Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

GENDER-BASED INCIDENCE OF MECHANICAL COMPLICATIONS AFTER ACUTE MYOCARDIAL INFARCTION AT A TERTIARY CARE HOSPITAL

1. Roheela Hikmat
Department of Health and Biological Sciences Abasyn University Peshawar
2. Adnan Khadim*
Coordinator Cardiology, Abasyn University, Peshawar.
Email: adnan.khadim@abasyn.edu.pk
3. Wasif khan
Department of Health and Biological Sciences, Abasyn University, Peshawar.
4. Shah Fahad khan
Department of Health and Biological Sciences, Abasyn University, Peshawar.
5. Muzamil Hussain
Department of Health and Biological Sciences, Abasyn University, Peshawar.
6. Sahiba Shoaib
Department of Health and Biological Sciences, Abasyn University, Peshawar.
7. Naeem Ullah
Department of Health and Biological Sciences, Abasyn University, Peshawar.

Author Details

Received on 25 May, 2026

Accepted on 28 June, 2026

Published on 30 June, 2026

Corresponding E-mails & Authors*:
Adnan Khadim*
adnan.khadim@abasyn.edu.pk

Abstract

Mechanical complications of acute myocardial infarction (AMI), including ventricular septal rupture (VSR), papillary muscle rupture (PMR) causing acute severe mitral regurgitation, and left ventricular free wall rupture (LVFWR), are among the most catastrophic consequences of transmural myocardial necrosis. Although their incidence has declined in high-income countries with the widespread adoption of primary percutaneous coronary intervention (PCI), these complications remain associated with extremely high short-term mortality. In low-and middle-income countries (LMICs), such as Pakistan, where reperfusion therapy may be delayed or unavailable, the burden of mechanical complications may be substantially higher. Sex differences in AMI presentation, management, and outcomes are well recognized; however, data on sex-based differences in mechanical complications from South Asian populations remain scarce. This study aimed to determine the sex-based incidence of mechanical complications among patients

admitted with AMI at Lady Reading Hospital (LRH), Peshawar, a major tertiary care center in Khyber Pakhtunkhwa, Pakistan.

Methods:

A descriptive cross-sectional study was conducted on 140 adult patients admitted with AMI (STEMI or NSTEMI) to the cardiology department of LRH during the data collection period. Patients aged ⩾ 18 years with a confirmed AMI diagnosis based on clinical features, electrocardiographic changes, and elevated cardiac biomarkers, and with complete clinical and echocardiographic records, were included. Patients with pre-existing structural heart disease were excluded. Data were collected using a structured proforma encompassing demographic characteristics, cardiovascular risk factors, AMI type, echocardiographic findings, laboratory values, management strategies, and in-hospital outcomes. Mechanical complications were defined as new-onset VSR, PMR causing acute severe mitral regurgitation, or LVFWR occurring during the index hospitalization. Data were entered and analyzed using SPSS version 27. Descriptive statistics were used to summarize the baseline characteristics. Chi-square tests and two-proportion Z tests were used to assess the associations between categorical variables. A p-value of less than 0.05 was considered statistically significant.

Results:

The study population comprised 86 men (61.4%) and 54 women (38.6%), with a mean age of 56.5 ± 11.2 years. STEMI was diagnosed in 72 patients (51.4%) and NSTEMI in 68 patients (48.6%). The most prevalent cardiovascular risk factors were hypertension (62.1%), diabetes mellitus (48.6%), and smoking (41.4%). Mechanical complications were documented in 48 patients (34.3%): papillary muscle rupture in 20 patients (41.7% of complicated cases), ventricular septal rupture in 16 patients (33.3%), and left ventricular free wall rupture in 12 patients (25.0%). Sex was not significantly associated with the occurrence of mechanical complications ($\chi^2 = 0.130$, $p = 0.718$; $Z = -0.544$, $p = 0.587$). AMI type, diabetes, smoking, hyperlipidemia, and a family history of ischemic heart disease were also not significantly associated with mechanical complications. However, there was a strong and statistically significant association between mechanical complications and in-hospital outcomes ($\chi^2 = 25.746$, $p < 0.001$), with substantially higher mortality among patients who developed complications.

Pakistan Journal of Medical & Cardiological Review
https://pakjmcr.com/index.php/1/about
Online ISSN 3007-2387
Print ISSN 3007-2379

Conclusion: The reported incidence of mechanical complications in this study (34.3%) is markedly higher than contemporary international benchmarks (<1% in the reperfusion era), potentially reflecting delayed hospital presentation, limited reperfusion access, and a high-risk case mix at a major tertiary referral center. No statistically significant sex-based difference in mechanical complication incidence was observed; however, this finding should be interpreted cautiously given the sample size and absence of multivariable adjustment. Mechanical complications were strongly associated with in-hospital mortality, underscoring their catastrophic clinical significance. These findings highlight the urgent need for early AMI recognition, rapid reperfusion therapy, routine echocardiographic surveillance, and strengthened cardiac surgical capacity at tertiary care centers in Pakistan. Future multicenter prospective studies with standardized diagnostic protocols and comprehensive reperfusion data are essential to validate these findings and inform healthcare policy.

