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Research Article

THE STUDY OF STRESS HYPERGLYCEMIA AND DIABETES MELLITUS IN PROGNOSIS OF ACUTE CORONARY SYNDROME IN TERTIARY CARE HOSPITAL

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ABSTRACT

Objective: Acute coronary syndrome (ACS) is a leading cause of morbidity and mortality globally. Stress hyperglycemia and diabetes mellitus significantly influence outcomes in ACS patients. This study aimed to compare their prognostic effects in terms of complications and in-hospital mortality.

Method: A cross-sectional study was conducted on 91 ACS patients (STEMI, NSTEMI, UA) admitted to a tertiary care hospital over 18 months. Patients with admission random blood sugar (RBS) >140 mg/dL were included in the study. Based on Glycosylated hemoglobin (HbA1c) levels, patients were categorized into the stress glycemic group (HbA1c <6.5) and the diabetic group (HbA1c ≥6.5). Outcomes were analyzed until discharge or death.

Results: Among the study population, 63.74% were male, and 36.26% were female. Cardiogenic shock occurred in 41.76% of patients, with a significantly higher prevalence in the stress glycemic group (73.68%) compared to the diabetic group (26.32%). Heart failure was observed in 61.54% of patients, predominantly in the stress glycemic group (64.29%) versus the diabetic group (35.71%). Arrhythmias affected 28.57% of patients, with a higher prevalence in the stress glycemic group (76.92%) compared to the diabetic group (23.08%). In-hospital mortality was 29.67%, with significantly higher mortality in the stress glycemic group (74.07%) compared to the diabetic group (25.93%).

Conclusion: Hyperglycemia at admission in ACS patients, particularly stress hyperglycemia, is associated with severe complications and increased mortality compared to diabetes mellitus. Regular monitoring and management of blood glucose levels in non-diabetic ACS patients are crucial to improve outcomes. Further research with long-term follow-up is warranted.

Keywords: Acute coronary syndrome, Stress hyperglycemia, Diabetes mellitus, Cardiogenic shock, Heart failure.

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INTRODUCTION

During stressful conditions such as myocardial infarction, the sympathetic discharge increase, resulting in adrenaline, noradrenaline, and other counter-regulatory hormone releases. Stress hyperglycemia is the outcome. The high level of these hormones also leads to insulin resistance, at receptor and post-receptors levels. Claude Bernard, a French physiologist, recorded stress hyperglycemia in 1855 [1].

Stress hyperglycemia is defined by American Diabetes Association as an elevation of fasting glucose eptommol/L (≥126 mg/dL), or 2-h postprandial glucose stingmmol/L (≥200 mg/dL) in a patient without evidence of previous diabetes and a random blood sugar (RBS) >140 mg/dL [2]. Glycosylated hemoglobin (HbA1c) value has been recommended to distinguish between patients with stress hyperglycemia and those with previously undiagnosed diabetes. HbA1c value ≥6.5% suggests pre-existing unrecognized diabetes, whereas an HbA1c value <6.5% indicates stress-induced hyperglycemia.

Stress hyperglycemia has several means. Stress conditions such as surgery, trauma, and acute illness increase the circulatory level of counter-regulatory hormones (glucagon, cortisol, and catecholamines) and proinflammatory cytokines and they alter the effect of insulin on the hepatic cells and on the skeletal muscle by increasing of the hepatic production of glucose and decreasing the peripheral utilization of glucose [3].

Coronary heart disease is a major global health concern, causing significant morbidity and mortality. Risk factors like diabetes mellitus are rising due to urbanization, unhealthy diets, and sedentary lifestyles. Both diabetes mellitus and stress hyperglycemia are linked to poor outcomes in coronary heart disease, primarily through platelet and thrombotic activation, promoting thrombus formation. While studies have examined the independent effects of these conditions on acute coronary syndrome (ACS), few have compared their impact [4]. This study aimed to evaluate and compare the effects of stress hyperglycemia and diabetes mellitus on in-hospital complications and mortality in ACS patients to determine which condition has a worse prognosis.

