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In-Hospital Complications among Patients with Acute Coronary Syndrome in a Tertiary Care Hospital in Pakistan: A Prospective Cohort Study

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Abstract

Background: Acute Coronary Syndrome (ACS) remains a leading cause of cardiovascular morbidity and mortality. While traditional risk factors such as hypertension, diabetes, smoking, and dyslipidemia are well recognized, patients without these factors (SMuRF-less ACS) may also experience adverse outcomes. This study compared early in-hospital complications between ACS patients with and without traditional cardiovascular risk factors.

Objective: To assess and compare early in-hospital complications among patients with ACS based on the presence or absence of traditional cardiovascular risk factors.

Methods: This prospective cohort study was conducted at Mardan Medical Complex from July to December 2024. Patients with a confirmed diagnosis of ACS were enrolled and categorized into two groups: exposed (≥1 traditional risk factor) and non-exposed (without traditional risk factors). Clinical, electrocardiographic, and

echocardiographic parameters were recorded at admission and at 24, 48, and 72 hours. Data were analyzed using IBM SPSS version 26.0. The Independent Samples t-test and Chi-square or Fisher's Exact test were applied, with $p < 0.05$ considered significant.

Results: Of the 174 patients, 116 (66.7%) had one or more traditional risk factors. The mean age was comparable between the exposed and non-exposed groups (60.9 ± 11.8 vs. 59.8 ± 11.4 years; $p = 0.54$). Hemodynamic instability was significantly more frequent among exposed patients at admission (35.6% vs. 9.2%; $p = 0.001$) and at 72 hours (22.0% vs. 6.1%; $p = 0.02$). Mitral regurgitation (41.5% vs. 22.6%) and reduced left ventricular ejection fraction (18.9% vs. 6.1%) were more common among the exposed group, though not statistically significant. Arrhythmias were observed in both groups (6.9% vs. 5.7%). Overall, 11 in-hospital deaths occurred, with no significant difference between groups.

Conclusion: ACS patients with traditional risk factors experienced more frequent early in-hospital complications. However, SMuRF-less patients also demonstrated notable electrical and functional abnormalities, underscoring the need for vigilant monitoring and comprehensive risk assessment in all ACS cases.

Introduction

Cardiovascular diseases (CVDs) represent a major global health burden, contributing to nearly one-third of all deaths (approximately 19.8 million) in 2022, with an estimated 85% of these fatalities resulting from myocardial infarction and cerebrovascular accidents (1). Among CVD, coronary artery disease is most common presentation that is characterized by accumulation of atherosclerotic plaque in the coronary arteries compromising blood perfusion to myocardium (2) and increasing the risk of myocardial infarction (MI) and stroke (3). Acute Coronary Syndrome (ACS) encompasses a range of ischemic heart conditions, including ST-segment elevation myocardial infarction (STEMI), non-ST elevation myocardial infarction (NSTEMI), and unstable angina (4). These conditions are leading contributors to global cardiovascular mortality and morbidity, with a disproportionate burden in low- and middle-income countries (LMICs), such as Pakistan (5).

Several complications after an episode of ACS can occur which increased the morbidity and mortality rates i.e., electrical, mechanical, thrombotic, and inflammatory complications (6). Electrical complications are atrial fibrillation (AF), ventricular tachycardia (VT), LBBB, RBBB, or bradycardia and AV blocks (6). Mechanical complications are heart failure, MR, papillary muscle dysfunctions, myocardial rupture, or aneurysm (6). Thrombotic complications are mural thrombus and recurrent ischemia. Dressler's syndrome and pericarditis are included in inflammatory complications (6). Furthermore, cardiogenic shock, LV failure, different types of arrhythmias, papillary muscle dysfunction. ventricular septal rupture (VSR), LV free wall rupture, early pericarditis are included in acute complications, occurred within days (7).

Cardiogenic shock is a serious complication after MI occurs in 5 to 10% subjects with ACS, and most prevalent in STEMI compared with NSTEMI (7). In arrhythmias, atrial fibrillation (AF) is most common, followed by accelerated idioventricular rhythm which is a common reperfusion arrhythmia (7). Prevalence of VT within 48 hours and after 48 hours is a life-threatening arrhythmia. Papillary muscle rupture, VSR, and LV free wall rupture account for 1% in complications requiring urgent surgical repair (7). Acute pericarditis accounts for 10% and treated with high dose of aspirin. LV thrombus, aneurysm, and Dressler's syndrome contribute 5-10%, 5% and less than 3% in complications post ACS, respectively (7).

