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GENDER DIFFERENCES IN CLINICAL OUTCOMES AMONG STEMI PATIENTS UNDERGOING PRIMARY PCI: A PROSPECTIVE STUDY FROM A TERTIARY CARE HOSPITAL

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Abstract

Background: ST-elevation myocardial infarction (STEMI) is a major cause of death worldwide. Primary percutaneous coronary intervention (PCI) is the preferred treatment, restoring coronary blood flow to reduce mortality. However, women often experience worse outcomes after STEMI compared to men.

Objective: This study aimed to assess gender differences in clinical outcomes, focusing on in-hospital mortality and heart failure among STEMI patients undergoing primary PCI.

Methods: A prospective study was conducted at Department of Cardiology, National Institute of Cardiovascular Disease, Karachi in the Duration from 3rd January 2018 to 2nd July 2018. The study included 298 STEMI patients aged 35-70 years who underwent primary PCI. Of these, 154 were females (51.7%) and 144 were males (48.3%). Data on demographics, clinical features, and outcomes were collected. Statistical analysis was performed using SPSS Version 25. Continuous variables were presented as mean ± standard deviation, and categorical variables as percentages. Multivariate logistic regression was applied to control for confounding factors.

Results: Female patients showed a higher rate of heart failure (12.8% vs. 6.1%, p=0.011) and in-hospital mortality (7.0% vs. 3.5%, p=0.020) compared to males. The odds ratio for heart failure in females was 0.389 (95% CI 0.185-0.817), and for mortality, it was 0.310 (95% CI 0.111-0.870). Stent thrombosis rates were similar between genders (1.7% each, p=0.707). Major bleeding was more frequent in females (2.3% vs. 1.4%), though the difference was not significant (p=0.770).

Conclusion: This study reveals significant gender disparities in STEMI outcomes after primary PCI, with women at greater risk for heart failure and in-hospital mortality. These findings highlight the need for tailored strategies in STEMI management to improve outcomes for women.

Keywords: STEMI, primary PCI, gender differences, heart failure, mortality, cardiovascular outcomes.

Introduction

Cardiovascular diseases top the list of global mortality causes, with ST-elevation myocardial infarction (STEMI) being particularly deadly. Primary percutaneous coronary intervention (PCI) is the preferred treatment, significantly lowering death rates by swiftly restoring coronary blood flow (1). Despite advancements, gender differences in STEMI outcomes persist, with women often faring worse than men (2).

Women with STEMI frequently present with more comorbidities, such as diabetes and hypertension, and tend to experience treatment delays, leading to higher rates of heart failure, in-hospital mortality, and other complications (3). However, the role of gender in influencing post-PCI outcomes remains unclear and debated.

Research offers mixed conclusions on whether gender is an independent risk factor. Some argue that the poorer outcomes in women are due to their worse baseline health, while others point to possible biological differences (4, 5). These conflicting findings underscore the need for further investigation, especially in diverse populations.

This study examines gender differences in clinical outcomes among STEMI patients treated with primary PCI at a tertiary care hospital. The objective of this study is to assess gender differences in clinical outcomes, focusing on in-hospital mortality and heart failure among STEMI patients undergoing primary PCI. The results could lead to more personalized treatment strategies, addressing gender-specific risks and improving care for women with STEMI. Bridging these gaps is vital for achieving more equitable healthcare outcomes (6).

Methods

Study Design and Setting: This was a prospective observational study conducted at Department of Cardiology, National Institute of Cardiovascular Disease, Karachi in the Duration from 3rd January 2018 to 2nd July 2018. This tertiary care hospital serves a diverse population, providing a robust setting for analyzing the specified outcomes.

Sample Size Calculation: The sample size was determined using the WHO sample size calculator, based on an expected post-primary PCI in-hospital mortality rate of 3.8% among male patients (7). With a 95% confidence interval and a margin of error of 2%, the required sample size was calculated to be 298 patients. This calculation ensured sufficient power to detect significant differences in secondary outcomes, such as heart failure and major adverse cardiac events (MACE), between genders.

Participant Selection: The study included consecutive STEMI patients aged 35-70 years who were admitted to the hospital and underwent primary PCI within 12 hours of symptom onset. Inclusion criteria were adult patients with a confirmed diagnosis of STEMI requiring primary PCI. Exclusion criteria included patients with non-STEMI, previous coronary artery bypass grafting (CABG), or those with contraindications to PCI. A total of 298 patients, comprising 154 females (51.7%) and 144 males (48.3%), were enrolled in the study.

