

**Prospective Study of Mechanical Complications in Patients with STEMI at Tertiary Care Centre of Western Rajasthan****Rohit Mathur<sup>1</sup>, Vivek Lakhawat<sup>2</sup>, Viplov Kesarwani<sup>2</sup>, Pawan Sarda<sup>3</sup>, Anil Baroopal<sup>4</sup>**<sup>1</sup>Associate Professor & Head, Department of Cardiology, Dr SN Medical College, Jodhpur, Rajasthan<sup>2</sup>Senior Resident, Department of Cardiology, Dr SN Medical College, Jodhpur, Rajasthan<sup>3</sup>Associate Professor, Department of Cardiology, Dr SN Medical College, Jodhpur Rajasthan<sup>4</sup>Assistant Professor, Department of Cardiology, Dr SN Medical College, Jodhpur, Rajasthan

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Conflict of interest: Nil

**Abstract:****Objective:** This single-center prospective observational study aimed to determine the proportion of mechanical complications in patients with acute ST-segment elevated myocardial infarction (STEMI) and assess the associated mortality rate in these patients.**Methods:** The study was conducted between June 2021 and May 2022, including 1307 patients admitted with STEMI. Mechanical complications were evaluated using 2D Echo during the patient's hospital stay.**Results:** Among the STEMI patients, 17 individuals (1.3%) experienced mechanical complications. The most prevalent complication was free wall rupture (n=9), followed by ventricular septal rupture (n=7). Only one patient suffered from papillary muscle rupture. Mortality was significantly higher in the group with mechanical complications compared to the non-complication group (64.71% vs. 4.81%, p<0.0001). Within the complication group, mortality rates were highest for FWR (88.9%), followed by VSR (42.9%) and PMR (0%). The mean day of complication occurrence was 3.9 days, with FWR presenting around day 4.2 and VSR around day 3.7. Mechanical complication occurrence was more frequent in older age (67.06±10.05 years vs. 57.10±12.33 years, p=0.0008) and in female patients (52.94% vs. 20.39%, p=0.009).**Conclusions:** This study highlights the relatively low rate of mechanical complications in patients admitted with acute STEMI. However, despite their low incidence, mechanical complications carry a significant mortality burden. Mortality rates were higher in older age and among female patients. Timely recognition and management of mechanical complications remain critical in improving patient outcomes in this population.**Keywords:** FWR, Mechanical Complications, Mortality, STEMI, VSR.

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**Introduction**

Acute ST-segment elevated myocardial infarction (STEMI) remains one of the most critical medical emergencies, posing a significant burden on global healthcare systems. It is a life-threatening condition characterized by the sudden occlusion of a coronary artery, leading to myocardial ischemia and subsequent necrosis of cardiac tissue. Despite significant advancements in the diagnosis and treatment of STEMI, it continues to be a major cause of morbidity and mortality worldwide. [1]

Over the years, considerable research has focused on exploring various aspects of STEMI, including its pathophysiology, risk factors, and therapeutic interventions. Among the numerous complications that arise from STEMI, mechanical complications (MC) represent a subgroup of highly concerning events that can significantly impact patient outcomes. Understanding the proportion of these complications is essential for several reasons. First,

it aids in risk stratification and predicting adverse outcomes, enabling healthcare providers to tailor individualized treatment strategies. Second, identifying these complications promptly can guide timely interventions, potentially mitigating the extent of damage to the myocardium and improving survival rates. Third, exploring the underlying mechanisms contributing to the development of mechanical complications may offer insights into novel therapeutic targets and innovative treatment approaches. [2]

The most dramatic complications of STEMI involve tearing of acutely infarcted tissue. The clinical characteristics of these lesions vary considerably and depend on the site of rupture, which involve: free wall rupture (FWR), ventricular septal rupture (VSR), or papillary muscle rupture (PMR). These complications are uncommon but devastating sequel of acute STEMI possesses early mortality. In the

reperfusion era proportion of these complications has decreased but once happen, they are associated with higher mortality rate. [3]

### Methods

This is a prospective observational study, conducted in the department of Cardiology, Dr. SN Medical College, Jodhpur. We aimed to investigate the incidence of mechanical complications in patients with STEMI during their hospital stay from June 2021 to May 2022. STEMI was defined according to the criteria set forth by the European Society of Cardiology (ESC)/American College of Cardiology Foundation (ACCF), specifically as new ST elevation at the J point in  $\geq 2$  contiguous leads of  $\geq 2$  mm in men or  $\geq 1.5$  mm in women in leads V2–V3, and/or of 1 mm in other contiguous chest or limb leads.(4)

As part of our study protocol, all enrolled patients underwent bedside 2D-ECHO at the time of admission, and whenever any signs or symptoms of mechanical complications were observed during their hospital stay. Additionally, we performed 2D-ECHO for patients with STEMI who suddenly collapsed while in the hospital, to assess the presence of mechanical complication, specially FWR.