Keywords: Acute myocardial infarction, mechanical complications, ventricular septal rupture, papillary muscle rupture, free wall rupture, gender differences, Pakistan, tertiary care

Introduction

Acute myocardial infarction (AMI) remains a leading cause of morbidity and mortality worldwide despite advances in prevention, diagnosis, reperfusion, and post-infarction care (Damluji et al., 2021; Gong et al., 2021). It results from sudden interruption of coronary blood flow, causing myocardial ischemia, necrosis, and irreversible loss of cardiac muscle. The burden of AMI is particularly high in low- and middle-income countries, including Pakistan, where delayed presentation, limited access to coronary intervention, and healthcare constraints contribute to poor outcomes (Burden and Trends of Cardiovascular Disease in Pakistan, 2024). South Asian populations are at increased risk because of the high prevalence of diabetes, hypertension, dyslipidemia, and tobacco use (South Asian Cardiovascular Disease: Dispelling Stereotypes and Disparity, 2021).

Mechanical complications of AMI are rare but life-threatening structural injuries caused by infarct-related myocardial necrosis. The major complications include ventricular septal rupture (VSR), papillary muscle rupture (PMR) leading to acute severe mitral regurgitation, and left ventricular free wall rupture (LVFWR) (Damluji et al., 2021; Gong et al., 2021). These complications usually occur within the first week after infarction and are associated with high mortality despite advances in reperfusion

therapy (Elbadawi et al., 2019). Their occurrence is strongly related to infarct size, delayed reperfusion, poor collateral circulation, advanced age, hypertension, chronic kidney disease, and first-time AMI (Damluji et al., 2021; Elbadawi et al., 2019).

Gender differences also influence AMI presentation and outcomes. Women often present at an older age with atypical symptoms and multiple comorbidities, resulting in delayed diagnosis and treatment, which may increase the risk of mechanical complications (Damluji et al., 2021; Gong et al., 2021). In South Asian countries, additional social and healthcare barriers may further delay access to emergency cardiac care, making gender-based evaluation particularly relevant. Lady Reading Hospital (LRH), Peshawar, is a major tertiary referral center that receives a large number of complicated AMI cases, including patients presenting late from peripheral healthcare facilities (Burden and Trends of Cardiovascular Disease in Pakistan, 2024). Since delayed treatment significantly increases the likelihood of mechanical complications, studying these patients is important for understanding the local disease burden. However, evidence from Pakistan remains limited, with most published data originating from high-income countries where healthcare systems and reperfusion services differ substantially from local settings. Therefore, this study provides valuable local evidence regarding the frequency, pattern, and gender differences of mechanical complications following AMI. The findings of this study are expected to support early identification of high-risk patients, improve echocardiographic surveillance and timely surgical referral, and assist healthcare planners in strengthening cardiac care services. Furthermore, the study will contribute baseline data for future multicenter research in Pakistan and enhance the understanding of post-AMI mechanical complications in South Asian populations.

Methodology

This study employed a descriptive cross-sectional design to determine the gender-related incidence of mechanical complications among patients with acute myocardial infarction (AMI). The design was selected because it enables simultaneous assessment of outcomes and associated variables within a defined population. The study was conducted at Lady Reading Hospital (LRH), Peshawar, a tertiary-care teaching hospital and major referral center for cardiac emergencies in Khyber Pakhtunkhwa. The cardiology department provides comprehensive diagnostic and therapeutic services, including electrocardiography, echocardiography, cardiac catheterization, and medical and surgical management of AMI.

The study included adult patients (⩾18 years) admitted with a confirmed diagnosis of STEMI or NSTEMI during the study period. AMI was diagnosed according to the Universal Definition of Myocardial Infarction based on clinical features, electrocardiographic changes, and elevated cardiac troponin levels. A total of 140 patients were selected using convenience sampling with a 95% confidence level and 5% margin of error. Although convenience sampling may introduce selection bias, it was considered appropriate because of the availability of complete clinical and echocardiographic records.

Eligible participants were adults with confirmed AMI and complete clinical records, whereas patients younger than 18 years, those with incomplete records, or those with pre-existing structural heart disease (e.g., ventricular septal defect, severe mitral valve disease, or previous cardiac surgery) were excluded. Data were collected using a structured proforma that recorded demographic characteristics, cardiovascular risk factors, AMI type, echocardiographic findings, laboratory values (HbA1c and random blood glucose), treatment strategies, and in-hospital outcomes. Mechanical complications were defined as ventricular septal rupture, papillary muscle rupture causing acute severe mitral regurgitation, or left ventricular free wall rupture diagnosed during the index hospitalization using clinical assessment and echocardiography. Left ventricular function was categorized as mild (EF 40–54%), moderate (EF 30–39%), or severe dysfunction (EF <30%).

