVEF (45–54%) in 26 patients (26%), severely reduced LVEF (<30%) in 12 patients (12%), and normal LVEF in 11 patients (11%).

Table-5: Distribution of Left Ventricular Ejection Fraction

LVEF Category	Number (n)	Percentage (%)
Normal (55–69%)	11	11
Mildly Reduced (45–54%)	26	26
Moderately Reduced (30–44%)	51	51
Severely Reduced (<30%)	12	12
Total	100	100

Comparison between EPSS and LVEF categories demonstrated a significant association between increasing EPSS values and worsening left ventricular systolic dysfunction. Among patients with normal LVEF, 45.45% had EPSS <7 mm and 54.55% had EPSS values between 7–10 mm, while none had EPSS >10 mm. In patients with mildly reduced LVEF, the majority (65.38%) had EPSS values between 11–15 mm. Similarly, among patients with moderately reduced LVEF, most patients (62.75%) had EPSS values between 11–15 mm, and 13.73% had EPSS >15 mm. In patients with severely reduced LVEF, 66.67% had EPSS values between 11–15 mm and 16.67% had EPSS >15 mm. This association was found to be statistically significant ($\chi^2 = 39.282$, $p = 0.001$).

Table-6: Distribution and Comparison of Severity of LVEF with EPSS

LVEF (%)	<7 mm (n)	<7 mm (%)	7–10 mm (n)	7–10 mm (%)	11–15 mm (n)	11–15 mm (%)	>15 mm (n)	>15 mm (%)	Total (n)
Normal (55–69%)	5	45.45	6	54.55	0	0.00	0	0.00	11
Mildly Reduced (45–54%)	2	7.69	7	26.92	17	65.38	0	0.00	26
Moderately Reduced (30–44%)	1	1.96	11	21.57	32	62.75	7	13.73	51
Severely Reduced (<30%)	0	0.00	2	16.67	8	66.67	2	16.67	12
Total	8	8.00	26	26.00	57	57.00	9	9.00	100

Fisher's exact $p < 0.001$

Correlation analysis using Pearson's correlation coefficient demonstrated a strong negative correlation between EPSS and LVEF ($r = -0.602$), which was statistically significant ($p < 0.001$). The scatter plot showed a clear inverse linear relationship, indicating that increasing EPSS values were associated with worsening left ventricular systolic function in patients with Acute Coronary Syndrome.

Scatter plot showing correlation between E-Point septal separation and left ventricular ejection fraction in patients with acute coronary syndrome.

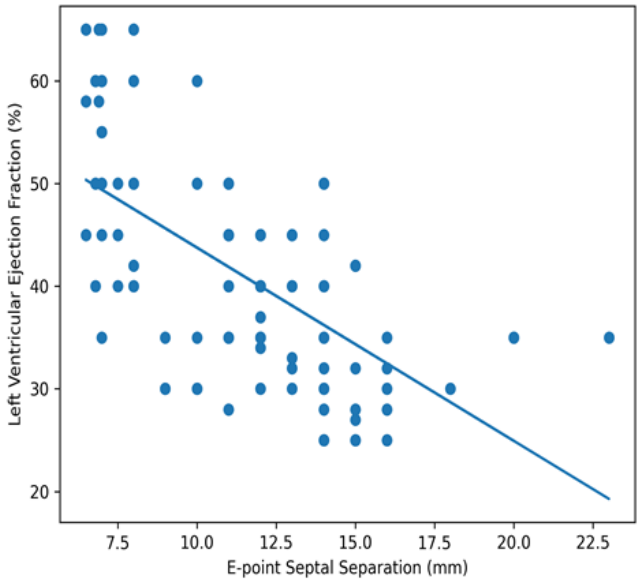

Fig-1: Scatter plot showing correlation between EPSS and LVEF

The scatter plot demonstrates a clear inverse linear relationship between EPSS and LVEF. Correlation analysis was performed using Pearson's correlation test. A strong negative correlation was observed between EPSS and LVEF (Pearson correlation coefficient r = −0.602), which was statistically significant ($p < 0.001$)

DISCUSSION

The present study enrolled a total of 100 patients admitted with Acute Coronary Syndrome (ACS) to evaluate the correlation between Mitral E-Point Septal Separation (EPSS) and Left Ventricular Ejection Fraction (LVEF). Detailed clinical history, physical examination, and echocardiographic evaluation were performed in all patients. EPSS was measured using M-mode echocardiography because it is a simple, rapid, cost-effective, and readily available bedside investigation for assessment of left ventricular systolic function [4].