To ensure adherence to ethical guidelines, written informed consent was obtained from all participating patients. Comprehensive clinical, procedural, and outcome data were collected for medical records, and any cases suspected of mechanical complications were meticulously reviewed by two independent investigators to confirm the presence of such complications.

This study received approval from the ethical committee. By conducting this research, we aimed to contribute valuable insights into the incidence and nature of mechanical complications in patients with acute STEMI, with the ultimate goal of enhancing patient care and outcomes in this critical medical condition.

### Study population

This study included patients of all ages and genders who were admitted to the cardiac department with a diagnosis of first episode of acute STEMI. Patients with Non-STEMI, unstable angina, pre-existing

cardiac diseases or previous STEMI were excluded from participation in this study.

### Statistical Analysis

Data gathered throughout the study were meticulously compiled in a Microsoft Excel spread sheet and subjected to comprehensive statistical analysis using MedCalc software version 22.00. For categorical variables, qualitative data were presented as numbers and percentages, while continuous variables were expressed as mean and standard deviations.

To assess differences in proportions between groups, Fisher exact test, chi-square test, and unpaired t-test were utilized as appropriate for the respective data sets. The results were clearly presented in the form of tables. A p-value  $<0.05$  was considered statistically significant, indicating the presence of meaningful associations or differences in the data that were not likely to occur by chance alone.

### Results

A total of 1307 patients diagnosed with STEMI were admitted in the Cardiology department, Dr SN Medical College Jodhpur, during the period from June 2021 to May 2022.

Table 1 presents a detailed overview of the baseline characteristics of patients with and without mechanical complications.

In the group without mechanical complications (Non-MC) comprising 1290 patients, the mean age was  $57.10 \pm 12.33$  years. Among them, 23.80% were female. The prevalence of risk factors in this group included diabetes mellitus in 20.39%, hypertension in 17.60%, and smoking in 17.60%.

For patients with mechanical complications (MC), totalling 17 individuals, the mean age was notably higher at  $67.06 \pm 10.05$  years. A higher proportion of females (52.94%) were observed in this group. However, the differences in the prevalence of risk factors, such as diabetes (17.65%), hypertension (29.41%), and smoking (23.53%), were not statistically significant ( $P > 0.05$ ).

Regarding the type of myocardial infarction, there were no cases of mechanical complications in patients with lateral wall myocardial infarction (LWMI).

**Table 1: Baseline Characteristics of Patients with STEMI with Mechanical Complication versus no Mechanical Complication.**

Variables	Non-MC (n=1290)	MC (n=17)	P value	
Mean age-year	57.10±12.33 year	67.06±10.05 year	<b>0.0008</b>	
Female-no./total no.(%)	307/1290 (23.80)	9/17 (52.94)	<b>0.009</b>	
Risk factors	DM-no./total no.(%)	263/1290 (20.39)	3/17 (17.65)	1.000
	HTN-no./total no.(%)	227/1290 (17.60)	5/17 (29.41)	0.204
	Smoking-no./total no.(%)	227/1290 (17.60)	4/17 (23.53)	0.521
Myocardial infarction	AWMI-no./total no.(%)	773/1290 (59.92)	10/17 (58.82)	0.928
	IWMI-no./total no.(%)	476/1290 (36.90)	7/17 (41.18)	0.716
	LWMI-no./total no.(%)	41/1290 (3.18)	0	-
Thrombolysis-no./total no.(%)	542/1290 (42.02)	8/17 (47.06)	0.675	
Mortality-no./total no.(%)	62/1290 (4.81)	11/17 (64.71)	<b>&lt;0.0001</b>	

Baseline characteristics like infarction zone and reperfusion therapy were also comparable in both the groups. The distribution of anterior wall myocardial infarction (AWMI) and inferior wall myocardial infarction (IWMI) was similar between the two groups, with AWMI observed in 59.92% of the Non-MC group and 58.82% of the MC group, and IWMI observed in 36.90% of the Non-MC group and 41.18% of the MC group ( $P > 0.05$ ). In terms of thrombolysis, 42.02% of patients in the Non-MC group received this treatment compared to 47.06% in the MC group, with no significant difference observed ( $P > 0.05$ ). However, the mortality rate exhibited a significant disparity between the two groups, with only 4.81% in the Non-MC group, compared to a substantially higher rate of 64.71% in the MC group ( $P < 0.0001$ ).

