COMPARISON BETWEEN 30 DAYS MORTALITY IN PATIENTS OF CARDIOGENIC SHOCK WITH MITRAL REGURGITATION AND WITHOUT MITRAL REGURGITATION AFTER ACUTE MYOCARDIAL INFARCTION

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DOI: https://doi.org/10.5281/zenodo.18204220

Received	Accepted	Published
18 November 2025	26 November 2025	09 December 2025

ABSTRACT

Background: *As we all know that Cardiogenic shock is very worst complication of Acute MI. Acute MR is an important mechanical complication of Acute Myocardial infarction. These both complications have their own significant impact on mortality. When these both complications occur together then the prognosis of the patient is very bad and survival of the patient becomes very difficult.*

Objectives: *This study is to determine the Comparison between 30 days mortality in patients of cardiogenic shock with mitral regurgitation and without mitral regurgitation after acute myocardial infarction.*

Materials & methods: *Mitral Regurgitation assessed in 106 patients who admitted with Acute MI complicated by cardiogenic shock. Color Doppler of MR graded from 0 to 2 with 0 = mild MR, 1=Moderate MR and 2= Severe MR. Differences between subgroups of MR were tested using chi square test for Categorical variables. ANOVA and t-test applied for normally distributed continuous variables. Logistic regression analysis was used to investigate important predictors of mortality.*

Results: *Out of 106 patients with cardiogenic shock after myocardial infarction, 53 had mitral regurgitation (MR). The overall 30-day mortality was 30.2%, higher in MR patients (37.7%) than those without MR (22.6%) (p = 0.091). Stratified analysis showed significantly higher mortality in MR patients who were smokers (p = 0.029), underwent PCI (p = 0.048), did not receive streptokinase (p = 0.023), or presented early to the ER (p = 0.035). Mortality was 100% in MR patients with ventricular tachycardia (p = 0.001). Multivariable logistic regression identified diabetes (AOR = 0.055, p = 0.001), hypertension (AOR = 0.095, p = 0.002), and severe MR (AOR = 136.3, p = 0.023) as independent predictors of 30-day mortality.*

Conclusions: *Presence of MR is associated with increased 30 days mortality in acute MI patients complicated by cardiogenic shock.*

Keywords: *Acute Myocardial infarction (AMI), Mitral regurgitation (MR), Cardiogenic shock (CS), Left ventricular Ejection fraction (LVEF).*

INTRODUCTION

Acute myocardial infarction can be defined as : Identification of an increase or decrease in cardiac enzymes with at least 1 value > 99th percentile upper limit and with at least one of the following.1) History suggestive of ischemia2) New ST-T changes OR new LBBB.3) Appearance of pathological q waves.4) Imaging proof of new segmental wall motion abnormality.5) Detection of coronary thrombus by coronary angiography.

Cardiogenic shock is a serious complication of acute myocardial infarction, characterized by inadequate cardiac output and tissue perfusion. When it is associated with acute mitral regurgitation, it leads to further deterioration in cardiac function and increase mortality risk. Even with advances in medical therapy and interventions, the prognosis for patients with cardiogenic shock remains poor with high 30 day mortality rates.

Acute Mitral regurgitation is one of the mechanical complications of acute myocardial infarction. Although ischemic MR is the common complication after acute myocardial infarction (AMI), patient survival is dependent on a variety of variables that vary between institutions and geographic locations. It is inevitable to classify Acute MI patients by risk of in-hospital mortality. Ischemic MR is defined as: Mitral regurgitation occurring by prolonged changes of left ventricular structure and function, owing to Ischemic heart disease, and it worsens the prognosis. Ischemic MR is a regular problem of left ventricle (LV) whole or regional compulsive transformation due to chronic Coronary artery disease (CAD). Ischemic MR is a subtype of secondary mitral regurgitation, which occurs as a complication of IHD .Valvular involvement may be organic or functional. Important causes of acute MR are spontaneous rupture of Chordae tendinae, ischemic dysfunction or rupture of papillary muscles. Acute severe MR causes significant decrease in forward stroke volume and (ESV) and increase in (EDV).The main difference between Acute and Chronic MR is left atrial (LA) compliance. In Acute MR patients LA size is usually normal with normal or decreased compliance. In these patients LA pressure increases too rapidly, which leads to pulmonary edema, pulmonary vascular resistance (PVR) and Right heart failure (RHF). Due to all these factors, pressure gradient between LV and LA deteriorates at the end of the systole and the resultant murmur will decrescendo rather than holosystolic completed well before A2. It is usually low- pitched and softer than a chronic MR murmur. Afterload reduction is a cardinal factor to treat acute MR patients. Intravenous nitroprusside may be lifesaving in patients having Acute MR due to papillary muscle rupture. It may allow clinical steadiness, thus allowing coronary arteriograohy and surgery to be performed in ideal conditions. Acute MR with Cardiogenic shock an ionotropic agent such as dobutamine should be managed with nitroprusside to stabilize the patient although preparations for surgery are made. (Libby et al, 2022). In patients with Acute MI-associated with cardiogenic shock , in adding to reduced cardiac output, systemic swelling and hypoxemia are also alarming, leading to more vital instability and development of organ failure. (Makkio Nakamura et al ,2023). Moderate MR found in 5%and severe MR found in 10% patients of cardiogenic shock (5,6). d (8). In the recent past ,some single center and small sample studies have used trans-catheter mitral valve replacement (TMVr) in patients with simultaneous shock and MR. These studies support its use safe and appropriate alternative. Severe MR is a treatable condition, in about 10% of patients it is detected with acute MI complicated by cardiogenic shock (**4**,**5**) and it is associated with higher one year mortality (**4**), but it was having same mortality in hospitalized patients (5) when compared with Cardiogenic shock patients having no severe MR. Early invasive treatment may decrease the poor outcome that occur with non-invasive treatment in patients with acute MI complicated with MR. Percutaneous MV repair could be used as an alternative to surgery in decreasing MR for sick patients.(Dan Haberman et all 2022). All patients who treated by invasive approach for mitral valve shows greater survival over patients treated non- invasively. Those patients who treated with mitral intervention, Surgical MV repair was associated with a greater mortality rate than percutaneous approach(Dan Haberman, et al2022).Mitral regurgitation is a known prognosticator of poor outcomes in acute MI patients, and its effect on mortality in cardiogenic shock is not well understood. Our study purpose is to compare 30-day mortality in patients with cardiogenic shock with and without mitral regurgitation after acute MI, and to recognize probable predictors of mortality. By investigating this connection, we hope to contribute to the development of more effective risk stratification and treatment strategies for these high-risk patients.

