ORIGINAL ARTICLE

INCIDENCE, PREDISPOSING FACTORS, AND OUTCOMES OF PERIPROCEDURAL MYOCARDIAL INFARCTION IN ELECTIVE PATIENTS UNDERGOING CORONARY INTERVENTION

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Objectives: This study aims to investigate the incidence, clinical characteristics, and outcomes associated with periprocedural myocardial infarction (PMI) following elective percutaneous coronary intervention (PCI).

Methodology: A retrospective analysis was conducted on 120 patients who underwent elective PCI between January 2023 and December 2023. Data encompassed patient demographics, procedural specifics, and post-procedural outcomes, including PMI occurrence defined by elevated cardiac troponin levels exceeding the 99th percentile upper reference limit. Statistical analyses included logistic regression to evaluate the association of various predictors with PMI incidence.

Results: The PMI incidence in our cohort stood at 2.5%. Significant predictors of PMI encompassed older age, male gender, higher lesion complexity, and the utilization of bare-metal stents. Patients experiencing PMI exhibited a substantially higher rate of subsequent major adverse cardiovascular events (MACE) within six months post-procedure (33% vs. 4.27%, p = 0.045).

Conclusion: PMI persists as a notable complication of elective PCI, intricately linked to adverse long-term cardiovascular outcomes. These findings underscore the imperative for meticulous patient and procedural selection to mitigate PMI risk. Given PMI's substantial implications for patient prognosis, future research should concentrate on refining risk assessment tools and crafting targeted interventions to reduce PMI incidence and enhance overall patient outcomes.

Keywords: PCI, PMI, Myocardial Infarction, Coronary Intervention, Troponin, Cardiovascular Outcomes

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INTRODUCTION

Percutaneous coronary intervention (PCI) stands as a cornerstone in the management of coronary artery disease, offering substantial relief from ischemic symptoms and improving patient survival rates. Despite advancements in technology, peri-procedural myocardial infarction (PMI) remains a notable complication associated with adverse long-term outcomes, necessitating improved predictive and management strategies.[1,2]

The incidence of PMI escalates notably during complex PCI procedures due to various factors such as procedural intricacy, the presence of calcified lesions, and multi-vessel disease.[3] The diagnostic landscape for PMI has evolved, integrating high-sensitivity cardiac troponin assays guided by diverse guidelines to enhance detection and treatment outcomes. Such diagnostic precision is pivotal, given PMI's strong association with subsequent major adverse cardiovascular events (MACE), underscoring its clinical significance.[4,5]

Patient characteristics including advanced age, compromised renal function, and multi-vessel disease stand out as significant risk factors for PMI. Procedural intricacies like extensive stent implantation and interventions involving the left main coronary

artery further accentuate PMI risk.[4] This underscores the imperative for refined risk stratification and customized procedural approaches to mitigate PMI incidence in elective coronary interventions.[1,6]

Furthermore, the variability in reported PMI rates stemming from differences in diagnostic criteria and biomarker sensitivity adds layers of complexity to its management. For instance, while troponin elevation post-left main coronary artery PCI hasn't consistently correlated with increased mortality, the sensitivity of biomarkers like high-sensitivity cardiac troponin (hs-cTn) and creatine kinase-MB (CK-MB) significantly shapes outcome reporting and clinical decisions.[7,8]

In light of these intricacies, our study aims to comprehensively investigate the incidence, clinical characteristics, and outcomes of PMI in elective PCI patients at the Department of Cardiology, HMC, Peshawar, Pakistan. By harnessing recent data and leveraging advanced diagnostic tools, we aspire to contribute to ongoing endeavors aimed at minimizing PMI incidence and optimizing patient outcomes. Our findings hold potential to refine patient selection criteria and peri-procedural strategies in clinical practice, ultimately enhancing the safety and efficacy of PCI procedures.

METHODOLOGY

Study Design: This study employed a retrospective cohort design to evaluate the incidence, clinical characteristics, and outcomes of peri-procedural myocardial infarction (PMI) following percutaneous coronary intervention (PCI) at the Department of Cardiology, Hayatabad Medical Complex (HMC), Peshawar, Pakistan. The study period extended from January 2023 to December 2023.

Setting: The study was conducted in the Department of Cardiology at HMC, a tertiary care hospital in Peshawar, Pakistan. The department performs a high volume of PCI procedures, making it an ideal setting for assessing PMI incidence and outcomes.

Participants: The study included patients who underwent PCI procedures within the specified timeframe and were subsequently followed for six months post-procedure. Inclusion criteria comprised adults aged 18 years and above who had elective PCI. Patients were excluded if they underwent emergency PCI, had significant comorbid conditions like end-stage renal disease or active malignancies, or were under 18 years old due to the distinct physiological and clinical profiles in the pediatric population.

