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Original Research Article

# A Hospital Based Study to Assess the Prognostic Implications of Admission Hyperglycemia in Non-Diabetic Acute Myocardial Infarction Patients

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**Abstract**

**Aim:** The aim of the present study was to assess the prognostic implications of admission hyperglycemia in non-diabetic acute myocardial infarction patients.

**Methods:** The study was conducted on 100 non diabetic STEMI patients admitted in Jeevandeep Hospital, Gujarat, India. The study was conducted on 100 non diabetic STEMI patients admitted in Jeevandeep Hospital, morbi, Gujarat, India for the period of one year. There were 50 patients in group I and 50 patients in group II.

**Results:** There were total 58 males and 42 females in the study. Group I had 20 females and 30 males. Group II had 22 females and 28 males. There was no significant difference between the number of males and females in two groups (p= 0.850). The mean age of patients in Group I and Group II were 63.47 ± 12.28 and 62.16 ± 11.36 respectively. Median age in group I and group II were 65 and 62 years respectively. There was no significant difference in patients' mean age in between the groups (p= 0.612). There were total 22 (22%) smokers in the study of which 11 were in group I and 10 in group II. History of smoking was present in 22% and 20% of patients of Group I and Group II respectively. There was no significant difference in number of smokers in between the two groups (p= 0.314). There were total of 30 patients with history of alcohol consumption in the study. Group I and Group II, both had 15 patients and there was no significant difference in number of patients with history of alcohol consumption between the two groups. The history of hypertension was present in 28 patients out of which 12 patients were in Group I and 16 patients in Group II. There was no statistically significant difference in number of hypertensives between the two groups. Mean heart rate, systolic blood pressure and diastolic blood pressure between the two groups. There was a statistically significant difference in heart rate, SBP and DBP between the two groups.

**Conclusion:** Hyperglycemia at admission in non-diabetic patients of acute ST elevation myocardial infarction is strongly associated with higher in hospital complications like cardiogenic shock, arrhythmias and AV block.

**Keywords:** Non-Diabetic, Acute Myocardial Infarction, Hyperglycemia.



## Introduction

Acute coronary syndromes (ACS) are a leading cause of death worldwide. Although declining, short and long term mortality rates in patients presenting for ST-elevation myocardial infarction (STEMI) remain highly preoccupying. [1] Compared to non-diabetic patients, diabetic ones are known to carry worse early and late outcomes. [2] On the other hand, and depending on the definition used, prevalence of hyperglycemia in different epidemiological studies ranges from 3% to 71% of patients hospitalized for ACS. [3] In patients presenting for STEMI, hyperglycemia on-admission has already been identified as a powerful predictor of adverse outcomes regardless to the implementation of a reperfusion therapeutic either by thrombolysis or primary percutaneous coronary intervention (pPCI). [4,5] Nevertheless, controversy remains as for a possible interaction between diabetic status and the prognostic value of hyperglycemia in patients presenting for STEMI.

Previous studies showed a stronger association between a diagnosis of clinical diabetes and incident mortality in hyperglycemia patients than non-hyperglycemia patients without diabetes when using the same prognostic cutoff value for both diabetic and non-diabetic patients. [6] Contributors to such diabetes status-based differences are not clear, although disparities in the prevalence of uncontrolled blood glucose and mortality are a

possibility. Data are also lacking on diabetes status differences in the prognostic relevance of the blood glucose levels for defining admission hyperglycemia. Although less is known about the association between admission hyperglycemia and mortality by diabetes status, recent studies demonstrated that admission hyperglycemia was an independent predictor of mortality in AMI patients without diabetes when used the same or different cutoff values for diabetic and non-diabetic patients. [7,8] Data are lacking on diabetes status differences in absolute measures of mortality risk associated with admission hyperglycemia. Therefore, there is a critical need to take patients' diabetes status into account to avoid incorrect estimation of the real prevalence of admission hyperglycemia.

Previous epidemiological studies showed that 25–50% of ACS patients had elevated blood glucose (BG) level at admission. Recent studies suggest that the effects of hyperglycemia on the prognosis of ACS differ between diagnosed and undiagnosed diabetes. Hyperglycemia is a stronger predictor of adverse events in ACS patients without known diabetes than those with history of diabetes.[8,9]

The aim of the present study was to assess the prognostic implications of admission hyperglycemia in non diabetic acute myocardial infarction patients.

**Materials and Methods**

The study was conducted on 100 non diabetic STEMI patients admitted in department of General Medicine Jeevandeep Hospital, Morbi ,Gujarat, India for the period of one year. There were 50 patients in group I and 50 patients in group II.

