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Admission Blood Glucose Level as A Predictor of In-Hospital Major Adverse Cardiovascular Events in Non-Diabetic Patients with Acute Coronary Syndrome

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Abstract: **Background:** Acute coronary syndrome (ACS) remains a major cause of morbidity and mortality worldwide. Despite advances in reperfusion strategies and pharmacotherapy, a significant number of patients develop in-hospital major adverse cardiovascular events (MACE). Admission hyperglycemia has emerged as a potential prognostic marker even in patients without known diabetes mellitus. The present study evaluated the role of admission blood glucose in predicting in-hospital MACE among non-diabetic ACS patients. **Methods:** This prospective observational study was conducted in the Department of Medicine, Sri Guru Ram Das Institute of Medical Sciences and Research, Amritsar, India. Eighty-two non-diabetic adults admitted with ACS were enrolled. Patients with known diabetes or HbA1c ≥5.7% were excluded. Admission random blood sugar (RBS) was measured, and patients were categorized into normoglycemic (<140 mg/dL) and hyperglycemic (≥140 mg/dL) groups. Patients were followed during hospitalization for development of MACE, including cardiogenic shock, arrhythmias, heart failure, reinfarction, and cardiac arrest. Statistical analysis was performed using SPSS.**Results:** The mean age group most affected was 51–70 years (54.88%), and males constituted 73.2% of cases. Hyperglycemia was present in 50% of patients. Significant associations were observed between admission hyperglycemia and cardiogenic shock (85.7% vs. 14.3%, p=0.001), arrhythmias (76.5% vs. 23.5%, p=0.014), cardiac arrest (88.8% vs. 11.1%, p=0.029), and pulmonary edema (85.2% vs. 14.8%, p=0.001). No significant association was seen with heart failure, myocardial reinfarction or duration of hospital stay. **Conclusion:** Admission hyperglycemia is a strong predictor of adverse in-hospital cardiovascular outcomes in non-diabetic ACS patients. Routine glucose assessment at admission may aid in early risk stratification and identification of high-risk patients requiring closer monitoring and aggressive management.

Keywords: Acute coronary syndrome, hyperglycemia, non-diabetic, MACE, cardiogenic shock, arrhythmia, prognosis, STEMI, NSTEMI, blood glucose.

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INTRODUCTION

Acute coronary syndrome (ACS), comprising ST-elevation myocardial infarction (STEMI), non-ST-elevation myocardial infarction (NSTEMI), and unstable angina, is one of the most common cardiovascular emergencies worldwide. It remains a leading cause of death, disability, and healthcare expenditure despite remarkable advances in diagnosis, medical treatment, and coronary revascularization strategies. Early identification of patients at increased risk for complications is essential for improving clinical outcomes (Yusuf *et al*., Fox *et al*.) [1,2].

Current risk stratification models such as TIMI and GRACE scores integrate clinical, electrocardiographic, and biochemical variables. However, there is continued interest in identifying inexpensive, rapidly available, and universally accessible biomarkers that can enhance early bedside risk assessment. Admission blood glucose is one such parameter that is routinely measured in emergency settings and may provide substantial prognostic information (Fox *et al*. and Antman *et al*.) [2,3].

Traditionally, hyperglycemia in ACS was considered a reflection of underlying diabetes mellitus. However, growing evidence suggests that even in patients without

known diabetes, elevated glucose at admission is associated with worse outcomes. This phenomenon is commonly referred to as stress hyperglycemia. It results from activation of the sympathetic nervous system and hypothalamic-pituitary-adrenal axis during acute illness, leading to increased catecholamines, cortisol, glucagon, and inflammatory cytokines. These hormonal and inflammatory responses promote hepatic glucose production, insulin resistance, endothelial dysfunction, oxidative stress, platelet activation, and a prothrombotic state (Capes *et al*.) [4].

These mechanisms may aggravate ischemic myocardial injury, impair microvascular perfusion, enlarge infarct size, and increase the risk of pump failure and arrhythmias. Several studies have shown that admission hyperglycemia predicts mortality and adverse cardiovascular events after myocardial infarction, often with stronger prognostic significance in non-diabetic individuals than in diabetic patients. This may be because acute hyperglycemia in non-diabetics reflects a more severe physiological stress response (Kosiborod *et al*., Kim *et al*.) [5-6].