METHODS

After obtaining approval from the Institutional Ethical Committee and written informed consent from the participants, this cross-sectional study was conducted in the Department of General Medicine at a tertiary care center in Central India over 18 months, from December 2018 to May 2020. The study included 91 patients admitted with ACS (STEMI, NSTEMI, and Unstable Angina) accompanied by hyperglycemia. Patients with chronic stable angina, malignancy, thyroid disorders (hypothyroidism or hyperthyroidism), asthma/COPD, sickle cell disease, or ST elevation/depression due to non-ACS causes (e.g., acute pericarditis, myocarditis, hyperkalemia, Brugada syndrome, arrhythmogenic right ventricular cardiomyopathy, hypothermia, left ventricular hypertrophy, or hypokalemia) were excluded from the study.

A detailed history, including prior history of diabetes mellitus, was obtained from the patients and their caregivers. A complete clinical examination was performed. An admission ECG was recorded and repeated as needed. Blood samples were collected at admission and analyzed for RBS, HbA1c, and cardiac markers. Patients with an RBS >140 mg/dL were included in the study, while others were excluded based on the outlined criteria. Patients were categorized into two groups based on their RBS and HbA1c levels: the stress glycemic group, with admission RBS >140 mg/dL and HbA1c <6.5, and the diabetic group, with admission RBS >140 mg/dL and HbA1c ≥6.5. A total of 46 patients were classified into the stress glycemic group, and 45 patients into the diabetic group. All patients received appropriate treatment as per clinical guidelines and were monitored throughout their hospital stay for the development of complications or death. The complications assessed included cardiogenic shock, heart failure, and arrhythmias. Arrhythmias considered in the study included atrioventricular blocks, atrial fibrillation, atrial flutter, re-entrant tachycardias, ventricular tachycardia, and ventricular fibrillation.

Data were entered into a Microsoft spreadsheet, and tables and charts were created using Microsoft Word and Excel. Continuous variables were presented as Mean±standard deviation, while categorical variables were expressed as frequencies and percentages. Independent t-tests and Mann–Whitney tests were used to compare continuous variables, depending on data normality. Categorical variables were analyzed using the Chi-square test or Fisher's exact test for smaller samples. Odds ratios with 95% confidence intervals were calculated to assess associations, and multivariate logistic regression identified independent predictors of stress hyperglycemia. Statistical significance was set at p<0.05, and analysis was performed using STATA version 14.0.

RESULTS

All 91 patients in the study population were divided into two groups based on admission RBS and HbA1c values: One group with stress hyperglycemia and the other with diabetes mellitus. The mean age of the study population was 58.41±12.90 years. The mean age of males was 57.80 ± 12.37 years, and that of females was 59.41±13.54 years, with no statistically significant difference (p=0.6494). The study included 58 males and 33 females. Among them, 32 males and 14 females had stress hyperglycemia, while 26 males and 19 females had diabetes mellitus (Table 1).

The mean RBS of the study population was 268.52±65.91 mg/dL. The stress glycemic group had a mean RBS of 236.50±29.84 mg/dL, while the diabetic group had 302.79±76.31 mg/dL. The mean HbA1c for the study population was 7.08, with the stress glycemic group at 5.56 and the diabetic group at 8.63. A significant difference in mean RBS and HbA1c values was observed between the two groups (p<0.0001) (Fig. 1).

There was no significant difference between mean systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate between the two groups, (p>0.05) (Fig. 2).

Raised JVP was observed in 48 patients, with no significant association found with stress hyperglycemia or diabetes mellitus. Elevated CPK-MB levels were noted in 69 patients, showing no significant difference between the two groups. Among the study population, STEMI was the most common infarction type, followed by NSTEMI and UA, with no significant association between infarction type and stress hyperglycemia or diabetes mellitus, (Table 2).

Cardiogenic shock, heart failure, arrhythmias, and mortality were significantly higher in the stress glycemia group compared to the diabetic group, with p=0.0002, 0.0009, 0.0015, and 0.0036, respectively (Table 3).

On multiple logistic regression analysis to determine various cardiovascular risk factors with stress hyperglycemia in patients of ACS, the adjusted odds ratio of cardiogenic shock, heart failure, arrhythmias, and death were 4.39, 4.91, 6.92, and 4.78, respectively, and all these values were highly significant (Table 4).

