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ADULT CARDIOLOGY

# Comparison of Short Term In-Hospital Outcomes in patients presenting with ST-Elevation Myocardial Infarction Versus Non-ST-Elevation Myocardial Infarction

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## ABSTRACT

***Objective:*** To compare the short term in-hospital outcomes in patients presenting with acute ST-Elevation Myocardial Infarction (STEMI) and Non-ST-Elevation Myocardial Infarction (NSTEMI).

***Study Design:*** Comparative Cross-sectional study.

***Place and Duration of Study:*** Adult cardiology department of tertiary care center, Rawalpindi Pakistan, from Aug 2022 to Feb 2023.

***Methodology:*** A sample of 323 patients of acute STEMI and NSTEMI were enrolled. Patients fulfilling the inclusion criteria were enrolled through non-probability consecutive sampling. Patients were divided into two groups. The data of short term in hospital outcomes was recorded. Data was entered and analyzed using SPSS version-26:00. Chi-square and t-test were used to find association and mean difference of study variables between study groups.

***Results:*** Out of total 317 patients, males were 262(82.6%) and females were 55(17.4%)) with an average age of 63.34±8.96 years in the study. 139(43.8%) patients had Diabetes Mellitus, 146(46.1%) were hypertensive and 73(23.0%) were smokers. 198(62.5%) patients had STEMI and 119(37.5%) had NSTEMI. Mortality within hospital was found in 10(3.2%) patients. There were significant findings with age ($p$<0.001), gender ($p$<0.001), diabetes ($p$=0.01), pulmonary edema ($p$=0.01) and severe Left Ventricular Dysfunction (LVD) ($p$<0.001). Higher in-hospital mortality rate was noted in NSTEMI group, i.e. 5(4.2%) compared to STEMI 5(2.5%), but the findings were statistically insignificant ($p$=0.40).

***Conclusion:*** There was no meaningful distinction between the two groups' immediate outcomes. Although patients with NSTEMI had relatively higher complication rates and in-hospital mortality, and patients with STEMI had better short-term outcomes, suggesting that patients with NSTEMI may also require immediate medical attention.

**Keywords:** In-hospital Mortality, Myocardial Infarction, Non-ST-Elevation Myocardial Infarction, Outcome, ST-Elevation Myocardial Infarction.

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## INTRODUCTION

Myocardial Infarction (MI) is one of the most common life-threatening diagnoses in emergency departments, with most complications occurring within the first few hours.[1] The prevalence of MI in Pakistan is estimated to be >30% of the population over 45 years of age.[2] MI is divided into two categories, i.e. acute ST-Elevation MI (STEMI) and non-ST-Elevation MI (NSTEMI). STEMI is electrocardiographically defined as new J-point ST-segment elevation in leads V2-V3 and/or additional adjacent thoracic or limb leads of less than 1 mm (0.1mv) in males older than 40 years; less than 2.5mm in men younger than 40 years; or less than 1.5mm (0.15mv) in women.[3] NSTEMI is identified electrocardiographically as a new down-sloping or horizontal or ST-segment depression of less than 0.5 mm in two adjacent leads, as well as a T wave inversion of more than 1mm in two-adjacent leads with a strong R wave or an R/S ratio of >1.[4]

Distinguishing acute Myocardial Infarction from Unstable Angina pectoris is based on the rise or fall of myocardial biomarkers such as Troponin-I (Hs).[5] Any cause leading to complete blocking of a coronary artery tends to have STEMI or incomplete arterial occlusion. Worse short-term outcomes were noted in patients with STEMI and worse long-term outcomes in patients with NSTEMI.[6] MI generally occurs when there is a sudden decrease in blood flow of coronary arteries following thrombotic occlusion of previously narrowed coronary artery due to atherosclerosis. Atherosclerosis is the formation of fibrous fatty lesions in the arterial intima that causes major worldwide morbidity followed by mortality, including most MI and many strokes, as well as disabling peripheral

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arterial disease.[7] High-grade stenosis which is developing slowly in coronary arteries stenosis usually does not cause an acute infarction due to the development of rich collateral network with time. This damage is caused or smoothed by factors such as hypertension, cigarette smoking, and lipid accumulation. Frequently, infarction occurs when the atherosclerotic plaque ruptures or ulcerates and when conditions, either local or systemic; favor thrombogenesis, so that a mural thrombus forms at the rupture site and leads to occlusion of coronary artery.[1,2]