The present study was therefore undertaken to evaluate admission blood glucose level as a predictor of in-hospital major adverse cardiovascular events (MACE) in non-diabetic patients with ACS admitted to a tertiary care centre in North India.

MATERIALS AND METHODS

This prospective observational study was conducted in the Department of Medicine, Sri Guru Ram Das Institute of Medical Sciences and Research, Amritsar, India, from July 2024 to December 2025. Institutional Ethics Committee approval was obtained prior to commencement. A total of 82 consecutive adult non-diabetic patients admitted with ACS were enrolled. ACS diagnosis was established on the basis of symptoms, ECG findings, cardiac biomarkers, and echocardiography wherever feasible. Patients with STEMI, NSTEMI, and unstable angina were included.

Patients with known diabetes mellitus, HbA1c ≥5.7%, prior administration of dextrose-containing fluids, recent surgery or trauma, medications affecting blood glucose, participation in another clinical trial, or deranged renal function tests were excluded. At admission, detailed demographic and clinical information was recorded. Baseline investigations included complete blood count, renal function tests, electrolytes, HbA1c, troponin-I or CPK-MB, and admission random blood sugar (RBS).

Patients were divided into two groups:

- Normoglycemic: RBS <140 mg/dL
- Hyperglycemic: RBS ≥140 mg/dL

The primary outcome was occurrence of in-hospital MACE, defined as cardiogenic shock, arrhythmias, heart failure, reinfarction, or cardiac arrest. Patients were followed until discharge or in-hospital death.

Data was analyzed using SPSS version 26. Continuous variables were expressed as mean ± standard deviation, and categorical variables as percentages. Chi-square test, Fisher's exact test, independent t-test, and ANOVA were applied where appropriate. A p-value <0.05 was considered statistically significant.

RESULTS

Table-1: Demographic Profile

Demographic profile	No. of cases	%age
Age group		
• 30-50	11	13.41
• 51-70	45	54.88
• >70	26	31.71
Gender		
• Female	22	26.83
• Male	60	73.17
BMI		
• NORMAL	15	18.29
• OBESE	48	58.54
• Overweight	18	21.95
• Underweight	1	1.22
Hypertension		
• Yes	34	41.46
• No	48	58.54
Smoking history		
• Yes	4	4.88
• No	78	95.12
Alcohol consumption		

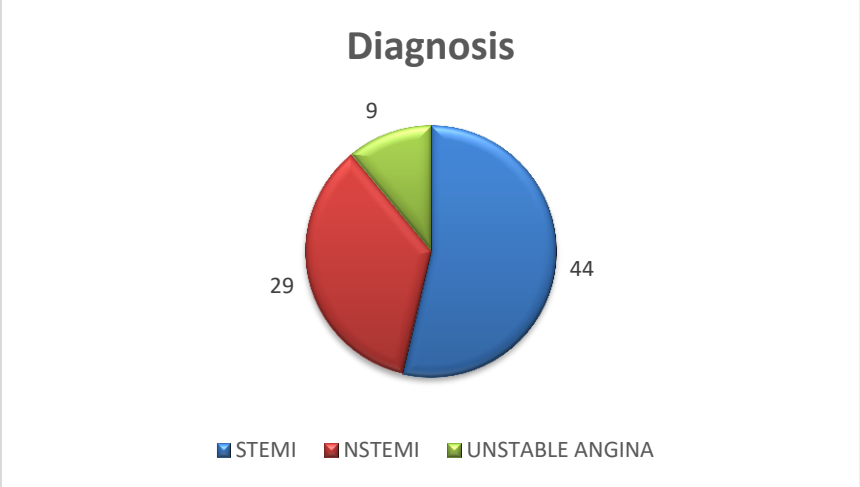
• Yes	13	15.85
• No	69	84.15
Family history		
• Positive	22	26.83
• Negative	60	73.17

The study population included 82 patients. The most common age group was 51–70 years (54.88%). Nearly 87% of patients were older than 50 years, confirming the predominance of ACS in older adults. Males represented 73.2% of the cohort, while females accounted for 26.8%.

