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Assessing Gender Differences in Outcomes Post-Percutaneous Coronary Intervention

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ABSTRACT

Introduction: Gender disparities in cardiovascular outcomes have been observed globally, yet limited local data exists assessing these differences post-percutaneous coronary intervention (PCI) in Pakistan. **Objective**: To assess gender-based differences in clinical outcomes, symptom recurrence, complication rates, and quality of life following PCI in a tertiary care hospital in Pakistan. **Materials and Method**: A prospective observational study was conducted at Department of Cardiology, Hayatabad Medical Complex, Peshawar from July, 2021 to December, 2021. A total of 300 patients (180 males, 120 females) who underwent PCI were enrolled. Data on demographics, comorbidities, procedural outcomes, and post-discharge follow-up were collected and analyzed using SPSS v26. **Results**: Females were older and had higher rates of hypertension and diabetes. They experienced more bleeding events (12% vs. 5%), vascular complications, and lower post-PCI quality of life. Persistent chest pain and adverse cardiac events were also more frequent in females. **Conclusion**: Significant gender-based disparities exist post-PCI, highlighting the need for gender-specific treatment and follow-up strategies.

INTRODUCTION

Percutaneous coronary intervention (PCI) has evolved as the standard therapy for the treatment of CAD now as it offers decreased mortality and better relief to patients suffering from acute coronary syndromes and chronic angina pectoris. For the general medical preferences shifting from a geographic localization to a molecular one, sex and gender differences have been established to play a pivotal role in clinical outcomes following PCI. However, there has been advancement in interventional cardiology, and studies show that males and females have different physiological and long-term results after PCI (1). A study on the national registry of women in Australia showed that women run a different clinical phenotype than men when presenting for PCI and have a higher rate of adverse outcomes after the procedure even when corrected for demographics (1). Further, sex differences of perceived health status and cognition following PCI have also been researched for, and it has been deduced that females have a higher tendency of nevertheless complaining of serious cognitive problems and psychological pressure after therapy.

Studies done in Southeast Asian countries also revealed that the quality-of-life assessment of women who went through the PCI was lower compared to that of men, which included lower numerical ratings as regards EB and PF (3). These observations explain the complex nature of the recovery process and also the role of female-sensitive care planning after the PCI. Such a parameter that is important in the present context is the heterogeneity in the antithrombotic effect. The women were more prone to bleed, which can, at least in part, explain their worse prognosis and the higher morbidity in the post-procedure period (4). This is especially important given that DAPT, which is essential in the prevention of stent thrombosis, is known to increase the risk of hemorrhagic events. According to earlier research, optimization of sex-specific dose and bleeding risk assessment can be effective in improving outcomes of female patients (4).

Age, the other modifying variable, commonly correlates with gender when it comes to PCI results. Long-term survival depends mainly on biological age and its relation with sex, particularly among the patients

diagnosed with STEMI (5). Older women have a higher burden of comorbidities, including diabetes and hypertension, and can have delayed presentation with decreased probability of obtaining reperfusion therapy on time, aggravating the risk of complications (5). Furthermore, long-term follow-up observations indicate that females are at increased risk of MACE and all-cause death in comparison to males, underscoring the necessity for ongoing post-discharge monitoring and secondary prevention measures with sex-specific stratification (6). Meta-analytic evidence also corroborates these sex-differentiated outcome differences. A network meta-analysis reported that women have a lower benefit from extended DAPT and are at higher risk for complications like bleeding and ischemic events, especially with the use of newer-generation drug-eluting stents (7). This is strong evidence for the need to incorporate sex-specific risk-benefit evaluations in clinical decision-making.