Patients with STEMI and NSTEMI have comparable pathophysiology and risk factors,[8] but the short- and long-term prognoses are very different. Patients with NSTEMI had a worse long-term prognosis, but patients with STEMI have higher in-hospital mortality and a worse short-term outcome.[9] The underlying origins of this behavior are not fully understood at this time, however a number of pathogenic mechanisms have been put out as potential explanations. Patients with NSTEMI have worse clinical risk profile (i.e., they are older, have more comorbidities, and have history of Ischemic Heart Disease more frequently),[8,9] a higher rate of recurrent ischemia, and are less likely to receive referrals for recommended treatment approaches at discharge.[10] This study compared the short-term results of inpatient care for patients with acute STEMI and NSTEMI. These findings helped determine when patients with acute MI (AMI) should start receiving aggressive early treatment. Therefore, the study was focused to compare the short term in-hospital outcomes in patients presenting with acute STEMI and NSTEMI.

## METHODOLOGY

This was a Comparative Cross-Sectional study conducted between August 2022 and February 2023 in an Adult Cardiology Department Armed Forces Institute of Cardiology/National Institute of Heart Diseases, Rawalpindi, Pakistan. Formal ethical approval (Ltr# 9/2/R&D/2022/194) was granted from the Institutional Ethical Review Board prior to initiation of the study. Data was collected using a non-probability consecutive sampling technique.

Sample size of n=120 for each study group was calculated by two group method using 48.31% and 30.9% prevalence of STEMI and NSTEMI,[11] respectively by keeping 95% confidence interval and a 5% margin of error. So, the sample for group-I was taken as $n_1$=198 and for group-II $n_2$=119.

**Inclusion Criteria:** All newly diagnosed acute STEMI and NSTEMI patients of both gender and age range 25-90 years were taken as study participants.

**Exclusion Criteria:** Patients with cardiomyopathy, congenital heart disease, valvular disease, and pericardial disease, history of CABG or PCI, and stable Ischemic Heart Disease were excluded from the study.

All patients meeting the inclusion criteria were included in this study via non-probability consecutive sampling technique. The patient's verbal and written informed permission was obtained. A detailed medical history was also taken from the patient or their caregiver and a complete examination was performed. The diagnosis of AMI was done by elevation of cardiac biomarkers (preferably Troponin) along with any of the criteria, such as; ECG changes suggestive of new ischemia (ST alterations or left bundle branch block (LBBB)), symptoms of ischemia, imaging evidence of myocardial viability loss, the emergence of a pathologic Q-wave on the ECG, or regional wall motion abnormalities.[3] Two groups were formed; a) STEMI and b) Non-STEMI. Their short-term in-hospital outcomes were documented on a designed proforma. Outcome variables including cardiogenic shock (SBP <90mmHg for >30 minutes or supportive intervention to maintain SBP>90 mmHg and evidence of end-organ damage (AMS, UO <30 ml/h or cold extremities), Pulmonary edema (progressively worsening, dyspnea, tachypnea, crackles, for BNP levels >500), cardiac arrest (sudden unresponsive, no normal breathing, no signs of circulation), type of Arrhythmias including VT, V-Fib, A-Fib & SVT and in-hospital mortality All basic examinations (complete blood count, kidney function, liver tests) were checked before data collection. All data, i.e. age, gender, BMI, hypertension and diabetes mellitus, type of technique performed were recorded on a proforma by the researcher himself. Strict exclusion criteria was followed to avoid biasness in the study results.

Data analysis was performed in Statistical Package For Social Sciences (SPSS) version-24:00. Continuous variables were represented as mean and standard deviation, and qualitative data was presented as frequencies and percentages. The association between the short-term in-hospital outcomes of STEMI patients and non-STEMI patients was assessed using Pearson's Chi Square test. Where required, an independent sample t-test was also used to find the mean difference of study variables between the STEMI

and NSTEMI groups. *p*-value ≤0.05 was considered significant.

