

# Frequency of Symptomatic Heart Failure After Primary PCI in STEMI Patients: A Clinical Snapshot

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## Article Info

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## Abstract

**Objective:** To determine the frequency of symptomatic heart failure in patients managed with primary percutaneous coronary intervention during one month follow up period.

**Methodology:** Descriptive, prospective observational study, conducted in the Department of Cardiology, Lady Reading Hospital, MTI, Peshawar. Study duration was from July 2023 to January 2024 and sample size of 228 participants. Male and female patients of 18 years and above undergoing primary PCI were enrolled. Patients were followed for a period of one month. Presence of symptomatic heart failure and New York Association of heart Failure (NYHA) class was assessed.

**Results:** Total 228 patients were enrolled. Mean age of the patients was  $50.60 \pm 7.548$  years. Male were 160 (70.2%) and female 68 (29.8%). Symptomatic heart failure at month follow up was present in 12.3% (28) patients. Among these, NYHA Class IV Heart failure was present in 05 (2.2%) and NYHA class III in 08 (3.5%) patients while NYHA class II and NYHA class I was present in 09 (3.9%) and 06 (2.6%) patients respectively.

**Conclusion:** Symptomatic heart failure after primary PCI for STEMI is not uncommon. Early identification of high-risk patients for HF development and more aggressive secondary prevention efforts may help to further reduce mortality and morbidity in these population.

**Keywords:** Heart failure, Primary Percutaneous Coronary Intervention, Coronary Artery Disease

## Introduction

Coronary artery disease (CAD) is still the leading cause of morbidity and mortality worldwide. While mortality from CAD is on the down trend over the past few decades due to advances in technology and improvement in diagnosis and treatment, particularly in developed countries, it is still on the uptrend in developing nations such as Pakistan and India.<sup>1,2</sup> Nearly one third deaths at the age above 35 years are due to Cardiovascular diseases.<sup>3</sup> The severity and extent of CAD are most of the time directly related to the number of affected coronary arteries, and its most significant risk factors include hypertension, cigarette smoking, diabetes mellitus, dyslipidemia, and obesity.<sup>4,5</sup>

Among consequences of CAD, Congestive heart failure (CHF) is critical complication leading to mortality. It also imposes heavy burden on health care resources because of recurrent hospitalizations and requirement of life time care and drugs.<sup>6</sup> Though primary percutaneous coronary intervention (PCI), the gold standard treatment for acute ST-elevation myocardial infarction (STEMI), a large proportion of patients develop symptomatic heart failure after the intervention, and heart failure develop more often when Acute STEMI is managed with thrombolytics.<sup>7,8</sup>

While timely reperfusion therapy has significantly improved myocardial salvage and reduced mortality, it has paradoxically increased the likelihood of survivors developing heart failure Left ventricular Function at the time of percutaneous coronary intervention (PCI) is a strong independent predictor of long-term mortality.<sup>10</sup> Kellay et al.<sup>12</sup> reported that up to 8% of patients developed symptomatic heart failure (New York Heart Association [NYHA] class II–IV) within one month of undergoing primary PCI. This issue is particularly relevant in the post-fibrinolytic era, when heart failure is more pronounced and severe.<sup>11</sup>

With the primary PCI is more frequently used as the preferred treatment strategy for ST-segment elevation myocardial infarction (STEMI) in recent years, there remains limited data regarding whether the incidence of heart failure has decreased and to what extent among these patients. A study conducted in Rawalpindi, Pakistan, reported a post-PCI symptomatic heart failure frequency of approximately 11% in STEMI patients.<sup>13</sup> Similarly, an Indian registry documented incidence rates ranging from 10% to 14%, depending on comorbid conditions and infarct size.<sup>14</sup>

Therefore, the present study was conducted to determine the true frequency and severity of heart failure in patients undergoing primary PCI in the local setting. This study aims to provide contemporary data on the burden of symptomatic heart failure in STEMI patients treated with primary PCI and to offer insights that may guide future strategies for prevention, early detection, and optimal management in this high-risk population.