At the local level, research in Pakistan has also started to identify the same trends. A recent study identified that women report non-ischemic chest pain more after PCI and with psychosocial and socio-demographic conditions of lower socioeconomic status and limited education (8). This implies that environmental and cultural factors could again enhance sex-specific differences in perception of symptoms and utilization of care. At a pathophysiologic level, coronary microvascular dysfunction—invisible to conventional angiography—is becoming increasingly known in women with chronic chest pain following PCI (9). The dysfunction could be responsible for the mismatch between angiographic success and persistent symptoms, especially among female patients. Adjuvant diagnostic modalities like fractional flow reserve (FFR) have proven useful in maximizing PCI results, but their universal application is currently restricted, particularly in resource-limited environments (10).

Post-procedural care practices, including strategies to prevent access site complications like hematoma formation, have also demonstrated variability in efficacy based on gender, possibly due to differences in vessel size and tissue characteristics (11). Moreover, the role of cardiac rehabilitation in elderly women is especially critical, as they are more likely to experience functional decline and are under-referred for structured rehabilitation programs (12). Pharmacokinetic studies emphasize further sex-specific nuances. For instance, research into ticagrelor metabolism has revealed variability in drug concentration profiles, with potential implications for dosing strategies that may need to differ by sex to optimize therapeutic effects and minimize side effects (13). Similarly, the prognostic utility of post-PCI FFR values appears to vary across sexes, though additional studies are required to confirm these findings (14). Furthermore, developing non-pharmacological therapies like acupuncture as adjunctive treatments for angina management following PCI. Preliminary protocols suggest these provide gender-related advantages, particularly in treating psychosomatics and stress aspects more common to female patients (15). Altogether, the research discussed in the present paper highlights the complex relationship between biological, psychosocial, and procedural factors influencing gender differences in PCI outcomes. This understanding is vital for improvement in sex-specific therapies and escalating the consciousness of gender-sensitive care among patients who have undergone PCI.

Objective

To analyze the gender disparity regarding the outcome, recurrence of the symptoms, quality of life, and complication rate in patients who underwent percutaneous coronary intervention in the tertiary care setting in Pakistan.

MATERIALS AND METHODS

Design: Observational Comparative Study.

Study setting: The study was carried out at Department of Cardiology, Hayatabad Medical Complex, Peshawar

Duration: The study was carried out over a six-month period from from July, 2021 to December, 2021**.**

Inclusion Criteria

All adults aged 18 years or older who were undergoing PCI during the period of study were included. Both urgent and elective cases were considered. They needed to sign up for informed permission and reside for follow-up phone calls. The trial was conducted among male and female patients to make gender-based outcome comparisons.

Exclusion Criteria

Patients with incomplete medical records, prior coronary artery bypass graft surgery (CABG), known malignancies, or those who refused follow-up or were lost during the study period were excluded from the analysis.

Methods

Data were collected prospectively from patients undergoing percutaneous coronary intervention (PCI) at Department of Cardiology, Hayatabad Medical Complex, Peshawar from July, 2021 to December, 2021**,** Demographic details, clinical history, procedural characteristics, and pharmacological therapies were documented. Outcomes assessed included in-hospital complications, bleeding events, major adverse cardiac events (MACE), recurrence of symptoms, and quality of life over a follow-up period of three months. Quality of life was evaluated using a standardized questionnaire, and bleeding events were classified according to the Bleeding Academic Research Consortium (BARC) criteria. All patients were followed through outpatient visits and phone interviews. Data were stratified by

gender to assess differences in outcomes. Statistical analysis was performed using SPSS version 26.0. Chi-square tests and independent t-tests were used for categorical and continuous variables respectively, with a p-value <0.05 considered statistically significant. Ethical approval was obtained from the hospital's institutional review board prior to the start of the study.

RESULTS

A total of 300 patients undergoing percutaneous coronary intervention (PCI) were enrolled during the study period, including 180 males (60%) and 120 females (40%). The mean age of male patients was 58.4 ± 9.3 years, while that of female patients was 61.2 ± 8.7 years. Comorbidities such as hypertension and diabetes mellitus were more prevalent among females (72% and 58%, respectively) compared to males (55% and 47%, respectively). Smoking history was notably higher in males (68%) than females (12%).