## RESULTS

A total of three hundred and twenty three (n=323) patients were enrolled in our study while lost to follow-up count was n=6. Mean age of the study participants was 63.34±8.96 years. The majority of the study population were males i.e. 262(82.6%) and only 55(17.4%) were females. As depicted in Table-I, 139(43.8%) patients had Diabetes Mellitus, 146(46.1%) were hypertensive and 73(23.0%) were smokers. Out of 317 study participants; 198 (62.5%) patients were admitted with STEMI and 119 (37.5%) with NSTEMI. In STEMI, 104(32.8%) had anterior location of MI while 94(29.7%) had non-anterior.

**Table-I: Co-morbidities, clinical findings and outcomes of study participants (n=317)**

| Variables | | Frequency (%) |
|---|---|---|
| Gender | Male | 262(82.6) |
| | Female | 55(17.4) |
| Age (years) (Mean±SD) | | 63.34±8.96 |
| Troponin levels (Mean±SD) | | 3354.78±5260.54 |
| Diabetes Mellitus | | 139(43.8) |
| Hypertension | | 146(46.1) |
| Smoking | | 73(23) |
| Location of MI | Anterior | 104(32.8) |
| | Non-anterior | 94(29.7) |
| Killip Class | I | 275(86.8) |
| | II | 12(3.8) |
| | III | 23(7.3) |
| | IV | 7(2.2) |
| Reperfusion therapy | PCI* | 228(71.9) |
| | SK* | 10(3.2) |
| | Medical therapy | 65(20.5) |
| | Guidelines directed medical treatment | 4(1.3) |
| | SK±PCI* | 4(1.3) |
| | Diffuse disease | 6(1.9) |
| Type of MI* | STEMI* | 198(62.5) |
| | NSTEMI* | 119(37.5) |
| Cardiogenic shock | | 6(1.9) |
| Pulmonary Edema | | 58(18.3) |
| Severe LVD* (EF<30) | | 45(14.2) |
| Arrhythmia | | 30(9.5) |
| Type of arrhythmias | VT* | 22(6.9) |
| | V-Fib* | 6(1.9) |
| | A-Fib* | 7(2.2) |
| | SVT* | 1(0.3) |
| Cardiac arrest | | 10(3.2) |
| CVA* | | 7(2.2) |
| Mortality | | 10(3.2) |

**PCI: percutaneous coronary intervention, SK: streptokinase, MI: myocardial infarction, STEMI: ST-elevation myocardial infarction, NSTEMI: Non-ST-elevation myocardial infarction, LVD: Left ventricular dysfunction, VT: Ventricular tachycardia, V-Fib: Ventricular fibrillation, A-Fib: Atrial fibrillation, SVT: Supraventricular tachycardia, CVA: cerebrovascular accident*

30(9.5%) patients had different types of arrhythmic issues which further categorized into VT, V-Fib, A-Fib and SVT. The type of arrhythmias in study sample is shown in Figure-I. Short term in-hospital outcome of patients presenting with MI are displayed in Figure-II. Most of the study participant had pulmonary edema 58(18.3%), only 6(1.9%) had cardiogenic shock and In-hospital mortality was found in 10(3.2%) patients.

