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Analyzing Risk Factors Associated with Post Myocardial Infarction Complications: A Retrospective Analysis

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ABSTRACT

Myocardial infarction is a major cause of mortality and results in several complications including post-MI arrhythmias, pulmonary edema, and cardiogenic shock. **Objective:** To evaluate and examine the clinical and demographic factors and their association with post-MI complications. **Methods:** This was a retrospective observational study and non-probability convenient sampling was recruited for assessment. A total of 188 patients aged 45 to 65 years, hospitalized for acute STEMI and of both genders were included. However, patients with NSTEMI or with comorbidities such as chronic renal failure or cirrhosis were not included. Age, gender, BMI, duration of hospitalization, etc. were recorded on a structured form. Patients were assessed for post-MI arrhythmias, cardiogenic shock, and pulmonary edema. This study took six months its completion. Spss software was employed for analysis and a chi-square test was used to identify associated risk factors with post-MI complications at a significant level ($p<0.05$). **Results:** Findings revealed that the occurrence of post-MI arrhythmias showed a significant association with smoking and family history ($p<0.001$), while no significant association was observed for BMI, hospital duration, hypertension, or family history. Cardiogenic Shock (CS) is strongly associated with DM ($p=0.001$) but shows no association with smoking, BMI, duration of hospital stays, hypertension, or family history. **Conclusions:** Smoking and a family history of cardiovascular disease are prevalent and found significant association with post-MI arrhythmias ($p<0.001$) after myocardial infarction; diabetes mellitus also resulted in significant association with pulmonary edema and cardiogenic shock ($p<0.001$).

INTRODUCTION

Cardiovascular diseases, especially atherosclerosis, are considered to be major public health issues locally and globally and have higher mortality rates [1]. Severe heart attacks (STEMI) are among the most common reasons for hospital stays particularly in the emergency department [2]. A blockage of coronary blood vessels that causes sudden onset of chest pain and discomfort which probably radiates to the jaw, abdomen, and left arm is defined as ischemic discomfort that leads to myocardial infarction [3]. The investigation of participants suffering from chest or sternal pain is based on the assessment of clinical signs or symptoms i.e. pain >30 minutes, or physical and biochemical examination including unambiguous new electrocardiographic alterations; or an increase of creatinine kinase level (CK-MB isoenzyme), indicating damage to the heart muscle [4]. It is the irreversible necrosis of heart muscle secondary to prolonged ischemia which is considered, part of a spectrum referred to as Acute Coronary Syndromes (ACS), which includes Unstable Angina, STEMI, and non-ST-elevation MI (NSTEMI) [5]. Patients with ischemic discomfort may or may not have ST-segment elevation. Most of those with ST-segment

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elevation will develop Q wave deviation [6]. When a blocked heart artery causes reduced blood flow to cardiac muscle causes muscle death and these cases range from 44 to 142 per 100,000 people across European countries [7]. Despite improvements in pharmacological medicine, catheter-based interventions, and surgical reperfusion for improving Acute Myocardial Infarction (AMI) outcomes, patients with large infarcts, necrotized cardiac muscle, or delayed revascularization remain at risk of mechanical complication [8]. Mechanical complications of AMI include ventricular wall and septal rupture, papillary muscle rupture, pseudoaneurysm, true aneurysm, interventricular septum rupture, and mitral valve dysfunction or regurgitation remains the most critical which although rare, can occur in less than 0.1% of patients often presenting with severe symptoms like cardiogenic shock or acute pulmonary edema within the first week following a heart attack [9, 10]. In patients with STEMI, either systolic dysfunction alone or both systolic and diastolic dysfunction can occur. Clinical manifestations of left ventricular failure become more common as the extent of the injury to the left ventricle increases and are considered one of the most vital predictors of mortality [11]. Risk factors of STEMI include age, sex, family history, smoking, high cholesterol, diabetes, hypertension, obesity, inactivity, poor diet, and stress, which contribute significantly towards increasing susceptibility towards developing severe forms like STEMI [12]. STEMI patients are greatly prone to developing in-hospital complications which significantly influence prognosis and compromise survival, necessitating prompt management in-hospital complications include cardiogenic shock, True and Pseudoaneurysms, Free Wall Rupture, Atrial Tachyarrhythmias, ventricular tachyarrhythmias, and Bradyarrhythmias [13]. Understanding the frequency and patterns of these complications is essential for early identification, risk stratification, and timely intervention.

