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Gender Disparities in Management and Outcomes of STEMI Patients Undergoing Primary PCI: A Single-Center Experience.

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Abstract

Background: Gender-based differences in the clinical presentation, angiographic findings, and outcomes of ST-elevation myocardial infarction (STEMI) are increasingly recognized worldwide. However, region-specific data, especially from South Asian cardiac centres, remain limited. To evaluate gender-based differences in angiographic characteristics, procedural interventions, and in-hospital outcomes among STEMI patients undergoing primary percutaneous coronary intervention (PCI) at a tertiary cardiac centre.

Methodology: This retrospective study included 257 STEMI patients (194 males, 63 females) admitted between March and August 2024. Upon admission, all patients underwent diagnostic workup including ECG, troponin, myocardial enzymes, and other biochemical markers, followed by primary PCI. Comparative analysis was performed between male and female patients regarding baseline risk factors, angiographic patterns, procedural characteristics, and in-hospital adverse events.

Results: The mean age of male patients was 57.84 ± 10.83 years and female patients 59.31 ± 12.06 years. Smoking was reported only in males (14.43% vs. 0%), whereas females had significantly higher rates of hypertension (76.19% vs. 42.27%), diabetes mellitus (58.73% vs. 23.71%), and heart failure (20.63% vs. 10.31%). Anterior wall myocardial infarction (AWMI) was predominant among males, while inferior wall myocardial infarction (IWMI) was more common in females. The left anterior descending (LAD) artery was identified as the most frequent culprit vessel in both sexes. No significant differences were observed in procedural parameters; however, catheterization lab-related complications ($p = 0.05$) and in-hospital major adverse cardiac events (MACE) ($p = 0.035$) were significantly higher in female patients.

Conclusion: Female patients with STEMI present with a greater burden of cardiovascular comorbidities and experience higher in-hospital complication rates and MACE following primary PCI, despite a similar age of onset and angiographic profiles to their male counterparts. These findings underscore the importance of sex-specific risk stratification and post-PCI monitoring to improve outcomes in women.

Keywords

Gender Disparity, ST-Elevation Myocardial Infarction, Primary Percutaneous Coronary Intervention, Treatment Outcome

Introduction

Cardiovascular disease remains the leading cause of mortality in both men and women worldwide. However, significant gender-based differences exist in clinical presentation, risk profiles, and outcomes. Women presenting with acute coronary syndrome (ACS) are typically older and have a higher prevalence of comorbid conditions such as hypertension and diabetes compared to men[1,2] Additionally, several studies have reported higher in-hospital mortality rates among women with acute myocardial infarction (AMI). One proposed explanation for this disparity is the underutilization of guideline-recommended therapies and less aggressive treatment in women[3].

Acute ST-elevation myocardial infarction (STEMI) is a time-sensitive, life-threatening condition that necessitates prompt reperfusion therapy, most effectively achieved through primary percutaneous coronary intervention (pPCI). While pPCI has substantially improved survival and outcomes for STEMI patients, disparities in treatment and prognosis between genders persist. Historical data from both the pre-thrombolytic and thrombolytic eras have consistently shown poorer outcomes and increased mortality in women. Conversely, some contemporary studies, such as analyses from the Mayo Clinic, suggest that when adjusted for baseline clinical differences, post-PCI complication rates between men and women may not significantly differ[3].

Given these mixed findings, further investigation is warranted, particularly in underrepresented populations. This study aims to explore gender-based differences in angiographic findings, procedural interventions, and in-hospital outcomes among STEMI patients undergoing pPCI at a tertiary cardiac care centre in Khyber Pakhtunkhwa. As the largest cardiac facility in the province, our centre offers a comprehensive patient dataset, providing meaningful insights into gender-specific management patterns and outcomes in this regional population.

Methodology

This retrospective observational study included patients diagnosed with acute ST-elevation myocardial infarction (STEMI) who underwent primary percutaneous coronary intervention (pPCI) at our institution between March and August 2024. A standardized data collection form was completed for each patient based on a thorough review of their medical records.

Collected data included demographic variables (age and gender), clinical presentation, time to first electrocardiogram (ECG), and door-to-balloon time. Procedural characteristics such as vascular access site, culprit artery, thrombolysis in myocardial infarction (TIMI) flow grade, thrombus burden, and SYNTAX score were extracted from catheterization laboratory and PCI registry forms. In-hospital outcomes, including post-PCI complications, mortality, and major adverse cardiac events (MACE), were also recorded and compared between male and female patients.

