# **Original Research Article**

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# Impact of glycosylated haemoglobin (HbA1c) levels on outcomes in patients with myocardial infarction

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## **ABSTRACT**

**Background:** People with diabetes have an increased prevalence of atherosclerosis and coronary heart disease (CHD) and experience higher morbidity and mortality after acute coronary syndrome and myocardial infarction than people without diabetes. Diabetes also appears to be a major cause of the higher rate of both short and long-term mortality observed in women hospitalized with acute MI compared to men. Objective of the study was to observe the impact of glycosylated hemoglobin (HbA1c) levels on outcomes in MI.

**Methods:** The prospective observational study was conducted on 200 patients from the age group more than 36 years and lesser than 95 years presented with acute myocardial infarction (STEMI or NSTEMI). Patients were divided into group A (Diabetics) and group B (non-diabetics). Investigations performed were FBS, RBS, HbA1c, CBC, LFT, RFT, lipid profile, ECG and echocardiography. Patients were followed up till discharge/death and all complications like arrhythmias, cardiac failure, cardiogenic shock and re infarction were noted.

**Results:** Majority of the 34.5% patients belongs to the age group of 56-65 years. No significant difference found between the subject population of the diabetic and non-diabetic group. The percentage of mortality in male patients was reported higher in the group having HbAlc level  $\geq$ 7 (21.15%) in comparison to a group having HbAlc level  $\leq$ 7 (6.15%) whereas in females the percentage of mortality was 11.63% in the group having HbAlc  $\geq$ 7, higher than the group having HbAlc level  $\leq$ 7, 2.5%. Percentage mortality was higher in the patients having HbAlc  $\geq$ 7, in both groups' patients aged below 60 years 14.81% and 17.65% in the group of patients aged above 60 years.

**Conclusions:** Higher HbAlc level significantly affects the outcome of MI patients. The percentage mortality due to MI was higher in male with aged above 60 years and having HbAlc level >7.

Keywords: Diabetes, Coronary heart disease, HbA1c level, ST elevation myocardial infarction

# INTRODUCTION

People with diabetes have an increased prevalence of atherosclerosis and coronary heart disease (CHD) and experience higher morbidity and mortality after acute coronary syndrome and myocardial infarction than people without diabetes.<sup>1,2</sup> Analysis of data collected for the Organization to Assess Strategies for Ischemic Syndromes (OASIS) registry, showed that diabetes significantly increased all cause death and the incidence of new MI, stroke and heart failure during a 2 years mean follow-up in patients who were hospitalized for unstable angina or non-Q-wave MI. A similar study of patient Hospitalized with a

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confirmed MI found that diabetes was associated with an adjusted hazard ratio for mortality of 1.7(95 percent confidence interval 1.2 to 2.3) compared with patients without diabetes and no previous MI.<sup>3</sup>

An ST elevation myocardial infarction (STEMI) most commonly occurs when thrombus formation results in complete occlusion of a major epicardial coronary vessel. The most serious form of acute coronary syndromes, STEMI is a life-threatening time-sensitive emergency that must be diagnosed and treated promptly via coronary revascularization, usually by percutaneous coronary intervention (PCI). Primary PCI is the preferred initial treatment of patients presenting with ST-segment elevation myocardial infarction (STEMI) within 12 h of symptom onset, provided treatment can be initiated expeditiously by an experienced team. 4-6 Unlike unstable angina and non-ST segment elevation myocardial infarction (NSTEMI), during STEMI the 12-lead ECG will show significant ST elevation as the name implies.

Diabetes also appears to be a major cause of the higher rate of both short and long-term mortality observed in women hospitalized with acute MI compared to men. In general, diabetes confers as much additional risk as having had a previous MI and the number of cardiovascular events associated with diabetes is growing. Various terms have been used to describe HbAlc, such as 'glycosylated hemoglobin' 'glycated hemoglobin' 'fast hemoglobin' and 'hemoglobin Alc'. There is a consensus among most diabetes specialist that assessment of HbAlc should be a standard part of diabetes care, providing as it does a reliable index of glycemic control over a 1-3 months period. The WHO recommends measuring HbAlc 3-4 times per year in adults, a guideline that is consistent with the recommendations of the Canadian Diabetes Associate and the American Diabetes Association. The American Diabetes Association recommended a target level of under 7%.