Standard Modifiable Risk Factors (SMuRF) i.e., hypertension, diabetes, smoking, and hyperlipidemia are well-documented predictors of poor outcomes in ACS, a significant subset of patients without these risk factors (SMuRF-less) also experiences adverse events (8). Identifying and characterizing in-hospital complications in both groups is critical for improving clinical decision-making in resource-constrained settings.
This study aims to document the type and frequency of early in-hospital complications of ACS and compare their occurrence between patients with and without traditional risk factors in a tertiary care setting in Khyber Pakhtunkhwa, Pakistan.

Material and Methods

This prospective cohort study was conducted at the Department of Cardiology, Mardan Medical Complex, a tertiary care teaching hospital affiliated with Bacha Khan Medical College, Mardan, Khyber Pakhtunkhwa, from July to December 2024.All adult patients aged 18 years and above admitted with a confirmed diagnosis of ACS, including ST-Elevation Myocardial Infarction (STEMI), Non-ST-Elevation Myocardial Infarction (NSTEMI), and Unstable Angina, were included. Participants were divided into two groups according to their cardiovascular risk profile: the exposed group consisted of patients with one or more traditional risk factors such as hypertension, diabetes mellitus, smoking, or dyslipidemia, while the non-exposed group included those without these risk factors. Patients with incomplete data, secondary cardiac complications unrelated to ACS i.e., myocarditis or pericarditis were excluded.
Patients were recruited using a convenience sampling technique. The sample size of 174 participants was calculated using the OpenEpi sample size calculator (http://www.openepi.com), assuming a 95% confidence level and 80% power, with expected outcome proportions of 5.9% in the unexposed group and 31.5% in the exposed group, based on previously published literature, and an unexposed-to-exposed ratio of 1.5:1.Data were collected prospectively at admission and at 24-, 48-, and 72-hours post-admission using a structured data collection form. Recorded variables included demographic characteristics, clinical presentation, diagnostic findings, and in-hospital complications.
Data were analyzed using IBM SPSS Statistics version 26.0 and Microsoft Office 365. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. Comparisons between the exposed and non-exposed groups were made using the Independent Samples t-test for continuous variables and the Chi-square test for categorical variables. When assumptions for the Chi-square test were violated, Fisher's Exact Test or Monte Carlo simulation was applied. A p-value of less than 0.05 was considered statistically significant.
Ethical approval was obtained from the Institutional Review Board of Bacha Khan Medical College, Mardan (Ref.No.579/BKMC). Written informed consent was obtained from all participants, and confidentiality was ensured in accordance with institutional ethical guidelines.

Results

A total of 174 patients diagnosed with acute coronary syndrome (ACS) were included in the study, comprising 116 (66.7%) patients with one or more traditional cardiovascular risk factors (exposed group) and 58 (33.3%) without such risk factors (non-exposed group). The mean age of patients in the exposed group was 60.9 ± 11.8 years, compared to 59.8 ± 11.4 years in the non-exposed group ($p = 0.54$). Similarly, the mean body weight did not differ significantly between the two groups (77.3 ± 6.3 kg vs. 77.8 ± 7.3 kg; $p = 0.61$). A male predominance was observed in both groups, though more prominent among exposed patients (37.4% vs. 24.1%; $p = 0.04$). The

proportion of patients residing in urban areas was also higher in the exposed group (45.4%) than in the non-exposed group (21.3%), though this difference was not statistically significant (p = 0.61) (Table 1).

Table 1: Demographic characteristics of ACS patients (N = 174)

Variable		Exposed (n = 116)	Non-Exposed (n = 58)	*p*-value
Age in years (mean ± SD)		60.9 ± 11.8	59.8 ± 11.4	0.54
Weight in kg (mean ± SD)		77.3 ± 6.3	77.8 ± 7.3	0.61
Gender	Male	65 (37.4%)	42 (24.1%)	0.04
	Female	51 (29.3%)	16 (9.2%)	
Residence	Urban	79 (45.4%)	37 (21.3%)	0.61
	Rural	37 (21.3%)	21 (12.1%)	