LITERATURE REVIEW

An acute myocardial infarction is a group of symptoms of (ACS) having three components 1 is unstable angina (UA),2nd is STEMI and 3rd is NSTEMI . It is a diffuse visceral pain mostly explain as heaviness, tightness, sequeezing, crushing, stabbing and sometimes burning pain. It include chest, shoulders, arms, epigastrium and back (inter-scapular area),neck and lower jaw (Boateng and Sanborn, 2013)

Ischemic mitral regurgitation is a common complication after acute MI which leads to worst outcome. It results from disbalence between opening and closing forces on Mitral valve secondary to LV remodeling. Most of the times IMR having critical stenosis (>70%) in one or more main coronary vessels. Mostly it occurs in ischemic cardiomyopathy patients (Báez-Ferrer *et al.*, 2018).

Cardiogenic shock can be defined as continued hypotension>30minutes,(SBP<90 mmHg) secondary to heart failure together with other signs of low perfusion (i.e. cold extremities, low urine output and altered state of consciousness), not responding to fluid . (den Unil *et al.*, 2010a)

Cardiogenic shock is a leading cause of death in hospitalized patients with acute myocardial infarction. In hospital survival in patients of cardiogenic shock getting better day by day due to aggressive early treatment but 30dsay mortality rates are still alarming. Reduced sublingual capillary density, at admission or after treatment can lead multi-organ failure and it is an indicator of worst outcome in patients with cardiogenic shock secondary to acute myocardial infarction (den Unil *et al.*, 2010b) Cardiogenic shock patients having Moderate MR 5% and severe MR 10% respectively. (5,6). d (8).In the Recent past some small sample size and single center based studies have used trans-catheter mitral vlave repair (TMVr) in shcok patients with concurrent MR ,these studies recommend it is safe and feasible alternative. (Jung et al., 2021). Early invasive treatment can reduce the poor outcome that occur with non-invasive therapy in patients with acute MI with MR. Nonsurgical mitral valve repair can be used as an alternative for surgery in reducing the degree of MR for very sick patients. In short, those patients who went under mitral intervention had greater survival than those who treated conservatively. Among patients of mitral intervention, Surgical mitral valve repair group having more mortality than the percutaneous mitral valve repair group.(Dan.Haberman et al.2022)

Severe MR is likely a treatable condition .It is detected in round about 10% patients of acute myocardial infarction complicated by CS (4,5) and has been showed with highest one year-mortality (4), having same in-hospital mortality (5) which is low in those patients whose only have acute MI and cardiogenic shock. (Lurz and Besler et al., 2021)

In the public, only MR is common and it also leads to high mortality and rapid heart failure after diagnosis in overall patient subsets, even in those with good LVEF and low comorbidities (Dziadzko *et al.*, 2018).First meta-analysis demonstrated that secondary MR, even-though mild, having poor prognosis in patients of ischemic or idiopathic cardiomyopathy diseases. Because secondary MR is an fundamental consequence of Left Ventricular dysfunction, connection between secondary MR and mortality should not be disguised.(Sannino *et al.*, 2017)

Ischemic MR was associated with poor prognosis in myocardial infarction patients. Patients with STEMI complicated by Mitral regurgitation undergoing primary percutaneous coronary intervention (PPCI) are related with poor short and long-term survival (Mentias *et al.*, 2017). Moderate MR and higher grades of MR in acute MI linked to age and atrial arrhythmias like fibrillation, leads to early increase in left ventricular diastolic dysfunction and reduce ejection fraction. Moderate MR and severe MR having significant impact on in-hospital cardiac deaths (Valuckienė, Urbonaitė and Jurkevičius,et al., 2015)

HYPOTHESIS

30 days mortality in patients of cardiogenic shock with MR is high as compare to without MR after acute MI.

OBJECTIVE

The objective is to determine the outcome between 30days mortality in patients of cardiogenic shock with MR and without MR after acute MI.

MATHODOLOGY

The present study was an explanatory comparative cohort study conducted in the Department of Cardiology, Bahawal Victoria Hospital, Bahawalpur, over a duration of 12 months following the approval of the research synopsis. The sample size was calculated using a randomization technique based on WHO health studies (version 2.0.21), keeping the study power at 80% and the level of significance at 5%. The parameters included $Z_{1-\beta}$ (study power = 80%), $Z_{1-\alpha}$ (significance level = 5%), P_1 (30-day mortality in group A without MR = 8%), and P_2 (30-day mortality in group B with MR = 30%), resulting in a calculated sample of 53 patients per group, totaling 106 patients (Engstrom et al., 2010). A non-probability consecutive sampling technique was applied. The inclusion criteria comprised patients of cardiogenic shock after first myocardial infarction (MI), aged 20 years and above, having moderate to severe mitral regurgitation (MR) on echocardiography, and of both genders. Exclusion criteria included patients with old MI, previous PCI or CABG, congenital or rheumatic heart diseases, valvular heart diseases, septicemia, renal failure, hepatitis, or other mechanical complications of acute MI such as ventricular septal rupture or free wall rupture. After ethical approval, 106 eligible patients were enrolled from the cardiology department. Informed consent was obtained, and demographic data including name, age, gender, occupation, education, and socioeconomic status were recorded. Acute MI was diagnosed using ECG, and MR was confirmed using the echocardiography machine VIVID E95 (General Electric) by the central jet area method. Cardiogenic shock was labeled when systolic blood pressure remained <90 mmHg for at least 30 minutes, accompanied by clinical signs of low cardiac output such as cold extremities, reduced urine output, or altered consciousness. Patients were divided into two groups: Group A (acute MI with cardiogenic shock but without MR) and Group B (acute MI with cardiogenic shock and MR). All patients received guideline-directed standard medical therapy, including intravenous fluids, inotropic support, and SK/PCI as indicated. Patients were discharged once clinically stable and able to ambulate, except in cases of cerebrovascular accidents (CVA). Follow-up was conducted at 15 and 30 days post-event through outpatient visits or telephonic contact if the patient missed their appointment. Emergency visits due to deterioration were also documented. All clinical events were recorded in a structured proforma. Statistical analysis was performed using SPSS version 25. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. Left ventricular function was categorized as mild, moderate, or severe, and age was treated as a continuous variable. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 106 patients diagnosed with cardiogenic shock following acute myocardial infarction were included in the study. Among them, 53 patients had associated mitral regurgitation (MR), while the remaining 53 did not. The mean age of patients without MR was 60.79 ± 9.09 years, whereas patients with MR had a significantly higher mean age of 65.11 ± 10.39 years. The overall mean age of the study population was 62.95 ± 9.96 years.

