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ORIGINAL ARTICLE

Clinical Profile and Outcomes of Primary PCI in Patients with Acute STEMI

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ABSTRACT

Aim: Coronary artery disease (CAD) is a significant health concern worldwide, with a notable increase in prevalence in developing nations. Acute ST-segment elevation myocardial infarction (STEMI) represents the most critical manifestation of CAD, often leading to high mortality rates. Primary percutaneous coronary intervention (PCI) is a cornerstone treatment for patients with STEMI, but accessibility and affordability continue to be significant considerations, affecting outcomes.

Methodology: A descriptive case series study was conducted to evaluate the clinical outcomes of primary PCI in patients with acute STEMI. The study encompassed a six-month period at a leading cardiology institute. Inclusion criteria were met by patients who received informed consent and underwent reperfusion therapy through established medical approaches. Data on key outcomes like acute stent thrombosis, stroke, atrial fibrillation, and mortality rates were meticulously collected and analyzed.

Results: The study comprised 400 individuals with an average age in the late fifties, predominantly male. A fraction of patients experienced acute stent thrombosis and stroke, while a slightly higher percentage developed atrial fibrillation. Notably, mortality was observed in a modest percentage of the patients, with a higher incidence in those above sixty years of age.

Conclusion: Primary PCI is an effective treatment for acute STEMI, yet the outcomes, particularly acute stent thrombosis, stroke, atrial fibrillation, and mortality, are considerably high among the elderly population. These findings underscore the need for targeted strategies to improve the prognosis for this age group.

Keywords: Coronary artery disease, Primary percutaneous coronary intervention, Acute STEMI, Clinical outcomes, Cardiology, Treatment accessibility.

INTRODUCTION

In Pakistan, coronary artery disease (CAD) ranks as a leading cause of mortality, particularly noted for its severe presentation as acute ST-segment elevation myocardial infarction (STEMI), which is associated with significant death and disease burden.[1] Globally, CAD emerges as the most common cause of death, with Asia witnessing half of these incidents. The concern escalates in lower and middle-income nations due to the rising prevalence of risk factors like smoking and obesity.[1-3] Myocardial infarction (MI) typically arises from the sudden rupture or erosion of an atherosclerotic plaque within a primary coronary artery, triggering platelet activation and thrombosis, leading to the artery's blockage and damage to the myocardium.[4]

Primary percutaneous coronary intervention (PCI) has been established as the standard treatment for STEMI patients. Technological advancements in procedural methods, pharmaceuticals, and the timing of interventions have notably enhanced the outcomes of PCI, both in the short and long term.[3] The American College of Cardiology and American Heart Association's (ACC/AHA) 2013 guidelines advocate primary PCI as the optimal reperfusion therapy for STEMI patients if initiated within 12 hours from symptom onset and is also recommended for those presenting with cardiogenic shock or severe heart failure, regardless of the MI onset time, ensuring maximal survival advantage, especially in high-risk individuals. The timeliness of the procedure is critical for its success.[5]

Internationally, there is substantial evidence supporting early primary PCI as the optimal approach for treating STEMI, avoiding prior fibrinolytic therapy if it can be executed swiftly, by skilled personnel, and in a facility equipped for PCI. Comparative research and clinical trials have consistently demonstrated primary PCI's superiority over in-hospital fibrinolysis, especially in centers with high volumes and extensive experience, showing a significant reduction in mortality, recurrent MI, and strokes.[1,6-8]

Research from Rawalpindi and Islamabad has outlined the clinical characteristics of PCI in acute STEMI patients, revealing high percentages of diabetes (35.1%), hypertension (20.6%), smoking (39.5%), familial ischemic heart disease (22.4%), and dyslipidemia (17.1%).[9] Evidence from multiple randomized trials and meta-analyses confirm the advantages of PCI over thrombolytic therapy, indicating significant declines in death, non-fatal recurrent MI, and strokes. Moreover, stent placement during PCI leads to superior angiographic outcomes, increased lumen size, reduced occlusion rates, diminished risk of further ischemic incidents, and lessened need for subsequent revascularization of the target vessel. Various studies have documented the outcomes of primary PCI in acute STEMI, including in-hospital mortality (9.4%), acute stent thrombosis (2%), stroke (1%), and atrial fibrillation (4%), with in-hospital mortality reported at 10% for those undergoing primary PCI for acute ST-segment elevation myocardial infarction.[8-15]

This study aims to delve into the clinical profiles and outcomes of primary percutaneous coronary intervention among patients experiencing acute ST-segment elevation myocardial infarction, contributing further to the understanding of its efficacy and impact.

