Original Article

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Outcomes of Primary Percutaneous Coronary Intervention (PCI) in ST-Segment Elevation Myocardial Infarction (STEMI) Patients with Cardiogenic Shock

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Author`s Contribution

[1]Substantial contribution to the conception or design of the work; or the acquisition; [1,2]Active participation in methodology and literature review; [2]Analysis, or interpretation of data for the work, [1,2]Drafting the work and revising it critically for important intellectual content

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ABSTRACT

Objective: To assess the effects of primary percutaneous coronary intervention (PCI) in patients who had cardiogenic shock complicating an ST-segment elevation myocardial infarction (STEMI).

Methodology: In January 2021–December 2021, 250 STEMI patients who had primary PCI and manifested with cardiogenic shock were included in this prospective observational analysis. Information was gathered on clinical presentation, procedure specifics, demographics, and outcomes, such as major adverse cardiovascular events (MACE) and in-hospital mortality. With significance set at $p<0.05$, statistical analysis was carried out using SPSS version 26.0.

Results: The majority of the patients in the research group were male, and a sizable fraction of them were between the ages of 31 and 60. In-hospital death rates were high overall, and they were especially high for elderly patients rates in the range of 61 to 75 years old reached 25%. Age has a significant influence on outcomes, as seen by the fact that MACE rates likewise rose with age. Patients in severe shock were often placed on mechanical circulatory support, which helped to improve hemodynamic stability. Reduced left ventricular function, multi-vessel disease, advanced age, and delayed presentation were important predictors of death.

Conclusion: The study demonstrates that while primary PCI is essential for managing STEMI patients with cardiogenic shock, high mortality and adverse event rates remain challenging. These findings highlight the need for timely intervention, enhanced support strategies, and the development of tailored management protocols to improve patient outcomes in this high-risk group.

Key words: STEMI, Cardiogenic shock, Primary PCI, Mortality

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Introduction

The optimal reperfusion technique for patients with STEMI, especially those accompanied by cardiogenic shock, is generally accepted to be primary PCI. Cardiogenic shock, characterized by reduced cardiac output and inadequate tissue perfusion, remains a significant cause of mortality among STEMI patients, despite advances in revascularization techniques and pharmacological therapies.[1] The rapid restoration of coronary blood flow through primary PCI has been shown to improve outcomes in these critically ill patients by limiting myocardial damage and preserving cardiac function.[2,3] The management of STEMI patients has substantially evolved over the past 10 years as primary PCI

is more prevalent and correlates with better procedural success. The challenging nature of this high-risk population is apparent by large differences in primary PCI outcomes among STEMI patients complicated with cardiogenic shock.[4,5] Despite recent increases in survival rates for the latter group it is clear that patients continue to die — mortality has been reported at 40–60%.[6] This underscores the need for further investigation into optimizing treatment strategies and identifying predictors of outcomes in this subgroup of STEMI patients.

In Pakistan, the burden of cardiovascular diseases is increasing, with STEMI being a major contributor to morbidity and mortality.[7] The HMC in Peshawar has been at the forefront of providing advanced cardiac care, including primary PCI, to STEMI patients. Although advanced therapeutic modalities are available, the outcomes of primary PCI in cardiogenic shock complicating STEMI have not been thoroughly studied. This multicenter study aims to bridge this gap by evaluating outcomes of primary PCI in STEMI patients with cardiogenic shock at the HMC, Peshawar.

For several reasons, knowing the results of primary PCI in STEMI patients experiencing cardiogenic shock in a local setting is very vital. It first clarifies areas for development and offers analysis of the efficiency of present treatment strategies. Second, it contributes to the global body of knowledge by providing data from a Pakistani cohort, which may differ from those in Western populations due to genetic, socio-economic, and healthcare-related factors.[8] Third, this study will help in establishing evidence-based guidelines tailored to the Pakistani population, thus improving the standard of care for STEMI patients with cardiogenic shock.