Data were analyzed using SPSS version 27 (IBM Corp., Armonk, NY, USA). Continuous variables were summarized as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Associations between variables were assessed using the Chi-square test, and the two-proportion Z-test was used to compare the incidence of mechanical complications between males and females. A p-value of <0.05 was considered statistically significant. The study was conducted in accordance with the Declaration of Helsinki after obtaining ethical approval from the Institutional Review Board of Abasyn University and the Research Ethics Committee of Lady Reading Hospital, Peshawar. Written informed consent was obtained from all participants or their legal representatives. Confidentiality was maintained by using coded identifiers, and participation was voluntary with the right to withdraw at any stage without affecting clinical care.

Results and Discussion

Baseline Demographic and Clinical Characteristics

The study included 140 patients who were admitted during the data collection period with AMI. The mean age of the population enrolled in the study was 56.5 ± 11.2 years (range 22-85 years). Men made up 86 patients (61.4%), and women 54 patients (38.6). The gender distribution is in line with the known higher incidence of AMI in males in the fifth and sixth decades of life and the typical gender distribution observed in South Asian AMI registries.

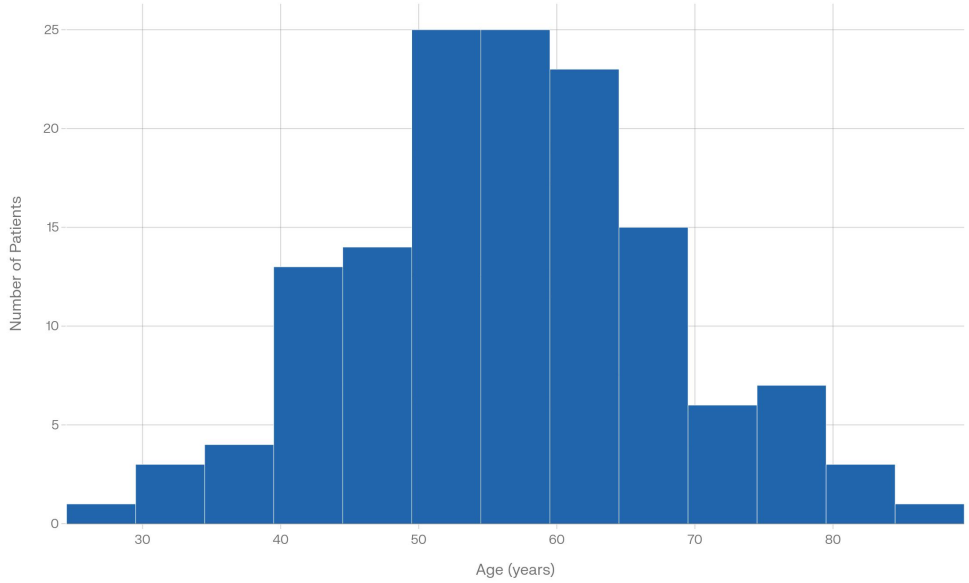

Figure 1: Age distribution of patients admitted with acute myocardial infarction at Lady Reading Hospital, Peshawar (n=140).

Table 1: Baseline Demographic and Clinical Characteristics of the Study Population

Variable	Total (n=140)	Male (n=86)	Female (n=54)	p-value
Age, mean ± SD (years)	56.5 ± 11.2	54.8 ± 10.9	59.2 ± 11.4	0.021
STEMI	72 (51.4%)	46 (53.5%)	26 (48.1%)	0.524
NSTEMI	68 (48.6%)	40 (46.5%)	28 (51.9%)	0.524

Hypertension	87 (62.1%)	50 (58.1%)	37 (68.5%)	0.204
Diabetes mellitus	68 (48.6%)	38 (44.2%)	30 (55.6%)	0.181
Smoking	58 (41.4%)	46 (53.5%)	12 (22.2%)	<0.001
Hyperlipidemia	52 (37.1%)	32 (37.2%)	20 (37.0%)	0.980
Family history of IHD	44 (31.4%)	26 (30.2%)	18 (33.3%)	0.685

As shown in Table 1, female patients were significantly older than male patients (mean age 59.2 ± 11.4 years vs. 54.8 ± 10.9 years, $p = 0.021$). Smoking was significantly more prevalent among male patients (53.5% vs. 22.2%, $p < 0.001$), consistent with the higher prevalence of tobacco use among men in Pakistan. Hypertension was the most prevalent risk factor overall (62.1%), followed by diabetes mellitus (48.6%) and smoking (41.4%). There were no statistically significant sex differences in the prevalence of hypertension, diabetes, hyperlipidemia, or family history of ischemic heart disease.

Mechanical Complication Incidence and Types

Mechanical complications were documented in 48 patients, yielding an overall incidence of 34.3% in the study population. Among the 48 patients with complications, papillary muscle rupture was the most frequent occurring in 20 patients (41.7% of complicated cases), followed by ventricular septal rupture in 16 patients (33.3%) and left ventricular free wall rupture in 12 patients (25.0%).