Elevated HbAlc increases the risk of microvascular and macrovascular complications in diabetics nondiabetics, where HbAlc value >6.5% are diagnostic of existing diabetes Glycosylated Hemoglobin estimation is useful for early and accurate interpretation hyperglycemia following ACS. HbAlc estimation at the time of admission in ICU clearly and quickly differentiates stress induced hyperglycemia in ACS from hyperglycemia seen in undiagnosed DM.<sup>7-9</sup> Thus it helps in prompt and precise identification of previously undiagnosed DM. Patients with high levels of HbAlc are predisposed to ACS at an early age and subsequently high incidence of complications of ACS. 10-11 It can be used as the prognostic marker of outcome of ACS. Patients with high HbAlc level have a higher incidence of post ACS complications. 12

#### **METHODS**

This prospective, observational study was conducted at department of medicine, Shri Shankaracharya Institute of

Medical Sciences, Durg, C.G. India. The study population consists of patients presented with acute myocardial infarction (STEMI or NSTEMI), admitted between July 2019 to November 2020 in Cardiac ICU of department of medicine.

#### Inclusion criteria

Inclusion criteria were patients with acute myocardial infarction both ST elevation MI and non-ST elevation MI.

#### Exclusion criteria

Exclusion criteria were patient's refusal to participate, patient with sepsis, haemoglobinopathy or hypothyroidism. Those patients whose HbAlc cannot be obtained. Those with sub-acute or chronic MI (longer than 48 hours between first symptom and admission).

An observational study of 200 patients of both gender from the age group more than 36 years and lesser than 95 years, suffered from and admitted for the treatment of myocardial infarction were selected for the study. Approval from the ethical committee and written information consent from the patients, was conducted. Patients had right to opt out anytime during the study period. Detailed history was taken after the enrollment and physical examination was carried out. The patients were divided into group A (Diabetics) and group B (non-diabetics). In patients without prior history of diabetes, a diagnosis of diabetes was made, if they had fasting blood sugar (FBS) ≥126mg/dl or random blood sugar (RBS) ≥200 mg/dl on two or more determinations along with an HbAlc of 6.5% or more. Investigations mentioned were performed Blood was collected by co-investigator in vaccutainors (1ml in EDTA bulb for CBC, 1 ml in fluoride bulb for blood sugar levels and 3 ml each for LFT/RFT/lipid profile/cardiac enzymes) and sent to central laboratory morning/afternoon trolley that comes for collections. Sample for serum HbAlc level (3 ml in EDTA bulb, collected within 3hrs of admission) was sent to Endocrine laboratory in our hospital for HbAlc level, ECG and echocardiaography were done in all patient. The treatment was given as per the standard protocol. Patients were followed up till discharge/death and all complications like arrhythmias, cardiac failure, cardiogenic shock and re infarction were noted. Data was recorded in MS excel and checked for its completeness and correctness then it was analysed by suitable statistical software and P value < 0.05 was considered as a statistically significant.

# **RESULTS**

Majority of the 34.5% patients belongs to the age group of 56-65 years (Table 1). The distribution of patients in each gender in both the groups were uniform and there is no significant difference found between the subject population of the diabetic and non-diabetic group. This evidence that the distribution of patients would not interfere with the results of the study (Table 2).

Table 1: Distribution of patients in different age group in both genders.

Age (in years)	Male N (%)	Female N (%)	Total N (%)
36-45	4 (2.0)	1 (0.5)	5 (2.5)
46-55	29 (14.5)	10 (5.0)	39 (19.5)
56-65	36 (18.0)	33 (16.5)	69 (34.5)
66-75	42 (21.0)	20 (10.0)	62 (31.0)
76-85	5 (2.5)	18 (9.0)	23 (11.5)
86-95	1 (0.5)	1 (0.5)	2 (1.0)
Total	117 (58.5)	83 (41.5)	200 (100.0)

Table 2: Gender wise distribution of patients in the diabetic and non-diabetic population, suffered from myocardial infarction.

Condon	Group		Dyolyo	
Gender	Diabetic	Non-diabetic	P value	
Male	53	64	0.15, insignificant	
Female	47	36		
Total	100	100		

Table 3: HbAlc level of patient suffered from myocardial infarction.

HbAlc level diabetic group	No. of patients	HbAlc level non-diabetic group	No. of patients
<7	5	<5	3
7-89	25	5-5.5	9
9-10.9	34	5.6-6	28
≥11	36	>6	60
Total	100	Total	100

In diabetic group, majority of the patients had HbA1c level  $\geq$ 11 and in non-diabetic group, 60 patients had >6 HbA1c level (Table 3). For the evaluation of the impact of the HbAlc on the patients were divided into two groups, group A comprises of total 105, patients having HbAlc level <7 and group B comprises of total 95, patients having  $\geq$ 7. Both the groups were monitored during their stay in the hospital for the treatment of myocardial infarction. It was

observed that there was no significant difference between the no. of days of the stay in the hospital of both the groups. The average days of hospital stay were the same.

Table 4: No. of days of hospital stay of patients according to their HbAlc level and correlation between HbAlc level outcomes of the patients admitted for the treatment of MI.