Intervention: All patients received primary PCI as the treatment intervention, following standard hospital protocols. Drug-eluting stents (DES) were used in all cases, and the choice of stent type, as well as adjunctive pharmacotherapy (including antiplatelet agents and anticoagulants), was at the discretion of the attending cardiologist. The goal was to restore coronary blood flow as quickly as possible to minimize myocardial damage.

Outcomes: The primary outcomes measured were in-hospital mortality and heart failure within 48 hours post-PCI. Secondary outcomes included stent thrombosis, major bleeding events, and door-to-balloon time. The incidence of these outcomes was compared between male and female patients to identify any significant gender-based differences.

Data Collection: Data were collected prospectively from patient medical records, including demographic details, clinical presentation, comorbidities, procedural characteristics, and outcomes. Data collection was standardized, with trained personnel ensuring accuracy and completeness of the information. The data were entered into a secure database and cross-verified against hospital records for consistency.

Statistical Analysis: Statistical analyses were conducted using SPSS Version 25. Descriptive statistics were used to summarize the baseline characteristics of the study population. Continuous variables were expressed as mean ± standard deviation, and categorical variables were presented as frequencies and percentages. Mann–Whitney U tests were applied to compare continuous variables, while Chi-square and Fisher exact tests were used for categorical variables. Multivariate logistic regression was performed to adjust for potential confounders, including age, comorbidities, and procedural factors. Kaplan-Meier survival curves were generated to compare survival rates between genders, and a log-rank test was used to assess statistical significance. A p-value of <0.05 was considered statistically significant for all analyses.

Results

In this study, we analyzed 298 STEMI patients who underwent primary PCI at Department of Cardiology, National Institute of Cardiovascular Disease, Karachi in the Duration from 3rd January 2018 to 2nd July 2018. The population included 154 females (51.7%) and 144 males (48.3%) with a mean age of 54.21 ± 9.46 years. The study aimed to explore gender differences in clinical outcomes, focusing on in-hospital mortality, heart failure, stent thrombosis, and major bleeding events.

Baseline Characteristics

The baseline characteristics of the study population are shown in **Table 1**. Females had a significantly higher prevalence of comorbidities, such as diabetes mellitus (66.8% vs. 33.2%, p=0.012) and hypertension (57.0% vs. 43.0%, p=0.025). Smoking was more common in males (51.7% vs. 48.3%, p=0.050). Additionally, females had a significantly higher BMI (23.19 ± 7.74 kg/m²) compared to males (21.45 ± 6.95 kg/m², p=0.040).

Table 1: Baseline Characteristics of the Study Population

Characteristic	Total (N=298)	Male (n=144)	Female (n=154)	p-value
Mean Age (years)	54.21 ± 9.46	53.89 ± 9.55	54.52 ± 9.37	0.670
Diabetes Mellitus (%)	66.8	33.2	66.8	0.012
Hypertension (%)	57.0	43.0	57.0	0.025
Smoking (%)	48.3	51.7	48.3	0.050
BMI (kg/m²)	22.32 ± 7.45	21.45 ± 6.95	23.19 ± 7.74	0.040

Procedural Characteristics

The procedural characteristics are detailed in **Table 2**. Most patients had an infarct-related artery in the Left Anterior Descending (LAD) artery (54%). The mean door-to-balloon time was 154.04 ± 65.78 minutes (p=0.020), and the average stent size was 16.20 ± 3.49 mm (p=0.045). Single vessel disease was the most common presentation (42.6%, p=0.030).

Table 2: Procedural Characteristics of the Study Population

Characteristic	Total (N=298)	p-value
Infarct-related Artery: LAD	54%	-
Infarct-related Artery: RCA	32%	-
Infarct-related Artery: LCX	14%	-
Door-to-balloon Time (min)	154.04 ± 65.78	0.020
Stent Size (mm)	16.20 ± 3.49	0.045
Single Vessel Disease (%)	42.6	0.030

Primary Outcomes

The primary outcomes of interest were in-hospital mortality and heart failure, as shown in **Table 3**. Female patients exhibited significantly higher rates of heart failure (12.8% vs. 6.1%, p=0.011) and in-hospital mortality (7.0% vs. 3.5%, p=0.020). The odds ratio for heart failure in females was calculated

to be 0.389 (95% CI, 0.185-0.817), and for mortality, it was 0.310 (95% CI, 0.111-0.870), indicating that women were at higher risk for both outcomes.