Pakistan Journal of Medical & Cardiological Review
https://pakjmcr.com/index.php/1/about
Online ISSN 3007-2387
Print ISSN 3007-2379

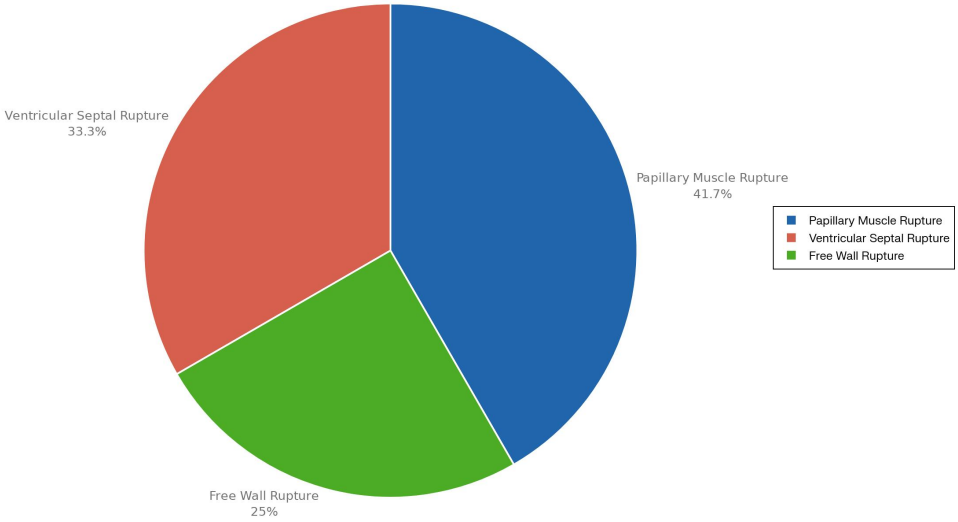

Figure 2: Distribution of mechanical complication types among patients who developed complications (n=48). PMR = Papillary Muscle Rupture; VSR = Ventricular Septal Rupture; LVFWR = Left Ventricular Free Wall Rupture.

Table 2: Frequency Distribution of Mechanical Complication Types

Complication Type	N	% of Complicated Cases	% of Total Sample
Papillary Muscle Rupture (PMR)	20	41.7%	14.3%
Ventricular Septal Rupture (VSR)	16	33.3%	11.4%
Left Ventricular Free Wall Rupture (LVFWR)	12	25.0%	8.6%
Total Mechanical Complications	48	100%	34.3%

4.3 Gender-Based Analysis

The primary objective of this study was to determine whether sex is associated with the occurrence of mechanical complications after AMI. Of the male patients, 30 of 86 (34.9%) developed mechanical complications, whereas of the female patients, 18 of 54 (33.3%) developed mechanical complications. The chi-square test showed no statistically significant association between sex and the occurrence of mechanical complications ($\chi^2 = 0.130$, $p = 0.718$). The two-proportion Z test also showed no significant difference between men and women ($Z = -0.544$, $p = 0.587$).

Table 3: Gender Distribution of Mechanical Complications

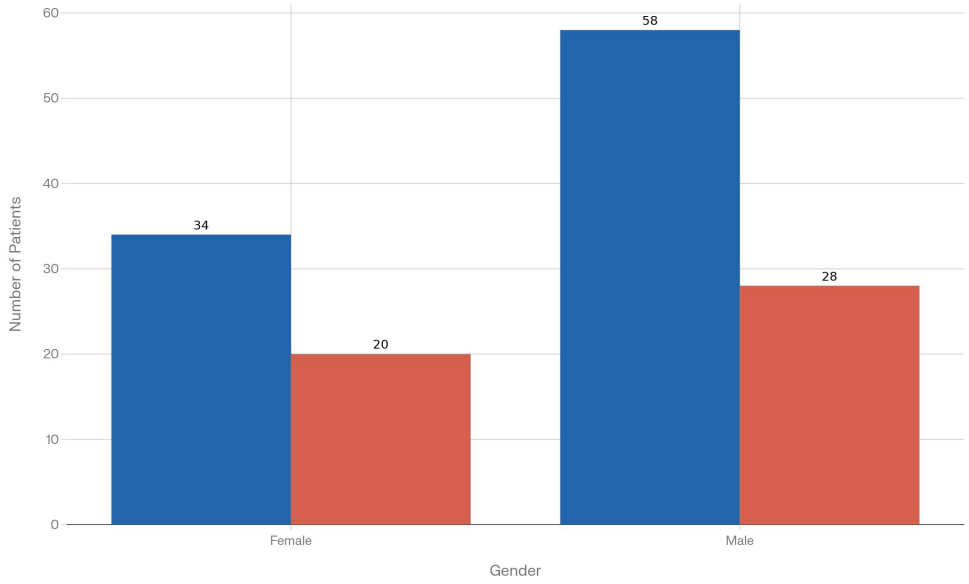

Figure 3: Mechanical complications stratified by gender. No statistically significant difference was found between males and females ($\chi^2 = 0.130$, $p = 0.718$).

