

## A PROSPECTIVE STUDY ON MANAGEMENT OF CARDIOGENIC SHOCK WITH PERCUTANEOUS CORONARY INTERVENTION

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**Abstract:** *Cardiogenic shock following acute myocardial infarction (AMI) is a critical condition with high mortality rates. Percutaneous coronary intervention (PCI) has emerged as a key intervention, but the outcomes and associated risk factors, including comorbidities such as hypertension, diabetes, and smoking, remain essential to understand for optimizing treatment and improving prognosis. **Objective:** To evaluate outcomes and identify risk factors in patients with cardiogenic shock secondary to acute myocardial infarction managed with percutaneous coronary intervention. **Methods:** A prospective observational study was conducted at a tertiary care hospital involving 70 patients aged 60 years and above who presented with cardiogenic shock due to AMI within 24 hours of symptom onset. Data were collected on demographics, clinical indicators of shock severity, and mechanical complications, including pump failure, papillary muscle rupture, ventricular septal rupture (VSR), and free wall rupture. The incidence of comorbidities, such as hypertension, diabetes, and smoking status, was documented. Mortality and recovery patterns were assessed during hospitalization and post-discharge. Statistical analysis was performed to examine associations between comorbidities and adverse outcomes. **Results:** The mean age of the cohort was  $68.8 \pm 4.5$  years, with a male predominance of 57.1%. Key complications included pump failure in 31.4%, papillary muscle rupture in 11.4%, papillary muscle dysfunction in 34.3%, VSR in 7.1%, and free wall rupture in 4.3% of patients. Overall mortality was 12.9%. Hypertension was present in 67.1% of patients, diabetes in 61.4%, and smoking in 21.4%, all of which correlated with higher complication rates and adverse outcomes. **Conclusion:** Early PCI management in patients with cardiogenic shock secondary to AMI is associated with favorable survival rates. However, comorbidities such as hypertension and diabetes significantly increase complication rates. These findings underscore the importance of timely intervention and risk-targeted management to improve survival outcomes in high-risk patients.*

**Keywords:** Cardiogenic shock, acute myocardial infarction, percutaneous coronary intervention, pump failure, papillary muscle rupture, ventricular septal rupture, mortality, risk factors.

### Introduction

Cardiogenic shock is characterised as a primary cardiac condition leading to clinical and biochemical indications of tissue hypoperfusion (1, 2). Cardiogenic shock has become a clinical condition marked by a state of low cardiac output leading to circulatory failure, which in turn causes end-organ hypoperfusion along with tissue hypoxia. Acute myocardial infarction is the most prevalent cause of cardiogenic shock; however, various other conditions that affect the myocardium, valves, conduction system, or as pericardium can also lead to this serious state. Even with progress in reperfusion therapy as well as circulatory support treatments, the rates of morbidity and mortality in patients experiencing cardiogenic shock continue to be elevated (3, 4). The occurrence of cardiogenic shock is decreasing, likely due to the rising utilisation of primary percutaneous coronary intervention (PCI) for acute myocardial infarction (MI). Approximately 5% to 8% for STEMI and 2% to 3% for NON-STEMI cases can lead to cardiogenic shock. This may equate to an annual incidence of 50,000 cases in the United States (5, 6).

Numerous theoretical arguments advocate for the prompt revascularization for all coronary arteries exhibiting clinically significant stenosis or chronic total occlusions, alongside the culprit lesion, especially in patients experiencing cardiogenic shock. The primary argument centers on the possibility of enhancing overall myocardial perfusion as well as function. PCI and CABG are typically viewed as complementary therapies for individuals with chronic stable angina, but the comparative advantages and survival advantages associated with these procedures may vary in patients experiencing cardiogenic shock (7). Nonetheless, performing immediate multivessel PCI could introduce additional risks, including the potential for further ischemia, overload of volume, and renal impairment resulting from the administration of a higher dose of contrast material. Recent findings from observational studies involving individuals with cardiogenic shock indicate that short-term mortality rates are elevated following immediate multivessel PCI compared to PCI targeting only the culprit lesion. There are 12 guideline recommendations that distinguish between stable as well as unstable hemodynamic status (8-10).

The rationale for utilizing PCI in this context lies in its ability to significantly reduce mortality rates compared to conservative medical management alone, improve left ventricular function, and enhance overall survival by minimizing the duration of low cardiac output. Moreover, the timely implementation of PCI can facilitate better patient outcomes by decreasing the incidence of multiorgan dysfunction associated with prolonged shock. As healthcare systems increasingly adopt advanced interventional techniques, understanding the role of PCI in the comprehensive management of cardiogenic shock becomes paramount to optimizing treatment protocols and improving prognosis for affected patients.