Data were entered and analyzed using Stata version 14.2. Quantitative variables were expressed as mean ± standard deviation or median with interquartile ranges, as appropriate. Qualitative variables were presented as frequencies and percentages. Comparisons of categorical variables between groups were performed using the chi-square test or Fisher's exact test, where applicable. Continuous variables were compared using the independent samples t-test or Mann-Whitney U test, based on their distribution. A two-tailed p-value of <0.05 was considered statistically significant.

This study was approved by the Ethics Committee of the Peshawar Institute of Cardiology. The requirement for informed consent was waived by the committee due to the retrospective nature of the study.

Results

A total of 257 patients who met the inclusion criteria were included in the study, comprising 194 males and 63 females. Baseline clinical and

demographic characteristics are summarized in Table 1.

The mean age was 57.84 ± 10.83 years for males and 59.31 ± 12.06 years for females. Hypertension was more prevalent among females (76.19%, n = 48) compared to males (42.27%, n = 82), as was diabetes mellitus (58.73%, n = 37 in females vs. 23.71%, n = 46 in males). Smoking was reported in 14.43% of males, while none of the female patients reported smoking.

The mean arrival-to-first ECG time was 8.89 ± 2.58 minutes in males and 9.20 ± 3.14 minutes in females. The mean door-to-balloon time was slightly longer in females (96.09 ± 37.92 minutes) than in males (88.75 ± 40.39 minutes), with an overall mean of 90.55 ± 39.85 minutes.

Heart failure was significantly more common among females (20.63%, n = 13) compared to males (10.31%, n = 20), although this difference was not statistically significant (p = 0.33). Chest pain was the most common presenting symptom in both groups. The most frequent type of myocardial infarction was anterior wall MI in males (45.36%) and inferior wall MI in females (49.21%).

The radial artery was the predominant access site, used in 93.30% (n = 181) of males and 90.48% (n = 57) of females. Single-vessel disease was the most common angiographic finding. The left anterior descending (LAD) artery was the most frequently involved culprit vessel in both males (52.06%) and females (46.77%), followed by the right coronary artery (36.08% in males vs. 41.94% in females), with no statistically significant difference (p = 0.70). Triple vessel disease was observed in 21.65% of males and 19.35% of females (p = 0.90).

Most patients presented with TIMI 0 flow and a thrombus burden graded as 5 in the culprit vessel, with no significant gender difference. More than half of the cohort underwent dottering and pre-dilation. The majority had a low SYNTAX score, with mean scores of 17.19 ± 16.91 in males and 16.77 ± 7.72 in females.

TIMI 3 flow post-PCI was achieved in over three-quarters of patients in both groups (p = 0.258). Although incomplete revascularization was observed in 33.87% of females and 21.24% of males, this difference was not statistically significant (Table 2).

There was no significant difference in catheterization lab mortality between male and female patients (p = 0.40). However, procedure-related complications during catheterization were significantly more frequent in females (p = 0.05). Additionally, the incidence of in-hospital major adverse cardiovascular events (MACE) including recurrent myocardial infarction, heart failure, arrhythmias, cardiac death, and stroke was significantly higher in females than in males (p = 0.035) (Table 3).

Table 1: Baseline Demographic and Clinical Characteristics by Gender (n = 257).

Variables		Male (n = 194)	Female (n = 63)	Total (n = 257)	p-value
Age (Mean ± SD)		57.84 ± 10.83	59.31 ± 12.06	58.20±10.02	0.363
Comorbidities	Hypertension	82 (42.27%)	48 (76.19%)	130 (50.58%)	<0.001*
	Diabetes Mellitus	46 (23.71%)	37 (58.73%)	83 (32.30%)	<0.001*
	Dyslipidemia	35 (18.04%)	14 (22.22%)	49 (19.07%)	0.398
	Smoking	28 (14.43%)	0 (0.00%)	28 (10.89%)	0.003*
	Coronary Artery Disease History	31 (15.98%)	11 (17.46%)	42 (16.34%)	0.782
	Stroke	2 (1.03%)	0 (0.00%)	2 (0.78%)	0.418
	Heart Failure	20 (10.31%)	13 (20.63%)	33 (12.84%)	0.033*
	Class I	21 (10.82%)	9 (14.29%)	30 (11.67%)	0.689