Gender	With Complications	Without Complications	Total	Incidence (%)
Male	30	56	86	34.9%
Female	18	36	54	33.3%

Total	48	92	140	34.3%

Association Analyses

Chi-square tests were performed to assess the association between mechanical complications and various clinical and demographic variables. The results are summarized in Table 4. None of the assessed variables (sex, AMI type, diabetes mellitus, smoking, hyperlipidemia, or family history of IHD) showed a statistically significant association with mechanical complications. The absence of a significant association between AMI type (STEMI vs. NSTEMI) and mechanical complications is notable, as STEMI is generally considered to carry a higher risk of mechanical complications due to the greater extent of transmural necrosis.

Table 4: Association Between Selected Variables and Mechanical Complications

Variable	With Complications (n=48)	Without Complications (n=92)	χ^2	p-value
Male gender	30 (62.5%)	56 (60.9%)	0.130	0.718
STEMI	26 (54.2%)	46 (50.0%)	0.241	0.623
Diabetes mellitus	24 (50.0%)	44 (47.8%)	0.062	0.803
Hypertension	32 (66.7%)	55 (59.8%)	0.622	0.430
Smoking	22 (45.8%)	36 (39.1%)	0.572	0.449
Hyperlipidemia	18 (37.5%)	34 (37.0%)	0.004	0.952
Family history of IHD	16 (33.3%)	28 (30.4%)	0.123	0.726

In-Hospital Outcomes

In-hospital outcomes were assessed for all 140 patients. Among patients without mechanical complications (n = 92), 74 (80.4%) survived to discharge, 12 (13.0%) died in the hospital, and six (6.5%) were referred to another facility. Among patients with mechanical complications (n = 48), 18 (37.5%) survived to discharge, 24 (50.0%) died in the hospital, and six (12.5%) were referred. The association between mechanical complications and in-hospital outcomes was strong and statistically significant (χ^2 = 25.746, $p < 0.001$).

Table 5: In-hospital Outcome by Mechanical Complication Status

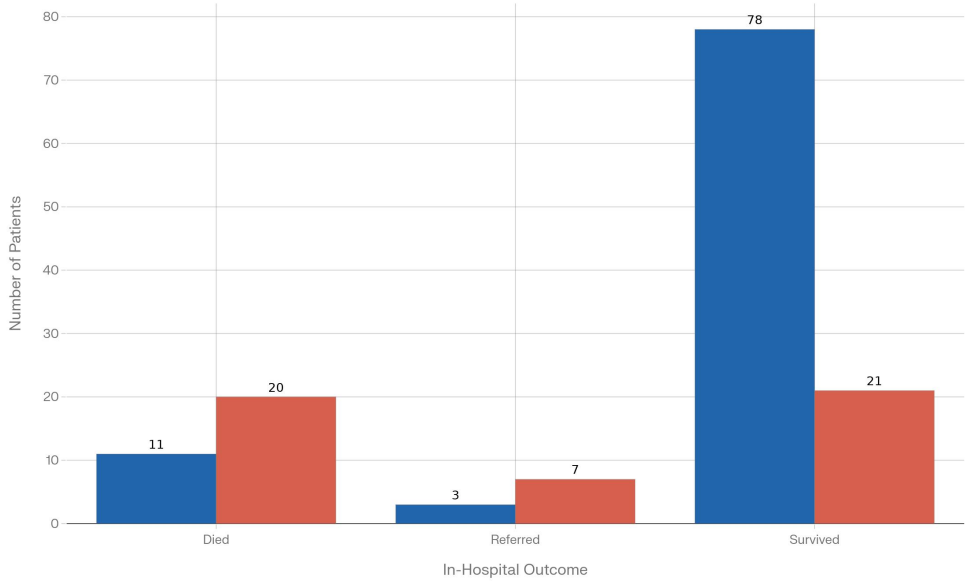

Figure 4: In-hospital outcomes by mechanical complication status. Patients with complications had significantly higher mortality (50.0% vs. 13.0%; χ^2 = 25.746, $p < 0.001$).

Outcome	With Complications (n=48)	Without Complications (n=92)	χ^2	p-value

Survived	18 (37.5%)	74 (80.4%)		
Died	24 (50.0%)	12 (13.0%)	25.746	<0.001
Referred	6 (12.5%)	6 (6.5%)		

Discussion of Key Findings

Incidence of Mechanical Complications

The overall incidence of mechanical complications in this study (34.3%) is markedly higher than that reported in contemporary international registries. In high-income countries with high primary PCI utilization, the incidence of mechanical complications is typically reported at 0.02-2.4%, with most contemporary estimates falling below 1% (Elbadawi et al., 2019; Damluji et al., 2021). The 10-100-fold discrepancy between the present findings and international benchmarks requires careful consideration and transparent discussion.