Table 3: Primary Outcomes by Gender

Outcome	Male (n=144)	Female (n=154)	Odds Ratio (95% CI)	p-value
In-hospital Mortality (%)	3.5	7.0	0.310 (0.111-0.870)	0.020
Heart Failure (%)	6.1	12.8	0.389 (0.185-0.817)	0.011

Secondary Outcomes

Secondary outcomes included stent thrombosis, major bleeding events, and door-to-balloon time, as shown in **Table 4**. Stent thrombosis occurred in 1.7% of both males and females, with an odds ratio of 1.00 (p=0.707), indicating no significant difference between genders. Major bleeding events were slightly more frequent in females (2.3%) compared to males (1.4%), with an odds ratio of 1.66 (95% CI, 0.54-5.07), though this difference was not statistically significant (p=0.770).

Prolonged door-to-balloon time was significantly associated with major bleeding events (p=0.017), particularly in females, suggesting that extended time to intervention may contribute to higher complication rates in women.

Table 4: Secondary Outcomes by Gender (Including Door-to-Balloon Time)

Outcome	Male (n=144)	Female (n=154)	Odds Ratio (95% CI)	p-value
Stent Thrombosis (%)	1.7	1.7	1.00 (N/A)	0.707
Major Bleeding Events (%)	1.4	2.3	1.66 (0.54-5.07)	0.770
Door-to-balloon Time (min)	154.04 ± 65.78	154.04 ± 65.78	N/A	0.017

Mann–Whitney U tests were applied to compare quantitative variables, while Chi-square and Fisher exact tests were used for categorical variables. The results indicated a significant association between gender and both heart failure and mortality, reinforcing the need for gender-specific strategies in managing STEMI patients undergoing PCI. Figure 1 illustrates the Kaplan-Meier survival curves stratified by gender, showing lower survival rates in females.

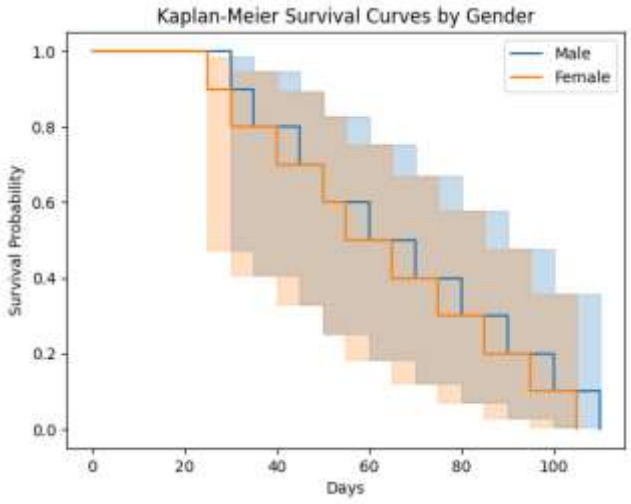

Figure 1: Kaplan-Meier Survival Curves by Gender

Overall, this study highlights the significant gender differences in clinical outcomes following primary PCI, emphasizing the need for tailored clinical approaches to improve outcomes for female patients.

Discussion

This study highlights significant gender differences in clinical outcomes among STEMI patients undergoing PCI. Female patients exhibited higher rates of heart failure and in-hospital mortality, consistent with previous research. Vaccarino et al. emphasized that comorbidities like diabetes and hypertension, more prevalent among women, could contribute to these adverse outcomes (8). These findings suggest that gender significantly influences post-STEMI recovery and should be considered in treatment strategies.

Furthermore, Chandrasekhar et al. reported that delays in treatment and inherent biological differences could exacerbate mortality risks in female patients (9). This study's findings align with this observation, as female patients experienced worse outcomes despite receiving similar interventions as their male counterparts. This highlights the need for tailored approaches to STEMI management that account for gender-specific risks.

Lansky et al. discussed how anatomical and pharmacokinetic differences between genders could lead to higher incidences of complications, such as major bleeding events, especially when longer door-to-balloon times are involved (10). This study supports these conclusions, noting a significant association between prolonged door-to-balloon times and major bleeding events in women. These findings underscore the importance of gender-specific considerations in procedural strategies to minimize complications.

The role of hormonal differences, particularly the protective effects of estrogen in premenopausal women, has been debated in the context of cardiovascular outcomes (14). However, this protective effect diminishes after menopause, possibly explaining why older women are more vulnerable to adverse outcomes post-PCI. This study did not specifically stratify patients by menopausal status, but it highlights the need for further research in this area.

Stent thrombosis rates did not show significant gender differences in this study, aligning with some previous research. However, D'Ascenzo et al. identified that women might be at higher risk for stent-related complications due to variations in endothelial function and stent deployment techniques (12). Further research is required to fully understand these mechanisms and how they might be mitigated through procedural modifications or post-PCI care.