Among the total cohort, 30-day mortality was observed in 32 patients (30.2%). A higher mortality rate was noted in patients with MR (37.7%) compared to those without MR (22.6%). Conversely, the survival rate was greater among patients without MR (77.4%) compared to those with MR (62.3%). Despite this difference in outcomes, the association between MR and 30-day mortality did not reach statistical significance (p = 0.091), indicating a trend but not conclusive evidence of impact (Table 1).

Table 1: Comparison of 30-Day Mortality Between Patients With and Without Mitral Regurgitation (n = 106)

Mortality Status	Without MR n (%)	With MR n (%)	Total n (%)	p-value
No (Survived)	41 (77.4%)	33 (62.3%)	74 (69.8%)	0.091
Yes (Died within 30 days)	12 (22.6%)	20 (37.7%)	32 (30.2%)	

To explore whether age influenced the relationship between MR and early mortality, patients were stratified into two age groups: 30–55 years and 56–80 years. In the younger age group (30–55 years), 30-day mortality remained low across both subgroups. Among patients without MR, only 1 (10.0%) out of 10 died, while 9 (90.0%) survived. In the MR group, 1 (12.5%) out of 8 patients died, with 7 (87.5%) surviving. This difference was not statistically significant (p = 0.867), suggesting that MR did not meaningfully affect short-term mortality among younger patients.

In contrast, among patients aged 56–80 years, 30-day mortality was substantially higher in the MR group. Specifically, 19 out of 45 patients with MR (42.2%) died compared to 11 out of 43 patients without MR (25.6%). Survival was also higher in the non-MR group (74.4%) than in the MR group (57.8%). Although the difference did not attain statistical significance (p = 0.100), this finding indicates a potentially important clinical association, implying that MR may contribute to increased early mortality particularly among older individuals (Table 2).

Table 2: Stratified Comparison of 30-Day Mortality Between Patients With and Without Mitral Regurgitation by Age Group (n = 106)

Age Group	Mortality Status	Without MR *n (%)*	With MR *n (%)*	Total n *(%)*	p-value
30–55 years	No (Survived)	9 (90.0%)	7 (87.5%)	16 (88.9%)	**0.867**
	Yes (Died within 30 days)	1 (10.0%)	1 (12.5%)	2 (11.1%)	
56–80 years	No (Survived)	32 (74.4%)	26 (57.8%)	58 (65.9%)	**0.100**
	Yes (Died within 30 days)	11 (25.6%)	19 (42.2%)	30 (34.1%)	

Gender-based stratification was conducted to examine whether sex modified the relationship between MR and early mortality. Among male patients, 13 of 35 (37.1%) with MR died compared to 6 of 34 (17.6%) without MR. Survival was significantly higher among males without MR (82.4%) compared to those with MR (62.9%). This difference approached statistical significance (p = 0.070), suggesting a possible gender-specific effect of MR on mortality.

Among female patients, however, mortality rates were more comparable. In the MR group, 7 of 18 (38.9%) patients died, while in the non-MR group, 6 of 19 (31.6%) died. Survival was 61.1% and 68.4%, respectively. The difference was not statistically significant (p = 0.642), indicating that MR may not significantly influence early mortality in female patients. These findings highlight a potential gender-specific disparity, where the negative impact of MR on short-term survival appears more pronounced in males than in females (Table 3).

Table 3: Stratified Comparison of 30-Day Mortality Between Patients With and Without Mitral Regurgitation by Gender (n = 106)

Gender	Mortality Status	Without MR n (%)	With MR n (%)	Total n (%)	p-value
Male	No (Survived)	28 (82.4%)	22 (62.9%)	50 (72.5%)	**0.070**
	Yes (Died within 30 days)	6 (17.6%)	13 (37.1%)	19 (27.5%)	
Female	No (Survived)	13 (68.4%)	11 (61.1%)	24 (64.9%)	**0.642**
	Yes (Died within 30 days)	6 (31.6%)	7 (38.9%)	13 (35.1%)	

To assess whether diabetes mellitus (DM) status influenced the relationship between mitral regurgitation (MR) and 30-day mortality, patients were stratified based on the presence or absence of a history of diabetes. Among non-diabetic patients, mortality remained low across both groups. Only 1 of 19 patients without MR (5.3%) died, while 18 (94.7%) survived. In the MR subgroup, 3 of 21 (14.3%) died, and 18 (85.7%) survived. Although the mortality rate was higher among diabetics with MR, the difference was not statistically significant (p = 0.342), indicating a limited impact of MR on short-term outcomes in non-diabetic patients.

However, the trend differed notably among diabetic patients. Among diabetic patients without MR, 11 of 34 (32.4%) died, and 23 (67.6%) survived. In comparison, 17 of 32 (53.1%) diabetic patients with MR died, while 15 (46.9%) survived. Although this difference did not meet the threshold for statistical significance (p = 0.088), the increased mortality rate in the MR group suggests that MR may have a stronger negative impact on early outcomes in diabetic patients compared to non-diabetics (Table 4).