Several factors may have contributed to the higher incidence observed in this study. First, LRH is a major tertiary referral center that receives a disproportionate number of high-risk and late-presenting AMI patients from across Khyber Pakhtunkhwa and neighboring regions. Patients who are late after symptom onset is a common occurrence in resource-limited settings with geographic and financial barriers to healthcare access and are at a substantially higher risk of large transmural infarctions and mechanical complications. Second, the availability and utilization of primary PCI at LRH during the study period may have been limited, resulting in higher rates of incomplete reperfusion and larger infarct sizes compared with high-income country registries. Third, the use of systematic echocardiographic screening in this study may

have detected subclinical or minor mechanical abnormalities that would not be captured in studies relying on symptom-driven echocardiography.

Fourth, the operational definitions used in this study may be broader than those employed in international registries, potentially classifying minor wall motion abnormalities, moderate mitral regurgitation, or small pericardial effusions as mechanical complications when they would not meet the strict criteria used in other studies. Future studies should use explicitly defined, echocardiographically validated diagnostic criteria to ensure comparability with the international literature.

The study recognises that the reported 34.3 percent incidence cannot be directly compared to international reference levels without detailed information on the rate of reperfusion, time to onset and diagnostic criteria. These findings should be interpreted as preliminary data from a high risk tertiary care population and should not be extrapolated to the wider Pakistani AMI population. A prospective multicenter study with standardised protocols is needed to determine the actual frequency of mechanical complications in Pakistan.

Gender Differences

The finding of no statistically significant gender difference in the incidence of mechanical complications ($\chi^2 = 0.130$, $p = 0.718$) is in line with some international studies but is at odds with other studies which have reported a higher incidence of LVFWR and mechanical complications in women. The null finding in this study may be due to the relatively small size of the sample and the limited statistical power to detect small gender differences, especially considering that only 54 female patients were enrolled and only 18 of these patients' developed complications. In addition, the lack of multivariable adjustment for age, reperfusion status, location of infarcts and other

confounding factors limit interpretation of the gender analysis. Female patients were significantly older than male patients (mean age 59.2 versus 54.8 years; p=0.021), and age is a known risk factor for mechanical complications. Future studies with larger samples and multivariable design are needed to determine whether gender is an independent predictor of mechanical complications in patients with PAI.

Association with In-Hospital Mortality

A strong association between mechanical complications and mortality in the hospital (χ^2 = 25.746, p<0.001) is supported by the international literature. The 50.0 percent mortality rate in hospital for mechanical complications in this study is comparable to rates reported in existing international registries (40-70 percent), which confirms the catastrophic clinical relevance of these events irrespective of geographical location. This underscores the urgent need for early detection, rapid echocardiographic evaluation and rapid multidisciplinary treatment of mechanical complications in Pakistan's Lahore Reference Hospital and similar tertiary care facilities.

Limitations of the Study

This study has some important limitations which need to be taken into account when interpreting the findings.

1. Convenience sampling: The use of non-random sampling for convenience introduces a potential for selection bias. The study population may not be representative of all AMI patients admitted to LRH or of the wider Pakistani AMI population.

2. Single-centre design: The study was performed in a single tertiary care centre, which limits the applicability of the findings to other hospitals, regions or healthcare settings.

3. Cross-sectional design: Cross-sectional design excludes time analysis, causal inference and evaluation of long-term outcomes beyond index hospitalisation.

4. Missing reperfusion data: The lack of detailed data on reperfusion strategies (primary percutaneous coronary intervention [PCI], thrombolysis or no reperfusion), time from door to balloon and time from symptom to presentation is a critical limitation, as reperfusion status is a major determinant of the risk of mechanical complications in modern age.

5. No multivariate analysis: only univariate associations were investigated, not adjusting for possible confounders such as age, status of reperfusion, location of the infarct, and size of the infarct.

6. No diagnostic validation: the second cardiologist did not independently validate the echocardiographic diagnosis of mechanical complications and the reliability of the interventional relationship was not evaluated.

7. Small sample size for subgroup analysis: a total of 48 mechanically complicated patients limits the statistical power of the subgroup analysis, especially for gender comparison.

8. No long-term follow-up: only hospital-based outcomes were evaluated; no 30-day, 6-month or 1-year results were available.

9. Incidence gap: Reported incidence of 34.3 percent is significantly higher than international reference values and may reflect differences in case definition, sampling or reperfusion procedures rather than a real difference in complication rates.

Summary

This descriptive cross-sectional study assessed the sex-based incidence of mechanical complications after acute myocardial infarction (AMI) at Lady Reading Hospital (LRH), Peshawar, a major tertiary care center in Khyber Pakhtunkhwa, Pakistan. We enrolled

140 adult patients with AMI, comprising 86 men (61.4%) and 54 women (38.6%), with a mean age of 56.5 ± 11.2 years.

Mechanical complications were identified in 48 patients (34.3%), with papillary muscle rupture being the most frequent type (41.7% of complicated cases), followed by ventricular septal rupture (33.3%) and left ventricular free wall rupture (25.0%). Sex was not significantly associated with the occurrence of mechanical complications ($\chi^2 = 0.130$, $p = 0.718$). None of the other assessed variables namely, AMI type, diabetes, hypertension, smoking, hyperlipidemia, or family history of IHD showed a statistically significant association with mechanical complications. However, mechanical complications were strongly associated with in-hospital mortality ($\chi^2 = 25.746$, $p < 0.001$), with an in-hospital mortality rate of 50.0% among patients with complications compared to 13.0% among those without.