## Methodology

This descriptive, prospective observational study was conducted in the Department of Cardiology, Lady Reading Hospital, MTI, Peshawar over a period of six months from 7<sup>th</sup> July 2023 to 6<sup>th</sup> January 2024.

The sample size was calculated using the WHO sample size formula, taking the prevalence of symptomatic heart failure as 8.0%, with a 95% confidence level and a 5% margin of error, resulting in a required sample size of 228 patients. A non-probability consecutive sampling technique was employed.

Ethical approval was obtained from the Institutional Review Board (Ref No: 800/LRH/MTI, dated 26<sup>th</sup> June 2023). Patients aged  $\geq 18$  years, of either gender, presenting with ST-elevation myocardial infarction (STEMI) and undergoing primary percutaneous coronary intervention (PCI) were included in the study. Patients were recruited from the emergency department and outpatient cardiology department. Written informed consent was obtained from all participants after ensuring confidentiality and explaining that participation involved no additional risk.

Patients with a prior history of coronary artery interventions, valvular heart disease, prior thrombolytic therapy for the current event, history of cerebrovascular accident, peripartum cardiomyopathy, or known bleeding diathesis were excluded from the study.

Baseline demographic and clinical data were recorded, including age, gender, and body mass index (BMI), calculated as weight in kilograms divided by height in meters squared ( $\text{kg}/\text{m}^2$ ). A detailed clinical history and physical examination were performed for all participants. Cardiovascular risk factors, including hypertension, diabetes mellitus, and smoking status, were documented. Left ventricular function was assessed at the time of PCI.

Coronary angiography and primary PCI were performed by a consultant cardiologist. To ensure procedural uniformity, all interventions were carried out in the same catheterization laboratory using the same equipment. Radial route and alternatively femoral route, when radial route was not successful, was used for the procedure. Drug eluting stent was used in all patients undergoing PCI. TIMI II/III flow was achieved in all patients except 2 patients who developed no reflow and were treated with tirofiban infusion. Patients were observed in the hospital for 48 hours post-procedure and subsequently followed up for one month through outpatient visits or emergency visit for class IV heart failure and telephone contact.

- Symptomatic heart failure was assessed based on clinical history and physical examination and classified according to the New York Heart Association (NYHA) functional classification. It was defined by the presence of symptoms such as dyspnea, paroxysmal

nocturnal dyspnea, orthopnea, fatigue, reduced exercise tolerance, and peripheral edema. The severity of heart failure was categorized into NYHA Class I to IV: Class I = no limitation

- Class II = symptoms with ordinary activity
- Class III = symptoms with less than ordinary activity
- Class IV = symptoms at rest

#### Data Analysis

Data were entered and analyzed using IBM SPSS version 23. Qualitative variables, including gender, type of STEMI, and presence of symptomatic heart failure, were expressed as frequencies and percentages. Quantitative variables, including age and BMI, were presented as mean  $\pm$  standard deviation.

Effect modifiers such as age, gender, BMI, type of STEMI, number of vessels involved, and duration from onset of chest pain to intervention were controlled through stratification. Post-stratification, the chi-square test was applied to assess associations. A  $p$ -value  $\leq 0.05$  was considered statistically significant.

## Results

A total of 228 patients undergoing primary percutaneous coronary intervention (PCI) for ST-elevation myocardial infarction (STEMI) were included in the study. The mean age of the patients was  $50.6 \pm 7.5$  years. Patients aged  $<40$  years comprised 50 (21.9%), while those aged  $\geq 40$  years were 178 (78.1%). The mean weight and height were  $75.14 \pm 5.87$  kg and  $172.89 \pm 6.49$  cm, respectively.

Out of the total participants, 160 (70.2%) were male and 68 (29.8%) were female. Based on body mass index (BMI), 184 (80.7%) patients had BMI  $\leq 24.0$  kg/m<sup>2</sup>,

while 44 (19.3%) had BMI  $>24.0$  kg/m<sup>2</sup>.