ST-elevation myocardial infarction (STEMI) remains a leading cause of cardiovascular mortality, with serious in-hospital complications such as post-MI arrhythmias, pulmonary edema, and cardiogenic shock significantly worsening patient outcomes. Although established risk factors like smoking, diabetes mellitus, hypertension, and family history contribute to myocardial infarction severity, limited local evidence exists regarding their specific association with post-MI complications in Pakistani populations, particularly in secondary care settings. Additionally, regional retrospective data on demographic and clinical predictors of these complications remain scarce, creating a gap in targeted risk stratification and management. Therefore, this study aimed to evaluate the frequency of in-hospital complications in STEMI patients and their associated risk factors that provide insights to enhance clinical decision-making, improve patient outcomes, and reduce hospital mortality.

METHODS

This retrospective study was conducted at DHQ Hospital Nowshera from 1st March 2020 - 31st August 2020.Ethical approval was obtained from the institutional ethical committee and.once approved, eligible patients presenting to the emergency department for thrombolytic therapy were enrolled after informed consent.Based on the previous studies, the estimated prevalence was 85.8% (14-16). A sample size of 188 patients was included in the study, determined by using the WHO sample size calculator.The calculation was based on a 95% confidence interval (CI), 5% margin of error (d), population (50%) and estimated prevalence (p) of 85.8%.

The sample size was calculated using the formula (17):

$$n=\frac{Z^2 \text{ x p x } (1\text{-p})}{d^2}$$

A non-probability consecutive sampling technique was used. Patients aged 45 to 65 years, hospitalized for acute STEMI, and of both genders were included. While those diagnosed with NSTEMI or with comorbidities such as chronic renal failure or cirrhosis were excluded. All patients who received anti-ischemic therapy underwent thrombolysis. Data on demographics BMI, diabetes, hypertension, smoking history, family history, hospital stay, and in-hospital complications including post-MI arrhythmias, pulmonary edema, and cardiogenic shock were recorded for a week. Assessment of complications was based only on clinical signs. Palpitations, irregular heartbeat, and fainting were assessed for post-MI arrhythmias [18].Cardiogenic shock was assessed based on low urine output, persistent hypotension (systolic BP<90mmHg), new chest pain, a cold and wet physiological state, dyspnea, jugular venous distension, rales and altered mental status and pulmonary edema was identified by of lung crackles, coarse rales, and acute dyspnea [19, 20]. Analysis was conducted on SPSS 25.0. Mean and standard deviation were obtained for quantitative variables while frequency and percentages were calculated for categorical variables such as gender and in-hospital complications. The chi-square test was applied in the P value < 0.05 was considered significant.

RESULTS

This study shows that the age groups of the participants comprised those between 45 and 55 years (56.4%) and aged between 56 and 65 years (43.6%). Out of the 188 sample hospitals, just over half (64.4%) were male. 43.6% of people have body mass indexes between 20 and 24. In addition, being 33,0% hospitalized for 6-8 days and 67,0% for 2-5 days.58,5% had raised blood glucose levels; out of those, 41.5% had been diagnosed with diabetes while 33.0% were hospitalized for 6 to 8 days. The last 10.6% had a family

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history of myocardial infarction, whereas 89.4% had no such history as shown in table 1.

