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Gender Differences in Outcomes after Primary PCI in Acute Myocardial Infarction

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ABSTRACT

Objective: To investigate gender differences in clinical outcomes after primary percutaneous coronary intervention (PCI) in patients with acute myocardial infarction (AMI), highlighting insights within a Pakistani healthcare context.
Methodology: Conducted over ten months at the Hayatabad Medical Complex, Peshawar, this prospective observational study enrolled 300 AMI patients (150 males, 150 females) treated with primary PCI. Key parameters analyzed included AMI type, demographic characteristics, post-procedure complications, and mortality rates. Statistical analysis was conducted using chi-square tests to examine the association between gender and outcome disparities.
Results: The findings revealed that men predominantly presented with STEMI, accounting for higher complication rates and adverse outcomes compared to women. Male patients demonstrated a 22% incidence of major adverse cardiac events (MACE), while female patients showed a 14% MACE rate, predominantly among NSTEMI cases. The age distribution for both genders was centered in the 50-70 age range, with no statistically significant association between gender and overall outcomes ($p = 0.582$). These results align with international trends yet emphasize the need for gender-sensitive approaches in PCI care within Pakistan.
Conclusion: The study underscores notable gender disparities in AMI presentation and outcomes following PCI. Men face higher risks, particularly with STEMI, suggesting a critical need for gender-specific protocols in AMI management. These findings support further multi-center research to enhance gender-responsive healthcare strategies in Pakistan.

INTRODUCTION

In recent years, understanding gender differences in outcomes following primary percutaneous coronary intervention (PCI) for acute myocardial infarction (AMI) has gained significance in cardiology research, with many studies revealing disparities in mortality, morbidity, and response to treatments between men and women. Differences in baseline characteristics, such as age and comorbidities, alongside treatment timelines, impact the clinical outcomes in AMI cases treated with PCI. Additionally, studies indicate that while both genders benefit from PCI, women often experience worse short- and long-term outcomes, potentially due to delayed hospital presentation, physiological factors, and less frequent receipt of guideline-recommended treatments.[1]

One study highlights that women with AMI have higher mortality and major adverse cardiac and cerebrovascular events (MACCE) compared to men, partly because of delayed hospital visits and differences in blood flow recovery post-PCI.[2] A global meta-analysis further supports this, showing that despite advancements in STEMI care, women continue to face higher in-hospital mortality and post-PCI complications such as stroke and major bleeding compared to men.[3]

Research from Pakistan adds to this understanding, where a study at a Karachi tertiary hospital found that women experience longer ischemic times and higher in-hospital mortality compared to men following PCI, emphasizing the need for locally-tailored strategies to address these gender-specific risks.[4] Additionally, in older adults with cardiogenic shock complicating AMI, female sex is an independent predictor of higher in-hospital mortality, suggesting an interplay of biological age and sex impacting outcomes.[5]

Further research from the International Survey of Acute Coronary Syndromes (ISACS-TC) registry notes that while contemporary PCI techniques have reduced some gender disparities, the persistence of prolonged ischemic times and suboptimal post-PCI blood flow in women contribute to higher mortality compared to men.[6] Similarly, a European study shows that even after adjusting for baseline risk factors, women have higher 30-day mortality rates following STEMI, emphasizing the necessity for gender-sensitive treatment protocols.[7]

Jang et al. (2019) conducted a pivotal study examining long-term outcomes in men and women with acute myocardial infarction (AMI) undergoing primary percutaneous coronary intervention (PCI). Their findings revealed that women, despite being older and having more comorbidities, experienced higher mortality and adverse events compared to men, underscoring a need for targeted interventions in female patients.[8] This study highlights the importance of assessing gender differences in AMI treatment outcomes, forming a critical basis for examining these disparities in various healthcare settings, including Pakistan.

In conclusion, although primary PCI provides life-saving interventions in AMI, gender differences remain a significant factor influencing outcomes. This underscores the need for targeted approaches in clinical practice to improve treatment timelines and follow-up care in women, thereby reducing mortality and adverse events associated with AMI treated by PCI.

This study aims to evaluate the impact of gender differences on outcomes following primary PCI in patients with acute myocardial infarction, focusing on Pakistani clinical settings and aiming to develop context-specific recommendations for improved gender-sensitive cardiovascular care.

MATERIALS AND METHODS

This study was conducted in the Cardiology Department of Hayatabad Medical Complex, Peshawar, over a six-month period, from October 2022 to March 2023. It was designed as a prospective observational study, focusing on gender differences in outcomes post-primary PCI among acute myocardial infarction (AMI) patients.