Ovetoomo	HbAlc level		Davolaro	
Outcome	<7	<u>≥</u> 7	P value	
Hospital	5.87±1.34	5.76±1.46	0.58,	
stays days)	3.8/±1.34	5.70±1.40	insignificant	
Dischaused	100	79		
Discharged	(95.23%)	(83.16%)	0.0058,	
Death	5 (4.76%)	16	significant	
		(16.84%)		

Total 95.23% patients were discharged from the patients having HbAlc level <7 and only 4.76% mortality were observed whereas in the group of patients having HbAlc ≥7, Percentage mortality was higher 16.84% and 83.16% patients were discharged. There is a significant difference found in both patient outcomes in between both the groups (Table 4).

The percentage of mortality in male patients was reported higher in the group having HbAlc level ≥7 i.e., 21.15% in comparison to a group having HbAlc level <7 (6.15%). Also, the patient discharge rate was higher in patients having a HbAlc level <7 i.e., 93.85% v/s 78.85%. Whereas in the female population the percentage of mortality was 11.63% in the group having HbAlc ≥7, higher than the group having HbAlc level <7, 2.5%. And percentage discharge was higher in the latter group 97.5% than first group 88.37%. Percentage mortality was higher in the patients having HbAlc ≥7, in both groups' patients aged below 60 years 14.81% and 17.65% in the group of patients aged above 60 years. This evident that the rate of mortality remains higher at any age above and below 60 years in the patients with HbAlc level >7. However, the rate increases at a higher age. Also, the percentage of discharge was higher in the patients having HbAlc level <7 (Table 5).

Table 5: Correlation of HbAlc level with the outcomes of patients and with patient's aged below and above 60.

Groups	HbA1c level	Outcome Discharged N (%)	Death N (%)	P value
Male	HbAlc <7	61 (93.85)	4 (6.15)	0.024, significant
	HbAlc ≥7	41 (78.85)	11 (21.15)	0.024, significant
Female	HbAlc <7	39 (97.5)	1 (2.5)	0.2, insignificant
	HbAlc ≥7	38 (88.37)	5 (11.63)	0.2, msignificant
Patient below 60	HbAlc <7	34 (94.5)	2 (5.55)	0.29 insignificant
	HbAlc ≥7	23 (85.18)	4 (14.82)	0.38, insignificant
Patient above 60	HbAlc <7	66 (95.65)	3 (4.35)	— 0.014, significant
	HbAlc ≥7	56 (82.35)	12 (17.45)	0.014, Significant

#### **DISCUSSION**

Coronary heart disease is a major contributor in mortality among patients with co-morbidities/risk factors worldwide. It is thus important to determine risk factors and subsequent percentage wise distribution so that mortality rates and long-term complication could be tackled properly.

Our study demonstrated that in patients with AMI, elevated glucose and HbA1c levels on admission are associated with higher ischemia and increased mortality rates compared with patients with normal levels on admission.

In our study male to female ratio is 1.4:1.0 whereas a study conducted by Bhatti MF et al showed different presentation gender wise male to female ratio was 3.5:1. Our study illustrated that the age group ranging from 56 to 65 years 34.5% are most commonly affected from MI followed by the elder age-group ranging from 66 to 75 years (31.0%) while the study by Bhatti MF et al concluded that 59.0% of the patients were between 31 to 50 years of age. The above-mentioned study results are nearly in accordance with our data. 13

Through the present study, it was observed that the percentage of mortality was higher in the patients with HbAlc level  $\geq 7$ , in all cases. This finding is backed up by a multivariate study done by C. J. O Sullivan, for patients with diabetes those with suboptimal HbAlc level (HbAlc level  $\geq 7\%$ ) had a significantly higher incidence of 30 days morbidity compared to those with HbAlc level  $\leq 7\%$  (59.1% vs 19%, p=0.018).<sup>14</sup>

Both genders were affected equally and mortality was higher in each case. However, in male patients, the mortality was higher at 21.15% than female patient 11.63%. well supported by the results of the study done by Cakmak et al demonstrated that admission plasma glucose and HbAlc level are prognostic factors associated with mortality after acute myocardial infarction.<sup>15</sup>

In another observation for finding out the correlation between the age of patients above and below 60 years, it was reported that the patients aged above 60 and having HbAlc level  $\geq$ 7, has a higher percentage of mortality 17.65% in comparison to the patients having HbAlc level  $\geq$ 7 and aged below 70 years 14.81%. This finding is supported by Muntner et al who reported that an association exists between higher levels of HbAlc and peripheral arterial disease, even among patients without diabetes. Although they did not consider the age factor but risk for patients having myocardial infarction can be justified. <sup>16</sup>

## **CONCLUSION**

From the above study, it is evident that a higher HbAlc level significantly affects the outcome of MI patients. The

percentage mortality due to MI was higher in male with aged above 60 years and having HbAlc level  $\geq$ 7. Significant reduction in mortality can be achieved by strict and long-term sugar control.

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