Table 1: Baseline Characteristics

Variables	Category	Frequency (%)
Age	45-55 Years	106 (56.4%)
	56-65 Years	82 (43.6%)
Gender	Male	121 (64.4%)
	Female	67 (35.6%)
BMI	20-24	82 (43.6%)
	24-28	86 (45.7%)
	28-32	20 (10.6%)
Hospital Stays	2-5 Days	126 (67.0%)
	6-8 Days	62 (33.0%)
Hypertension	Yes	104 (55.3%)
	No	84 (44.7%)
Diabetes Mellitus	Yes	78 (41.5%)
	No	110 (58.5%)
Smoking History	Yes	99 (52.7%)
	No	89 (47.3%)
Family History of MI	Yes	20 (10.6%)
	No	168 (89.4%)

N=188, BMI=Body Mass Index, MI= Myocardial Infarction

Table 2 demonstrated complication frequency among patients with STEMI. Arrhythmias after myocardial infarction occurred in 17.6% of study participants and were absent in 82.4% of subjects. Lung congestion or pulmonary edema was developed in 44.7% of the patients and cardiogenic shock was developed in 48.9% of cases, while 51.1% did not develop this complication.

Table 2: Frequency of Complications in STEMI Patients

Complications of STEMI	Category	Frequency (%)
Post-MI Arrhythmias	Yes	33 (17.6%)
	No	155 (82.4%)
Pulmonary Edema	Yes	84 (44.7%)
	No	104 (55.3%)
Cardiogenic Shock	Yes	92 (48.9%)
	No	96 (51.1%)

N=188

The associations between age and post-MI complications such as arrhythmias, pulmonary edema, and cardiogenic shock were classified into two groups of ages- 45-55 years and 56-65 years in Tables 3. "Post-MI" arrhythmias are seen to be significantly increased as compared to the 9.4% that belongs to 45-55 years' group. The significance difference between the two groups is of p=0.001, indicating a strong relationship with advancing age. Pulmonary edema was observed in 40.6% of patients 45-55 years of age and 50% in ages of patients 56-65 years, yet with a p-value of 0.197, the difference was not statistically significant. On the contrary, the cardiogenic sock was significantly higher in the 56-65 years' group compared with the 45-55 years' group (62.2% vs. 38.7%) with a p-value of 0.001, thus revealing a strong association between adult age and risk of cardiogenic shock. Such findings indicate that post-MI arrhythmias and cardiogenic shock display a significant relation with age, while pulmonary edema does not show a statistically significant association with age.

Table 3: Age-Wise Stratification of STEMI Complications

Complications of STEMI	44-55 Years	44-55 Years	56-65 Years	56-65 Years	p-Value
	Yes Frequency (%)	No Frequency (%)	Yes Frequency (%)	No Frequency (%)	
Post-MI arrythmias	10 (9.4%)	96 (90.6%)	23 (28.0%)	59 (72.0%)	0.001
Pulmonary Edema	43 (40.6%)	63 (59.4%)	41 (50.0%)	41 (50.0%)	0.197
Cardiogenic Shock	41 (38.7%)	65 (61.3%)	51 (62.2%)	31 (37.8%)	0.001

N=188

Table 4 showed gender-wise distribution among the complications of STEMI such as post-MI Arrhythmias, pulmonary edema, and cardiogenic shock along with the statistical significance. Post-MI arrhythmias were more prevalent in males (27.3%) than females (0.0%), with p-value <0.001 thereby indicating a strong association between male gender and occurrence of arrhythmias. Pulmonary edema was significantly more common in female patients (56.7%, p=0.014) than in their male counterparts (38.0%), indicating that exposure to female gender is a strong point in developing pulmonary edema after STEMI. Cardiogenic shock was more common among females (58.2%) than among males (43.8%); however, a p-value of 0.058 could not yield statistical significance and therefore doesn't provide strong evidence for associating gender with cardiogenic shock.

Table 4: Gender-Wise Stratification of STEMI Complications

Complications of STEMI	Male		Female		p-Value
	Yes Frequency (%)	No Frequency (%)	Yes Frequency (%)	No Frequency (%)	
Post-MI Arrhythmias	33 (27.3%)	88 (72.7%)	0 (0.0%)	67 (100%)	<0.001
Pulmonary Edema	46 (38.0%)	75 (62.0%)	38 (56.7%)	29 (43.3%)	0.014
Cardiogenic Shock	53 (43.8%)	68 (56.2%)	39 (58.2%)	28 (41.8%)	0.058