The clinical presentation of ACS varied between the two groups. Angina, dyspnea, and palpitations were more frequently reported in exposed patients compared to non-exposed patients, but the differences were statistically non-significant. ST-segment elevation myocardial infarction (STEMI) and non-ST-segment elevation myocardial infarction (NSTEMI) were more common among exposed individuals (33.9% and 30.5%, respectively) than among the non-exposed group (20.1% and 13.2%, respectively). No significant difference was observed in unstable angina or biochemical marker elevation between groups. (Table 2)

Table 2: Clinical presentation and ACS classification

Parameter	Exposed (n = 116)	Non-Exposed (n = 58)	*p*-value
Angina	112 (64.4%)	55 (31.6%)	0.68
Dyspnea	86 (49.4%)	41 (23.6%)	0.62
Palpitations	85 (48.9%)	37 (21.3%)	0.19
STEMI	59 (33.9%)	35 (20.1%)	0.12
NSTEMI	53 (30.5%)	23 (13.2%)	0.15
Unstable angina	4 (2.3%)	0 (0.0%)	0.27
Elevated cardiac biomarkers	112 (64.4%)	57 (32.8%)	0.66

In-hospital complications were evaluated at admission and at subsequent 24-hour intervals up to 72 hours. At admission, arrhythmias, AV blocks, and conduction

disturbances showed no statistically significant difference between groups ($p > 0.05$). However, hemodynamic instability was significantly higher among exposed patients compared to non-exposed patients (35.6% vs. 9.2%, $p = 0.001$).
Within the first 24 hours, LV systolic dysfunction and hemodynamic instability were more frequent in the exposed group (22.2% and 32.7%, respectively) than in the non-exposed group (6.4% and 9.4%), with hemodynamic instability showing statistical significance ($p = 0.009$).
At 48 hours, LV systolic dysfunction (20.8% vs. 6.0%) and hemodynamic instability (26.2% vs. 8.3%) remained more prevalent among exposed patients, both nearing statistical significance ($p = 0.05$).
By 72 hours, hemodynamic instability remained significantly higher in the exposed group (22.0% vs. 6.1%, $p = 0.02$), while other complications such as mitral regurgitation, decreased ejection fraction, and LV systolic dysfunction showed no significant intergroup differences. Mortality remained low and comparable across all time points (Table 3)

Table 3: In-hospital complications at admission, and within 24, 48, and 72 hours

Complication Type	Exposed (n = 116) n (%)	Non-Exposed (n = 58) N (%)	*p*-value
At Admission			
Arrhythmias	12 (6.9%)	10 (5.7%)	0.19
AV blocks (any type)	06 (3.4%)	02 (1.1%)	0.14
Conduction disturbances	14 (8.0%)	07 (4.0%)	1.00
Hemodynamic instability	62 (35.6%)	16 (9.2%)	0.001
In-hospital death	02 (1.1%)	01 (0.6%)	1.00
Within 24 Hours			
Mitral regurgitation	68 (39.8%)	41 (24.0%)	0.10
Decreased ejection fraction	68 (39.8%)	28 (16.4%)	0.10
LV systolic dysfunction	38 (22.2%)	11 (6.4%)	0.05
Hemodynamic instability	56 (32.7%)	16 (9.4%)	0.009
Death	03 (1.8%)	0 (0.0%)	0.50
Within 48 Hours			
Mitral regurgitation	69 (41.1%)	37 (22.0%)	0.70
Decreased ejection fraction	67 (39.9%)	27 (15.5%)	0.10
LV systolic dysfunction	35 (20.8%)	10 (6.0%)	0.05
Hemodynamic instability	44 (26.2%)	14 (8.3%)	0.05
Death	04 (2.4%)	0 (0.0%)	0.30
Within 72 Hours			
Mitral regurgitation	68 (41.5%)	37 (22.6%)	0.80
Decreased ejection fraction	63 (38.4%)	25 (15.2%)	0.10
LV systolic dysfunction	31 (18.9%)	10 (6.1%)	0.10
Hemodynamic instability	36 (22.0%)	10 (6.1%)	0.02
Death	0 (0.0%)	1 (0.6%)	0.30

Discussion

The present study demonstrates that patients presenting with acute coronary syndrome (ACS) and traditional cardiovascular risk factors are at a greater risk of developing early in-hospital complications, including mitral regurgitation, reduced left ventricular ejection fraction, and hemodynamic instability. Notably, electrical complications were also observed among patients without traditional risk factors, emphasizing an under

recognized pattern of adverse outcomes in South Asian populations. These findings highlight the clinical significance of both conventional and non-traditional risk profiles in determining the short-term prognosis of patients with ACS.