These findings shed light on the contrasting baseline characteristics and outcomes of patients with

STEMI, depending on the presence or absence of mechanical complications. Table 2 presents the proportion of mechanical complications in the total study population, which comprised 1307 patients with STEMI. Out of the total study population, 1290 patients (98.7%) did not experience any mechanical complications during their hospital stay, while a minority of 17 patients (1.3%) did encounter such complications. FWR was observed in 9 patients (0.69%) while VSR in 7 patients (0.54%). A single individual (0.08%) suffered from PMR.

These findings underscore the relatively low occurrence of mechanical complications in the total study population. Among these complications, FWR was the most common, occurring in 9 patients, representing 52.94% of the cases, followed by VSR, observed in 7 patients, accounting for 41.18% of the cases. A smaller proportion of patients, specifically 1 individual (5.88%), suffered from PMR.

**Table 2: Proportion of Mechanical Complication.**

Type of Mechanical Complications	Total Mechanical Complication (N=17)	Total Study Population (N=1307)
FWR-no./total no.(%)	9/17 (52.94)	9/1307 (0.69)
VSR-no./total no.(%)	7/17 (41.18)	7/1307 (0.54)
PMR-no./total no.(%)	1/17 (5.88)	1/1307 (0.08)

The results highlight the importance of identifying and managing such complications in a timely and effective manner to optimize patient outcomes in cases of STEMI.

Table 3 presents the baseline characteristics and mortality data of patients with different types of mechanical complications, including FWR, VSR, and PMR. For patients with FWR, the mean age was 65.33yr, and the mean day of complications occurring after onset of symptoms was 4.2 days. Among them, 44.44% were female. The distribution of myocardial infarction types in this group consisted of 55.56% with AWMI and 44.44% with

IWMI. Thrombolysis was administered to 77.78% of patients with FWR, and unfortunately, the mortality rate was 88.89%. Regarding patients with VSR, the mean age was 69.85yr, and the mean day of complications occurring after onset of symptoms was 3.7 days. Among them, 57.14% were female. The majority of cases (71.43%) had AWMI, while 28.57% had IWMI. Only one patient received thrombolysis (14.29%), and the mortality rate was 42.86%.

In the case of PMR, the patient was 63 years old, and the complication occurred 3 days after symptom onset. The patient was female and had IWMI.

Thrombolysis was not administered in this case, and fortunately, there was no mortality.

**Table 3: Baseline characteristics of patients with mechanical complication**

Variables	Type of mechanical complications		
	FWR (N=9)	VSR (N=7)	PMR (N=1)
Mean age-year	65.33	69.85	63.00
Mean day of complications-day	4.2	3.7	3.00
Female-no./total no.(%)	4/9 (44.44)	4/7 (57.14)	1/1 (100)
Myocardial infarction	AWMI-no./total no.(%)	5/9 (55.56)	5/7 (71.43)
	IWMI-no./total no.(%)	4/9 (44.44)	2/7 (28.57)
	LWMI-no./total no.(%)	0	0
Thrombolyse-no./total no.(%)	7/9 (77.78)	1/7 (14.29)	0
Mortality-no./total no.(%)	8/9 (88.89)	3/7 (42.86)	0

These findings highlight the differences in baseline characteristics and mortality outcomes among patients with various types of mechanical complications. Notably, patients with FWR exhibited a higher mortality rate compared to those with VSR and PMR.

Table 4 shows the association between thrombolysis and mechanical complication. Out of the total study population, mechanical complications were seen in 10 patients (1.92%) who received thrombolytic therapy while in patients with delayed presentation

who didn't received thrombolytic therapy, mechanical complications were noted in 7 patients (0.89%), which was not significant ( $p > 0.05$ ).

Among these mechanical complications, FWR was seen more in patients who received thrombolytic therapy (1.35% v/s 0.25%,  $p < 0.05$ ). Incidence of VSR was similar in both the groups (0.58% v/s 0.51%,  $p = 0.05$ ). PMR was seen only in one patient in the non thrombolytic group and there were zero patients in thrombolytic group.

**Table 4: Association between Thrombolysis and Mechanical Complication.**

Mechanical Complications	Thrombolysed (N=520)	Not Thrombolysed (N=787)	p-value
FWR-no./total no.(%)	7/520 (1.35)	2/787 (0.25)	<b>0.034</b>
VSR-no./total no.(%)	3/520 (0.58)	4/787 (0.51)	1.000
PMR-no./total no.(%)	0	1/787 (0.13)	-
Total-no./total no.(%)	10/520 (1.92)	7/787 (0.89)	0.134

## Discussion

The present research article sought to investigate the proportion of mechanical complications in patients with acute STEMI during their hospital stay and its impact on patients outcome. The findings of this study provide valuable insights into the incidence and nature of mechanical complications in patients with acute STEMI.