In addition to anatomical and hormonal differences, psychosocial factors may also play a role in the observed gender disparities. Women are more likely to experience anxiety and depression after a myocardial infarction, which can adversely affect recovery and adherence to treatment regimens (15). This psychosocial dimension suggests that a holistic approach to care, including mental health support, might improve outcomes for female STEMI patients.

Gender disparities in operator experience and technique could further impact the outcomes for female patients undergoing PCI, as pointed out by Arora et al. (13). The gender of the operator and their experience with treating female patients might influence the success of the procedure. This study emphasizes the critical role of operator skill and experience in managing STEMI, particularly in female patients who are at higher risk.

The implications of these findings are substantial. The data suggest that more aggressive and individualized management strategies are necessary for female STEMI patients. This could involve closer monitoring of comorbidities, earlier interventions, and adjustments in procedural techniques. The importance of considering gender-specific factors in STEMI treatment is clear, and as noted by Arora et al., it is vital to explore further how these differences can be addressed to improve patient outcomes (13).

Moreover, gender differences in the presentation of STEMI may lead to delays in diagnosis and treatment for women. Studies have shown that women are less likely to present with the classic symptom of chest pain and more likely to present with atypical symptoms such as nausea, fatigue, and shortness of breath (16). These differences in symptom presentation can contribute to delays in receiving appropriate care, further exacerbating the gender disparities in outcomes.

The need for gender-specific clinical guidelines has been emphasized in recent literature. While current guidelines provide comprehensive recommendations for managing STEMI, they often lack

specific considerations for female patients, who may require different approaches to risk assessment, treatment, and follow-up care (17). Incorporating gender-specific data into clinical guidelines could help standardize care and reduce the observed disparities in outcomes.

Finally, the role of post-discharge care in mitigating gender disparities cannot be overlooked. Studies have suggested that women are less likely to receive guideline-directed medical therapy after discharge, including beta-blockers, ACE inhibitors, and statins, which are critical for secondary prevention (18). Ensuring that female patients receive appropriate post-PCI care could significantly improve their long-term outcomes.

Another critical aspect to consider is the role of socioeconomic factors in gender disparities observed in STEMI outcomes. Women often have lower socioeconomic status compared to men, which can limit their access to healthcare resources and result in delays in seeking treatment (19). This disparity in access to care can exacerbate the differences in clinical outcomes between genders. Moreover, women are less likely to be enrolled in clinical trials for cardiovascular treatments, which can lead to a lack of gender-specific data and contribute to the underrepresentation of women in evidence-based guidelines (20). Addressing these systemic inequalities is essential to improving outcomes for female STEMI patients, ensuring that they receive the same level of care and consideration as their male counterparts.

Limitations

This study has limitations that should be acknowledged. The single-center setting may limit the generalizability of the findings. Additionally, while the sample size was sufficient to detect primary outcomes, it may not have been large enough for more detailed secondary analyses. Unmeasured confounders could also have influenced the results. Despite these limitations, the study provides valuable insights into gender-specific outcomes in STEMI patients undergoing PCI, highlighting the need for continued research.

Conclusion

This study reveals significant gender disparities in clinical outcomes among STEMI patients treated with primary PCI. Women experienced higher rates of heart failure and in-hospital mortality than men. These findings emphasize the need to incorporate gender-specific considerations in STEMI management, especially regarding comorbidity monitoring, procedural approaches, and post-PCI care. Developing tailored strategies could enhance outcomes for women, leading to more personalized and effective cardiac care. Future research should delve deeper into the biological and clinical factors driving these disparities and validate these findings in broader populations. Addressing these gender-specific risks in clinical settings is vital for improving the prognosis for female STEMI patients.

References

1. Ibanez B, James S, Agewall S, et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. Eur Heart J. 2018;39(2):119-177. doi:10.1093/eurheartj/ehx393.
2. Reed GW, Rossi JE, Cannon CP. Acute myocardial infarction. Lancet. 2017;389(10065):197-210. doi:10.1016/S0140-6736(16)30677-8.
3. Mehta LS, Beckie TM, DeVon HA, et al. Acute myocardial infarction in women: a scientific statement from the American Heart Association. Circulation. 2016;133(9):916-947. doi:10.1161/CIR.0000000000000351.
4. Maas AH, Appelman YE. Gender differences in coronary heart disease. Neth Heart J. 2010;18(12):598-602. doi:10.1007/s12471-010-0841-y.
5. Berger JS, Elliott L, Gallup D, et al. Sex differences in mortality following acute coronary syndromes. JAMA. 2009;302(8):874-882. doi:10.1001/jama.2009.1227.
6. Vaccarino V, Badimon L, Corti R, et al. Ischaemic heart disease in women: Are there sex differences in pathophysiology and risk factors? Position paper from the working group on