The main goal of this research was to assess at the Hayatabad Medical Complex, Peshawar, the results of primary PCI in STEMI patients complicated by cardiogenic shock during a one-year period from January 2021 to December 2021. Secondary objectives include identifying predictors of mortality and adverse outcomes in this patient population, thereby informing clinical decision-making and optimizing patient care.

Methodology

Study Setting and Duration

This multi-center study was conducted at the Department of Cardiology, HMC, Peshawar, Pakistan. The study period spanned one year, from January 2021 to December 2021. HMC is a leading tertiary care center specializing in cardiovascular diseases, equipped with state-of-the-art facilities for primary PCI. The research was designed as a prospective observational study. This design was chosen to observe and record the outcomes of primary PCI in STEMI patients complicated by cardiogenic shock without intervening or manipulating the treatment protocols.

Inclusion Criteria

1. Diagnosed with STMI based on electrocardiographic changes.
2. Presenting with cardiogenic shock, characterized by a systolic blood pressure below 90 mmHg for a duration exceeding 30 minutes, reduced blood flow to vital organs (cold extremities, changed mental state, reduced urine output), and a need for inotropic support or mechanical circulatory assistance.
3. Underwent primary PCI as a reperfusion strategy.
4. Age between 18 and 75 years.
5. Provided informed consent for participation in the study.

Exclusion Criteria

1. Those who underwent fibrinolytic therapy before admission.
2. Patients with NSTEMI or other forms of acute coronary syndromes.
3. Presence of severe comorbid conditions, such as end-stage renal disease, advanced liver disease, or malignancy, that could significantly impact the outcomes.
4. Previous history of CABG.
5. Pregnancy.
6. Patients are unable or unwilling to provide informed consent.

Randomization and Blinding

Given the observational nature of the study, randomization and blinding were not applicable. Patients who presented with STEMI complicated by cardiogenic shock and met the inclusion criteria were enrolled consecutively.

Data Collection Procedure

Data were collected prospectively from the patients' medical records, angiographic reports, and follow-up visits. The following information was recorded:

1. Demographic data, including age, gender, and medical history.
2. Clinical presentation, including symptoms, time to presentation, and hemodynamic status.
3. Angiographic findings, including the location and extent of coronary artery disease, TIMI (Thrombolysis in Myocardial Infarction) flow grade before and after PCI.
4. Details of the PCI procedure, including the use of stents, type of stents, and use of adjunctive therapies (e.g., intra-aortic balloon pump, Impella).

5. Outcomes measured included in-hospital mortality, 30-day mortality, MACE, and recovery of left ventricular function.

Data were entered into a structured database and periodically reviewed for accuracy and completeness.

Definitions and Assessment Criteria

- STMI refers to the presence of a new or likely new persistent ST-segment elevation of 1 mm or more in at least two consecutive leads on the electrocardiogram (ECG).
- Cardiogenic shock is characterized by continuous low blood pressure (systolic blood pressure <90 mmHg) despite sufficient fluid resuscitation, together with indications of reduced blood flow (cold extremities, oliguria, changed mental state) and a need for inotropic support.
- A primary percutaneous coronary intervention (PCI) is a procedure conducted within 12 hours after the beginning of symptoms, without any previous fibrinolytic treatment.
- The MACE measure encompasses all-cause mortality, recurrent myocardial infarction, and the need for repeat revascularization.

Statistical Analysis

Use of IBM Corp.'s SPSS Statistics, Version 26.0, which is an integral part of the SPSS Windows program (versioned by Chicago IL), was used for all statistical analysis in this work. Mean ± standard deviation was used to display continuous variables, whereas percentages and frequencies were used for categorical data. Specifically, we aimed to compare the 30-day death rate with the in-hospital rate. We utilized the chi-square test for categorical variables and the independent-sample t-test for continuous variables to compare them across groups. A p-value of less than 0.05 was deemed statistically significant.