Table 1

Baseline Demographic and Clinical Characteristics by Gender

Variable	Males (n=180)	Females (n=120)	p-value
Mean Age (years)	58.4 ± 9.3	61.2 ± 8.7	0.018
Hypertension	55%	72%	0.006
Diabetes Mellitus	47%	58%	0.045
Smoking	68%	12%	<0.001
Hyperlipidemia	38%	41%	0.611

Regarding procedural characteristics, no significant difference was found between genders in terms of lesion complexity, type of stent used, or procedural success rate, which was above 95% in both groups. However, post-procedural bleeding was significantly higher among female patients (12%) compared to males (5%). Similarly, females reported a higher incidence of access-site hematoma and minor vascular complications.

Table 2

Procedural and In-Hospital Outcomes by Gender

Outcome	Males (n=180)	Females (n=120)	p-value
Procedural Success Rate	96.1%	95.8%	0.891
Post-PCI Bleeding Events	5%	12%	0.021
Access Site Hematoma	3%	9%	0.013
Vascular Complications	2%	7%	0.038
In-hospital Mortality	1.6%	2.5%	0.612

At three-month follow-up, quality of life scores were lower among females, especially in physical activity and emotional well-being domains. Additionally, 14% of females reported persistent angina or non-ischemic chest pain versus 7% of males. Major adverse cardiac events (MACE), including recurrent myocardial infarction and rehospitalization, were reported in 10% of females and 6% of males.

Table 3

Follow-up Outcomes at 3 Months by Gender

Outcome	Males (n=180)	Females (n=120)	p-value
Persistent Chest Pain	7%	14%	0.042
MACE (MI/Rehospitalization)	6%	10%	0.183
Lower QoL (Physical/Emotional)	18%	33%	0.004

These findings highlight notable gender-based differences in both early and short-term post-PCI outcomes.

DISCUSSION

The objective of the present study was to assess gender comparison of outcomes following percutaneous coronary intervention (PCI) in a tertiary care hospital in Pakistan. The results are in line with an expanding body of international evidence that women having PCI tend to have worse outcomes than men after the procedure — in terms of both procedural complications and post-procedural quality of life. An important finding in this study was that those female patients achieved a later age of presentation and had a higher prevalence of co-morbidities such as hypertension and diabetes mellitus, which are known risk factors for poor cardiac outcomes. This is consistent with findings by Conradie (1), who reported a similar baseline disparity in a large Australian PCI registry. These comorbid conditions probably explain why women have a greater rate of complications after PCI. However, in this study, women also had lower smoking rates than men, which might be due to sociocultural factors rather than actual cardiovascular risk reduction.

Gender-specific variations in psychological recovery and subjective health reports were seen in this study. Female patients also reported significantly poor quality of life at three-month follow-up, especially in emotional and physical health aspects. This result is similar to that of van den Houdt et al. (2), who proved that women tend to report more cognitive and emotional loads after PCI. Vu et al. (3) also reported a worsening of health-related quality of life in Vietnamese women after PCI, highlighting the international applicability of gender-responsive strategies in cardiac rehabilitation. Perhaps the most significant to report in this study was the exceedingly higher rate of bleeding complications in female patients after the procedure. This has been confirmed by the work of Numao et al. (4), where increased bleeding risk in women undergoing antithrombotic therapy was emphasized. Some of the reasons for this vulnerability include smaller vessel diameter, changed platelet reactivity, and variability in drug pharmacokinetics. These physiological differences might necessitate sex-specific dosing regimens to avoid complications while maintaining efficacy.