Table 1: Distribution of study population according to gender

Gender	Stress glycemic		Diabetic	
Male	32	69.57	26	57.78
Female	14	30.43	19	42.22
Total	46	100.0	45	100.0

Table 2: Association of JVP, CPK-MB, and type of infarction with stress glycemia and diabetes mellitus

Parameters	Stress glycemic (%)	Diabetic (%)	p-value
JVP			
Yes	25 (52.08)	23 (47.92)	0.757
No	21 (48.81)	22 (51.16)	
CPKMB			
Yes	38 (55.07)	31 (44.93)	0.126
No	08 (36.36)	14 (63.64)	
Type of infarction			
STEMI	31 (59.62)	21 (40.38)	0.130
NSTEMI	07 (41.18)	10 (58.82)	
UA	08 (36.36)	14 (63.64)	

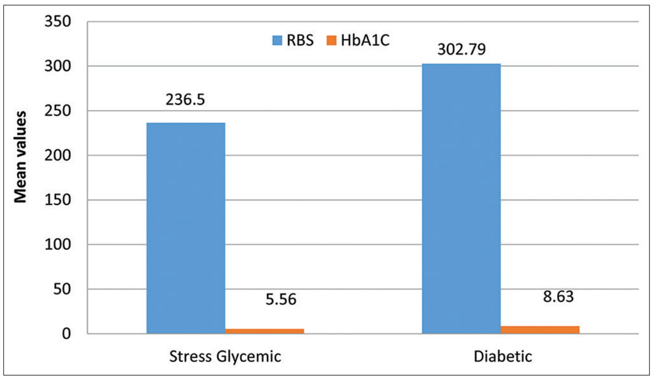

Fig. 1: Comparison of RBS and HbA1C values between Stress glycemic and diabetic patients. RBS: Random blood sugar, HbA1C: Glycosylated hemoglobin

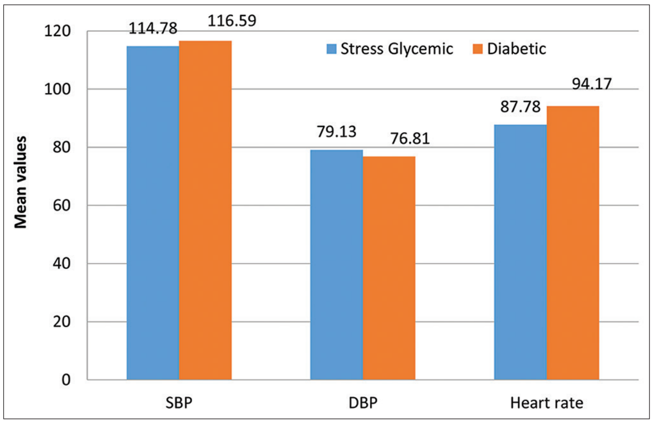

Fig. 2: Comparison of SBP, DBP, and heart rate values between stress glycemic and diabetic patients. SBP: Systolic blood pressure, DBP: Diastolic blood pressure

DISCUSSION

Cardiovascular diseases are the leading cause of death worldwide, accounting for a quarter of all mortality in India. Numerous studies have highlighted the negative impact of stress hyperglycemia and diabetes mellitus on mortality and morbidity in ACS [5]. According to Capes *et al.* [6], diabetic patients with ACS are at risk for in-hospital

Table 3: Comparison of clinical outcome between two groups

Clinical outcome	Stress glycemic (%)	Diabetic (%)	p-value
Cardiogenic shock			
Yes	28 (73.68)	10 (26.32)	0.0002
No	18 (33.96)	35 (66.04)	
Heart failure			
Yes	36 (64.29)	20 (35.71)	0.0009
No	10 (28.57)	25 (71.73)	
Arrhythmias			
Yes	20 (76.92)	06 (23.08)	0.0015
No	26 (40.0)	39 (60.0)	
Death			
Yes	20 (74.07)	07 (25.93)	0.0036
No	26 (70.63)	38 (59.38)	

Table 4: Multiple logistic regression analysis to determine various cardiovascular risk factors with stress glycemia in patients of acute coronary syndrome