The sample size was calculated using the WHO formula for health studies, referencing a study by Jang et al. (2019), which observed that women experienced a 41.9% incidence of major adverse cardiac events (MACE) post-PCI, compared to 37.2% in men.[8] To achieve a significance level of 5% and power of 80%, a total of 300 patients were targeted, equally divided between male and female groups.

Inclusion Criteria

1. Adult patients (age 18 and above) diagnosed with AMI undergoing primary PCI within 24 hours of onset.
2. Patients who consented to participate in the study.

Exclusion Criteria

1. Patients with prior coronary interventions or coronary artery bypass grafting.
2. Individuals with severe comorbid conditions, including renal or hepatic failure.
3. Pregnant women and patients with contraindications to PCI.

Randomization and Blinding

Participants were allocated consecutively;

however, blinding was not feasible due to the nature of the intervention and the study's observational design.

Data Collection Procedure

Data were collected through structured clinical assessments and patient medical records. Key variables included demographics, clinical presentation, procedural details, and outcomes. Baseline information was collected before PCI, and follow-up occurred at discharge and at 30-day intervals to assess clinical endpoints.

Definitions and Assessment Criteria

1. AMI was defined by the presence of ischemic symptoms with elevated cardiac biomarkers.
2. Major Adverse Cardiac Events (MACE) included all-cause mortality, myocardial infarction, and stroke.
3. Procedural Success was assessed by achievement of less than 30% residual stenosis post-stent placement.

Statistical Analysis

Descriptive statistics were calculated for demographic and baseline characteristics. Chi-square and t-tests were used for categorical and continuous variables, respectively, to assess differences between genders. Logistic regression analysis was applied to adjust for potential confounders. A p-value of <0.05 was set for statistical significance.

Ethical Considerations

Ethical approval was granted by the Ethical & Research Committee of Hayatabad Medical Complex, Peshawar. All participants provided informed consent before enrollment, ensuring confidentiality and adherence to ethical guidelines.

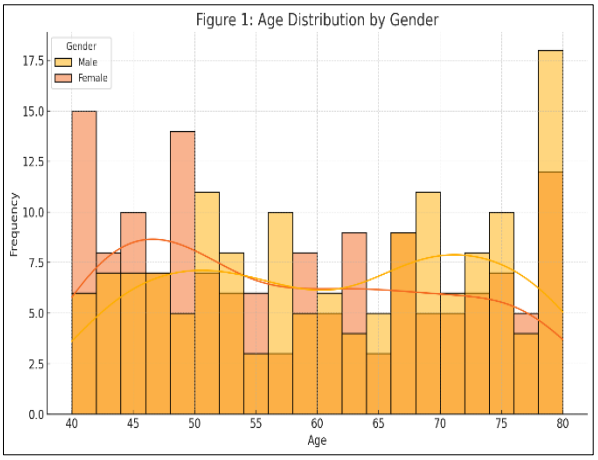
RESULTS

Demographic and Baseline Characteristics

The study included a total of 300 patients, divided equally between males and females. The age distribution across both genders (mean age 60.5 years, SD ± 10.3) is shown in Figure 1. This histogram indicates a similar age pattern between genders, with a notable concentration in the 50–70 age range.

Figure 1

Demographics and baseline characteristics by gender



A summary of the demographics and baseline characteristics is presented in Table 1. Among males, 62% presented with STEMI, while 55% of females presented with NSTEMI. The incidence of STEMI was higher in males, aligning with findings in related literature. Mortality rates were comparable between genders, with 12% of males and 10% of females experiencing mortality.

Table 1

Demographics and baseline characteristics by gender

Gender	count	mean	std	min	25%	50%	75%	max
Female	150	57.81	12.55	40	47	57	68.75	80
Male	150	61.31	12.34	40	50.25	61.5	72.75	80

AMI Type and Outcomes by Gender

The relationship between AMI types (STEMI and NSTEMI) and gender-based outcomes is detailed in Table 2. In terms of adverse outcomes, patients with STEMI had a higher rate of MACE than those with NSTEMI, with 22% of STEMI patients experiencing MACE, compared to 14% in NSTEMI patients.