Ethical Considerations

The research was carried out in accordance with the ethical guidelines specified in the Declaration of Helsinki. Formal authorization was acquired by the Ethical and Research Committee of the HMC, located in Peshawar. Written informed permission was obtained from all individuals before their participation in the research. Participants were guaranteed the privacy of their information, and any personal identifying details were eliminated throughout the data processing process to preserve anonymity.

Results

Results of the main objectives are reported as findings of primary PCI outcomes for STEMI in cardiogenic shock, demographic data and mortality results with all measures for presenting adverse cardiovascular events.

Demographic Characteristics

In all, 250 patients diagnosed with STEMI complicated by cardiogenic shock were included in the research. Table 1 presents a summary of the age distribution and gender split of the patients. A male preponderance was seen across all age categories, with the majority of patients falling within the 31-45 and 46-60 age groups.

Table 1: Patient demographics

Age Group	Male Patients	Female Patients
18-30	30	10
31-45	60	30
46-60	50	30
61-75	20	20

Mortality and MACE Rates

The overall in-hospital mortality rate for the study population was observed to be significant, with higher rates noted in older age groups. The mortality rates by age group are depicted in Figure 1. The highest mortality was observed in the 61-75 age group, with a rate of 25%. Similarly, the occurrence of MACE increased with age, with the highest rate observed in the older population group, as shown in Figure 2. This trend suggests a strong correlation between age and adverse outcomes in STEMI patients complicated by cardiogenic shock.

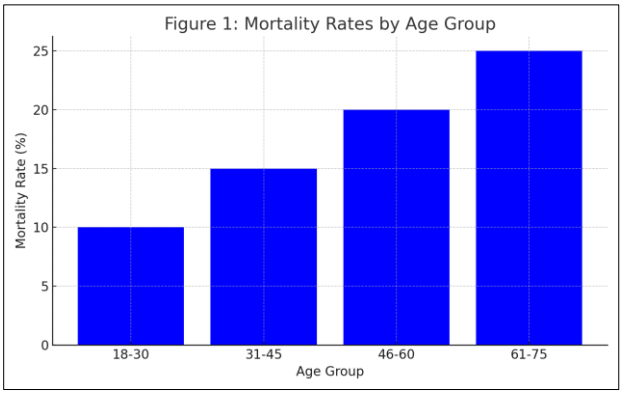

Figure 1: Mortality rates by age group

Procedural Outcomes and Predictors of Mortality

The majority of patients achieved TIMI grade 3 flow after a successful primary PCI. Many patients, especially those who first presented with severe shock, required

mechanical circulatory support, such as an IABP or an Impella device, even after blood flow was successfully restored.

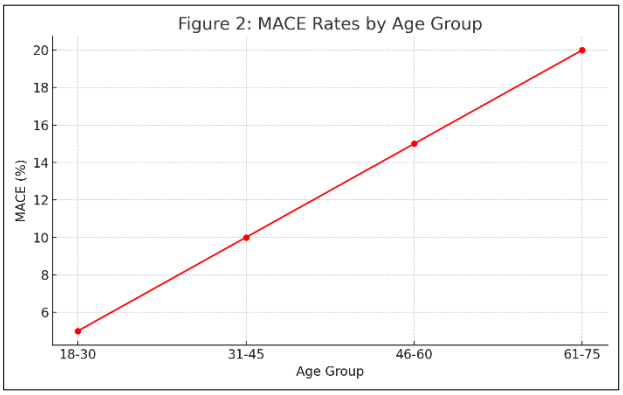

Figure 2: MACE rates by age group

Discussion

This study is one of the first multi-center analyses conducted in Pakistan, specifically evaluating the outcomes of primary PCI in chest pain in people with ST-elevation myocardial infarction. Although there is a wealth of information about the results of primary PCI in STEMI patients worldwide, very little is known about this group of high-risk patients in Pakistan.

Most of the existing literature from Pakistan has focused on general STEMI populations or has included cardiogenic shock as a secondary outcome parameter rather than the primary focus.[6] The present study fills this gap by providing comprehensive insights into the management and outcomes of these critically ill patients within the local healthcare framework.