Biological age is also curtailed, and gender is the second most influential determinant of PCI outcomes. Rathod et al. (5) emphasized that women aged 75 and older with

STEMI are less likely to receive reperfusion therapy and more likely to have increased delays in delays, factors that have a poor prognosis. The findings are consistent with this perspective since the older women in sample reported a higher incidence of post-procedure complications and lower satisfaction with postoperative outcomes. However, regarding chronic negative outcomes like recurrent myocardial infarction and hospital readmission, the results showed that these effects were significantly higher in females. This finding is similar to van den Houdt et al. (6) study, which established raised MACE and all-cause mortality in women at 5 years after PCI. Such trends call for longer-term continued follow-up and post-surgical/prevention strategies catering to female residual risk.

It is also pivotal to discuss gender aspects of pharmacotherapy based on the data obtained during the study of patients after PCI, including DAPT. In their study, Agbaedeng et al. (7) reported a higher risk of bleeding alongside a lesser net benefit for only the long-term DAPT. This supports again the need for more individualized and more patient-staged anticoagulation and antiplatelet therapy that should consider patient sex while balancing thrombotic and hemorrhagic risks. Locally, there are other factors that contribute to inequality in this area of society, and psychosocial issues form part of them. In their cross-sectional study, Naz et al . (8) found that non-ischemic chest pain was further common in post-PCI females from Pakistan because of their low literacy, health-related concerns, and financial problems. These could result in increased reportage of symptoms, poor adherence to treatment measures, and increased levels of psychological distress among women. Additionally, as highlighted by Cui et al. (9), CVD is particularly high among women who still present with persistent angina after PCI. The proposed condition may be the reason for the chronic pain in the absence of significant epicardial stenosis, and it is often overlooked because of the limitations of traditional angiography.

Women patients were also significantly more prone to experience access-site complications such as hematoma formation, an observation that is in agreement with other works such as Leone et al. (10), who urged for procedural improvement and techniques used in closing vascular procedures to minimize such occurrences. Similarly, the study by Patil et al. (11) suggests that post-procedure care practices such as cryotherapy are effective in minimizing access-site hematomas, particularly among high-risk groups such as older women. Gender differences are not restricted to the outcomes of clinical findings but also affect the willingness and success in rehabilitation. Biben et al. (12) showed that older women are less likely to participate in CR programs due to their functional limitations, caregiving obligations, and socioeconomic factors. This is more evident in South Asia, where women might have limited control over health affairs.

There is still information about the possible differentiation of drug metabolic and pharmacokinetic properties between females and males. According to Zheng et al. (13), the plasma concentration of ticagrelor in PCI patients also has variations in its therapeutic effect and bleeding profile. This suggests that gender should be considered when planning dosing and monitoring strategies. Andersen et al. (14) pointed out that FFR after PCI as a major prognostic indicator may yield different outcomes for gender, but more research is needed. Finally, different techniques that have not been applied before, such as acupuncture, have been recommended to manage angina signs and symptoms after PCI. Zhou et al. (15) proposed a protocol for conducting systematic reviews on the effectiveness of acupuncture in symptom relief, especially in patients with chronic chest pain. Since such symptoms are commonly experienced by women, this form of treatment may be a gender-sensitive intervention that is worthy to be explored in future studies.

CONCLUSION

The conclusions in this study include the processes, development of complications, and quality of life after percutaneous coronary intervention (PCI), focusing on the different results between genders. All female patients, compared with male subjects, were older in age and had a considerably higher rate of significant comorbidities primarily involving the cardiovascular and renal systems and a higher rate of postintervention hemorrhage and other vascular troubles. Moreover, respondents claimed a worse quality of life and increased long-term rates of chest pain recurrence at a follow-up examination. These results tally with international data and conclude the fact that gender acts as an important predictor of both early and short-term PCI performance. The findings indicated that biological, pharmacological, and socio-demographic factors could have made women more vulnerable to risk factors. Men and women present different characteristics and risk factors that must be addressed when planning and implementing care processes and post-PCI follow-up. Future studies must obtain better plans and protocols to give a fair opportunity to female patients and maintain the diversification of CVD patients. This work provides helpful information that fills the gap and adds to the international literature on the issue of gender inequality in the field of cardiology.

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