The present study demonstrated a statistically significant inverse correlation between EPSS and LVEF ($r = −0.602$, $p < 0.001$), indicating that increasing EPSS values were associated with worsening left ventricular systolic dysfunction. Similar observations have been reported in previous studies evaluating EPSS as a surrogate marker of left ventricular systolic performance [7,8]. Ahmadpour *et al*. [7] demonstrated that EPSS is a reliable index of left ventricular performance in patients with coronary artery disease, while Silverstein *et al*. [8] reported that EPSS correlates significantly with quantitative estimation of LVEF.

In the present study, the majority of patients belonged to the 61–80 years age group, followed by the 41–60 years age group. This finding is consistent with the established epidemiological pattern of coronary artery disease, which predominantly affects the elderly population because of progressive atherosclerotic changes and increasing prevalence of cardiovascular risk factors with advancing age [1,2].

A clear male predominance was observed in the present study, with males constituting 71% of the study population. Similar gender distribution has been reported in earlier studies on Acute Coronary Syndrome [1]. This may be attributed to a higher prevalence of smoking, hypertension, dyslipidemia, and other cardiovascular risk factors among males.

Assessment of EPSS revealed that most patients had EPSS values between 11–15 mm, while only a small proportion had EPSS values <7 mm. Similarly, most patients demonstrated moderately reduced LVEF. Patients with normal LVEF predominantly had EPSS values <7 mm, whereas patients with severely reduced LVEF had higher EPSS values. These findings further support the concept that increasing EPSS is associated with progressive impairment of left ventricular systolic function [7,8].

Echocardiography remains one of the most important non-invasive modalities for assessment of cardiac function [4,5]. However, accurate estimation of LVEF may not always be rapidly feasible in emergency settings because it requires technical expertise, adequate imaging windows, and time-consuming calculations. In contrast, EPSS measurement can be performed rapidly at the bedside using basic M-mode echocardiography and therefore may serve as an important adjunctive tool in emergency and critical care settings [4,7].

The findings of the present study are also supported by Zwank [9], who emphasized the usefulness of rapid bedside ultrasound assessment of left ventricular systolic function in emergency settings. The ease, reproducibility, and rapid applicability of EPSS make it particularly valuable in resource-limited settings and

busy emergency departments where early identification of ventricular dysfunction is essential.

The present study has certain limitations. It was conducted at a single tertiary care center with a relatively small sample size, which may limit generalizability of the findings. In addition, conditions such as mitral valve disease, hypertrophic cardiomyopathy, and abnormal septal motion may affect EPSS measurements and reduce their accuracy in estimating LVEF [7].

Overall, the present study highlights the clinical utility of EPSS as a simple, rapid, and reliable bedside echocardiographic parameter for assessment of left ventricular systolic function in patients with Acute Coronary Syndrome. The significant inverse correlation observed between EPSS and LVEF supports its role as a useful screening tool for early identification of left ventricular dysfunction, particularly in emergency and resource-limited settings.

CONCLUSION

The present study demonstrates that mitral EPSS measurement by M mode echocardiography is a simple, easy and a reliable qualitative and quantitative estimate of LVEF in patients of ACS. There was statistically significant association present between EPSS severity and left ventricular ejection fraction, with higher EPSS values corresponding to worsening left ventricular systolic function. Mitral EPSS showed a strong association with LVEF, though it did not show a significant association with conventional risk factors, type of ACS, or mortality in the present study. Further studies are needed to demonstrate the relationship of EPSS in acute settings of MI. However a statistically significant inverse relationship was observed between EPSS and LVEF. Patients with normal EF had EPSS<7mm while moderately and severely reduced EF were exclusively associated with EPSS>7mm. EPSS thus can be used as a non-invasive bedside tool for early assessment of left ventricular systolic function, particularly in resource-limited settings.

Conflict of Interest- The authors declare that there is no conflict of interest regarding the publication of this study.

Source of Funding- No financial support or funding was received for this study.

Ethical Approval- The study was conducted after obtaining approval from the Institutional Ethics Committee of Sri Guru Ram Das Institute of Medical Sciences & Research, Amritsar, Punjab, India.

Informed Consent- Written informed consent was obtained from all participants prior to enrolment in the study.

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