Table 4: Stratified Comparison of 30-Day Mortality Between Patients With and Without Mitral Regurgitation by Diabetes History (n = 106)

Diabetes History	Mortality Status	Without MR n (%)	With MR n (%)	Total n (%)	p-value
No	No (Survived)	18 (94.7%)	18 (85.7%)	36 (90.0%)	0.342
	Yes (Died within 30 days)	1 (5.3%)	3 (14.3%)	4 (10.0%)	
Yes	No (Survived)	23 (67.6%)	15 (46.9%)	38 (57.6%)	0.088
	Yes (Died within 30 days)	11 (32.4%)	17 (53.1%)	28 (42.4%)	

The modifying role of hypertension was assessed by stratifying patients according to their history of hypertension. Among non-hypertensive patients, mortality was relatively low. In the non-MR group, 3 of 31 (9.7%) patients died, while 28 (90.3%) survived. Among MR patients, 4 of 21 (19.0%) died, and 17 (81.0%) survived. The difference was not statistically significant (p = 0.331), suggesting that MR may not substantially alter mortality in patients without hypertension.

Among hypertensive patients, higher overall mortality was observed. In the MR group, 16 of 32 (50.0%) died and 16 (50.0%) survived. In comparison, 9 of 22 (40.9%) patients without MR died, while 13 (59.1%) survived. Although the difference between MR and non-MR groups among hypertensive patients was not statistically significant (p = 0.510), the absolute mortality was noticeably higher than in non-hypertensive patients, indicating that hypertension may compound the negative prognosis in this clinical setting. However, it does not appear to significantly alter the MR–mortality association on its own (Table 5).

Table 5: Stratified Comparison of 30-Day Mortality Between Patients With and Without Mitral Regurgitation by Hypertension History (n = 106)

Hypertension History	Mortality Status	Without MR n (%)	With MR n (%)	Total n (%)	p-value
No	No (Survived)	28 (90.3%)	17 (81.0%)	45 (86.5%)	0.331
	Yes (Died within 30 days)	3 (9.7%)	4 (19.0%)	7 (13.5%)	
Yes	No (Survived)	13 (59.1%)	16 (50.0%)	29 (53.7%)	0.510
	Yes (Died within 30 days)	9 (40.9%)	16 (50.0%)	25 (46.3%)	

To evaluate the potential interaction between smoking and mitral regurgitation (MR) on 30-day mortality, patients were stratified based on smoking history. Among non-smokers, mortality rates were relatively similar across both groups. In the non-MR group, 8 of 32 (25.0%) died, and 24 (75.0%) survived. Among MR patients, 11 of 36 (30.6%) died, and 25 (69.4%) survived. The difference was not statistically significant (p = 0.610), indicating that smoking status did not appear to significantly influence the relationship between MR and mortality among non-smokers.

However, a significant association was observed among smokers. In the MR group, 9 of 17 (52.9%) patients died, while only 8 (47.1%) survived. In contrast, among smokers without MR, only 4 of 21 (19.0%) patients died, with 17 (81.0%) surviving. This difference was statistically significant (p = 0.029), indicating that the presence of MR is significantly associated with increased 30-day mortality in smokers. These results suggest a possible synergistic effect, where smoking in the presence of MR substantially elevates the risk of early mortality following myocardial infarction complicated by cardiogenic shock (Table 6).

Table 6: Stratified Comparison of 30-Day Mortality Between Patients With and Without Mitral Regurgitation by Smoking Status (n = 106)

Smoking Status	Mortality Status	Without MR n (%)	With MR n (%)	Total n (%)	p-value
Non-smoker	No (Survived)	24 (75.0%)	25 (69.4%)	49 (72.1%)	0.610
	Yes (Died within 30 days)	8 (25.0%)	11 (30.6%)	19 (27.9%)	
Smoker	No (Survived)	17 (81.0%)	8 (47.1%)	25 (65.8%)	0.029
	Yes (Died within 30 days)	4 (19.0%)	9 (52.9%)	13 (34.2%)	

To assess the impact of streptokinase (SK) therapy on the relationship between mitral regurgitation (MR) and 30-day mortality, patients were stratified based on whether they received SK therapy or not. Among those who did not receive SK therapy, a marked difference in mortality was observed. In the MR group, 14 of 23 (60.9%) patients died, while only 9 (39.1%) survived. In contrast, among patients without MR, 6 of 22 (27.3%) died and 16 (72.7%) survived. This difference was statistically significant (p = 0.023), indicating that MR was associated with significantly worse short-term outcomes in the absence of SK therapy.

Among patients who received SK therapy, mortality rates were almost identical in both groups. In the MR group, 6 of 30 (20.0%) patients died, while 24 (80.0%) survived. Similarly, in the non-MR group, 6 of 31 (19.4%) died, and 25 (80.6%) survived. This difference was not statistically significant (p = 0.949), suggesting that SK therapy may have a protective effect that mitigates the adverse impact of MR on early mortality in patients with cardiogenic shock post-myocardial infarction (Table 7).

Table 7: Stratified Comparison of 30-Day Mortality Between Patients With and Without Mitral Regurgitation by SK Therapy (n = 106)

SK Therapy	Mortality Status	Without MR n (%)	With MR n (%)	Total n (%)	p-value
No	No (Survived)	16 (72.7%)	9 (39.1%)	25 (55.6%)	0.023
	Yes (Died within 30 days)	6 (27.3%)	14 (60.9%)	20 (44.4%)	
Yes	No (Survived)	25 (80.6%)	24 (80.0%)	49 (80.3%)	0.949
	Yes (Died within 30 days)	6 (19.4%)	6 (20.0%)	12 (19.7%)	

To determine whether the timing of presentation to the cardiology emergency room (ER) influences the association between mitral regurgitation (MR) and 30-day mortality, patients were stratified based on whether they presented within or after 12 hours of symptom onset. Among the 98 patients who presented within 12 hours, MR was associated with significantly higher mortality. Specifically, 19 of 50 (38.0%) MR patients died, compared to 9 of 48 (18.8%) in the non-MR group. This difference was statistically significant (p = 0.035), indicating that in early presenters, MR was strongly associated with a greater risk of early mortality.

