Original Article

Outcome of Primary Percutaneous Coronary Intervention for STEMI due to Stent Thrombosis

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ABSTRACT

Background: Stent thrombosis (ST) is a critical complication following percutaneous coronary intervention (PCI), contributing significantly to morbidity and mortality in patients with ST-elevation myocardial infarction (STEMI). Advances in drug-eluting stent technology and antiplatelet therapy have mitigated, but not eliminated, the risk of ST. The management of STEMI due to ST in resource-limited settings remains a challenging endeavor, necessitating a comprehensive evaluation of treatment outcomes.

Objective: To assess the mortality rates and clinical outcomes following primary PCI in patients with STEMI attributed to stent thrombosis in a resource-constrained setting, and to analyze the association of mortality with patient age and TIMI flow grade post-PCI.

Methods: This quasi-experimental study was conducted at Lady Reading Hospital, Peshawar, from July to December 2023. A total of 150 patients presenting with STEMI due to ST and undergoing PCI were included. Diagnostic measures included electrocardiography, troponin levels, echocardiography, and angiography to assess left ventricular function and stent thrombosis. The procedures were performed by experienced interventional cardiologists, followed by standard post-procedure management. Data analysis was performed using SPSS version 25, focusing on mortality rates, the association of mortality with patient age, and TIMI flow grades.

Results: Among the 150 patients studied, mortality was observed in 36 cases (24%). The mean age of patients who died was 48.33 years (SD = 14.267), compared to 42.47 years (SD = 12.618) for survivors, with a significant association between age and mortality (P = 0.02). Analysis of TIMI flow grade post-PCI revealed a strong correlation with mortality; patients with TIMI flow grades I and II exhibited higher mortality rates, with a highly significant P value of 0.0001.

Conclusion: The study highlights a significant mortality rate among patients with STEMI due to stent thrombosis undergoing primary PCI in a resource-limited setting. Advanced age and lower TIMI flow grades post-PCI were significantly associated with increased mortality. These findings underscore the necessity for vigilant post-PCI monitoring and tailored management strategies to improve clinical outcomes in this high-risk population.

Keywords: STEMI, Stent Thrombosis, Percutaneous Coronary Intervention, Mortality, TIMI Flow Grade, Resource-Limited Settings.

INTRODUCTION

Stent thrombosis (ST) represents a significant complication associated with percutaneous coronary intervention (PCI), manifesting as a complete or nearly complete occlusion of the stent lumen by a thrombus (1, 2). This adverse event can occur at any point following stent deployment, ranging from the immediate peri-procedural period to several years post-implantation. The rising prevalence of PCI as a therapeutic strategy has shifted the focus from procedural success towards the prevention of in-stent thrombosis (3, 4). The advent of drug-eluting stents (DES) was initially heralded as a breakthrough in reducing the rate of restenosis observed with bare metal stents (BMS). Nonetheless, enthusiasm waned as DES were subsequently associated with incidents of late stent thrombosis (LST) and very late stent thrombosis (VLST), casting shadows on their long-term safety profile (5, 6).

Despite advancements in antiplatelet therapy aimed at mitigating thrombotic risks, such events remain the leading cause of mortality in the aftermath of PCI. Early stent thrombosis, occurring within the first 30 days post-PCI, presents at an incidence rate of approximately 1%. Beyond this acute phase, the annual risk of ST hovers between 0.2% and 0.6%. Notably, first-generation DES

exhibit an annual LST occurrence rate of 0.4% to 0.6% over up to four years, underscoring a persistent risk. The incidence of LST and VLST in patients with BMS, on the other hand, remains inadequately characterized (6-8).