The reported incidence of 34.3% is markedly higher than that of contemporary international benchmarks (<1% in the reperfusion era), potentially reflecting the high-risk case mix at LRH, delayed hospital presentation, limited reperfusion access, and possible differences in diagnostic criteria. These findings should be interpreted as preliminary data from a single tertiary care center and require validation through prospective multicenter studies.

Conclusion

Mechanical complications after AMI, although less common in many contemporary settings with high reperfusion rates, remain critical emergencies associated with high in-hospital mortality. This study provides the first contemporary data on mechanical complications after AMI from a major Pakistani tertiary care center and contributes to filling an important gap in South Asian cardiovascular literature. The strong association

between mechanical complications and in-hospital mortality underscores the need for early recognition, rapid echocardiographic evaluation, and prompt multidisciplinary management.

No significant sex-based difference in the incidence of mechanical complications was observed in this study. However, this finding should be interpreted cautiously, given the small sample size, absence of multivariable adjustment, and the known confounding effect of age differences between male and female patients. All patients with AMI, regardless of sex, should be closely monitored for sudden hemodynamic deterioration, new murmurs, or acute pulmonary edema. Early echocardiographic assessment and timely referral for interventional or surgical management are essential to improve survival.

Recommendations

Based on the findings of the study, the following recommendations are made:

1. Clinicians should maintain a high index of suspicion of mechanical complications in all patients with AMI that is large or late-onset, irrespective of gender. Any sudden haemodynamic deterioration, new heart rhythm or unexplained clinical deterioration should prompt immediate evaluation by echocardiography.
2. Hospitals should ensure rapid access to echocardiography and establish multidisciplinary protocols for recognising and managing mechanical complications, including clear referral routes for cardiac surgery.
3. Public education campaigns should highlight the importance of early hospitalisation after the onset of chest pain or other ischaemic symptoms to reduce the delay in treatment and minimise the size of the infarct.

4. To improve the outcome of patients with mechanical complications, the institutional capacity for primary PCI, cardiac surgery and advanced haemodynamic support (IABP, ECMO) should be reinforced in tertiary care institutions in Pakistan.

5. Future multicentre prospective studies should be conducted with a larger sample size, standardised diagnostic protocols, comprehensive reperfusion data and long-term follow-up to confirm the findings of this study and to determine the true incidence of mechanical complications following AMI in Pakistan.

6. Standardised echocardiographic criteria for diagnosis of mechanical complications should be adopted in all cardiac centres in Pakistan to ensure comparability of data and facilitate multicentre research.

7. Gender-sensitive approaches to the treatment of AMI, including awareness of atypical symptomatology in women and efforts to reduce the delay in diagnosis, should be included in clinical guidelines and educational programmes for healthcare professionals.

References

1. Arai, R., Fukamachi, D., Ebuchi, Y., et al. (2021). Mechanical complications of myocardial infarction. International Heart Journal, 62(3), 475-482. https://doi.org/10.1536/IHJ.20-595

2. Crenshaw, B. S., Granger, C. B., Birnbaum, Y., et al. (2000). Risk factors, angiographic patterns, and outcomes in patients with ventricular septal defect complicating acute myocardial infarction. Circulation, 101(1), 27-32. https://doi.org/10.1161/01.CIR.101.1.27

3. Damluji, A. A., van Diepen, S., Katz, J. N., et al. (2021). Mechanical complications of acute myocardial infarction: A scientific statement from the American Heart Association. Circulation, 144(2), e16-e35. https://doi.org/10.1161/CIR.0000000000000985

4. Durko, A. P., Budde, R. P. J., Geleijnse, M. L., et al. (2018). Recognition, assessment and management of the mechanical complications of acute myocardial infarction. Heart, 104(14), 1216-1223. https://doi.org/10.1136/heartjnl-2017-311473

5. Elbadawi, A., Elgendy, I. Y., Mahmoud, K. D., et al. (2019). Temporal trends and outcomes of mechanical complications in patients with acute myocardial infarction. JACC: Cardiovascular Interventions, 12(18), 1825-1836. https://doi.org/10.1016/j.jcin.2019.04.039

6. French, J. K., Hellkamp, A. S., Armstrong, P. W., et al. (2010). Mechanical complications after percutaneous coronary intervention in ST-elevation myocardial infarction (from APEX-AMI). American Journal of Cardiology, 106(11), 1395-1401. https://doi.org/10.1016/j.amjcard.2010.07.006

7. Gong, F. F., Vaitenas, I., Malaisrie, S. C., et al. (2021). Mechanical complications of acute myocardial infarction: A review. JAMA Cardiology, 6(3), 341-349. https://doi.org/10.1001/jamacardio.2020.3690