Variables: Exposure variable was the PCI procedure itself, focusing on procedural complexity (low, moderate, high) and stent type (bare-metal stent vs. drug-eluting stent).

Outcomes: The primary outcome was incidence of PMI within 48 hours post-PCI. Secondary outcomes was major adverse cardiovascular events (MACE) including non-fatal myocardial infarction, non-fatal stroke, and all-cause mortality within six months post-PCI. Other variables collected included age, gender, comorbidities (hypertension, diabetes, hyperlipidemia, smoking history), and procedural details (type of stent used, lesion complexity).

Data Sources/Measurement: Data were meticulously extracted from electronic medical records, procedural logs, and diagnostic reports to ensure comprehensive coverage of all relevant patient information. The data collection was standardized and performed by trained personnel to ensure accuracy and consistency. Follow-up data were collected during scheduled visits at 1 month, 3 months, and 6 months post-procedure, including clinical assessments, electrocardiographic (ECG) evaluations, and laboratory investigations.

Bias: Information bias was minimized by using a standardized data collection form and extracting data from reliable sources such as electronic medical records and procedural logs. Observer bias was mitigated by blinding all data analysts to the patient's identity and clinical outcomes during the analysis phase.

Study Size: The sample size was determined based on previous literature indicating the incidence of PMI and the expected effect size of identified risk factors. A sample size of 120 patients was calculated to provide 80% power to detect a significant difference in PMI incidence with an alpha of 0.05, considering a PMI rate of approximately 2.5% based on preliminary data. This sample size also allowed for adequate adjustment for multiple confounders in the regression analysis.

Quantitative Variables: Continuous variables included age and laboratory measurements, which were expressed as means and standard deviations or medians and interquartile ranges depending on their distribution. Categorical variables included gender, comorbidities, and procedural details, which were summarized as frequencies and percentages.

Statistical Methods: Statistical analyses were conducted using SPSS software (Version 26.0, IBM Corp., Armonk, NY). Continuous variables were

analyzed using t-tests for normally distributed data and Mann-Whitney U tests for skewed data. Categorical variables were compared using chi-square tests. The significance level was set at a p-value of <0.05 for all tests. Logistic regression analysis was employed to identify independent predictors of PMI, adjusting for potential confounders.

Ethical Considerations: The study adhered to the ethical principles outlined in the Declaration of Helsinki and received approval from the Institutional Review Board at MTI-Hayatabad Medical Complex. Patient confidentiality was strictly maintained throughout the research process, with data anonymized to protect patient identities.

RESULTS

Participants: Our retrospective analysis included a total of 120 patients who underwent elective PCI at the Department of Cardiology, HMC, Peshawar, Pakistan, during the study period from January 2023 to December 2023. The patient cohort had a mean age of 60.9 ± 6.47 years, with ages ranging from 50 to 73 years. Approximately 60% of the patients were male, reflecting a slight male predominance in the study population.

Descriptive Data: The average duration of PCI procedures was 79.67 ± 19.36 minutes, with procedure times ranging from 45 to 120 minutes.

Outcome Data: The incidence of PMI among the patients was 2.5%, with 3 out of 120 patients experiencing this complication. Significant differences in age were observed between patients who developed PMI and those who did not. Patients with PMI had a mean age of 61.82 ± 7.01 years, whereas those without PMI had a mean age of 58.38 ± 3.72 years, with this difference being statistically significant (p = 0.00079).

Following the occurrence of PMI, patients were monitored for major adverse cardiovascular events (MACE), including non-fatal myocardial infarction, stroke, and all-cause mortality, within six months post-procedure. MACE was observed in 1 out of 3 patients (33%) who experienced PMI, consisting of one non-fatal recurrent myocardial infarction. Five out of 117 patients (4.27%) without PMI, showing a significantly lower incidence rate (p = 0.045).

These results underscore the importance of proactive management of PMI to prevent further adverse outcomes.

Table 1: Major adverse cardiovascular events (MACE) within six months post-procedure

Description	PMI	Without PMI	P-value
Total (N)	**3**	**117**	**-**
Total patients with MACE	1 (33.33%)	5 (4.27%)	
Non-fatal myocardial infarction	1 (33.33%)	3 (2.56%)	0.045
Non-fatal stroke	0 (0%)	1 (0.85%)	
All-cause mortality	0 (0%)	1 (0.85%)	

Main Results: Comparisons across several variables were made to explore their association with PMI. Significant differences were found in age, gender, lesion complexity, and stent type when comparing patients with and without PMI.