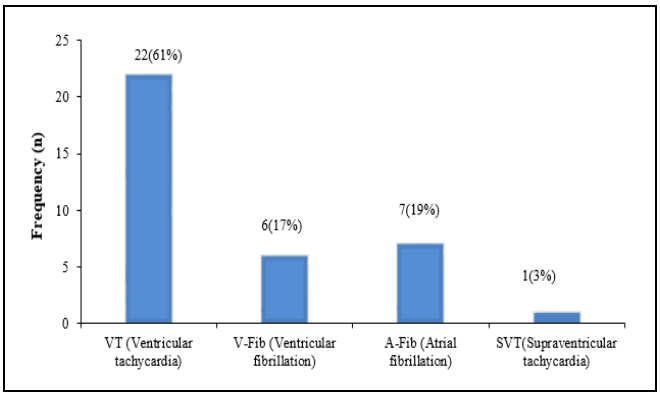


**Figure-1: Type of Arrhythmias Observed in Study participants (n=317)**

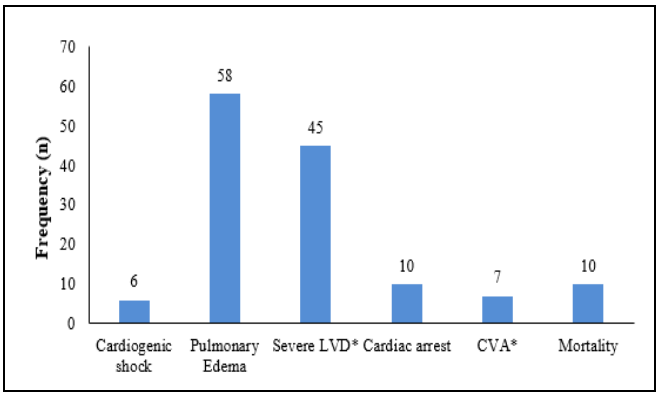


**Figure-2: Short-term In-Hospital Outcomes of Patients Presenting with MI (n=317)**

*LVD=Left ventricular dysfunction; CVA= cerebrovascular accident*

Table-II presented the comparison between STEMI and NSTEMI group. When compared, there was statistically significant difference between the two groups with age ($p$<0.001), troponin levels ($p$<0.001), gender ($p$<0.001), diabetes ($p$=0.01), Killip class ($p$<0.001), reperfusion therapy ($p$<0.001), pulmonary edema ($p$=0.01) and severe LVD ($p$<0.001). Higher in-hospital mortality was noted in the NSTEMI group 5(4.2%) compared to the STEMI group 5(2.5%), but the findings were not statistically significant ($p$=0.40).

**Table-II: Comparison of STEMI & NSTEMI with age, clinical parameters and in-hospital outcome (n=317)**

| Variables | | STEMI (Total=198) Frequency(%) | NSTEMI (Total=119) Frequency(%) | *p*-value |
|---|---|---|---|---|
| Age (years) (Mean±SD) | | 61.42±9.30 | 66.53±7.50 | <0.001 |
| Troponin levels ( Mean±SD) | | 4505.40±6329.00 | 1603.10±1971.20 | <0.001 |
| Gender | Male | 177(89.4) | 85(71.4) | <0.001 |
| | Female | 21(10.6) | 34(28.6) | |
| Diabetes Mellitus | | 76(38.4) | 63(52.9) | 0.01 |
| Hypertension | | 84(42.4) | 62(52.1) | 0.09 |
| Smoking | | 50(25.3) | 23(19.3) | 0.22 |
| Killip class | I | 186(93.9) | 89(74.8) | <0.001 |
| | II | 05(2.5) | 07(5.9) | |
| | III | 07(3.5) | 16(13.4) | |
| | IV | -- | 07(5.9) | |
| Reperfusion therapy | PCI* | 155 (78.3) | 73(61.3) | <0.001 |
| | SK* | 14 (7.1) | -- | |
| | Medical therapy | 21(10.6) | 44(37.0) | |
| | Guideline directed medical therapy | 04 (2.0) | -- | |
| | Diffused disease | 4(2.0) | 02(1.7) | |
| Cardiogenic shock | | 4(2.0) | 2(1.7) | 0.83 |
| Pulmonary edema | | 28(14.1) | 30(25.2) | 0.01 |
| Severe LVD* (EF <30) | | 16(8.1) | 29(24.4) | <0.001 |
| Arrhythmias | | 17(8.6) | 13(10.9) | 0.49 |
| Cardiac Arrest | | 04(2.0) | 06(5) | 0.13 |
| CVA* | | 02(1.0) | 05(4.2) | 0.06 |
| In-hospital mortality | | 05(2.5) | 05(4.2) | 0.40 |

*PCI=percutaneous coronary intervention; SK=streptokinase; LVD=Left ventricular dysfunction; CVA=cerebrovascular accident*

## DISCUSSION

Thousands of patients presenting with AMI are usually admitted to hospitals every day throughout the world and undergo subsequent management. We aimed to determine the short term in-hospital outcomes in STEMI versus NSTEMI patients. Our study reported the prevalence of STEMI (62.5%) and NSTEMI (37.5%). Majority of the study sample were males 262(82.6%). Almost half of the study subjects were diabetic (43.8%) and hypertensive (46.1%), while 23% were smokers. 30(9.5%) patients had rhythm issues (including VT, V-Fib, A-Fib and SVT). Short term in-hospital outcome of patients including pulmonary edema was noted in 58(18.3%), cardiogenic shock in 6(1.9%) and In-hospital mortality 10(3.2%) was reported by current study.In STEMI, 104(32.8%) had anterior location of MI while 94(29.7%) had non-anterior MI.