**Inclusion criteria:**

- Patients with acute myocardial infarction proven by
- ECG (ST segment elevation > 0.1mV in at least 2 contiguous leads)
- Cardiac enzymes (Positive Troponin I or CPK-MB)
- Symptoms suggestive of acute myocardial infarction who have no previous history of diabetes.
- Patients with HbA1c <6.5

**Exclusion Criteria:**

- Patients who present with Non-ST Elevation MI (NSTEMI)
- Patients with a previous history of diabetes mellitus.
- Patients receiving drugs that are known to elevate blood sugar levels (eg. Corticosteroids)
- Patients who received dextrose containing intravenous fluids before admission.
- Time from the beginning of symptoms to admission to Critical Care Unit more than 48 hrs.

A complete history of all patients was noted. All patients' blood sample was collected on admission for estimating plasma glucose level. Complete general and systemic examination of the patients was done. ECG of all the patients were read and recorded. Patients were examined for complications of AMI including arrhythmias, cardiogenic shock, conduction abnormalities.

Patients were grouped in to TWO categories according to their admission blood glucose levels,

Group I: Blood glucose level ≤ 140 mg%, Group II: If their blood glucose level is > 140 mg%.

The groups were compared to demonstrate correlation between stress hyperglycemia and cardiovascular outcomes of arrhythmias, cardiogenic shock, AV block and death. Normality of data was tested by Kolmogorov- Smirnov test. If the normality was rejected then non parametric test was used. Quantitative variables were compared using Independent t test/Mann-Whitney Test (when the data sets were not normally distributed) between the two groups. Qualitative variables were correlated using Chi-Square test/Fisher's Exact test. Univariate and multivariate logistic regression was used to assess the significant risk factors of RBS>140. The data was entered in MS EXCEL spreadsheet and analysis was done using Statistical Package for Social Sciences (SPSS) version 21.0.

**Results**

**Table 1: Patient details**

| Parameters | Group I | Group II | P Value |
|---|---|---|---|
| **Gender** | | | |
| Male | 30 | 28 | 0.850 |
| Female | 20 | 22 | |
| Mean age | 63.47 ± 12.28 | 62.16 ± 11.36 | 0.612 |

There were total 58 males and 42 females in the study. Group I had 20 females and 30 males. Group II had 22 females and 28 males. There was no significant difference between the number of males and females in two groups (p= 0.850). The mean age of patients in Group I and Group II were 63.47 ± 12.28 and 62.16 ± 11.36 respectively. Median age in group I and group II were 65 and 62 years respectively. There was no significant difference in

patients' mean age in between the groups (p= 0.612).

**Table 2: Personal and past history**

| Parameters | Group I | Group II | P Value |
|---|---|---|---|
| **Smoking** | | | |
| Yes | 11 | 10 | 0.314 |
| No | 39 | 40 | |
| **Alcohol** | | | |
| Yes | 15 | 15 | 0.750 |
| No | 35 | 35 | |
| **Hypertension** | | | |
| Yes | 12 | 16 | 0.512 |
| No | 38 | 34 | |

There were total 22 (22%) smokers in the study of which 11 were in group I and 10 in group II. History of smoking was present in 22% and 20% of patients of Group I and Group II respectively. There was no significant difference in number of smokers in between the two groups (p= 0.314). There were total of 30 patients with history of alcohol consumption in the study. Group I and Group II, both had 15 patients and there was no significant difference in number of patients with history of alcohol consumption between the two groups. The history of hypertension was present in 28 patients out of which 12 patients were in Group I and 16 patients in Group II. There was no statistically significant difference in number of hypertensives between the two groups.

**Table 3: General physical examination**

| Parameters | Group I | Group II | P Value |
|---|---|---|---|
| Mean heart rate (beats/min) | 74.86 ± 12.68 | 80.82 ± 13.57 | 0.020 |
| Mean SBP (mmHg) | 123.47 ±24.76 | 112.57 ±25.28 | 0.001 |
| Mean DBP (mmHg) | 78.06 ± 12.62 | 72.48 ± 14.16 | <0.001 |

Mean heart rate, systolic blood pressure and diastolic blood pressure between the two groups. There was a statistically significant difference in heart rate, SBP and DBP between the two groups.

**Table 4: Complications**

| Complications | Group I | Group II | P Value |
|---|---|---|---|
| Cardiogenic shock | 5 | 10 | 0.023 |
| Arrhythmias | 5 | 20 | 0.025 |
| AV Block | 3 | 7 | 0.040 |

Total 15 patients developed cardiogenic shock. 5 patients in group I and 10 patients in group II developed cardiogenic shock. There was statistically significant (p= 0.023) increase in number of patients developing cardiogenic shock in group II. A total of 25 patients developed arrhythmias of which 5 patients were in group I and 20 patients in group II. There was a statistically significant increase in number of patients with arrhythmias in group II (p= 0.025). Total 10 patients in the study developed an AV block of ≥2nd degree. 3 patients in group I developed AV block (≥2nd degree) and 7 patients in group II developed AV block. There was a statistically significant (p=0.040) increase in patients developing AV block in group II.