Regarding the type of myocardial infarction, anterior wall STEMI was the most common, observed in 126 (55.3%) patients, followed by inferior wall STEMI in 46 (20.2%), lateral wall STEMI in 32 (14.0%), posterior wall myocardial infarction (with or without inferior wall involvement) in 14 (6.1%), and combined myocardial infarctions (anterolateral and antero-inferior) in 10 (4.4%). Baseline characteristics of the study population are shown in Table 1.

At one-month follow-up, 28 (12.3%) patients developed symptomatic heart failure. Among these, NYHA Class IV heart failure was observed in 5 (2.2%) patients, Class III in 8 (3.5%), Class II in 9 (3.9%), and Class I in 6 (2.6%) patients.

The frequency of heart failure according to the type of myocardial infarction is presented in Table 2. The highest frequency was observed in patients with combined myocardial infarctions (20%), followed by anterior wall MI (14.3%).

There was no statistically significant difference in the frequency of heart failure between male and female patients (male: 20/160 [12.5%] vs female: 8/68 [11.8%];  $p = 0.67$ ). However, heart failure was significantly more frequent in older patients. Among patients aged  $<40$  years, only 2 (4.0%) developed heart failure compared to 26 (14.6%) patients aged  $\geq 40$  years ( $p = 0.003$ ).

The association between BMI and heart failure was not statistically significant (BMI  $\leq 24.0$  kg/m<sup>2</sup> vs  $>24.0$  kg/m<sup>2</sup>;  $p = 0.347$ ).

A significant association was observed between delayed presentation and the development of heart failure. Patients presenting more than 12 hours after the onset of chest pain had the highest frequency of heart failure (53.6%), as shown in Table 3.

**Table 1. Baseline Characteristics of Study Population**

Parameters	Frequency (%) / Mean $\pm$ SD
Age(years)	50.6 $\pm$ 7.5
Male	160(70.2%)
Weight (Kg)	75.14 $\pm$ 5.87
Height(cm)	172.89 $\pm$ 6.49
Diabetes Mellitus	51(22.3%)
Hypertension	108 (47.3%)
BMI(Kg/m2)	21.7
Systolic BP	128mmHg
Diastolic BP	83 mmHg
Dyslipidemia	17(7.4%)
Smoking	18(7.8%)

**Table 2. Frequency of Heart Failure According to Type of Myocardial Infarction**

Type of Myocardial Infarction	Heart Failure (n/N)	Percentage (%)
Anterior Wall MI	18/126	14.3%
Inferior Wall MI	5/46	10.9%
Lateral Wall MI	2/32	6.3%
Posterior Wall MI (PWMI)	1/14	7.1%
Combination MI*	2/10	20.0%
Total	28/228	12.3%

Values are presented as number of patients who developed heart failure / total number of patients in that myocardial infarction category (n/N). Percentages represent the proportion of patients developing heart failure within each specific type of myocardial infarction, not the overall study population. The total percentage (12.3%) represents the overall frequency of heart failure in the entire study cohort.

\*One anterolateral and one antero-inferior MI

**Table 3. Frequency of Heart Failure According to Duration of Chest Pain**

Duration of Chest Pain	Heart Failure (n)	Percentage (%)
<4 hours	0	0.0%
4–8 hours	4	14.3%
8–12 hours	5	17.9%
>12 hours	15	53.6%
Total	28	100%

Note: This table shows the distribution of heart failure cases according to duration of chest pain prior to presentation. Percentages are calculated from the total number of patients who developed heart failure (n = 28).

## Discussion

In the present study, the frequency of symptomatic heart failure at one-month follow-up after primary percutaneous coronary intervention (PCI) for ST-elevation myocardial infarction (STEMI) was 12.3%. Among these, advanced heart failure (NYHA Class III and IV) was observed in 3.5% and 2.2% of patients, respectively. These findings highlight that despite timely reperfusion strategies; heart failure remains a significant early complication following STEMI.