8. Hao, Z., Ma, J., Dai, J., et al. (2020). A real-world analysis of cardiac rupture on incidence, risk factors and in-hospital outcomes in 4190 ST-elevation myocardial infarction patients from 2004 to 2015. Coronary Artery Disease, 31(5), 415-421. https://doi.org/10.1097/MCA.0000000000000877

9. Holmes, D. R., Jr., Bates, E. R., Kleiman, N. S., et al. (1995). Contemporary reperfusion therapy for cardiogenic shock: The GUSTO-I trial experience. Journal of the American College of Cardiology, 26(3), 668-674. https://doi.org/10.1016/0735-1097(95)00219-7

10. Mallma Gómez, M., & Muñoz Moreno, J. M. (2022). Complicaciones mecánicas posinfarto de miocardio en un hospital de referencia nacional. Archivos Peruanos de

Cardiología y Cirugía Cardiovascular, 3(1), 25-31. https://doi.org/10.47487/apcyccv.v3i1.200

11. Margineanu, C., Antohi, E. L., Bubenek, S., et al. (2022). Cardiac rupture after ST elevation myocardial infarction a decade's experience of a tertiary cardiology centre. European Heart Journal, 43(Suppl 2), ehac544.1446. https://doi.org/10.1093/eurheartj/ehac544.1446

12. Matteucci, M., Ronco, D., Massimi, G., et al. (2022). Surgical management for mechanical complications of acute myocardial infarction: A systematic review of long-term outcomes. Annals of Cardiothoracic Surgery, 11(3). https://doi.org/10.21037/acs-2021-ami-20

13. Matteucci, M., Ronco, D., Massimi, G., et al. (2022). Systematic review and meta-analysis of the mechanical complications of ischemic heart disease: Papillary muscle rupture, left ventricle rupture and post-infarct ventricular septal defect. Annals of Cardiothoracic Surgery, 11(3). https://doi.org/10.21037/acs-2022-ami-24

14. Pohjola-Sintonen, S., Muller, J. E., Stone, P. H., et al. (1989). Ventricular septal and free wall rupture complicating acute myocardial infarction: Experience in the Multicenter Investigation of Limitation of Infarct Size. American Heart Journal, 117(4), 809-820. https://doi.org/10.1016/0002-8703(89)90627-2

15. Radford, M. J., Johnson, R. A., Daggett, W. M., Jr., et al. (1981). Ventricular septal rupture: A review of clinical and physiologic features and an analysis of survival. Circulation, 64(3), 545-553. https://doi.org/10.1161/01.CIR.64.3.545

16. Schachner, T. (2019). Mechanische Komplikationen beim akuten Myokardinfarkt. Wiener Klinisches Magazin, 22(5), 204-211. https://doi.org/10.1007/s00740-019-0293-y

17. Thompson, C. R., Buller, C. E., Sleeper, L. A., et al. (2000). Cardiogenic shock due to acute severe mitral regurgitation complicating acute myocardial infarction: A report from the SHOCK Trial Registry. Journal of the American College of Cardiology, 36(3 Suppl A), 1104-1109.

18. Damluji, A. A., van Diepen, S., Katz, J. N., Menon, V., Tamis-Holland, J. E., Bakitas, M., Cohen, M. G., Balsam, L. B., Chikwe, J., et al. (2021). Mechanical complications of acute myocardial infarction: A scientific statement from the American Heart Association. Circulation, 144(2), e16-e35.

19. Gong, F. F., Vaitenas, I., Malaisrie, S. C., & Maganti, K. (2021). Mechanical complications of acute myocardial infarction: A review. JAMA Cardiology, 6(3), 341-349. https://doi.org/10.1001/jamacardio.2020.3690

20. Elbadawi, A., Elgendy, I. Y., Mahmoud, K., Ghattas, M. H., Saad, M., Mentias, A., & Jneid, H. (2019). Temporal trends and outcomes of mechanical complications in patients with acute myocardial infarction. JACC: Cardiovascular Interventions, 12(18), 1825-1836.

21. South Asian cardiovascular disease: Dispelling stereotypes and disparity. (2021). Current Atherosclerosis Reports.

22. Prevention of atherosclerotic cardiovascular disease in South Asians in the US: A clinical perspective from the National Lipid Association. (2021). Journal of Clinical Lipidology, 15(3), 402-422. https://doi.org/10.1016/j.jacl.2021.03.007

23. Burden and trends of cardiovascular disease and its attributable risk factor in Pakistan from 1990-2019: A benchmarking analysis. (2024). Circulation, abstract P266.

24. Confronting system barriers for ST-elevation MI in low- and middle-income countries with a focus on India. (2018). Indian Heart Journal, 70(1), 185-190.

25. Acute myocardial infarction treatment delay in South Asia. (2025). PubMed record.

26. Surgical and transcatheter treatments of mechanical complications of acute myocardial infarction. (2024). Heart, 110(7), 531-539.

27. Untangling mechanical complications of acute myocardial infarction. (2025). JACC: Case Reports.

28. Mechanical complications after acute myocardial infarction: A shock-stage and timing-based management framework. (2026). Journal of Clinical Medicine, 15(6), 2399.