Among the small subgroup of patients who presented after 12 hours (n = 8), the trend was reversed. Three of five (60.0%) patients without MR died, whereas only one of three (33.3%) patients with MR died. However, this difference was not statistically significant (p = 0.465), and the limited sample size in this group restricts meaningful interpretation. Overall, the findings suggest that MR confers a significantly higher risk of mortality in patients presenting early after infarction (Table 8).

Table 8: Stratified Comparison of 30-Day Mortality Between Patients With and Without Mitral Regurgitation by Time of Presentation to Cardiology ER (n = 106)

Presentation Time	Mortality Status	Without MR n (%)	With MR n (%)	Total n (%)	p-value
Within 12 hours	No (Survived)	39 (81.3%)	31 (62.0%)	70 (71.4%)	0.035
	Yes (Died within 30 days)	9 (18.8%)	19 (38.0%)	28 (28.6%)	
After 12 hours	No (Survived)	2 (40.0%)	2 (66.7%)	4 (50.0%)	0.465

Presentation Time	Mortality Status	Without MR n (%)	With MR n (%)	Total n (%)	p-value
	Yes (Died within 30 days)	3 (60.0%)	1 (33.3%)	4 (50.0%)	

This analysis evaluated whether the performance of percutaneous coronary intervention (PCI) influenced the relationship between mitral regurgitation (MR) and 30-day mortality. Among the 51 patients who did not undergo PCI, mortality rates were relatively low. In the MR group, 5 of 28 (17.9%) patients died, compared to 2 of 23 (8.7%) in the non-MR group. This difference was not statistically significant (p = 0.344), although mortality was numerically higher among MR patients.

In contrast, among the 55 patients who underwent PCI, mortality was significantly higher in the MR group. Specifically, 15 of 25 (60.0%) MR patients died, compared to 10 of 30 (33.3%) in the non-MR group. Survival was also higher in non-MR patients (66.7%) compared to MR patients (40.0%). This difference reached statistical significance (p = 0.048), suggesting that MR may be a strong negative prognostic factor in patients undergoing PCI, possibly due to greater myocardial damage or hemodynamic compromise. These findings underscore the importance of evaluating MR severity in PCI candidates to anticipate adverse outcomes and optimize post-procedural care (Table 9).

Table 9: Stratified Comparison of 30-Day Mortality Between Patients With and Without Mitral Regurgitation by PCI Status (n = 106)

PCI Status	Mortality Status	Without MR n (%)	With MR n (%)	Total n (%)	p-value
No PCI	No (Survived)	21 (91.3%)	23 (82.1%)	44 (86.3%)	0.344
	Yes (Died within 30 days)	2 (8.7%)	5 (17.9%)	7 (13.7%)	
PCI Done	No (Survived)	20 (66.7%)	10 (40.0%)	30 (54.5%)	0.048
	Yes (Died within 30 days)	10 (33.3%)	15 (60.0%)	25 (45.5%)	

This analysis examined whether the type of myocardial infarction (MI) modified the association between mitral regurgitation (MR) and 30-day mortality. Among patients with anterior wall MI (n = 67), mortality was higher in the MR group, with 13 of 35 patients (37.1%) dying within 30 days, compared to 7 of 32 (21.9%) in the non-MR group. Although this suggested a trend toward increased mortality in the MR group, the difference was not statistically significant (p = 0.173).

Similarly, among patients with inferior wall MI (n = 37), mortality was 41.2% (7 of 17) in the MR group versus 25.0% (5 of 20) in the non-MR group. This difference was also not statistically significant (p = 0.295). For the two patients with MI classified as "other type," both survived, making statistical analysis irrelevant for this subgroup. Although not statistically significant, the consistent pattern of higher mortality in MR groups across MI types suggests that MR may have a deleterious impact on survival following infarction, which could reach significance in a larger cohort (Table 10).

Table 10: Stratified Comparison of 30-Day Mortality Between Patients With and Without Mitral Regurgitation by MI Type (n = 106)

MI Type	Mortality Status	Without MR n (%)	With MR n (%)	Total n (%)	p-value
Anterior Wall MI	No (Survived)	25 (78.1%)	22 (62.9%)	47 (70.1%)	0.173
	Yes (Died within 30 days)	7 (21.9%)	13 (37.1%)	20 (29.9%)	
Inferior Wall MI	No (Survived)	15 (75.0%)	10 (58.8%)	25 (67.6%)	0.295
	Yes (Died within 30 days)	5 (25.0%)	7 (41.2%)	12 (32.4%)	
Other MI Type	No (Survived)	1 (100.0%)	1 (100.0%)	2 (100.0%)	
	Yes (Died within 30 days)	0 (0.0%)	0 (0.0%)	0 (0.0%)	

To explore whether atrial fibrillation (AF) following myocardial infarction modifies the relationship between mitral regurgitation (MR) and early mortality, patients were stratified based on the occurrence of post-MI AF. Among patients who did not develop AF (n = 105), mortality was higher in the MR group, where 19 of 52 patients (36.5%) died, compared to 12 of 53 (22.6%) in the non-MR group. Although this trend favored better survival in the non-MR group, the difference was not statistically significant (p = 0.119).

Only one patient in the entire study cohort developed AF after MI. This individual belonged to the MR group and died within 30 days. Due to the singular nature of this case, statistical analysis could not be performed. However, the outcome may hint at a potentially poor prognosis in patients who develop post-MI AF in the presence of MR, warranting closer clinical attention (Table 11).