N=188

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The association of the different risk factors to post-MI arrhythmia, pulmonary edema, and cardiogenic shock is illustrated in Table 5. In our findings, BMI categories were not significantly associated with any of the complications of STEMI (p>0.05). Further, Hypertension was also non-significantly associated with prolonged hospitalization for all post-MI complications (p>0.05) in each case. Conversely, a significant association was found between diabetes mellitus and the outcome in both cardiogenic shock (p=0.001) and lung congestion or pulmonary edema (P<0.001), suggesting that patients with diabetes were more prone to those complications but were non-significantly associated with post-MI- arrhythmias (p=0.510). After that, smoking and family history was found significantly associated with post-MI arrhythmias (p<0.001) and pulmonary edema (p<0.001) while not significant concerning cardiogenic shock (p=0.060). But had no significant association with pulmonary edema and cardiogenic shock as shown in table 5.

Table 5: Association of Risk Factors with Post MI Complications

Variables	Post-MI Arrhy				PE			CS		
	Categories	Yes Frequency (%)	No Frequency (%)	p-Value	Yes Frequency (%)	No Frequency (%)	p-Value	Yes Frequency (%)	No Frequency (%)	p-Value
BMI	20-24	18 (22.0%)	64 (78.0%)	0.327	32 (39.0)	50 (61.0)	0.327	40 (48.8%)	42 (51.2%)	0.927
	24-28	13 (15.1%)	73 (84.9%)		41 (47.7)	45 (52.3)		43 (50.0%)	43 (50.0%)	
Hospital Stay	2-5 days	20 (15.9%)	106 (84.1%)	0.388	55 (43.7)	71 (56.3)	0.385	64 (50.8%)	62 (49.2%)	0.468
	6-8 days	13 (21.0%)	49 (79.0%)		71 (56.3)	33 (53.2)		28 (45.2%)	34 (54.8%)	
HTN	Yes	21 (20.2%)	83 (79.8%)	0.290	47 (45.2)	57 (54.8)	0.875	48 (46.2%)	56 (53.8%)	0.396
	No	12 (14.3%)	72 (85.7%)		37 (44.0)	47 (56.0)		44 (52.4%)	40 (47.6%)	
DM	Yes	12 (15.4%)	66 (84.6%)	0.510	47 (60.3)	31 (39.7)	<0.001	27 (34.6%)	51 (65.4%)	0.001
	No	`21 (19.1%)	89 (80.9%)		37 (33.6)	73 (66.4)		65 (59.1%)	45 (40.9%)	
Smoking	Yes	33 (33.3%)	66 (66.7%)	<0.001	28 (28.3%)	71 (71.1%)	<0.001	42 (42.4%)	57 (57.6%)	0.060
					56 (62.9%)	33 (37.1%)				
	No	0 (0.0%)	89 (100%)		56 (62.9%)	33 (37.1%)		50 (56.2%)	39 (43.8%)	
Family History	Yes	12 (60.0%)	8 (40.0%)	<0.001	8 (40.0%)	12 (60.0%)	0.656	8 (40.0%)	12 (60.0%)	0.398
	No	21 (12.5%)	147 (87.5%)		76 (45.2%)	92 (54.8%)		84 (50.0%)	84 (50.0%)	

N=188: MI: myocardial infarction, Arrh: arrhythmias. PE: pulmonary edema. CS: cardiogenic shock

