



ASSOCIATION BETWEEN ACUTE AND CHRONIC HYPERGLYCEMIA IN PATIENTS WITH STEMI: A COMPARATIVE ANALYSIS

General Medicine

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ABSTRACT

Diabetes mellitus (DM) significantly elevates the risk of vascular complications, including acute myocardial infarction (AMI). This study investigated the association between acute and chronic hyperglycemia in patients with ST-segment elevation myocardial infarction (STEMI), providing a comparative analysis of their impacts on cardiovascular outcomes. Hyperglycemia, whether acute or chronic, triggers detrimental effects within the vascular system. Acute hyperglycemia exacerbates myocardial damage through increased oxidative stress and inflammatory responses, while chronic hyperglycemia, as indicated by elevated HbA1c levels, reflects long-term glucose management and vascular health. **Material And Methods-** The study was conducted on patients attending the outpatient (OPD) and inpatient departments (IPD) in the Department of General Medicine at Rajshree Medical Research Institute, Bareilly. It was a prospective cohort study that included patients diagnosed with acute STEMI using a 12-lead ECG. Exclusion criteria included patients with hemoglobin (Hb) levels less than 7 mg/dl, hemoglobinopathy, or hypothyroidism. A sample size of 100 was determined using statistical formulas. Data collection utilized digital glucometers and high-performance liquid chromatography (HPLC) devices. Blood samples were collected upon admission before any treatment. Data were entered into a Microsoft Excel sheet and analyzed using the T-test. **Results-** The study revealed significant associations between age, gender, and HbA1c levels among STEMI patients. The 40-49 age group had the highest percentage of diabetics, and males were more likely to be diabetic compared to females. Clinical conditions such as shortness of breath showed significant associations with higher percentages of diabetic patients. Other conditions like jugular venous pressure (JVP), pulmonary edema, and cardiogenic shock were also analyzed, highlighting the role of hyperglycemia in influencing cardiovascular outcomes. However, the analysis of patient outcomes, including death and discharge, indicated no significant correlation with HbA1c levels. **Conclusion-** This study highlighted significant associations between acute and chronic hyperglycemia in STEMI patients. Higher percentages of diabetic patients were observed across multiple clinical conditions, emphasizing the impact of glycemic control on cardiovascular health. Gender analysis revealed a predominance of male diabetic patients, and age distribution showed the highest percentage of diabetics in the 40-49 age group. Despite these associations, no significant correlation was found between HbA1c levels and patient outcomes such as death or discharge. These findings underscore the need for comprehensive management strategies in STEMI patients, focusing on both acute and chronic hyperglycemia to improve cardiovascular outcomes.

KEYWORDS

hyperglycemia, HbA1c, diabetes mellitus, cardiovascular outcomes, glycemic control

INTRODUCTION

Diabetes mellitus (DM) significantly elevates the risk of vascular complications, including acute myocardial infarction (AMI). Among the various factors associated with DM, hyperglycemia plays a critical role in influencing cardiovascular outcomes. Acute hyperglycemia, often referred to as stress hyperglycemia, can occur during events like ST-segment elevation myocardial infarction (STEMI), while chronic hyperglycemia is typically monitored through glycated hemoglobin (HbA1c) levels. This study aimed to investigate the association between acute and chronic hyperglycemia in patients with STEMI, providing a comparative analysis of their impacts on cardiovascular outcomes.[1]

HbA1c offers a reliable measure of average blood glucose levels over approximately three months and is a key diagnostic tool for DM. Maintaining HbA1c levels below 7% is crucial to reducing cardiovascular disease risk. However, recent studies suggest that blood glucose levels at admission may serve as a more robust predictor of short-term mortality following AMI than HbA1c levels alone. This shift in focus underscores the need to differentiate the impacts of acute and chronic hyperglycemia on STEMI outcomes. [2]

Hyperglycemia, whether acute or chronic, triggers detrimental effects within the vascular system.[3] Acute hyperglycemia can exacerbate myocardial damage through increased oxidative stress and inflammatory responses during critical events like STEMI. [4,5] In contrast, chronic hyperglycemia, as indicated by elevated HbA1c levels, reflects long-term glucose management and its impact on vascular health.[6,7] Understanding the distinct roles of these two forms of hyperglycemia is essential for improving risk stratification and therapeutic strategies in STEMI patients.

This study provided a comprehensive analysis of the association between acute stress hyperglycemia and chronic hyperglycemia in STEMI patients.

MATERIAL & METHODS

The study was conducted on patients attending the outpatient (OPD) and inpatient departments (IPD) in the Department of General Medicine at Rajshree Medical Research Institute, Bareilly. This prospective cohort study included patients of both genders diagnosed with acute ST-segment elevation myocardial infarction (STEMI) using a 12-lead ECG. Exclusion criteria comprised patients with hemoglobin (Hb) levels less than 7 mg/dl, those with hemoglobinopathy, or those diagnosed with hypothyroidism. The study period spanned 18 months from the date of approval by the ethics committee until the required sample size was achieved.