In the current study, the frequency of arrhythmias on the day of admission was 6.9% among patients with traditional risk factors and 5.7% among those without. These rates are considerably lower than the 23% arrhythmia incidence reported by Meng et al. (9), Similarly, S. Mani et al. (2023) documented an even higher incidence of up to 77.6%, with arrhythmias being most prevalent among patients presenting with ST-elevation myocardial infarction (STEMI)-ACS (10)**.**

In the present study, hemodynamic instability and cardiogenic shock (CS) were observed more frequently among patients with traditional cardiovascular risk factors compared to those without. The proportion of patients developing CS was 35.6% versus 9.2% at admission ($p < 0.001$), 32.7% versus 9.4% within 24 hours ($p < 0.009$), 26.2% versus 8.3% within 48 hours ($p = 0.05$), and 22.0% versus 6.1% within 72 hours ($p < 0.02$). These observations are consistent with the findings of Maimaitiming et al. (2025), who reported that female sex, advanced age, diabetes mellitus, smoking, and STEMI presentation were significant independent predictors of cardiogenic shock following acute coronary syndrome (10).

In the present study, left ventricular systolic failure was observed in 22.2% of patients with traditional cardiovascular risk factors compared to 6.4% of those without within the first 24 hours of the ACS episode. At 48 and 72 hours, the corresponding proportions were 20.8% versus 6.0% and 18.9% versus 6.1%, respectively. The differences were statistically significant at 24 and 48 hours ($p = 0.05$) but not at 72 hours ($p > 0.10$). These findings are consistent with those of John et al. (2022), who reported coronary artery disease (CAD) as a significant risk factor for heart failure with preserved ejection fraction (HFpEF) ($p < 0.001$)(11).

In the present study, a total of 11 in-hospital deaths were observed, of which three occurred within the first 24 hours and four within 48 hours of the ACS episode among patients with traditional cardiovascular risk factors. These findings are consistent with those of Sana Sheikh et al. (2023), who reported no significant difference in in-hospital mortality between patients with and without standard modifiable risk factors (SMuRFs) ($p = 0.59$).(12).

Strength and limitation

The strengths of our study include the implementation of follow-up assessments and the use of comprehensive diagnostic tools such as ECG and ECHO. Additionally, our study design incorporates a comparative approach by analyzing two groups—exposed (traditional risk factors) and non-exposed (non-traditional risk factors)—which enhances the validity of our findings. However, a limitation of our study is the absence of renal function tests (RFTs), which could have provided insights into the impact of renal failure on acute coronary syndrome (ACS) patients. Future research should address this gap by including RFTs. Additionally, chest X-rays were not performed for all patients, limiting our ability to assess pulmonary edema comprehensively.

Conclusion

Patients with Acute Coronary Syndrome (ACS) having traditional cardiovascular risk factors such as hypertension, diabetes mellitus, dyslipidemia, and smoking experienced a higher frequency of early in-hospital complications compared to those without these risk factors. Hemodynamic instability, left ventricular systolic dysfunction, and mitral regurgitation were more frequently observed among this group, underscoring the adverse prognostic influence of modifiable risk factors.

However, patients without traditional risk factors (SMuRF-less ACS) also developed notable complications, indicating that the absence of conventional risk factors does not eliminate the risk of adverse outcomes. Electrical complications and arrhythmias were more frequently noted in this subgroup, suggesting alternative pathophysiological pathways.

These findings highlight the importance of early risk stratification, vigilant in-hospital monitoring, and aggressive management of both traditional and non-traditional ACS patients to improve short-term outcomes, particularly in low- and middle-income healthcare settings.

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Author contributions

Shakeel Nawab: Concept, Data collection, drafting

Syed Arshad Ullah: Concept, methodology, supervision, manuscript writing

Muhammad Nouman Khan and **Sawaira Jamshed**: Data analysis and literature review

Syed Liaquat Ali Shah: Manuscript Writing, drafting & review

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Data availability

Data supporting the findings are available from the corresponding author upon reasonable request.

Declarations

None declared.

Conflict of interest

None declared.

Ethical approval and informed consent

The study was approved by the Institutional Research Committee of BKMC Mardan. Written informed consent was obtained from all participants.

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