Table 11: Stratified Comparison of 30-Day Mortality Between Patients With and Without Mitral Regurgitation by Atrial Fibrillation After MI (n = 106)

AF After MI	Mortality Status	Without MR n (%)	With MR n (%)	Total n (%)	p-value
No	No (Survived)	41 (77.4%)	33 (63.5%)	74 (70.5%)	0.119
	Yes (Died within 30 days)	12 (22.6%)	19 (36.5%)	31 (29.5%)	
Yes	No (Survived)	–	0 (0.0%)	0 (0.0%)	Not tested
	Yes (Died within 30 days)	–	1 (100.0%)	1 (100.0%)	

To assess the interaction between ventricular tachycardia (VT) episodes and mitral regurgitation (MR) in predicting 30-day mortality, patients were stratified by VT status. Among the 95 patients who did not experience VT, mortality was similar across groups: 12 of 45 (26.7%) MR patients died, compared to 12 of 50 (24.0%) non-MR patients. The difference was not statistically significant (p = 0.765), suggesting that MR alone does not significantly alter prognosis in the absence of VT.
In contrast, among the 11 patients who developed VT, a striking difference was observed. All 8 MR patients with VT died (100.0% mortality), while all 3 non-MR patients with VT survived (0.0% mortality). This difference was statistically significant (p = 0.001), underscoring a profound prognostic interaction between VT and MR. These findings indicate that VT in the setting of MR is associated with extremely poor outcomes and highlights the need for aggressive monitoring and intervention in such high-risk patients (Table 12).

Table 12: Stratified Comparison of 30-Day Mortality Between Patients With and Without Mitral Regurgitation by Ventricular Tachycardia Episode (n = 106)

Ventricular Tachycardia	Mortality Status	Without MR n (%)	With MR n (%)	Total n (%)	p-value
No VT Episode	No (Survived)	38 (76.0%)	33 (73.3%)	71 (74.7%)	0.765
	Yes (Died within 30 days)	12 (24.0%)	12 (26.7%)	24 (25.3%)	
VT Episode Present	No (Survived)	3 (100.0%)	0 (0.0%)	3 (27.3%)	0.001
	Yes (Died within 30 days)	0 (0.0%)	8 (100.0%)	8 (72.7%)	

This section explores the relationship between the severity of mitral regurgitation (MR), as assessed by central jet area on echocardiography, and 30-day mortality. Among patients with moderate MR (jet area 20–39%), mortality was higher in the MR group, where 14 of 44 patients (31.8%) died. In contrast, among non-MR patients in the same jet area category (n = 1), no deaths were recorded. However, the difference between groups was not statistically significant (p = 0.497). The survival rate in the MR group with moderate MR was 68.2%.
In the subgroup with severe MR (central jet area >40%), all 8 patients were from the MR group. Among these, 6 (75.0%) died within 30 days, while

only 2 (25.0%) survived. Due to the small sample size and absence of severe MR in the non-MR group, formal statistical testing could not be performed. Nonetheless, this observed mortality rate strongly suggests that severe MR is associated with markedly worse outcomes.

For those with no MR (jet area 0%), mortality was 23.1% (12 of 52) in the non-MR group, while the sole MR patient in this category survived. Again, the difference was not statistically significant (p = 0.585). Collectively, these findings imply that increasing MR severity particularly severe MR may portend higher early mortality following acute myocardial infarction and cardiogenic shock, despite limitations in statistical testing due to small subgroup sizes (Table 13).

Table 13: Stratified Comparison of 30-Day Mortality Between Patients With and Without Mitral Regurgitation by Central Jet Area on Echocardiography (n = 106)

MR Severity (ECHO)	Mortality Status	Without MR n (%)	With MR n (%)	Total n (%)	p-value
Moderate (20–39%)	No (Survived)	1 (100.0%)	30 (68.2%)	31 (68.9%)	**0.497**
	Yes (Died within 30 days)	0 (0.0%)	14 (31.8%)	14 (31.1%)	
Severe (>40%)	No (Survived)	0 (0.0%)	2 (25.0%)	2 (25.0%)	Not tested
	Yes (Died within 30 days)	0 (0.0%)	6 (75.0%)	6 (75.0%)	
Normal (0%)	No (Survived)	40 (76.9%)	1 (100.0%)	41 (77.4%)	**0.585**
	Yes (Died within 30 days)	12 (23.1%)	0 (0.0%)	12 (22.6%)	

To assess the influence of left ventricular ejection fraction (LVEF) on the association between mitral regurgitation (MR) and 30-day mortality, patients were categorized based on systolic function into mild (41–45%), moderate (30–40%), and severe (<30%) dysfunction.

Among patients with mild LV dysfunction, outcomes were uniformly favorable. No deaths occurred in either MR or non-MR groups, yielding a 100% survival rate, suggesting excellent short-term prognosis regardless of MR status.

In the moderate LV dysfunction group, mortality was slightly higher in MR patients (33.3%) compared to non-MR patients (24.3%). However, this difference did not reach statistical significance (p = 0.379), indicating a potentially increased but inconclusive risk in the presence of MR.

Strikingly, all patients with severe LV dysfunction died within 30 days, irrespective of MR status. This outcome illustrates the dominant prognostic importance of severely depressed systolic function in this population. While MR may contribute additional risk in moderate dysfunction, LVEF appears to be a key determinant of mortality, particularly in its severe form (Table 14).

Table 14: Stratified Comparison of 30-Day Mortality Between Patients With and Without Mitral Regurgitation by LVEF Category (n = 106)

LVEF Category	Mortality Status	Without MR n (%)	With MR n (%)	Total n (%)	p-value
Mild (EF 41–45%)	No (Survived)	13 (100.0%)	5 (100.0%)	18 (100.0%)	Not tested
	Yes (Died within 30 days)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
	No (Survived)	28 (75.7%)	28 (66.7%)	56 (70.9%)	**0.379**

LVEF Category	Mortality Status	Without MR n (%)	With MR n (%)	Total n (%)	p-value
Moderate (EF 30–40%)	Yes (Died within 30 days)	9 (24.3%)	14 (33.3%)	23 (29.1%)	
Severe (EF <30%)	No (Survived)	0 (0.0%)	0 (0.0%)	0 (0.0%)	Not tested
	Yes (Died within 30 days)	3 (100.0%)	6 (100.0%)	9 (100.0%)	

An evaluation of the place of death revealed a clinically important pattern. Of the 74 patients who survived, all remained alive during their hospitalization, with no in-hospital deaths observed across either MR or non-MR groups indicating a 100% hospital survival rate.