Our results are consistent with several international registries. The SWEDEHEART registry<sup>15</sup> reported a higher incidence of heart failure ranging from 16–20% among STEMI patients, with anterior wall infarction and delayed revascularization identified as major predictors. Similarly, the ACTION Registry–GWTG<sup>16</sup> demonstrated heart failure in 12–15% of patients following PCI, which closely aligns with our observed frequency of 12.3%. The TAMAMI registry from Japan<sup>17</sup> reported a comparable incidence of 14.7%, particularly in elderly patients and those with multivessel coronary artery disease.

The slightly lower frequency observed in our study compared to some international cohorts may be explained by the shorter follow-up duration (one month), whereas many registries report outcomes over longer

periods, including 6 months to 1 year. Additionally, differences in patient characteristics, healthcare infrastructure, and early management strategies may contribute to these variations.

In the regional context, studies from South Asia<sup>18,19</sup> have reported higher rates of symptomatic heart failure, ranging from 18% to 25%. A study conducted in Rawalpindi, Pakistan, reported a frequency of approximately 11%, which is comparable to our findings. The relatively higher burden reported in South Asian populations is likely due to delayed presentation, limited access to PCI-capable centers, and a higher prevalence of uncontrolled cardiovascular risk factors such as diabetes, hypertension, and dyslipidemia.

In our study, increasing age was significantly associated with the development of heart failure, which is consistent with previous studies demonstrating reduced myocardial reserve and higher comorbidity burden in elderly patients. Furthermore, patients with multivessel disease showed a higher tendency to develop heart failure, likely reflecting a larger area of myocardial ischemia and impaired left ventricular function.

Importantly, delayed presentation emerged as a key determinant of heart failure in our cohort. Patients presenting more than 12 hours after the onset of chest pain had the highest frequency of heart failure. This finding is in agreement with multiple international and

regional studies, which have consistently shown that prolonged ischemic time results in greater myocardial damage and poorer functional recovery. In low- and middle-income countries, including Pakistan, delays are often attributed to lack of symptom awareness, transportation barriers, and limited availability of specialized cardiac care facilities.

This study has several limitations that should be considered while interpreting the results. First, it was a single-center study, which may limit the generalizability of the findings to other populations. Second, the use of a non-probability consecutive sampling technique may introduce selection bias. Third, the follow-up period was limited to one month, which may underestimate the true incidence of heart failure, as some patients may develop symptoms later.

Additionally, heart failure was assessed primarily on clinical criteria without systematic use of advanced imaging parameters such as serial echocardiographic assessment of left ventricular ejection fraction, which could provide more objective evaluation. Furthermore, potential confounding factors such as medication adherence, infarct size quantification, and biochemical markers were not fully evaluated.

The findings of this study emphasize the need for early identification of high-risk patients. Efforts to reduce ischemic time through improved public awareness, efficient referral systems, and expansion of PCI-capable centers are essential particularly the elderly and those with delayed presentation or extensive coronary artery disease.

Primary PCI program should be integrated to BHU level and organized in a way that this Life saving procedure be delivered in a timely fashion, thereby not only improving mortality due to STEMI, but at the same time reducing STEMI complication such as heart failure and improve long-term outcomes.

## Conclusion

Symptomatic heart failure remains a common early complication following primary PCI for STEMI, affecting more than one in ten patients. Advancing age, delayed presentation, and extent of coronary artery involvement were key determinants. Addressing these factors through timely intervention and comprehensive post-procedural care is essential to improve patient outcomes.

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#### Authors' Contribution Statement

ZU contributed to the design, acquisition, analysis, interpretation of data, drafting of the manuscript, and critical review of the manuscript. MAI contributed to the conception, design, acquisition, analysis, interpretation of data, critical review of the manuscript, and final approval of the version to be published. All authors are accountable for their work and ensure the accuracy and integrity of the study.

#### Conflict of Interest

Authors declared no conflict of interest

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None

#### Data Sharing Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.