The study's included a total of 1307 patients admitted between June 2021 and May 2022. The proportion of patients experiencing mechanical complications was remarkably low, accounting for only 1.3% of the total study population. The incidence of mechanical complications was highly variable in different studies. In the pre-reperfusion era, studies reported higher rates of mechanical complications, ranging from 4% to 6%. [2,5,6] However, with the introduction of reperfusion therapies and advancements in medical care, the incidence of mechanical complications has significantly decreased in the reperfusion era, as evidenced by various studies. [2,7,8] The current study's proportion of mechanical complications, which was 1.3%, aligns with reports from the Grace

registry and other studies, reflecting the trends observed in the reperfusion era. [2,5,9-11] The reduced incidence of mechanical complications in the reperfusion era is undoubtedly a positive development, attributed to improved reperfusion strategies and enhanced medical care. However, it is crucial for healthcare providers to remain vigilant and proactive in recognizing and addressing these rare yet critical events. Among the mechanical complications observed, FWR was the most common, followed by VSR. These results align with existing literature, where FWR and VSR are frequently reported complications in patients with STEMI. [2,5,9,11] The incidence of VSR in this study was slightly higher compared to previous studies, although the mortality rate among patients with VSR was similar to findings from other studies, indicating that VSR remains associated with significant mortality. [5,10,12]

Mortality rates associated with mechanical complications in STEMI patients have been a matter of significant concern. While overall mortality rates have decreased in the reperfusion era, the mortality attributed to mechanical complications has shown less substantial improvement. [7,13,14] The current

study's finding of significantly higher mortality rates in patients with mechanical complications, particularly those with FWR, highlights the critical impact of mechanical complications on patient outcomes and underscores the importance of early identification and prompt management of these complications to improve survival rates. [15]

The study's analysis also revealed that patients experiencing mechanical complications tended to be older and more likely to be females. Age and gender have been previously identified as potential risk factors for developing mechanical complications following STEMI [13,16-18], which is consistent with the findings of this study. Older patients, especially those with delayed thrombolysis, have been found to be at higher risk of FWR. [7,13,19] Understanding these risk factors can aid in risk stratification and help healthcare providers identify patients at higher risk of developing complications, enabling tailored treatment strategies.

The study's analysis didn't find any association of thrombolysis therapy to aggregate mechanical complications, however among individual mechanical complications; incidence of FWR was more in patients who received thrombolytic therapy. Some previous study also shows an association between thrombolysis and cardiac rupture as a mechanical complications [20,21], which is consistent with the findings of this study. Some studies have suggested that thrombolytic therapy may increase the risk of FWR in patients of advanced age but the association in younger age group is still debatable. [22,23] Prevalence of other confounding risk factor like diabetes, hypertension and smoking, were almost similar in both the groups implying no impact on mechanical complications of these risk factors in our study.

This study didn't found any association of type of mechanical complications with territory involved in myocardial infarction.

Mechanical complications associated with STEMI are rare and have devastating outcomes. There are very limited studies in Indian population, exploring these complications [24], and most of them are focused on a single mechanical complication, especially on VSR. [8,25,26] In our knowledge this study's was the first of its kind in the western Rajasthan.

The present research article contributes valuable insights to the existing literature by providing updated data on the incidence of mechanical complications in acute STEMI patients and their impact on mortality rates. The findings reaffirm the significance of timely identification and management of mechanical complications to improve patient outcomes.

Overall, the study supports the continued need for vigilance and prompt intervention to address mechanical complications in STEMI patients, despite their low incidence in the reperfusion era. Future research should aim to replicate and build upon these findings in larger multicenter studies to further validate the current findings and advance our understanding of mechanical complications in acute STEMI.

The study's had several limitations that should be taken into consideration while interpreting the results of the study. It was an observational study conducted at a single center over a relatively short period so the findings may not be entirely representative of the broader population. The study population consisted only of admitted patients, which could lead to the exclusion of complications that occurred after discharge. Also the study did not record complications that might have occurred before admission, such as cases of free wall rupture leading to sudden death. As a result, the overall burden of mechanical complications might have been underestimated.

### Conclusions

In conclusion, our prospective observational study examined the proportion of mechanical complications in patients with acute STEMI during their hospital stay. The findings revealed a relatively low incidence of these complications, with FWR being the most common complication, followed by VSR. Despite the low overall incidence, mechanical complications were associated with significantly higher mortality rates, particularly in patients with FWR. Our study emphasizes the critical impact of timely identification and management of mechanical complications to improve patient outcomes. Age and gender were identified as potential risk factors for the development of such complications, highlighting the need for individualized risk assessment and treatment strategies.

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