The prevalence of STEMI and NSTEMI reported by national PCI registry in Thailand was 14.5% and 16.2% respectively. The difference in the results was probably due to comparison of ACS and UA patients.[12] According to the Chinese PEACE Registry, 34.8%, 8.1%, and 41.8% of patients having PCI had STEMI, NSTEMI, or UA, respectively.[13] According to Lim et al., the prevalence of STEMI was 5.4% and NSTEMI was 68.2%.[6] According to Paolisso P et al., patients of NSTEMI were generally elders, females, and patients with more comorbidities like hypertension, diabetes, dyslipidemias, and kidney disease. Though, no significant results were observed with sex, cholesterol levels and medicinal history.[14]

Gender difference pattern among study participants (demographic, clinical factors and outcome) were consistent with prior research. A study by Vu HTT *et al*.[15] found that 1/3rd of study participants were females, who had PCI, most of them were of older age group and had more co-morbidities as compared to male participants, while female to male ratio was 0.47. In contrast, a study conducted in Vietnam reported the alternate findings,( female to male ratio of 1.616). This difference may be due to the difference in culture of Vietnam, their conservative environment towards females. Accessibility of tertiary care hospital is one of the other reason because the referral of males over the province was high in males as compared to females($p$=0.001), this is due to the convenience of travelling for males in such a conservative country like Vietnam.[17] GRACE (Global Registry of Acute Coronary Events) registry showed higher rate of females having comorbidities like diabetes and hypertension but less rate of smoking.[18] These findings are similar with our results, where 63.6% females were had diabetes, 56.4% were

hypertensive and only 1.8% were smokers in our study.

Our data reported that the comparison of STEMI and NSTEMI had significant findings with demographics, clinical parameters and with comorbidities. Short term in hospital outcome including pulmonary edema ($p$=0.014) and severe LVD ($p$<0.0001) were statistically significant. Higher in-hospital mortality was noted in NSTEMI group 5(4.2%) compared to the STEMI group 5(2.5%), but the findings were not significant ($p$=0.40). Findings for short-term in-hospital outcome were insignificant as there was a slight difference between the two groups. However, the study reported a mortality of 1(0.9%) in 107 patients.[6] While the results of the ACTION--GWTG study showed an in-hospital mortality rate of 1.1%.[19] A recent study claimed that the rate of in-hospital mortality was statistically higher in STEMI as compared to NSTEMI (STEMI=5.4% & NSTEMI=2.9% with $p$=0.006) as reported by Kilickap M *et al*. a study conducted in Turkey. They also reported that women (11.2%) in the STEMI group had higher mortality than men (3.8%) and the findings were statistically significant ($p$=0.001). The study also suggested that in acute MI patients, performance of PCI reduces the risk of complications and it resulted in 50% reduced mortality rate. However, the risk of females with STEMI remained higher.[20] The difference between the rates may be due to the regional difference and they had recruited around 1930 patients which is a larger sample size compared to our data. We recruited only 317 patients.

The current study provided valuable insights regarding the clinical features and outcomes of PCI patients within hospital. The results also revealed gender differences in comorbidities and in-hospital outcomes, as well as demographic and clinical features, which suggested that patients with NSTEMI may also require immediate medical attention. The results may aid in the assessment of PCI-related complications and identify potential gaps in cardiovascular care. In addition, further advanced researches are needed that could provide more overall insights into PCI practices in the Pakistani population.

## LIMITATIONS OF STUDY

There were some limitations in our study. Although the data was collected from one of the largest national tertiary cardiac interventional centers in Rawalpindi, our results cannot be illustrative of the entire population, especially due to the smaller sample size. In addition, there may be some patient uncertainty and inaccuracy in providing data on demographics, socioeconomic status, and cardiovascular risk factors, which may account for differences between the two groups.

## CONCLUSION

We found no promising difference between the short-term results of the two groups. Although patients with NSTEMI had relatively higher complication rates and in-hospital mortality, while patients with STEMI had a better prognosis, suggesting that patients with NSTEMI may require prompt medical attention.

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**Conflict of interest:** None

**Authors' Contribution**

Following authors have made substantial contributions to the manuscript:

MK, MS & AS: Concept, Final approval, Critical review, Intellectual contribution, Data acquisition.

SP, ZH & AS: Critical review, Final approval, Proof reading, Data acquisition, Data interpretation.

NA, & JK: Proof reading, Formatting, Final approval.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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