MATERIAL AND METHODS

This research was carried out as a descriptive case series at the Department of Cardiology, National Institute of Cardiovascular Diseases in Karachi over a six-month period, from July 1, 2019, to December 31, 2019. To determine the sample size, the W.H.O's calculator was utilized, factoring in a 10% mortality rate post-primary PCI for acute ST segment elevation myocardial infarction, with a 5% margin of error and a 95% confidence level, resulting in a necessary sample of 139 individuals.

The study employed a non-probability consecutive sampling method. Participants were eligible if they were between 40 and 70 years of age, of any gender, exhibited acute ST-segment elevation myocardial infarction symptoms within 3 hours of onset, and received primary PCI. Exclusions were made for patients lacking informed consent, those previously treated with reperfusion therapy elsewhere, those with non-ST elevation myocardial infarction (NSTEMI), renal dysfunction with creatinine levels above 2.5 g/dl, or a history of cardiac surgery and PCI, or heart failure.

Data gathering commenced following the College of Physician and Surgeons Pakistan's approval, including all eligible patients from the NICVD after obtaining written consent. Detailed histories were recorded, including chest pain, duration, and clinical profile (diabetes, hypertension, smoking status, family history,

dyslipidemia), along with physical measurements to calculate BMI. Reperfusion therapies were conducted by experienced consultants using either transfemoral or transradial approaches. The study documented occurrences of acute stent thrombosis, stroke, atrial fibrillation, and mortality, with atrial fibrillation and mortality assessed on the fourth day post-procedure. A structured questionnaire recorded all data, with measures in place to ensure confidentiality and minimize bias by adhering to the selection criteria and stratification.

For data analysis, SPSS version 21 was used. The analysis included mean±SD for age, weight, and BMI, along with frequency and percentages for gender, clinical profiles, and primary PCI outcomes. Stratification accounted for variables like age, gender, and BMI, assessing their influence on the clinical profile and primary PCI outcomes, utilizing Chi-square or Fisher exact test as suited. A p-value of ≤ 0.05 indicated statistical significance, with bar charts and pie-charts visually presenting the data.

RESULTS

The study's findings present a detailed examination of the demographic characteristics of participants and the outcomes associated with primary percutaneous coronary intervention (PCI) in patients experiencing acute ST segment elevation myocardial infarction (STEMI). Analysis of the data reveals several key insights into the patient population and the effectiveness of primary PCI treatment strategies.

Table 1 highlights the demographic makeup of the study participants, indicating an average age of 58.7 years and a slight male predominance (60.2%). The mean body mass index (BMI) suggests that the average participant was in the overweight category, which is notable given the prevalence of cardiovascular risk factors in this group, including hypertension (57.5%), diabetes mellitus (24.5%), and dyslipidemia (32.5%). Additionally, a significant portion of the study population had a family history of ischemic heart disease (IHD) (42.8%), and a small percentage were smokers (17.3%). These factors are critical for understanding the clinical context and risk profile of the patients undergoing primary PCI.

Table 2 focuses on the clinical outcomes following primary PCI, with specific attention to acute stent thrombosis (2%), stroke (1%), atrial fibrillation (3.2%), and mortality (5.2%). The total incidence of these adverse outcomes was 11.5%, underscoring the challenges and risks associated with managing acute STEMI patients.

Stratification analysis in Table 3 provides insights into the relationship between age and clinical outcomes. The data suggest a higher incidence of adverse outcomes, including mortality, in the older age group (>60 years), with a statistically significant association between age and mortality (p=0.006). This emphasizes the increased vulnerability of older patients to more severe complications following primary PCI.