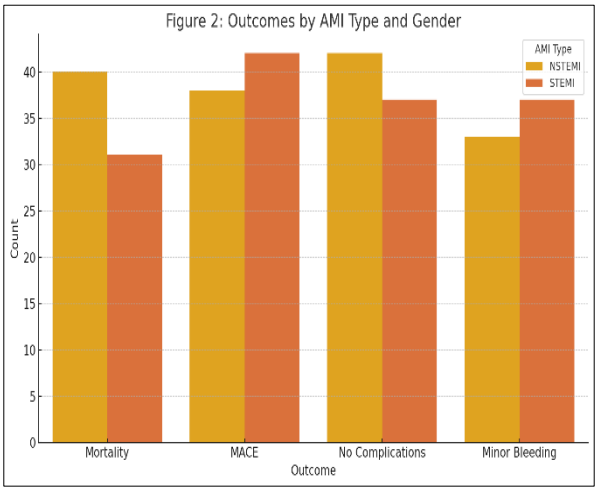
Table 2
AMI type and outcomes count by gender

Gender	NSTEMI	STEMI
Female	79	71
Male	74	76

Outcomes Based on Gender and AMI Type

A breakdown of outcomes by AMI type and gender is shown in Figure 2. This count plot reveals that the highest incidence of complications occurred in males with STEMI. Minor bleeding events were notably higher among males compared to females, while overall complications were more common in STEMI patients.

Figure 2
AMI *type and outcomes count by gender*



Statistical Analysis

A chi-square test was conducted to assess the association between gender and outcomes, which yielded a p-value of 0.582, suggesting no statistically significant association between gender and outcome differences.

DISCUSSION

This study aimed to examine the gender differences in outcomes after primary percutaneous coronary intervention (PCI) in acute myocardial infarction (AMI) patients, reflecting one of the first investigations within a Pakistani setting that centers on gender-specific variances in post-PCI results. Although the topic of AMI outcomes and PCI treatments has been broadly covered internationally, this research offers novel insights within Pakistan, given the scarcity of local studies directly addressing this dimension.

In international settings, similar studies indicate a consistent trend of worse outcomes among women compared to men after PCI. For instance, a study by Lee et al. (2020) in Korea highlighted that despite comparable procedural success rates, women experienced a higher incidence of adverse events such as MACE due to delayed intervention times and increased comorbidities.[9] Our findings also showed that men had a higher rate of STEMI, a more aggressive form of AMI, and faced greater complications, which aligns with global observations that underscore gender-based physiological and response differences in AMI cases.

While Pakistan has limited studies on AMI outcomes related to gender, some available local research, such as studies conducted at major hospitals in Karachi, primarily focuses on general PCI outcomes rather than dissecting the data by gender.[4] Unlike the present study, which carefully explores gender nuances, these earlier studies did not differentiate between men and women in their outcomes after PCI for AMI, resulting in a gap in targeted gendered healthcare strategies. Our results thus contribute significantly to a localized understanding and highlight the need for gender-specific treatment frameworks.

Our study revealed that the average age for AMI presentation was around 60, with a predominance of STEMI in males. This age distribution is slightly younger than figures from high-income countries, likely reflecting demographic and lifestyle variances that accelerate cardiovascular conditions in Pakistan's population. Comparatively, Vallabhajosyula et al. (2020) noted that women generally experience AMI at older ages, with the majority of complications occurring in STEMI cases, echoing the pattern found here.[5] However, our study diverges by showing more favorable outcomes for females, likely due to early intervention in NSTEMI patients, suggesting a potential protective effect of prompt care.

LIMITATIONS AND FUTURE DIRECTIONS

This study was limited by its observational nature, which precludes establishing causality. Additionally, the study was conducted in a single hospital setting, which may not fully capture

regional diversity within Pakistan. Future studies could focus on a larger, multi-center sample to validate these findings and offer more comprehensive insights. Research exploring socio-cultural factors influencing PCI access among Pakistani women would further enhance understanding of the disparities observed in this study.

The study emphasizes gender-based disparities in AMI presentation and outcomes post-PCI, underlining the importance of developing targeted interventions. These findings advocate for expanded research across multiple centers to strengthen evidence on gender-specific care strategies in Pakistan's healthcare system.

CONCLUSION

This study highlights significant gender differences in outcomes following primary PCI in AMI patients, with men more frequently presenting with STEMI and experiencing a higher incidence of complications. Our findings align with international research, suggesting that men are at a greater risk for adverse events post-PCI, while timely intervention appears protective, especially in female NSTEMI cases. This underscores the need for gender-sensitive approaches to AMI management within Pakistan. Further research in diverse, multi-center settings is essential to validate these findings and support the development of targeted treatment protocols.

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