Cardiovascular factor	Adjusted Odds Ratio	95% Confidence interval	p-value
Cardiogenic shock	4.39	1.44–13.35	0.009
Heart failure	4.91	1.62–14.88	0.005
Arrhythmias	6.92	1.92–24.87	0.003
Deaths	4.78	1.55–5.73	0.005

complications when admission blood glucose concentrations are equal to or above 180 mg/dL, while non-diabetic patients with ACS are at risk when blood glucose levels exceed 110 mg/dL. Timmer *et al*. [7] demonstrated that the increased mortality risk is not limited to individuals with pre-existing diabetes, categorizing blood glucose levels exceeding 140 mg/dL as stress hyperglycemia in non-diabetic patients. The HI-5 studies showed that individuals with acute myocardial infarction who maintained mean blood glucose levels above 144 mg/dL had a higher 6-month mortality rate [8].

The present study highlights the relevance of stress hyperglycemia and diabetes mellitus on short-term outcomes in ACS patients and compares the prognosis between these two groups. The mean age of patients in our study was 58.49±12.90 years, with no statistically significant correlation between mean age and outcomes, which aligns with studies by Timmer *et al*. [9], Cinar *et al*. [10] and Aggarwal *et al*. [11] In the present study, there were 58 males and 33 females, with no significant difference between the two groups. The male-to-female ratio was similar to the 4:1 ratio reported by Aggarwal *et al*. [11] in their study on non-diabetic myocardial infarction patients. There was no statistically significant difference between stress hyperglycemia and diabetes mellitus in terms of SBP, DBP, heart rate, JVP, CPK MB values, and the type of infarction in our study.

The mean RBS in the two groups was 236.50 and 302.79, respectively. The difference between the mean admission RBS of the two groups was statistically significant, with a p<0.0001, consistent with the findings of Aggarwal *et al*. [11] The mean HbA1c values for the two groups were 5.56 and 8.63, respectively, with a statistically significant difference (p<0.0001), in line with the study by Kadri *et al*. [12].

The present study found a statistically significant increase in the risk of cardiogenic shock (p=0.0002), heart failure (p=0.0009), arrhythmias (p=0.0015), and in-hospital mortality (p=0.0036) in patients with stress hyperglycemia, consistent with previous studies [10-15]. Kadri *et al*. [12] reported a higher incidence of ventricular fibrillation in the hyperglycemic group, while other studies [10,11,13-15], which assessed all types of arrhythmias, showed comparable results. Mortality rates in the study by Timmer *et al*. [9] were higher, as they referred to 30-day and 8-year mortality, while the present study focused on in-hospital mortality, which was significantly higher in the hyperglycemic group. The larger difference in in-hospital mortality in the study by Mak *et al*. [15] can be explained by their classification of groups based on an admission RBS of ≤120 mg% and >120 mg%, unlike the present study, which used ≤140 mg% and >140 mg%.

Our study compared the outcomes of stress hyperglycemia and diabetes mellitus in ACS patients and found that stress hyperglycemia was associated with worse short-term outcomes. This is in line with Mak *et al*. [15], who showed that non-diabetic patients with elevated admission RBS had worse immediate outcomes than those with known diabetes. Goyal *et al*. [16] found increased mortality in ACS patients with an admission RBS >144 mg/dL, regardless of prior diabetes status. Similarly, Hsu *et al*. [17] identified elevated initial glucose levels as an independent predictor of both short- and long-term adverse outcomes in first-time MI patients.

The current study had several limitations, including a small sample size and the potential exclusion of patients with a history of old ischemic heart disease, which could have impacted the outcomes. In addition, the lack of post-discharge follow-up prevented the assessment of the long-term impact of stress hyperglycemia on ischemic heart disease. Moreover, stress hyperglycemia in known diabetic patients was not considered or clearly defined in this study.

CONCLUSION

Hyperglycemia at admission, whether in diabetic or non-diabetic patients with ACS, is strongly associated with complications such as heart failure, cardiogenic shock, arrhythmias, and early mortality. Stress hyperglycemia results in worse outcomes compared to pre-existing diabetes mellitus. Non-diabetic patients with hyperglycemia should not be overlooked, and regular monitoring and management of blood sugar levels is essential. Larger studies with post-discharge follow-up are needed to better understand the long-term effects of stress hyperglycemia and diabetes on coronary heart disease.

CONFLICTS OF INTEREST

None.

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