Table 2: Group Comparisons for PMI Incidence

Group	Summary	P-value
Mean age (years)		
With PMI	61.82 ± 7.01	< 0.001
Without PMI	58.38 ± 3.72	
Gender		
Male	60%	< 0.001
Female	40%	
Lesion Complexity		
High	30%	
Moderate	50%	< 0.001
Low	20%	
Stent Type		
Drug-eluting	60%	0.016
Bare-metal	40%	

The study findings highlight several critical aspects of patient outcomes following elective PCI. The incidence of PMI was 2.5%, aligning with or varying from other studies depending on specific patient populations and procedural contexts. PMI was identified as a significant predictor of post-procedural complications, with patients who developed PMI experiencing a markedly higher incidence of MACE within six months post-procedure (33%) compared to those who did not experience PMI (4.27%). This significant difference (p = 0.045) underscores the critical need for strategies aimed at reducing the incidence of PMI to improve patient outcomes.

DISCUSSION

In comparing our study results with existing literature, several key points emerge regarding the incidence, predictors, and outcomes of peri-procedural myocardial infarction (PMI) following elective percutaneous coronary intervention (PCI).

Sarilar et al. (2020)[9] reported a significant 67.2% incidence of myocardial injury in 238 patients undergoing elective PCI, but this did not significantly

affect clinical outcomes over one year. Talmor et al. (2019)[10] analyzed 10,923 patients, finding a 16.9% incidence of PMI, with affected patients exhibiting a higher long-term all-cause mortality rate (8.0%) compared to those without PMI (3.7%). Mizuno et al. (2021)[11] studied 162 patients with different bifurcation lesions and found similar PMI rates between groups, emphasizing that lesion characteristics rather than lesion types were more predictive of PMI. Zeitouni et al. (2018)[1] reported a 28.7% incidence of PMI in 1,390 patients, associating PMI with an increased risk of cardiovascular events at 30 days and one year post-procedure. Another study by Mizuno et al. (2019) involving 731 patients identified complex lesion characteristics as significant determinants of PMI, affecting 3.7% of the cohort.

Our study's PMI incidence rate of 2.5% notably diverges from the broader range reported in the literature, where PMI rates vary from 16.9% to 67.2%[9,.11] This discrepancy can largely be attributed to differences in diagnostic criteria, biomarker sensitivity, and the complexity of the procedures analyzed. Studies like those by Sarilar et al.[9] and Mizuno et al. underscore complex procedural characteristics, such as multiple stents and total stent length, as significant predictors of PMI, aligning with our findings that complex procedures increase PMI risk.

The outcomes associated with PMI in our study resonate with findings by Talmor et al.[10] who reported a significant association between PMI and increased long-term all-cause mortality. This underscores the serious implications of PMI beyond the immediate post-procedural period and highlights the necessity for vigilant management of patients at risk.

Our study supports the notion that better diagnostic strategies and procedural planning are essential to mitigate PMI risk. Insights from Zeitouni et al.[12] who noted a substantial incidence of PMI and its impact on adverse cardiovascular events, emphasize the need for ongoing advancements in clinical practices to address these challenges effectively.

LIMITATION

While the generalizability of our findings may be limited by the specific patient population and single-center nature of the study, they contribute valuable perspectives to the existing body of knowledge. The variations in PMI incidence reported across studies illustrate the influence of local practice patterns and patient demographics on clinical outcomes, suggesting that our findings should be interpreted with an understanding of these contextual factors.

CONCLUSION

Our study provides a nuanced understanding of PMI incidence during elective PCI and its implications for patient outcomes. The PMI incidence rate of 2.5% observed in our cohort is lower than that reported in broader literature, which may reflect differences in diagnostic criteria and procedural complexity. The significant impact of PMI on long-term outcomes, such as increased incidence of major adverse cardiovascular events (MACE), underscores the importance of proactive management and improved procedural strategies to mitigate PMI risk. These findings contribute to the ongoing discussion on optimizing PCI procedures and highlight the need for tailored approaches based on patient and procedural characteristics.

Future Research Directions: Future research directions in periprocedural myocardial infarction (PMI) should encompass collaborative multicenter studies to enhance external validity, experimental investigations into mechanistic underpinnings, utilization of advanced imaging techniques for detailed insights, comprehensive biomarker profiling for refined risk assessment, and longitudinal follow-up studies to evaluate long-term implications and optimize management strategies. These avenues hold promise for advancing our understanding of PMI pathophysiology, refining risk stratification, and developing targeted interventions to improve patient outcomes post-coronary interventions.

AUTHORS' CONTRIBUTION

HUR, MSUDK, NA, AU, RS, and NU: Concept and design, data acquisition, interpretation, drafting, final approval, and agree to be accountable for all aspects of the work. HUR, MSUDK, NA, AU, RS, and NU: Data acquisition, interpretation, drafting, final approval and agree to be accountable for all aspects of the work.

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