Hypertension was present in 41.5% of patients. Excess body weight was common, with obesity (58.54%) comprising the majority of patients. Family history of coronary artery disease was present in 26.8%. Alcohol consumption was observed in 15.9% of patients while smoking was present in 4.9% of patients.

Table-2: Distribution of Patients According to Diagnosis

Diagnosis	No. of cases	%age
NSTEMI	29	35.4
STEMI	44	53.7
Unstable angina	9	11.0
Total	82	100.0



DISTRIBUTION OF PATIENTS ACCORDING TO DIAGNOSIS

STEMI was the most common presentation (53.7%), followed by NSTEMI (35.4%) and unstable angina (11.0%).

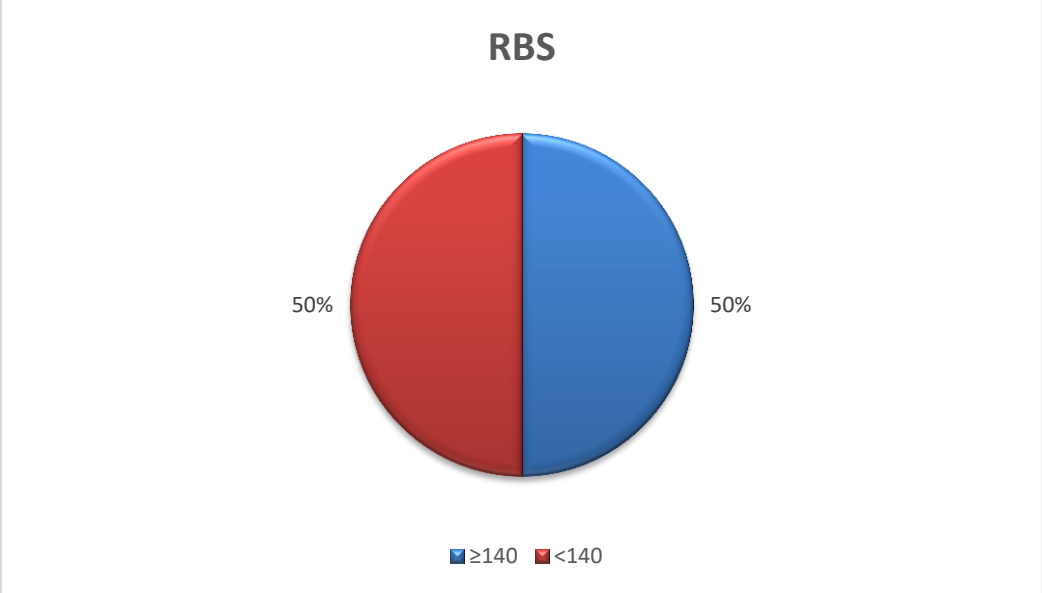
Table-3: Distribution of Ejection Fraction in ACS Patients (N = 82)

Ejection Fraction range (%)	Number (n)	Percentage (%)
≥50%	14	17.07
41–49%	13	15.85
≤40%	55	67.07
Total	82	100.00

Severely reduced left ventricular ejection fraction (≤40%) was seen in 67.1% of patients, indicating substantial myocardial dysfunction.

Table-4: Distribution of Patients According to Admission Random Blood Sugar (RBS)

RBS Category (mg/dL)	Number of Patients (n)	Percentage (%)
< 140 (Normoglycemia)	41	50.0
≥ 140 (Hyperglycemia)	41	50.0
Total	82	100.0