## Discussion

Stress hyperglycemia represents increased blood glucose levels result of activation of neurohormonal processes in organism exposed to stress. Increased glucose level during stress is evoked by integrated hormonal, cytokine and nervous counter regulatory signals on glucose metabolic pathways and, therefore, presented in the same time with hyperinsulinemia and insulin resistance. The mortality and morbidity of a diabetic patient is poor as compared to non-diabetic patient. [10] Elevated admission glucose levels in non-diabetic patients with acute myocardial infarction are independently associated with large infarct sizes and a higher mortality rate when compared with patients with normal glucose levels. [11] A strong correlation between glycaemia and shock or development of heart failure has also been reported. [12,13]

There were total 58 males and 42 females in the study. Group I had 20 females and 30 males. Group II had 22 females and 28 males. There was no significant difference between the number of males and females in two groups (p= 0.850). The mean age of patients in Group I and Group II were 63.47 ± 12.28 and 62.16 ± 11.36 respectively. Median age in group I and group II were 65 and 62 years respectively. There was no significant difference in patients' mean age in between the groups (p= 0.612). There were total 22 (22%) smokers in the

study of which 11 were in group I and 10 in group II. History of smoking was present in 22% and 20% of patients of Group I and Group II respectively. There was no significant difference in number of smokers in between the two groups (p= 0.314). There were total of 30 patients with history of alcohol consumption in the study. Group I and Group II, both had 15 patients and there was no significant difference in number of patients with history of alcohol consumption between the two groups. The history of hypertension was present in 28 patients out of which 12 patients were in Group I and 16 patients in Group II. Hyperglycaemia (blood glucose ≥ 8.9 mmol/L), persists from admission to at least 24 h after symptom onset, is associated both with reduced myocardial perfusion despite patency of the infarct related artery and with pre-discharge left ventricular impairment. [14] In another study, persistent hyperglycemia in myocardial infarction has a stronger relation with 30-day MACE than elevated glucose at admission. [15] Fasting glucose was superior to admission glucose with regard to 30-day mortality in previous study. [16] The superiority of FBG over random glucose levels in predicting outcome probably results from factors such as differences in the amount of caloric intake and time since the last meal. In a recent study, random blood glucose and FBG were positively correlated with the Gensini score in AMI patients, and FBG was an independent risk factor for the Gensini score in AMI patients. [17]

There was no statistically significant difference in number of hypertensives between the two groups. Mean heart rate, systolic blood pressure and diastolic blood pressure between the two groups. Probable explanation for this might be due to the reason that studies have reported that patients with stress hyperglycemia have poor LV function and lower ejection fraction.5 Previous studies have reported similar results with respect to mean SBP and DBP. [18,19] The mean heart rate in the present study was 79.39 ± 13.34 bpm. The mean heart rate in the study by Sanjuan R et al [11] was 79 ± 22 bpm which is close to the present study. There was a statistically significant difference in heart rate, SBP and DBP between the two groups. Total 15 patients developed cardiogenic shock. 5 patients in group I and 10 patients in group II developed cardiogenic shock. There was statistically significant (p= 0.023) increase in number of patients developing cardiogenic shock in group II. A total of 25 patients developed arrhythmias of which 5 patients were in group I and 20 patients in group II. There was a statistically significant increase in number of patients with arrhythmias in group II (p= 0.025). Total 10 patients in the study developed an AV block of ≥2nd degree. 3 patients in group I developed AV block (≥2nd degree) and 7 patients in group II developed AV block. There was a statistically significant (p=0.040) increase in patients developing AV block in group II.

The exact mechanism through which hyperglycemia worsens the prognosis of ischemic patients has not been well established. Its pathophysiology is believed to be based on endothelial and microvascular dysfunction, causing a prothrombotic state produced by vascular inflammation. The endothelial dysfunction inactivates nitric oxide and increases oxidative stress, responsible for the production of oxygen reactive species. [20] The production of those radicals activates transcription and growth factors and secondary mediators. Through direct tissue lesion or activation of those secondary mediators, hyperglycemia-induced oxidative stress causes additional lesion to myocytes. [20,21] There is evidence that the prothrombotic state generated by hyperglycemia originates from reduced plasma fibrinolytic activity and action of tissue plasminogen activator. [22,23]

## Conclusion

Hyperglycemia at admission in non-diabetic patients of acute ST elevation myocardial infarction is strongly associated with higher in hospital complications like cardiogenic shock, arrhythmias and AV block. Hyperglycemia at admission is a strong predictor of early mortality during hospital stay. Though hyperglycemia at admission is a strong predictor of in hospital complications and mortality, it is not an independent predictor of either of them. Stress hyperglycemia is also associated with significantly lower systolic and diastolic blood pressure and higher heart rate at admission.

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