The rate of definite or probable stent thrombosis also varies with the type of stent used, with acute ST associated with mortality rates of 20% to 45% and myocardial infarction (MI) rates of 50% to 70%. Additionally, approximately 20% of patients experiencing ST are at risk of recurrence within two years (9, 10). The significance of this study lies in evaluating the outcomes of PCI for ST-elevation myocardial infarction (STEMI) resulting from stent thrombosis, particularly in resource-constrained settings like Pakistan. Despite these limitations, a variety of PCI procedures, including primary PCI, complex PCI, and interventions in high-risk groups, are routinely performed, highlighting the need for a comprehensive assessment of their efficacy and outcomes in managing such critical complications (10-12).

MATERIAL AND METHODS

This quasi-experimental study was conducted at Lady Reading Hospital, Peshawar, over a six-month period from July to December 2023, following the receipt of ethical approval from the institutional review board, in compliance with the Declaration of Helsinki principles for ethical research (13). The study cohort comprised 150 patients who were diagnosed with ST-elevation myocardial infarction (STEMI) attributable to stent thrombosis (ST) and subsequently underwent percutaneous coronary intervention (PCI). Upon presentation in the emergency department, patients underwent electrocardiography (ECG) and had their troponin levels assessed to confirm the diagnosis of STEMI. Following confirmation, patients were managed in accordance with the hospital's established protocol for STEMI treatment (14, 15).

Demographic and clinical data were meticulously collected for each participant. Diagnostic evaluations, including echocardiography and angiography, were performed prior to PCI to assess left ventricular ejection fraction and the presence and extent of ST. PCIs were performed by interventional cardiologists with a minimum of five years of post-fellowship experience. The decision regarding stent placement was left to the discretion of the operating cardiologist. Post-procedural care adhered to standard care guidelines, encompassing the administration of unfractionated heparin, dual antiplatelet therapy (DAPT) with Aspirin (100 mg) and Ticagrelor (90 mg twice daily), and, where indicated, glycoprotein IIb/IIIa inhibitors. Additionally, Clopidogrel was prescribed as part of the antiplatelet regimen (16).

Patient outcomes, specifically mortality, were closely monitored during the post-PCI observation period. The data collected from the study were analyzed using SPSS version 25. The statistical analysis aimed to elucidate the outcomes of PCI in patients experiencing STEMI due to stent thrombosis, with a particular focus on mortality rates. The comprehensive data collection and methodical approach to patient management and follow-up ensured the reliability and validity of the study findings, contributing valuable insights into the effectiveness of PCI in a resource-limited setting.

RESULTS

The results regarding gender distribution shown by pie chart illustrating the gender distribution among participants in the study, with females comprising 70% and males making up 30% of the study population. The chart highlights a predominant female representation in the sample, with a significantly higher proportion compared to males, visually represented by the larger segment for females and emphasized by the chart's color coding and data labels.
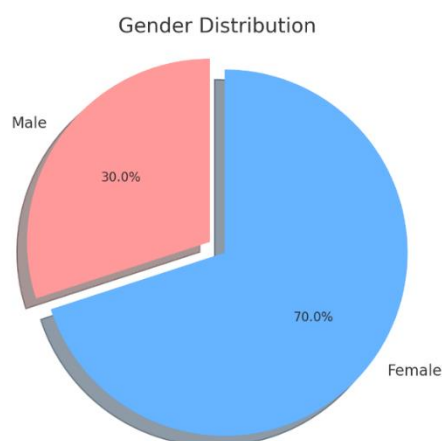

Figure 1 Gender Distribution

Table 1: Association of Mortality with Patient's Age

Status	N	Mean Age (Years)	Standard Deviation	P value
Yes	36	48.33	14.267	0.02
No	114	42.47	12.618	

This table presents the association of mortality with the age of patients. Patients who died (mortality "Yes") had an average age of 48.33 years with a standard deviation of 14.267, whereas survivors (mortality "No") had an average age of 42.47 years with a standard deviation of 12.618. The difference in age distribution between the two groups is statistically significant (P = 0.02).