NYHA Functional Class	Class II	164 (84.54%)	50 (79.37%)	214 (83.27%)	
	Class III	8 (4.12%)	4 (6.35%)	12 (4.67%)	
	Class IV	1 (0.52%)	0 (0.00%)	1 (0.39%)	
Presenting Symptoms	Chest Pain	159 (81.96%)	49 (77.78%)	208 (80.93%)	0.500
	Shortness of Breath	20 (10.31%)	8 (12.70%)	28 (10.89%)	
	Apprehension	7 (3.61%)	1 (1.59%)	8 (3.11%)	
	Others	8 (4.12%)	5 (7.94%)	13 (5.06%)	
Type of MI	Anterior Wall MI (AWMI)	88 (45.36%)	19 (30.16%)	107 (41.63%)	0.264
	Extensive AWMI (ExAWMI)	6 (3.09%)	1 (1.59%)	7 (2.72%)	
	Anterolateral Wall MI (ALWMI)	12 (6.19%)	7 (11.11%)	19 (7.39%)	
	Inferior Wall MI (IWMI)	76 (39.18%)	31 (49.21%)	107 (41.63%)	
	Posterior Wall MI (PWMI)	1 (0.52%)	0 (0.00%)	1 (0.39%)	
	Inferoposterior Wall MI (IPWMI)	11 (5.67%)	5 (7.94%)	16 (6.23%)	
Time Metrics	Arrival to First ECG (min, mean ± SD)	8.89 ± 2.58	9.20 ± 3.14	8.96 ± 2.72	0.427
	Door-to-Balloon Time (min, mean ± SD)	88.75 ± 40.39	96.09 ± 37.92	90.55 ± 39.85	0.851

*p<0.05 is considered statistically significant.

Table 2: Procedural Characteristics of Patients Undergoing Primary PCI by Gender.

Variable		Male (n=194)	Female (n=63)	Total (n=257)	p-value
Access Site	Radial	181 (93.30%)	57 (90.48%)	238 (92.61%)	0.457
	Femoral	13 (6.70%)	6 (9.52%)	19 (7.39%)	
LM Disease		12 (6.19%)	4 (6.45%)	16 (6.25%)	0.940
No. of Diseased Vessels	SVCAD (Single Vessel)	88 (45.36%)	28 (45.16%)	116 (45.31%)	0.903
	DVCAD (Double Vessel)	64 (32.99%)	22 (35.48%)	86 (33.59%)	
	TVCAD (Triple Vessel)	42 (21.65%)	12 (19.35%)	54 (21.09%)	
Culprit Vessel	LAD	101 (52.06%)	29 (46.77%)	130 (50.78%)	0.704
	LCX	23 (11.86%)	7 (11.29%)	30 (11.72%)	
	RCA	70 (36.08%)	26 (41.94%)	96 (37.50%)	
Initial TIMI Flow in Culprit Vessel	0	94 (48.45%)	35 (55.56%)	129 (50.19%)	0.203
	I	9 (4.64%)	3 (4.76%)	12 (4.67%)	
	II	19 (9.79%)	1 (1.59%)	20 (7.78%)	
	III	72 (37.11%)	24 (38.10%)	96 (37.35%)	
Thrombus Burden	Grade 1	19 (9.79%)	5 (7.94%)	24 (9.34%)	0.80
	Grade 2	23 (11.86%)	8 (12.70%)	31 (12.06%)	
	Grade 3	50 (25.77%)	12 (19.05%)	62 (24.12%)	
	Grade 4	9 (4.64%)	3 (4.76%)	12 (4.67%)	
	Grade 5	93 (47.94%)	35 (55.56%)	128 (49.81%)	
Dottering Performed		110 (60.11%)	34 (54.84%)	144 (58.78%)	0.466
Pre-Dilatation Done		110 (57.59%)	40 (64.52%)	150 (59.29%)	0.335
Mean SYNTAX Score		17.09 ± 15.17	17.19 ± 16.91	17.09 ± 15.17	0.851

SYNTAX Score Severity	Low	151 (77.84%)	46 (73.02%)	197 (76.65%)	0.714
	Intermediate	37 (19.07%)	15 (23.81%)	52 (20.23%)	
	High	6 (3.09%)	2 (3.17%)	8 (3.11%)	
Final TIMI Flow Post-PCI	0	1 (0.52%)	1 (1.59%)	2 (0.78%)	0.258
	1	-	-	-	
	2	21 (10.82%)	11 (17.46%)	32 (12.45%)	
	3	172 (88.66%)	51 (80.95%)	223 (86.77%)	
Residual SYNTAX / Revascularization Status	Complete Revascularization	88 (45.60%)	22 (35.48%)	110 (43.14%)	0.118
	Reasonable Incomplete	64 (33.16%)	19 (30.65%)	83 (32.55%)	
	Incomplete Revascularization	41 (21.24%)	21 (33.87%)	62 (24.31%)	
Post-PCI Tirofiban Infusion		58 (30.37%)	18 (29.03%)	76 (30.04%)	0.842

*p<0.05 is considered statistically significant.