A sample size of 100 was determined using the formula $n=4pq/d^2$ with a 95% confidence level, 10% precision, and 5% alpha error. A pilot study, including 20 cases from the OPD and IPD, indicated that achieving the sample size of 100 within three months was feasible. All eligible patients admitted to the Department of Medicine's IPD with a diagnosis of STEMI were consecutively included until the sample size was met.

Data collection utilized standardized digital glucometers for measuring blood glucose levels at admission and high-performance liquid chromatography (HPLC) for determining HbA1c levels. Patient data were documented using electronic medical records and patient interviews, with data entry facilitated through secure hospital database systems.

Blood samples were collected from all study participants upon admission before any treatment was administered. These samples were used to measure immediate blood glucose levels and assess HbA1c, providing insights into the patients' glucose control over the preceding three months. Written informed consent was obtained from all participants, and the study received approval from the institute's research and ethics committee.

For data analysis, the collected data were numerically coded and

entered into a Microsoft Excel sheet. The significance of research parameters on the category scale between two groups was determined using the T-test.

RESULTS

Table 1 Association Between Acute And Chronic Hyperglycemia In Patients With STEMI By Age And Gender.

Age/ Gender	Diabetic	Normal	Pre Diabetic	Total	p Value	Chi- Square
20-29	1	0	3	4	0.011	25.954a
%	25.0%	0.0%	75.0%	100.0%		
30-39	7	3	3	13		
%	53.8%	23.1%	23.1%	100.0%		
40-49	31	3	6	40		
%	77.5%	7.5%	15.0%	100.0%		
50-59	14	5	1	20		
%	70.0%	25.0%	5.0%	100.0%		
60-69	15	1	0	16		
%	93.8%	6.3%	0.0%	100.0%		
70-79	2	1	2	5		
%	40.0%	20.0%	40.0%	100.0%		
80-89	2	0	0	2		
%	100.0%	0.0%	0.0%	100.0%		
Total	72	13	15	100		
%	72.0%	13.0%	15.0%	100.0%		
Female	19	4	6	29	0.566	1.140a
%	65.5%	13.8%	20.7%	100.0%		
Male	53	9	9	71		
%	74.6%	12.7%	12.7%	100.0%		
Total	72	13	15	100		
%	72.0%	13.0%	15.0%	100.0%		

Table 1 illustrates the distribution of HbA1c levels by age and gender among STEMI patients. Significant associations were found between age groups and HbA1c categories, particularly within the 40-49 age group, which had the highest percentage of diabetics. Gender analysis revealed that a higher percentage of males were diabetic compared to females, emphasizing the importance of monitoring both acute and chronic hyperglycemia in STEMI patients to improve cardiovascular outcomes.

Table 2 Association Between Acute and Chronic Hyperglycemia in Patients with STEMI Across Various Clinical Conditions.

Condition	Diabetic	Normal	Pre Diabetic	Total	p Value	Chi- Square
Chest Pain	72	13	15	100	-	-
%	72.0%	13.0%	15.0%	100.0%	-	-
Shortness of Breath					0.004	10.893a
Absent	8	3	7	18		
%	44.4%	16.7%	38.9%	100.0%		
Present	64	10	8	82		
%	78.0%	12.2%	9.8%	100.0%		
JVP					0.755	0.562a
Absent	63	11	14	88		
%	71.6%	12.5%	15.9%	100.0%		
Present	9	2	1	12		
%	75.0%	16.7%	8.3%	100.0%		
Pulmonary Edema					0.723	0.648a
Absent	62	11	14	87		
%	71.3%	12.6%	16.1%	100.0%		
Present	10	2	1	13		
%	76.9%	15.4%	7.7%	100.0%		
Cardiogenic Shock					0.737	0.610a
Absent	65	11	14	90		
%	72.2%	12.2%	15.6%	100.0%		
Present	7	2	1	10		
%	70.0%	20.0%	10.0%	100.0%		
Arrhythmia					0.555	1.178a
Absent	66	13	14	93		
%	71.0%	14.0%	15.1%	100.0%		
Present	6	0	1	7		
%	85.7%	0.0%	14.3%	100.0%		
Wall Affected					0.688	2.369a

Anterior Wall MI	28	5	9	42		
%	66.7%	11.9%	21.4%	100.0%		
Inferior Wall MI	21	4	3	28		
%	75.0%	14.3%	10.7%	100.0%		
Lateral Wall MI	23	4	3	30		
%	76.7%	13.3%	10.0%	100.0%		
Total	72	13	15	100		
%	72.0%	13.0%	15.0%	100.0%		

Table 2 represents the association between acute and chronic hyperglycemia in STEMI patients across various clinical conditions. Significant associations were observed in cases of shortness of breath, with higher percentages of diabetic patients presenting with this symptom. Other conditions like JVP, pulmonary edema, cardiogenic shock, arrhythmia, and affected wall location were also analyzed, highlighting the critical role of hyperglycemia in influencing cardiovascular outcomes in STEMI patients.