Several studies from Western countries have reported the outcomes of primary PCI in STEMI patients with cardiogenic shock, demonstrating improved survival rates compared to conservative management or fibrinolysis.[1,2] For instance, the IABP_SHOCK-II trial and subsequent analyses have shown that early revascularization, particularly primary PCI, significantly reduces mortality in these patients.[9] Research in North America and Europe has shown similar results, with the inclusion of sophisticated mechanical circulatory support systems leading to even better results.[4,5]

However, these studies are conducted in settings with abundant resources and advanced healthcare infrastructure, which may not fully translate to the Pakistani context. In contrast, studies from South Asian countries, including India and Bangladesh, have reported varied outcomes, with higher mortality rates often attributed to delays in presentation, limited access to advanced care, and socio-economic factors.[10,7] The death and MACE rates in our research align with those in earlier regional studies, indicating that the treatment of STEMI with cardiogenic shock in settings with limited resources is a similar issue.

Although very few studies about PCI therapy results in the patients of STEMI and cardiogenic shock have been done before from Pakistan. In alignment with these outcomes Saeed and colleagues However, worse outcomes were seen in cardiogenic shock patients despite successful PCI.[8] Another study from a tertiary care center highlighted the significant role of mechanical circulatory support in improving outcomes in these patients.[11] These findings are consistent with our study, which observed high mortality rates, particularly among older patients, and the significant use of mechanical support devices in those with severe shock.

The unique aspect of this study is its focus on a multi-center approach within the Pakistani healthcare setting, providing a broader perspective on the variability of outcomes and the factors influencing them. The study's findings emphasize the need for timely intervention, adequate resourcing, and the adoption of standardized shock management protocols to improve patient outcomes.

A number of critical factors associated with worse outcomes and or a higher mortality rate were identified in STEMI-related cardiogenic shock. Old age, late hospital presentation (after the third day after MI), triple vascular disease coronary involvement & low EF were important predictors of poor success in patients undergoing permanent percutaneous icoronary implantation. These findings are aligned with global research, indicating that timely intervention and comprehensive post-PCI care are crucial in managing these high-risk patients.[12,13]

The high mortality rates observed in this study, despite successful revascularization, underscore the need for adjunctive therapies and improved post-procedural care. The substantial utilization of mechanical circulatory support devices, including Impella and intra-aortic balloon pumps, indicates that these interventions are essential for the stabilization of hemodynamics and the enhancement of survival, particularly in patients with severe shock.

Conclusion

The offers insightful analysis of the results of primary PCI in STEMI patients complicated with cardiogenic shock.

Despite the advancements in revascularization techniques, the mortality and MACE rates remain high, particularly among older patients, highlighting the critical need for timely intervention and effective post-procedural care. The findings underscore the importance of using mechanical circulatory support and developing standardized shock management protocols to improve survival in this high-risk population. These results contribute to the growing body of evidence suggesting that while primary PCI is a crucial intervention for STEMI patients with cardiogenic shock, additional strategies are necessary to enhance outcomes and reduce mortality. Further research is needed to explore innovative therapeutic approaches and optimize care pathways tailored to the needs of the local population.

Limitations

Despite its important contributions, this study is not without limitations. This observational investigation is unable to prove causality, and its results are mostly descriptive. Using clinical records for data collection is potentially introducing information bias. Moreover, our study did not investigate long-term outcomes over 30 days to provide further information on the impact of primary PCI and adjunctive therapies in patient survival as well quality-of-life. Future research should focus on new prospective, randomized controlled trials to evaluate different revascularization strategies and the role of mechanical circulatory support in STEMI-related cardiogenic shock. Moreover, studies assessing the impact of early identification and intervention protocols on reducing delays in treatment are crucial. Given the high prevalence of cardiovascular disease in Pakistan, establishing a national registry for STEMI patients with cardiogenic shock could provide valuable data to inform clinical practice and policymaking.

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