Table 3: Outcomes by Gender.

Outcomes		**Male (n=194)**	**Female (n=63)**	**Total (n=257)**	**P-value**
Mortality in Cath Lab		1 (0.52%)	1 (1.59%)	2 (0.78%)	0.400
Cath Lab Complications	Arrhythmia	0 (0.00%)	2 (3.17%)	2 (0.78%)	0.050*
	No Complications	172 (88.66%)	51 (80.95%)	223 (86.77%)	
	Perforation	1 (0.52%)	0 (0.00%)	1 (0.39%)	
	No Flow or Slow Flow	21 (10.82%)	10 (15.87%)	31 (12.06%)	
In-Hospital MACE (Major Adverse Cardiac Events)	Recurrent MI	1 (0.52%)	1 (1.59%)	2 (0.78%)	0.035*
	Heart Failure	7 (3.61%)	3 (4.76%)	10 (3.89%)	
	Arrhythmias	7 (3.61%)	1 (1.59%)	8 (3.11%)	
	Cardiac Death	5 (2.58%)	8 (12.70%)	13 (5.06%)	
	Stroke	1 (0.52%)	0 (0.00%)	1 (0.39%)	
	None	173 (89.18%)	50 (79.37%)	223 (86.77%)	

*p<0.05 is considered statistically significant.

Discussion

This study provides valuable insight into gender-based differences in the clinical presentation, angiographic findings, and in-hospital outcomes among patients with acute ST-elevation myocardial infarction (STEMI) undergoing primary percutaneous coronary intervention (pPCI) in a tertiary cardiac care center.

Contrary to findings from several international studies[4-6] and regional data from India and Bangladesh[7,8] which report that women typically present with myocardial infarction at an older age than men our study observed no significant age difference between genders. This deviation may be attributed to the premature exposure of women in our population to risk factors such as hypertension and diabetes. While estrogen is known to confer vascular protection before menopause, its effects may be offset by a high prevalence of undiagnosed or poorly managed cardiometabolic conditions. Socioeconomic disparities, lifestyle differences, genetic predisposition, and ethnic variability may further explain the narrowed age gap in STEMI presentation between genders in our cohort.

Consistent with existing literature[9,10], our findings confirm a higher burden of cardiovascular risk factors in females particularly hypertension and diabetes compared to males. Interestingly, none of

the female patients in our study reported tobacco use, in contrast to 14.4% of males. While smoking is a well-established risk factor for coronary artery disease (CAD), the absence of this behavior in women may suggest either lower exposure to tobacco products or a more dominant role of metabolic and hormonal factors in disease development among females in our setting.

Although historically women were thought to present with atypical symptoms during acute coronary syndromes, recent evidence shows that chest pain remains the predominant symptom in both sexes[11]. Our findings align with this trend, as chest pain was the most common presenting symptom for both men and women in our study population.

Angiographic profiles including culprit vessel, number of diseased vessels, TIMI flow grade, thrombus burden, SYNTAX score, and tirofiban use were largely similar between the two groups. Although incomplete revascularization was more common in females, the difference was not statistically significant. These findings mirror the results of a previous large-scale national study conducted in Pakistan[12].

Importantly, this study observed a significantly higher rate of catheterization lab complications and in-hospital major adverse cardiovascular events (MACE) in females compared to males. This aligns with a body of evidence[12-15] reporting worse procedural and short-term outcomes in female STEMI patients, which may be explained by their higher burden of comorbidities, smaller coronary artery calibers, delayed symptom recognition, and potential differences in platelet reactivity or vascular responsiveness.

Limitations

This study has several limitations. Firstly, the retrospective design and single-center setting may affect the generalizability of the findings to broader populations. Secondly, the relatively small sample size especially in the female subgroup may have limited the statistical power to detect more subtle differences. Thirdly, only in-hospital outcomes were recorded; therefore, conclusions regarding long-term prognosis and post-discharge complications cannot be made. Additionally, gender disparities in access to healthcare, diagnostic bias, and sociocultural factors may have influenced the recognition and management of coronary artery disease, potentially underestimating the true burden in women. Despite these limitations, our study addresses a critical gap in regional data and emphasizes the need for gender-sensitive approaches in cardiovascular care. Future research should focus on prospective, multi-center studies with larger, more balanced cohorts and long-term follow-up to better understand the mechanisms underlying gender disparities in STEMI outcomes and to develop targeted strategies for improving care delivery and outcomes for all patients.