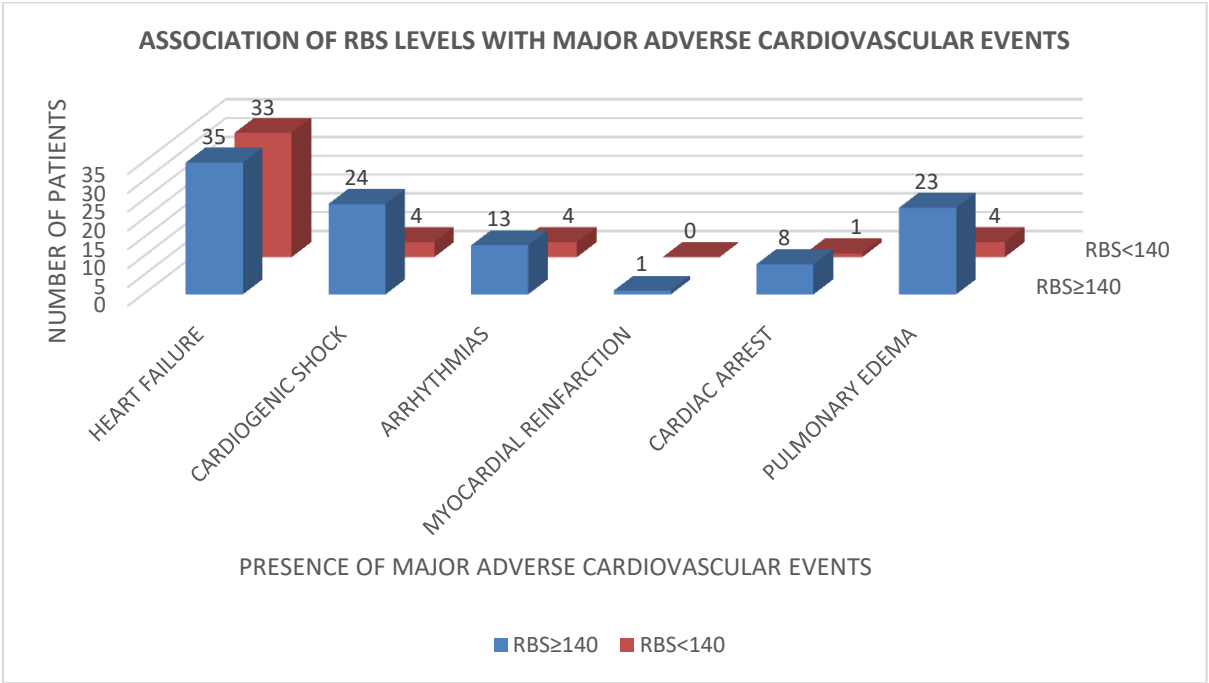


DISTRIBUTION OF PATIENTS ACCORDING TO ADMISSION RANDOM BLOOD SUGAR (RBS)

Admission hyperglycemia (RBS ≥140 mg/dL) was present in 41 patients (50%), while the remaining 41 patients were normoglycemic.

Table-5: Association of RBS Levels with Major Adverse Cardiovascular Events

EVENT	RBS≥140	RBS<140	TOTAL
HEART FAILURE	35(51.48%)	33(48.52%)	68
CARDIOGENIC SHOCK	24(85.71%)	4(14.29%)	28
ARRHYTHMIAS	13(76.47%)	4(23.53)	17
MYOCARDIAL REINFARCTION	1(100%)	0(0%)	1
CARDIAC ARREST	8(88.8%)	1(11.11%)	9
PULMONARY EDEMA	23(85.2%)	4(14.8%)	27



ASSOCIATION OF RBS LEVELS WITH MAJOR ADVERSE CARDIOVASCULAR EVENTS

Heart failure occurred frequently in the cohort (51.48%), but no statistically significant association

was found between hyperglycemia and heart failure (p=0.840). However, other major complications showed strong associations with elevated glucose levels.

Cardiogenic shock developed in 28 patients (34.15%). Of these, 24 patients (85.71%) belonged to the hyperglycemic group, whereas only 4 patients (14.29%) were normoglycemic (p=0.001). This indicates a powerful relationship between elevated admission glucose and severe hemodynamic compromise.

Arrhythmias occurred in 17 patients (20.73%). Thirteen of these patients (76.47%) had admission hyperglycemia, compared with four (23.53%) in the normoglycemic group (p=0.014). Sinus bradycardia was the most common rhythm disturbance.

Cardiac arrest was documented in 9 patients (10.98%). Eight of these patients (88.8%) had elevated admission glucose, while only one patient (11.1%) had normal glucose values (p=0.029).