Table 2: Association of Mortality with TIMI Flow Grade Post PCI

TIMI Flow Grade Post PCI	Mortality (Yes)	%	Mortality (No)	%	Total	P value
0	3	8.3%	4	3.5%	7	0.0001
I	15	41.7%	8	7.0%	23	
II	17	47.2%	52	45.6%	69	
III	1	2.8%	50	43.9%	51	
Total	36	100.0%	114	100.0%	150	

This table outlines the relationship between mortality and TIMI flow grade after PCI. It delineates the distribution of mortality across different TIMI flow grades (0, I, II, III) post-PCI. The percentage of mortality within each TIMI flow grade is provided alongside the number of cases. The overall P value of 0.0001 indicates a highly significant association between TIMI flow grade and mortality.

DISCUSSION

In the realm of managing ST-elevation myocardial infarction (STEMI) complicated by Left Ventricular Systolic Dysfunction (LVSD), the adoption of straightforward, non-invasive methodologies is paramount (15, 17, 18). The assessment of left ventricular systolic function (LVSF), both globally and locally, has been effectively conducted via two-dimensional transthoracic echocardiography (TTE), which stands as a cornerstone in the diagnostic process. Particularly, the Left Ventricular Ejection Fraction (LVEF), assessed through the Simpson method, has emerged as a critical independent predictor of LVSF, albeit contingent on the expertise of a seasoned echocardiographer to accurately delineate the endocardial border (16, 19, 20). Furthermore, Tissue Doppler Echocardiography has introduced innovative capabilities for the quantitative analysis of myocardial function, offering a robust temporal resolution independent of traditional echocardiographic parameters. Notably, the delineation of peak systolic mitral annular velocity thresholds has facilitated the identification of subendocardial damage and prognostication of LVSF post-myocardial infarction, underscoring the nuanced complexities of diagnosing LVSD following STEMI (21, 22).

The phenomenon of stent thrombosis (ST) in the context of percutaneous coronary intervention (PCI) remains a formidable challenge, with initial generations of drug-eluting stents (DES) grappling with safety concerns, primarily ST. Subsequent iterations have sought to mitigate these risks through the utilization of thinner strut stent frameworks alongside biodegradable or biocompatible polymers, reflecting a concerted effort to enhance the safety profile of DES (6, 11). Despite these advancements, the pathophysiological underpinnings of ST remain elusive, with factors such as lesion morphology, adherence to dual antiplatelet therapy (DAPT), diabetes prevalence, and stent design emerging as significant contributors. The heterogeneity observed in histopathological analyses of thrombus specimens further complicates the understanding of ST, with a diverse array of components such as platelet-rich clots and fibrin/fibrinogen fragments being implicated (2, 3, 14).

Our investigation aligns with existing literature, highlighting a mortality rate of 24% in patients undergoing primary PCI for STEMI attributed to ST, a figure that resonates with findings from other studies within the Pakistani context, which have reported similar mortality rates post-PCI. This study notably underscores the association between TIMI flow grades I and II and elevated mortality rates, alongside age as a pertinent risk factor, thereby contributing to the broader discourse on the management of STEMI patients afflicted by ST (5, 6, 8).

This discourse is underpinned by a meticulous analysis of mortality in conjunction with TIMI flow grades and patient age, yielding insights that are pivotal for the formulation of therapeutic strategies and clinical decision-making processes. The study's strength lies in its comprehensive evaluation of these parameters, offering a valuable addition to the corpus of knowledge on STEMI management. However, it is not without limitations, including the potential for selection bias and the inherent constraints of a single-center study, which may affect the generalizability of the findings (11, 21, 22). Future research endeavors should aim to incorporate larger, multicentric cohorts to enhance the robustness and applicability of the results.

CONCLUSION

In conclusion, the study elucidates the intricate relationship between mortality, TIMI flow grades, and patient age in the context of STEMI due to ST, advocating for a nuanced approach to patient management. Recommendations for future research include the exploration of alternative diagnostic and therapeutic modalities, alongside a sustained focus on optimizing patient outcomes through tailored clinical interventions.

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