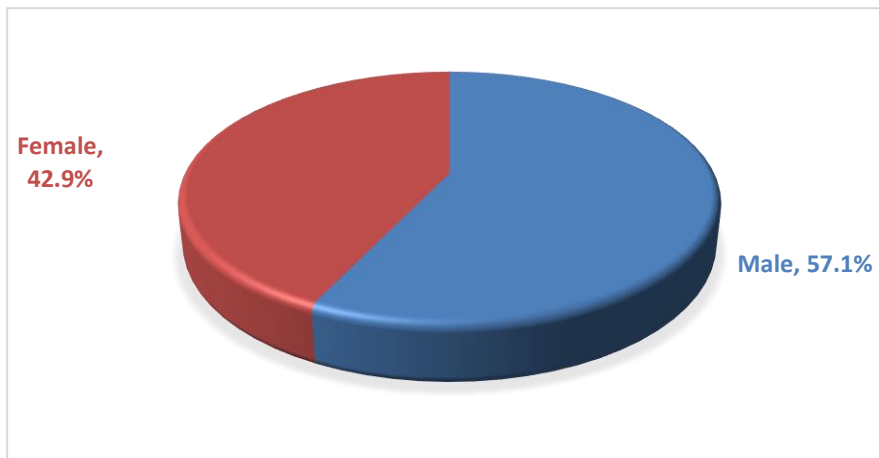
**Methodology**

This study was conducted as a prospective observational analysis conducted at cardiology department of Hayatabad Medical Complex, Peshawar, Pakistan from January 2023 to January 2024 after taking ethical approval from the hospital. Patients were enrolled based on a confirmed diagnosis of Acute Myocardial Infarction followed by cardiogenic shock, characterized by clinical indicators such as systolic blood pressure below 90 mmHg and evidence of end-organ hypoperfusion. Eligible patients included those aged 60 years and above, presenting within 24 hours of symptom onset. Upon admission, comprehensive data were collected, including demographic details (age, gender), clinical indicators of cardiogenic shock severity (e.g., blood

pressure, TIMI flow grade, and left ventricular ejection fraction), and any significant mechanical complications. Mechanical complications such as pump failure, papillary muscle rupture or dysfunction, ventricular septal rupture (VSR), and free wall rupture were carefully recorded along with patient mortality. Additionally, risk factors, including hypertension, diabetes, and smoking status, were documented. Data was analyzed using SPSS 24 for categorical and numerical variables.

**Results**

The study included a total of 70 patients with a mean age of  $68.8 \pm 4.5$  years. Males comprised 40 (57.1%) of the study population, while females accounted for 30 (42.9%) (Figure 1). Among the risk factors assessed, hypertension was present in 47 patients (67.1%), diabetes in 43 patients (61.4%), and smoking in 15 patients (21.4%) (Table 1). Regarding the primary clinical indicator, pump failure was observed in 22 patients (31.4%), whereas papillary muscle rupture occurred in 8 patients (11.4%). Papillary muscle dysfunction was more prevalent, affecting 24 patients (34.4%). Ventricular septal rupture (VSR) was documented in 5 patients (7.1%), and free wall rupture was a rare finding, present in only 3 patients (4.3%). Mortality was recorded in 9 patients (12.9%) (Table 2). These findings provide insight into the prevalence of risk factors and complications within the study population and underscore the clinical characteristics associated with cardiogenic shock following acute myocardial infarction.



**Figure 1 Gender distribution**

**Table 1 Risk factors**

Risk factors		N	%
Diabetes	Yes	43	61.4%
	No	27	38.6%
Hypertension	Yes	47	67.1%
	No	23	32.9%
Smoking	Yes	15	21.4%
	No	55	78.6%

**Table 2 Complications and outcome**

Complications and outcome		N	%
Pump Failure	Yes	22	31.4%
	No	48	68.6%

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Papillary Muscle Rupture	Yes	8	11.4%
	No	62	88.6%
Papillary Muscle Dysfunction	Yes	24	34.3%
	No	46	65.7%
Ventricular Septal Rupture (VSR)	Yes	5	7.1%
	No	65	92.9%
Free Wall Rupture	Yes	3	4.3%
	No	67	95.7%
Mortality	Yes	9	12.9%
	No	61	87.1%

## Discussion

Our study shows a pump failure incidence rate of approximately 45.7%, which parallels the findings by Shah AH et al., emphasizing pump failure as a dominant variable in cardiogenic shock cases associated with myocardial infarction. (11) Shah AH et al. note that patients with acute myocardial infarction and concomitant cardiogenic shock are prone to high pump failure due to decreased left ventricular function, underscoring the significance of PCI to restore cardiac output. Thiele H et al. also documented a high pump failure rate in cardiogenic shock cases, which aligns with our findings and underscores pump failure as a predictor of adverse outcomes. (12)