Pulmonary edema occurred in 27 patients (32.9%), while 55 patients (67.1%) did not experience it. Among patients who developed Pulmonary edema, most (85.2%) had elevated RBS ≥140 mg/dL, while only 14.8% had RBS <140 mg/dL. Thus, pulmonary edema was observed in hyperglycemic patients compared to normoglycemic patients, with a highly significant association (p=0.001).

Reinfarction occurred in only one patient and did not show statistical significance. Duration of hospital stay was similar in both groups (6.37 ± 2.85 days vs. 6.15 ± 3.19 days, p=0.744).

DISCUSSION

The present study demonstrates that admission hyperglycemia is strongly associated with adverse in-hospital cardiovascular outcomes in non-diabetic patients presenting with ACS. Although traditionally considered a metabolic response to acute stress, elevated glucose appears to be an important marker of disease severity and poor prognosis, which is in agreement with the observations of Capes *et al*. and Kosiborod *et al*. [4,5].

The demographic profile of this cohort aligns with established epidemiology of ACS. Older age and male predominance observed in the present study are consistent with previous reports by Yusuf *et al*. and Fox *et al*., [1,2] who described higher ACS incidence among elderly males. The high prevalence of obesity and hypertension further reflects the growing burden of cardiometabolic risk factors in developing countries.

One of the most important findings of the study was the strong association between hyperglycemia and cardiogenic shock. Patients with elevated glucose had a markedly higher incidence of shock, suggesting larger infarct burden, poorer ventricular function, and more severe systemic stress. Similar findings were reported by Kim *et al*., [6] who showed that non-diabetic AMI patients with admission glucose ≥200 mg/dL had substantially higher mortality and more cardiogenic shock.

The association between admission hyperglycemia and arrhythmias in the present study is also clinically significant. Hyperglycemia can promote electrical instability through catecholamine excess, electrolyte shifts, oxidative stress, and ischemic injury. These findings are supported by studies such as those of Paolisso *et al*. and Ding *et al*., [7,8] who demonstrated worse short-term outcomes in hyperglycemic ACS patients.

Cardiac arrest occurred predominantly among hyperglycemic patients. This likely reflects the cumulative effect of larger infarct size, malignant arrhythmias, severe pump failure, and hemodynamic collapse. Similar observations have been described by Moustafa *et al*. [9] in non-diabetic STEMI cohorts.

Pulmonary edema was significantly more frequent among hyperglycemic patients, further indicating more severe ventricular dysfunction. Hyperglycemia impairs endothelial function, worsens myocardial metabolism, and increases inflammatory injury, all of which may contribute to acute heart failure.

Interestingly, heart failure as a composite bedside diagnosis did not reach statistical significance, possibly because of the already high prevalence of heart failure features in the overall cohort. Reinfarction occurred in only one patient and did not show statistical significance. Similarly, length of hospital stay did not differ significantly, which may reflect standardized treatment protocols or early mortality among severely ill patients.

The present findings are consistent with studies by Paolisso *et al*., Ding *et al*., Moustafa *et al*., Aggarwal *et al*., [7-10] and others, all of whom identified admission hyperglycemia as an independent predictor of mortality or MACE in ACS, especially among non-diabetic individuals.

The clinical implication of these findings is substantial. Blood glucose measurement is inexpensive, rapidly available, and universally performed in emergency departments. Its incorporation into early risk stratification may help identify patients who need intensive monitoring, aggressive hemodynamic support, earlier invasive strategies, or closer surveillance for arrhythmias and shock.

The study is limited by single-center design and relatively small sample size. Long-term follow-up was not included. Future multicentric studies with larger

cohorts and evaluation of stress hyperglycemia ratio may provide deeper insights.

CONCLUSION

Admission blood glucose level is a valuable and readily available prognostic marker in non-diabetic patients with acute coronary syndrome. Hyperglycemia at presentation was significantly associated with cardiogenic shock, arrhythmias, cardiac arrest, and pulmonary edema. These findings suggest that stress hyperglycemia identifies a metabolically vulnerable subgroup at increased risk of in-hospital complications.

Routine assessment of admission glucose should be considered an essential component of initial ACS evaluation. Early recognition of hyperglycemia may facilitate prompt risk stratification, closer monitoring, and targeted management strategies aimed at reducing adverse outcomes.

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