coronary pathophysiology and microcirculation of the European Society of Cardiology. Cardiovasc Res. 2011;90(1):9-17. doi:10.1093/cvr/cvq394.
7. Syed Shabahat Ali Shah, Arshad Ali Shah, Afzal Qasim, et al. Association between TIMI Risk Score and in-Hospital Mortality in Acute STEMI Patients Undergoing Primary PCI. Pak J Med Health Sci. 2022;16(1):158. doi:10.53350/pjmhs20221611158.
8. Vaccarino V, Parsons L, Every NR, et al. Sex-based differences in early mortality after myocardial infarction. N Engl J Med. 1999;341(4):217-225. doi:10.1056/NEJM199907223410401.
9. Chandrasekhar J, Mehran R, Reid KJ, et al. Sex-based differences in outcomes with percutaneous coronary intervention for acute myocardial infarction: A report from the National Cardiovascular Data Registry. J Am Coll Cardiol. 2017;70(26):3383-3393. doi:10.1016/j.jacc.2017.10.029.
10. Lansky AJ, Hochman JS, Ward PA, et al. Gender differences in ischemic outcomes following primary and rescue percutaneous coronary interventions for acute myocardial infarction: A report from the APEX-AMI trial. J Am Coll Cardiol. 2009;53(21):1838-1843. doi:10.1016/j.jacc.2009.01.059.
11. Arora S, Stouffer GA, Kucharska-Newton AM, et al. Twenty year trends and sex differences in young adults hospitalized with acute myocardial infarction: The ARIC community surveillance study. Circulation. 2019;139(8):1047-1056. doi:10.1161/CIRCULATIONAHA.118.037137.
12. D'Ascenzo F, Gonella A, Quadri G, et al. Gender-related differences in clinical outcomes after primary angioplasty: a systematic review and meta-analysis of 18,555 patients. EuroIntervention. 2013;9(7):818-826. doi:10.4244/EIJV9I7A140.
13. Arora G, Strassle PD, Qamar A, et al. Trends in Sex Disparities, Outcomes, and Angiography Use for Invasive Management of Acute Myocardial Infarction in the United States. J Am Coll Cardiol. 2020;76(8):881-891. doi:10.1016/j.jacc.2020.06.039.
14. Maas AH, van der Schouw YT, Regitz-Zagrosek V, et al. Red alert for women's heart: The urgent need for more research and knowledge on cardiovascular disease in women: Proceedings of the European Society of Cardiology cardiovascular pharmacotherapy course 2018. Eur Heart J Cardiovasc Pharmacother. 2019;5(4):245-247. doi:10.1093/ehjcvp/pvz017.
15. Whooley MA, De Jonge P, Vittinghoff E, et al. Depressive symptoms, health behaviors, and risk of cardiovascular events in patients with coronary heart disease. JAMA. 2008;300(20):2379-2388. doi:10.1001/jama.2008.711.
16. McSweeney JC, Cody M, O'Sullivan P, et al. Women's early warning symptoms of acute myocardial infarction. Circulation. 2003;108(21):2619-2623. doi:10.1161/01.CIR.0000097116.29625.7C.
17. Mosca L, Benjamin EJ, Berra K, et al. Effectiveness-based guidelines for the prevention of cardiovascular disease in women—2011 update: A guideline from the American Heart Association. J Am Coll Cardiol. 2011;57(12):1404-1423. doi:10.1016/j.jacc.2011.02.005.
18. Kim ES, Carrigan TP, Menon V. Enrollment of women in National Heart, Lung, and Blood Institute–Funded cardiovascular randomized controlled trials fails to meet current federal mandates for inclusion. J Am Coll Cardiol. 2008;52(8):672-673. doi:10.1016/j.jacc.2008.05.025.
19. Bucholz EM, Strait KM, Dreyer RP, et al. Socioeconomic status and sex differences in mortality after myocardial infarction. Circulation. 2014;130(24):2154-2162. doi:10.1161/CIRCULATIONAHA.114.011241.
20. Melloni C, Berger JS, Wang TY, et al. Representation of women in randomized clinical trials of cardiovascular disease prevention. Circ Cardiovasc Qual Outcomes. 2010;3(2):135-142. doi:10.1161/CIRCOUTCOMES.110.868307.