DISCUSSION

In the present study, the individuals were noted to be aged from 45 to 55 years (56.4%) and 56 to 65 years (43.6%) and were predominantly male (64.4%); this was compatible with previous findings that suggested a higher prevalence of STEMI among male, as Marinsek *et al.*, in 2023 reported that 69.4% of STEMI patients were male and diabetes was observed to be the leading cause of in-hospital mortality as opposed to other causes and it also found that complications including hemorrhage and left main coronary artery disease increased the mortality risk in women and pulmonary edema was substantially more common in females (56.7% vs. 38.0%, p = 0.014) [21]. Comparatively, our analysis identified that post-MI arrhythmias (28.0% vs. 9.4%, p = 0.001) and cardiogenic shock (62.2% vs. 38.7%, p = 0.001) were more prevalent in the 56–65 years of individual, which were consistent with other research showing that complication risks increase with age.Nonetheless, the current study found a somewhat smaller percentage of men and also showed diabetes to be a risk factor for STEMI consequences, such as arrhythmias and heart failure. Further current study also reported that 41.5% of the respondents were diabetic. In addition, the current study's BMI distribution revealed that 45.7% of individuals had a BMI between 24 and 28 (Kg/m2). However, prior research, such as Bono *et al.*, in 2021 had not consistently made BMI a significant predictor of problems. Of those admitted to the hospital, 33.0% remained for 6–8 days, and 67.0% stayed for 2–5 days and had shown that the majority of STEMI problems occur within the first 48 hours of hospitalization, which was consistent with our findings that complications were prevalent early on [22]. Ullah *et al.*, in 2022 Identified MR and Killip class ≥ 2 as powerful predictors of death in patients with STEMI, which did not align with our findings, as it did not use the TIMI score for classifying MI patients [23]. Additionally, current results showed that 55.3% of the participants had hypertension while 44.7% were non-hypertensive that were consistent with the findings of the past study done by Mavungu Mbuku *et al.*, in (2023), which reported that hypertension and smoking were the most important predictor of acute heart failure in STEMI patients with a risk of adjustment of 3.38 and 3.52 [24]. However, our research showed that hypertension was non-significantly associated with STEMI consequences. Moreover, the current study observed that 52.7% of the participants had a smoking history and also established a significant association between smoking and post-MI arrhythmias and pulmonary edema (p < 0.001). Nevertheless, in contrast to past research studies, there was no considerable link between smoking and cardiogenic shock (p>0.05). Current research findings also observed

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the prevalence of post-MI complications that included, arrhythmias in 17.6% of individuals, pulmonary edema (44.7%), and cardiogenic shock (48.9%). Our study revealed the statistical association between male gender and post-MI arrhythmias (27.3% vs. 0%, p < 0.001).According to the findings of the present study, early monitoring would help prevent the deleterious effects of STEMI, especially in older people, smokers, and those with diabetes.While most results corroborated previous studies, some interesting dissimilarities include the lack of a significant association between smoking and cardiogenic shock, the absence of an effect in terms of BMI, and gender-related patterns in pulmonary edema and arrhythmias. Further studies should look more closely at these variations to enhance the targeted STEMI management strategies.

This study was limited by its retrospective single-center design, non-probability consecutive sampling, moderate sample size, and reliance primarily on clinical signs without advanced diagnostic tools such as echocardiography or radiological confirmation, which may have affected diagnostic accuracy and generalizability. Important factors such as pre-hospital delays, reperfusion success, and additional complications like renal dysfunction were also not assessed. Future prospective multicenter studies with larger populations, standardized diagnostic protocols, and comprehensive evaluation of clinical, biochemical, and imaging parameters are recommended to strengthen causal understanding, enhance complication prediction, and develop more effective preventive and management strategies for STEMI patients at high risk of post-MI complications.

CONCLUSIONS

The current study highlighted that post-MI complications were significantly associated with certain clinical and demographic factors. Such as smoking and a family history of cardiovascular diseases appeared to be strong indicators of post-MI arrhythmias (p<0.001). On the other hand, diabetes mellitus was considered a key predictor and had a significant association (p<0.001) with pulmonary edema and cardiogenic shock.These findings emphasized the importance of targeted risk stratification in acute STEMI patients to identify individuals at higher risk for adverse outcomes. The present study has several limitations as it was a cross-sectional study and it did not analyze pre-hospital delays and their impact on post-MI-complication. It only found the duration of the hospitalization. Our research solely focused on clinical signs to find post-MI complications, and not perform echocardiographic parameters and chest X-rays. Further, it only focused on specific in-hospital complications rather than other complications such as kidney failure, and reperfusion success was also not recorded. The use of a consecutive sampling technique in this study could induce selection bias therefore limiting generalizability.

Authors' Contribution

Conceptualization: ME
Methodology: ME, TM, SK, SZ, AA
Formal analysis: ME, TM, SK, MSK, AA
Review and Editing: ME, TM, SK, MSK, SZ, AA
Writing and Drafting: ME, TM, SK, MSK, SZ, AA

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

All the authors declare no conflict of interest.

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