In contrast, all 32 deaths in the study occurred after discharge, at home. This included 12 (100%) patients from the non-MR group and 20 (100%) from the MR group. Since no variability in location of death existed within the deceased subgroup, statistical comparison was not feasible. Nevertheless, the uniform occurrence of post-discharge mortality highlights a critical vulnerability period. This finding underscores the importance of post-hospital care and follow-up, particularly for patients with MR, who may be at elevated risk for sudden deterioration. Enhanced discharge counseling, early outpatient evaluation, and potentially home-based monitoring strategies may improve outcomes in this high-risk population (Table 15).

Table 15: Stratified Comparison of 30-Day Mortality Between Patients With and Without Mitral Regurgitation by Place of Mortality (n = 106)

Place of Mortality	Mortality Status	Without MR n (%)	With MR n (%)	Total n (%)	p-value
Hospital	No (Survived)	41 (100.0%)	33 (100.0%)	74 (100.0%)	
	Yes (Died within 30 days)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Home	No (Survived)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
	Yes (Died within 30 days)	12 (100.0%)	20 (100.0%)	32 (100.0%)	

The mean age of the entire study population (n = 106) was 62.95 ± 9.96 years. A statistically significant difference was observed when comparing the mean age between patients with and without mitral regurgitation (MR). Patients without MR had a mean age of 60.79 ± 9.09 years, whereas those with MR had a higher mean age of 65.11 ± 10.39 years. The difference was statistically significant (p = 0.025), as determined using an independent samples t-test with equal variances assumed (Levene's test p = 0.539). These findings indicate that MR was more prevalent in older individuals, suggesting age may be a contributing factor to the development or worsening of MR in the context of cardiogenic shock following acute myocardial infarction (Table 16).

Table 16: Comparison of Mean Age Between Study Groups (Independent Samples t-test)

Variable	Category	Without MR (n = 53)	With MR (n = 53)	p-value
Age (years)	Mean ± SD	60.79 ± 9.09	65.11 ± 10.39	**0.025**

Univariate Logistic Regression Analysis

Univariate logistic regression was conducted to assess the association between individual clinical variables and 30-day mortality. Several variables demonstrated statistically significant associations:

- **Diabetes mellitus**: Patients without DM had significantly lower odds of 30-day mortality (OR = 0.151, p = 0.001).
- **Hypertension**: Absence of hypertension was associated with reduced mortality (OR = 0.180, p < 0.001).
- **Streptokinase (SK) therapy**: Receiving SK therapy was linked to higher odds of survival (OR = 3.267, p = 0.007).
- **Percutaneous coronary intervention (PCI)**: Patients undergoing PCI had a significantly lower risk of mortality (OR = 0.191, p = 0.001).
- **Ventricular tachycardia (VT)**: Patients without VT had significantly reduced odds of mortality (OR = 0.127, p = 0.004).
- **Severe mitral regurgitation (central jet area on ECHO)**: Severe MR was associated with markedly higher odds of death (OR = 10.250, p = 0.008).

Other variables, including age group, gender, smoking status, and presentation timing to the emergency room, were not statistically significant. Additionally, variables such as ischemic heart disease (IHD) history, atrial fibrillation, MI type, and LVEF could not be reliably estimated due to small sample sizes, quasi-complete separation, or model instability, and thus were interpreted cautiously (Table 17).

Table 17: Univariate Logistic Regression Analysis for 30-Day Mortality

Variable	Odds Ratio (OR)	95% Confidence Interval	p-value
Age Group (30–55 vs. 56–80 years)	0.242	0.052 – 1.121	0.070
Gender (Male vs. Female)	0.702	0.298 – 1.653	0.418
DM History (Yes vs. No)	0.151	0.048 – 0.473	0.001
HTN History (Yes vs. No)	0.180	0.069 – 0.471	<0.001
IHD History (Yes vs. No)	–	–	–
Smoking (Yes vs. No)	0.746	0.317 – 1.752	0.501
SK Therapy (No vs. Yes)	3.267	1.379 – 7.741	0.007
Presentation to ER (≤12h vs. >12h)	0.400	0.093 – 1.711	0.217
PCI (Yes vs. No)	0.191	0.073 – 0.498	0.001
MI Type (AWMI vs. IWMI)	–	–	0.963
Atrial Fibrillation (Yes vs. No)	–	–	1.000
Ventricular Tachycardia (Yes vs. No)	0.127	0.031 – 0.517	0.004
MR Jet Area (Severe vs. None)	10.250	1.827 – 57.514	0.008
LVEF (Moderate vs. Severe)	–	–	1.000
Mortality Place (Home vs. Hospital)	–	–	<0.001

Multivariable Logistic Regression Analysis

A multivariable logistic regression model was constructed to identify independent predictors of 30-day mortality. The model was statistically significant ($\chi^2 = 70.235$, df = 9, $p < 0.001$), indicating that the included predictors collectively distinguished between survivors and non-survivors. The model fit was excellent (Hosmer–Lemeshow p = 0.982), and it explained 68.6% of the variance in 30-day mortality (Nagelkerke $R^2 = 0.686$), with an overall prediction accuracy of 89.6%.

Significant independent predictors included:

- **Diabetes Mellitus (DM) History**: Absence of DM was associated with a markedly reduced risk of mortality (AOR = 0.055, p = 0.001; 95% CI: 0.009–0.320).
- **Hypertension (HTN) History**: Absence of hypertension was similarly associated with lower odds of death (AOR = 0.095, p = 0.002; 95% CI: 0.021–0.431).
- **Severe Mitral Regurgitation**: Patients with severe MR (as assessed by central jet area) had significantly higher odds of 30-day mortality (AOR = 136.3, p = 0.023; 95% CI: 1.97–9451.31).

Other variables including SK therapy, PCI, ventricular tachycardia, and LVEF did not remain significant in the multivariate model (p > 0.05), though they were significant in univariate analysis. This suggests that the effects of these variables may be mediated by or confounded with more dominant predictors such as MR severity and comorbid conditions (Table 18).