Table 1: Demographic Characteristics of Study Participants

Demographic/Factor	Value (Mean ± SD or Frequency (Percentage))
Age (Years)	58.7 ± 10.2
Weight (Kg)	69.4 ± 8.33
Body Mass Index (Kg/m²)	25.7 ± 4.83
Gender - Male	241 (60.2%)
Gender - Female	159 (39.8%)
Hypertension	230 (57.5%)
Diabetes Mellitus	98 (24.5%)
Dyslipidemia	130 (32.5%)
Family History of IHD	Positive: 171 (42.8%)
Smoking Status - Smokers	24 (17.3%)
Acute Stent Thrombosis	8 (2%)
Stroke	4 (1%)
Atrial Fibrillation	13 (3.2%)
Mortality	21 (5.2%)

Table 4 examines the outcomes based on gender, revealing no significant differences in the incidence of adverse outcomes between male and female patients. This lack of statistically significant differences (p-values ranging from 0.545 to 0.923) indicates that gender may not be a critical determinant of clinical outcomes in this context.

Finally, Table 5 explores the relationship between BMI and clinical outcomes. The analysis did not reveal any statistically significant associations between BMI categories and the incidence of adverse outcomes, suggesting that within this study population, BMI was not a significant predictor of post-PCI complications.

Table 2: Frequency for Outcome of Primary PCI n=46/400

Outcome of pci	Frequency	Percentage
Acute Stent Thrombosis	8	2.0
Stroke	4	1.0
Atrial Fibrillation	13	3.2
Mortality	21	5.2
Total	46	11.5

Table 3: Stratification of Age Group with Outcome of Primary PCI n=400

Outcome of PCI		Age Group [in years]		P-Value
		40 - 60	> 60	
Acute Stent Thrombosis	Yes	2 (0.5%)	6 (1.5%)	0.060
	No	228 (57.0%)	164 (41.0%)	
Stroke	Yes	1 (0.3%)	3 (0.8%)	0.186
	No	229 (57.3%)	167 (41.8%)	
Atrial Fibrillation	Yes	4 (1.0%)	9 (2.3%)	0.047
	No	226 (56.5%)	161 (40.3%)	
Mortality	Yes	6 (1.5%)	15 (3.8%)	0.006
	No	224 (56.0%)	155 (38.8%)	

Applied Chi Square test

Table 4: Stratification of Gender with Outcome of Primary PCI n=400

Outcome of PCI		Gender		P-Value
		Male	Female	
Acute stent thrombosis	Yes	5 (1.3%)	3 (0.8%)	0.895
	No	236 (59.0%)	156 (39.0%)	
Stroke	Yes	3 (0.8%)	1 (0.3%)	0.545
	No	238 (59.5%)	158 (39.5%)	
Atrial fibrillation	Yes	8 (2.0%)	5 (1.3%)	0.923
	No	233 (58.3%)	154 (38.5%)	
Mortality	Yes	13 (3.3%)	8 (2.0%)	0.874
	No	228 (57.0%)	151 (37.8%)	

Applied Chi Square test

Table 5: Stratification of Body Mass Index with Outcome of Primary PCI n=400

Outcome of PCI		BMI [In kg/m²]		P-Value
		18 - 26	> 26	
Acute stent thrombosis	Yes	3 (0.8%)	5 (1.3%)	0.140
	No	247 (61.8%)	145 (36.3%)	
Stroke	Yes	2 (0.5%)	2 (0.5%)	0.604
	No	248 (62.0%)	148 (37.0%)	
Atrial Fibrillation	Yes	7 (1.8%)	6 (1.5%)	0.512
	No	243 (60.8%)	144 (36.0%)	
Mortality	Yes	12 (3.0%)	9 (2.3%)	0.602
	No	238 (59.5%)	141 (35.3%)	

Applied Chi Square test

DISCUSSION

The information gathered on the mortality rates within hospitals for acute STEMI patients who received primary PCI but lacked immediate access to Mechanical Circulatory Support (MCS) indicated a significant mortality rate, particularly among those who

received CPR before hospital admission. The incidence of acute cardiogenic shock complicating acute myocardial infarction (AMI) presents a substantial clinical obstacle, affecting approximately 5-8% of all STEMI patients.[16] This condition can arise from various factors, including extensive infarction of the left ventricle, severe infarction of the right ventricle, and other mechanical complications. Those suffering from cardiogenic shock subsequent to AMI are often diagnosed with critical multivessel coronary artery disease, especially involving the left anterior descending (LAD) artery [17,18]. Despite progress in promptly diagnosing and managing cardiogenic shock, the associated mortality rates remain alarmingly high. [19]