Table 3 OUTCOME WITH HbA1c.

Outcome	HbA1c			Total	P Value	chi- SQU ARE
	Diabe tic	Norm al	Predia betic			
DEATH	N 10	1	2	13	.829	.376 ^a
%	76.9%	7.7%	15.4%	100.0%		
DISCHARGE	N 62	12	13	87		
%	71.3%	13.8%	14.9%	100.0%		
TOTAL	N 72	13	15	100		
%	72.0%	13.0%	15.0%	100.0%		

Table 3 represents the outcomes of individuals categorized by their HbA1c levels into diabetic, pre-diabetic, and normal groups. The analysis examines the association between these categories and two outcomes: death and discharge. Among the diabetic group, 76.9% experienced death, while 7.7% were discharged, and 15.4% were pre-diabetic. Conversely, among the discharged individuals, 71.3% were diabetic, 13.8% were pre-diabetic, and 14.9% were normal. The total distribution shows 72.0% diabetic, 13.0% pre-diabetic, and 15.0% normal individuals, with p-values indicating no significant association between HbA1c categories and outcomes (p = .829 for death and p = .376 for discharge, Chi-square test).

DISCUSSION

Our study aimed to investigate the relationship between age, gender, and HbA1c levels among STEMI patients, with a focus on the association between acute and chronic hyperglycemia. The data revealed significant patterns in age and gender distribution. Notably, the majority of participants across all age groups were male, with a pronounced male predominance in the 60-69 and 70-89 age brackets. This trend aligns with findings from [Odoi et al. \[8\]](#), which indicated higher myocardial infarction (MI) hospitalization risks among males compared to females. Moreover, our analysis showed a significant relationship between age and gender distribution ($\chi^2 = 9.758$, $p = 0.135$), suggesting that age influences gender distribution among STEMI patients.

The correlation between HbA1c levels and chest pain in our study underscores the importance of glycemic control in cardiovascular health. Among individuals presenting with chest pain, a significant proportion were classified as diabetic, indicating a potential link between poor glycemic control and cardiovascular symptoms. This finding aligns with [Manistamara et al. \[9\]](#), who reported notable differences in chest pain characteristics among ACS patients with and without diabetes. Diabetic patients tended to report lower levels of chest pain, which could influence their clinical management and outcomes. Our study further highlights the need for clinicians to consider glycemic control when evaluating and managing chest pain in STEMI patients.

In our examination of JVP, pulmonary edema, cardiogenic shock, and arrhythmia, the data indicated varied associations with HbA1c levels. For instance, a majority of individuals with raised JVP were diabetic, suggesting a potential link between diabetes and elevated JVP levels. Similarly, normal HbA1c levels were more prevalent among patients without pulmonary edema or cardiogenic shock, indicating that good glycemic control might reduce the likelihood of these conditions.

However, in the case of arrhythmia, normal HbA1c levels did not necessarily correlate with a reduced risk, as a significant number of arrhythmia cases were observed among those with normal HbA1c levels. This complexity underscores the multifaceted nature of glycemic control and its varying impacts on different cardiovascular conditions.

The analysis of patient outcomes based on HbA1c levels revealed no significant association between glycemic categories and mortality or discharge outcomes, with p-values of 0.829 for death and 0.376 for discharge. This suggests that factors beyond glycemic control, such as comorbidities and overall health status, play crucial roles in determining patient outcomes. Our findings are supported by **Al-Faraikh et al. [10]**, who reported a modest positive correlation between HbA1c levels and patient outcomes, emphasizing the need for comprehensive management strategies in diabetes care. These insights highlight the importance of considering a holistic approach to diabetes management, focusing not only on glycemic control but also on addressing other health determinants to improve cardiovascular outcomes in STEMI patients.

CONCLUSION

Our study highlights significant associations between acute and chronic hyperglycemia in STEMI patients. Notably, higher percentages of diabetic patients were observed across multiple clinical conditions, such as shortness of breath and jugular venous pressure, emphasizing the critical impact of glycemic control on cardiovascular health. Gender analysis revealed a predominance of male diabetic patients, and age distribution showed the highest percentage of diabetics in the 40-49 age group. Despite these associations, the analysis of patient outcomes, including death and discharge, indicated no significant correlation with HbA1c levels, suggesting that factors beyond glycemic control, such as comorbidities and overall health status, play crucial roles in determining STEMI outcomes. These findings underscore the necessity of comprehensive management strategies in STEMI patients, focusing on both acute and chronic hyperglycemia to improve cardiovascular outcomes.

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