Conclusion

Female patients constitute a significant proportion of the STEMI population and bear a distinct clinical profile compared to their male counterparts. Although women present with ST-elevation myocardial infarction at a similar age as men, they exhibit a higher prevalence of comorbid conditions such as hypertension and diabetes. While angiographic characteristics appear broadly comparable between genders, the increased rate of in-hospital complications and major adverse cardiovascular events in women following primary PCI highlights persistent disparities in outcomes. These findings emphasize the importance of adopting a gender-sensitive, evidence-based approach in the management of STEMI. Tailored risk stratification, early identification of high-risk female patients, and equitable delivery of guideline-directed therapies may help close the outcome gap and improve overall cardiovascular care for women.

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References

1) Afaque SM, Muhammad AS, Kumar M, Aamir KF, Ahmed A, Soomro NA, Karim M, Ashraf T. Gender-based differences in clinical profile and outcome of primary percutaneous coronary intervention in patients with St-segment elevation myocardial infarction. Pak Heart J. 2021;54(3):254-260.
2) Gudnadottir GS, Andersen K, Thrainsdottir IS, James SK, Lagerqvist B, Gudnason T. Gender differences in coronary angiography, subsequent interventions, and outcomes among patients with acute coronary syndromes. Am. Heart J. 2017;191:65-74.
3) Singh M, Rihal CS, Gersh BJ, Roger VL, Bell MR, Lennon RJ, Lerman A, Holmes DR. Mortality differences between men and women after percutaneous coronary interventions: a 25-year, single-center experience. J Am Coll Cardiol. 2008;51(24):2313-2320.
4) Song X.T., Chen Y.D., Pan W.Q. Gender based differences in patients with acute coronary syndrome: findings from Chinese Registry of acute coronary events (CRACE). China Med J. 2007;120:1063-1067.
5) Guelker J.E., Bansemir L., Ott R. Gender-based acute outcome in percutaneous coronary intervention of chronic total coronary occlusion. Neth. Heart J. 2017;25:304-311.
6) Lempereur M., Magne J., Cornelis K. Impact of gender difference in hospital outcomes following percutaneous coronary intervention. Results of the Belgian working group on interventional cardiology (BWGIC) registry. EuroIntervention. 2014;10:1-8.
7) Deshmukh PP, Singh MM, Deshpande MA, Rajput AS. Clinical and angiographic profile of very young adults presenting with first acute myocardial infarction: Data from a tertiary care center in Central India. Indian Heart J. 2019;71(5):418-421.
8) Prakash B, Jaiswal A, Shah MM. Demographic & angiographic profile of young patients aged 40 year & less undergoing coronary angiography in a tier II city of Eastern India. Journal of family medicine and primary care. 2020;9(10):5183-5187.
9) Gender differences in coronary angiography, subsequent interventions, and outcomes among patients with acute coronary syndromes. Gudnadottir GS, Andersen K, Thrainsdottir IS, James SK, Lagerqvist B, Gudnason T. Am Heart J. 2017;191:65-74.
10) Leuzzi C., Sangiorgi G.M., Modena M.G. Gebdrr-specific aspects in the clinical presentation of cardiovascular disease. Fundam. Clin. Pharmacol. 2010;24:711-717.
11) Bhandari M, Singh V, Venkatraman D. A study of risk factors for acute myocardial infarction in patients below 35 years in eastern India. Nigerian journal of Cardiology. 2017;14(2):84-91.
12) Afaque SM, Muhammad AS, Kumar M, Aamir KF, Ahmed A, Soomro NA, Karim M, Ashraf T. Gender-based Differences in Clinical Profile and Outcome of Primary Percutaneous Coronary Intervention in Patients with ST-Segment Elevation Myocardial Infarction. Pak Heart J. 2021;54(03):254-260
13) Gender differences in coronary angiography, subsequent interventions, and outcomes among patients with acute coronary syndromes. Gudnadottir GS, Andersen K, Thrainsdottir IS, James SK, Lagerqvist B, Gudnason T. Am Heart J. 2017;191:65-74.
14) Venetsanos D, Lawesson SS, Alfredsson J, Janzon M, Cequier A, Chettibi M, et al. Association between gender and short-term outcome in patients with ST elevation myocardial infraction participating in the international, prospective, randomised Administration of Ticagrelor in the catheterisation Laboratory or in the Ambulance for New ST elevation myocardial Infarction to open the Coronary artery (ATLANTIC) trial: a prespecified analysis. BMJ Open. 2017;7(9):e015241.5.
15) Zachura M, Wilczek K, Kurzawski J, Gierlotka M, Gąsior M, Sadowski M. Gender-related differences in men and women with ST-segment elevation myocardial infarction and incomplete infarct-related artery flow restoration: a multicenter national registry. Postepy Kardiol Interwencyjnej. 2018;14(4):356.