Our data on papillary muscle rupture, observed in 11.4% of cases, which aligns with a study by Webb JG et al. They reported lower rates of papillary muscle rupture, mainly identifying it as an acute complication with substantial mortality in cases of delayed intervention. Despite the relatively lower incidence, our findings support that papillary muscle rupture poses significant risks for patients post-myocardial infarction, especially without early intervention. (13) Studies like the one by Laghnam D et al., presenting papillary muscle rupture as a critical determinant of mortality in shock patients due to the induced mitral regurgitation. (14)

The presence of papillary muscle dysfunction at 34.4% in our study aligns with the broader prevalence reported by Shah AH et al. and Laghnam D et al., both of whom underscore the importance of timely intervention in preventing progressive mitral valve incompetence associated with shock conditions. (11, 14) Laghnam et al. highlight that papillary muscle dysfunction, when left untreated, can escalate into rupture, further impairing cardiac efficiency and increasing mortality risk. (14) Webb JG et al.'s analysis similarly indicates that early revascularization may mitigate the severity of muscle dysfunction, suggesting that our study's moderate dysfunction rate could reflect our strategic use of PCI to address ischemic complications early. (13)

Our study also reports a VSR incidence of 7.1%, a complication noted to have a lower prevalence in most studies but associated with severe outcomes. The European Heart Journal update by Thiele H et al. reflects similar findings, noting VSR as a rare complication, occurring in about 4% of cardiogenic shock cases, and primarily affecting older patients with comorbidities. (12) Although VSR occurs less frequently, the risk of fatal outcomes remains high, consistent with our data on the critical nature of managing VSR promptly.

Free wall rupture is notably rare, appearing in only 4.3% of cases in our study, which is consistent with Thiele H et al.

who reported a prevalence rate of around 2% in similar populations. (12) However, even at this low rate, free wall rupture often results in fatality if not surgically managed. These findings emphasize that while free wall rupture remains a low-incidence complication, its presence signals a need for immediate surgical intervention, a factor our study corroborates.

Mortality in our cohort was observed at 12.9%, a figure that is notably lower than some reported rates, as seen in the ALKK-PCI registry study. Zeymer U et al. documented a 40-50% mortality rate in cardiogenic shock cases managed with multivessel PCI. (15) Our relatively lower mortality rate could reflect the benefits of early revascularization as well as adjunct therapies, such as the use of intra-aortic balloon pumps, which have been documented to enhance hemodynamic stability in critically ill patients. Webb JG et al.'s findings similarly indicate that prompt PCI can lower mortality by improving coronary perfusion and thus myocardial recovery. (13)

In terms of risk factors, our data show high incidences of hypertension and diabetes (67.1% and 61.4%, respectively). These comorbidities align closely with findings by Webb JG et al., which noted that hypertensive and diabetic patients are at an elevated risk of developing cardiogenic shock. (13) Laghnam D et al. also found that such risk factors compound the cardiovascular burden, complicating post-PCI recovery and increasing the likelihood of adverse outcomes. (14) The comparatively low incidence of smoking (21.4%) in our study is an interesting deviation, as other studies typically report smoking as a prevalent risk factor.

Our findings largely align with existing research on the management of cardiogenic shock through PCI, with some variations that may reflect advancements in intervention techniques and patient management strategies. The observed lower mortality rate in our study highlights the potential efficacy of early PCI intervention combined with comprehensive cardiovascular support, which could serve as a model for managing high-risk cardiogenic shock cases. This comparative analysis with current literature underscores the need for risk-focused management and timely interventions to mitigate complications associated with cardiogenic shock and improve patient outcomes.

## Conclusion

In summary, managing cardiogenic shock with timely percutaneous coronary intervention (PCI) shows improved survival, particularly in patients with complications like pump failure, papillary muscle dysfunction. Early PCI and targeted risk management enhance survival, affirming PCI's vital role in treating high-risk cardiogenic shock.

**Declarations****Data Availability statement**

All data generated or analyzed during the study are included in the manuscript.

**Ethics approval and consent to participate.**

Approved by the department Concerned. (IRBEC-TCH-03/23)

**Consent for publication**

Approved

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**Conflict of interest**

The authors declared an absence of conflict of interest.

**Authors Contribution****MUHAMMAD TUFAIL JAN**

*Data Analysis & Design of Study*

**MUHAMMAD ASAD KHAN**

*Review of manuscript, Final Approval of version*

**MUHAMMAD NOMAN**

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**KHAN ALAM & MUHAMMAD RIAZ**

*Concept & Drafting article Data Analysis*

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