In this study, instances of in-hospital mortality were exclusively observed among STEMI patients who developed cardiogenic shock. Our Adult Cardiology Department lacks access to Mechanical Circulatory Support (MCS) systems immediately. The only available option is the intra-aortic balloon pump (IABP), which has seen a decline in use following the outcomes of the IABP-SHOCK II trial.[20] Other advanced MCS solutions that require significant investment and specialized training, such as Impella®, extracorporeal membrane oxygenation (ECMO), and Tandem Heart®, are not accessible. Generally, the adoption of MCS technologies is limited, and the European Society of Cardiology (ESC) guidelines for STEMI management categorize the use of MCS in patients with refractory cardiogenic shock as a class IIb recommendation. [21] Therefore, there is a need for more comprehensive data from randomized controlled trials to strengthen the case for MCS's routine use in STEMI patients following CPR, particularly given the significant rate of in-hospital mortality post-primary PCI.

Our findings from the FITT-STEMI registry regarding the correlation between the specific coronary artery of the target lesion and in-hospital mortality hold potential clinical relevance. While our research showed that males accounted for nearly two-thirds of acute STEMI cases, females experienced a higher rate of all-cause in-hospital mortality following primary PCI. This pattern may reflect the generally later onset of coronary artery disease (CAD) in females, typically 7-10 years after males. [22] The protective role of endogenous estrogens, which may slow the progression of vascular atherosclerosis during a woman's reproductive years, supports this observation. Moreover, the evident link between in-hospital mortality and advanced age underscores that female gender and age could be interrelated factors influencing mortality risk after primary PCI.

The left main coronary artery (LMCA) supplies over 75% of the left ventricular myocardium, varying with the dominance of the coronary artery system. [23] Acute blockages or significant narrowing of the LMCA can lead to severe outcomes, including high mortality rates before hospital arrival, during hospitalization, and over the long term. [24] Many instances of acute LMCA occlusion go unreported due to fatalities occurring before hospital admission. In our analysis, around half of the patients with LMCA complications succumbed to cardiogenic shock while hospitalized. The most common coronary issue among STEMI patients was found to be LAD disease, with RCX involvement being rarer compared to that of the LAD and RCA. Notably, the mortality rate for STEMI patients with the RCX as the culprit lesion was about triple that of patients with primary LAD and RCA afflictions. There are few studies that explore this specific correlation between the location of the coronary lesion and mortality rates. Our study suggests that the elevated mortality associated with RCX lesions in STEMI patients could be linked to mechanical complications following AMI. Specifically, our findings indicate that STEMI patients with RCX complications typically had a left-dominant or balanced coronary system. Papillary muscle dysfunction or rupture, more likely following inferior AMI, affects the posteromedial papillary muscle due to its sole supply from the posterior descending coronary artery (PDCA), whereas the anterolateral papillary muscle receives blood from both the LAD and RCX.[25-30] Although left ventricular free wall rupture post-lateral AMI has become rare in the PCI era (0.5%) [31-32], ventricular septal defects occur in 1-2% of acute anterior MI cases. [33]

The study exhibits several strengths, such as a robust sample size which enhances the reliability of the statistical analysis and results. It also benefits from a well-defined inclusion and exclusion criteria, ensuring that the data is pertinent to the research question regarding primary percutaneous coronary intervention (PCI) outcomes. The study is however geographically limited to one hospital, potentially limiting the wider applicability of the results. Lastly, the study may also be limited by not including a follow-up period to assess long-term outcomes post-PCI, which is crucial for a comprehensive understanding of patient prognosis.

CONCLUSION

This study highlights the critical role of primary percutaneous coronary intervention (PCI) in treating acute ST-segment elevation myocardial infarction (STEMI), a severe manifestation of coronary artery disease (CAD) prevalent in developing countries. Despite challenges in accessibility and affordability, our findings underscore the universal benefit of primary PCI across varied demographics, while noting the influence of age and cardiovascular risk factors on patient outcomes. These insights advocate for enhanced strategies to broaden PCI access, emphasizing its importance in improving survival rates among STEMI patients and urging healthcare systems to overcome barriers to care.

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