Table 18: Multivariable Logistic Regression Analysis for 30-Day Mortality

Variable	B	S.E.	p-value	AOR	95% CI for AOR
DM History (No vs Yes)	-2.900	0.898	0.001	0.055	0.009 – 0.320
HTN History (No vs Yes)	-2.359	0.774	0.002	0.095	0.021 – 0.431
Streptokinase Therapy (Yes vs No)	0.828	0.906	0.361	2.288	0.388 – 13.498
PCI (Yes vs No)	-1.440	1.016	0.156	0.237	0.032 – 1.736
Ventricular Tachycardia (Yes vs No)	-0.741	1.038	0.475	0.477	0.062 – 3.643
Central MR Jet Area			0.067		
– Moderate vs reference	0.870	0.717	0.225	2.388	0.585 – 9.741
– Severe vs reference	4.915	2.163	0.023	136.325	1.966 – 9451.312
LVEF			1.000		
– Moderate vs reference	-44.506	12816.913	0.997	~0	Undefined
– 2 vs reference	-24.821	10190.973	0.998	~0	Undefined

Model Fit Indicators:

- **-2 Log Likelihood**: 59.605
- **Nagelkerke R²**: 0.686
- **Hosmer and Lemeshow Test**: χ^2 = 1.520, p = 0.982
- **Overall Prediction Accuracy**: 89.6%

DISCUSSION:

Mitral regurgitation (MR) in the context of cardiogenic shock following acute myocardial infarction (AMI) presents a multifaceted challenge with implications for short-term survival. Although our study did not find a statistically significant difference in 30-day mortality between patients with and without MR (37.7% vs. 22.6%, p = 0.091), the consistent pattern of higher mortality in MR patients aligns with contemporary evidence suggesting MR as a clinically important adverse prognostic factor.

Recent large-scale studies confirm that MR significantly increases early and intermediate-term mortality in cardiogenic shock post-MI. According to a comprehensive meta-analysis of over 5,400 patients, transcatheter edge-to-edge repair (TEER) of MR in cardiogenic shock resulted in 30-day mortality of 14%, with higher rates observed in AMI subgroups (up to 20%) (Dimitriadis et al., 2025). Another large registry found MR independently associated with significantly increased in-hospital mortality, even in patients undergoing reperfusion therapy (Ullah et al., 2022).

The severity of MR emerges as a critical determinant. In our study, patients with severe MR experienced a 75% mortality rate within 30 days. This is consistent with findings from recent trials, such as those in the IREMMI registry, where severe MR in the setting of shock carried a significantly higher mortality risk than mild or moderate MR (Estévez-Loureiro et al., 2021).

Our study also observed that MR was more prevalent and more fatal in older adults. This aligns with evidence showing that aging contributes to increased mitral annular calcification, papillary muscle dysfunction, and reduced compensatory mechanisms, all of which compound MR severity post-MI (Sharma et al., 2021). Moreover, comorbid conditions such as diabetes mellitus and hypertension, both more prevalent in older populations, amplified mortality in MR patients in our dataset.

A notable observation from our results is the synergy between MR and other adverse clinical conditions, particularly ventricular tachycardia (VT). All patients who had both MR and VT died within 30 days, underscoring the compounded hemodynamic burden and arrhythmogenic potential in this group. This echoes recent findings by So et al. (2022), who demonstrated that MR in conjunction with mechanical complications like VT leads to dramatically increased short-term mortality (So et al., 2022).

Smoking was found to be a significant modifier of MR-related mortality. Smokers with MR had more than 50% mortality, a finding consistent with studies identifying smoking as a trigger for adverse cardiac remodeling and endothelial dysfunction, thereby aggravating the hemodynamic burden of MR (Haberman et al., 2022).

Our results also suggest that early reperfusion strategies, such as streptokinase (SK) therapy, significantly attenuate the negative impact of MR on early mortality. This aligns with recent reviews emphasizing the role of early revascularization and mechanical circulatory support in stabilizing patients before mitral intervention (Estévez-Loureiro et al., 2024).

Emerging interventional options, especially TEER with the MitraClip device, show promise for improving outcomes in this population. According to a systematic review by Soulaidopoulos et al. (2023), TEER significantly reduced mortality and hospitalization in patients with MR and cardiogenic shock, particularly when performed in the early phase of AMI (Soulaidopoulos et al., 2023). Other reports document successful hemodynamic stabilization and MR reduction even in high-risk or inoperable patients (Ahmed et al., 2023), (Ashraf et al., 2020).

A final critical insight from our study was that all deaths occurred post-discharge, pointing to a dangerous transitional period for patients with MR post-AMI. This reflects the need for robust follow-up care, early outpatient evaluation, and possibly home-based monitoring. Several recent case series and reviews echo this concern, advocating for multidisciplinary management that extends well beyond hospitalization (Garcia et al., 2020).

In summary, mitral regurgitation, especially when severe or coexisting with other high-risk features (e.g., diabetes, VT, smoking, older age), consistently emerges as a significant predictor of early mortality in patients with cardiogenic shock after AMI. While our study's sample size limited statistical significance, the trends mirror global evidence. Future research should continue evaluating the efficacy of percutaneous interventions like TEER and focus on optimizing early identification, treatment timing, and post-discharge monitoring.

CONCLUSION

This study demonstrates that mitral regurgitation (MR) is associated with increased 30-day mortality in patients with cardiogenic shock following acute myocardial infarction. Although the overall difference was not statistically significant, subgroup analyses revealed that MR had a stronger adverse impact among older patients, males, diabetics, smokers, and those undergoing PCI. Severe MR emerged as an independent predictor of mortality, while the absence of diabetes and hypertension was protective. The finding that all deaths occurred post-discharge highlights the importance of close follow-up in high-risk patients. Early identification and targeted management of MR may improve short-term outcomes in this critically ill population.

LIMITATIONS OF STUDY

There are following limitations of the study

The study was conducted at a single tertiary care center, limiting generalizability.

- Small sample size (n = 106) reduced statistical power, especially in subgroup analyses.
- Observational design may involve residual confounding and selection bias; causality cannot be confirmed.

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