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Prognostic effect of glycated hemoglobin in acute myocardial infarction

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Abstract

Background

Impaired glucose tolerance and even prediabetic states have a crucial role as risk factors among several different risk factors in acute myocardial infarction (AMI). Some recent studies have shown that poor diabetes management, diagnosed by glycated hemoglobin (HbA1C), has poor prognostic value regarding future cardiovascular events, whereas other studies recommend that it is the blood glucose level at admission that predicts short-term mortality after AMI and not the HbA1C level.

Aim

The target of this research is to detect the correlation between the level of HbA1C and risk factors in the patients with AMI and its value regarding the severity of coronary lesions and prognosis.

Patients and methods

A total of 80 consecutive patients presenting with ST elevation MI to the National Heart Institute and treated with primary percutaneous coronary intervention represented the target population. Patients were classified inconsistent with HbA1C level into three groups: group 1: HbA1C less than 5.7%, group 2: HbA1C 5.7–6.4%, and group 3: more than 6.4%. Comparison among the three groups was done regarding the risk factors, troponin level, blood glucose level, lipid profile, kidney function, number of affected vessels, length of the stented area, type of MI, EF, morbidity, and mortality.

Results

Our results showed that regarding risk factors, diabetes and hypertension were significantly more common in group 3 as compared with the other two groups. Patients in group 3 also had significant elevated admission blood glucose. No other significant difference was noted among the three groups.

Conclusion

Our result suggests that in spite diabetes being a major risk factor for atherosclerotic coronary artery disease, HbA1C level has no correlation with severity and short-term prognosis.

Keywords: Diabetes mellitus, glycated hemoglobin, primary percutaneous coronary intervention, ST elevation myocardial infarction

Introduction

Diabetes mellitus (DM) is one among the foremost common diseases world-wide that predisposes to vascular complications, and considerably, it is one of the major risk factors for acute myocardial infarction (AMI). Impaired glucose tolerance and even prediabetic states have an important role as risk factors among many other factors such as male sex, smoking, hypertension, obesity, hyperlipidemia, bad nutritional habits, and lack of exercise [1].

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Glycated hemoglobin (HbA1C) is formed through the accelerated glycation of the hemoprotein beta-chain N-terminus. It can estimate the average level of blood glucose in the last 3 months. In the year 2009, HbA1C

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threshold more than or equal to 6.5% was recommended by the diabetes international committee to diagnose DM. The American Diabetes Association also recommends this level for diagnosis of DM. The diagnosis should be standardized to the National Glycohemoglobin Standardization Program-certified method [2].

Regarding diabetes control, the value of HbA1C less than 7% in all cases of DM was recommended by the American Diabetes Association to avoid development of cardiovascular disease [3]. Above this level, it is associated with increased incidence of cardiac morbidity and mortality. Effective control of HbA1C is important to avoid the adverse outcome in the patients with ACS. Mechanism of atherosclerosis in hyperglycemia is due to activation of phenomenon of oxidative stress through vascular smooth muscle inhibition of nitrous oxide. It also leads to reactive oxygen species in the endothelium [4].

Recent studies have shown that poor diabetes control, diagnosed by HbA1C, has poor prognostic value regarding future cardiovascular events [5]. Some studies suggested that it is the blood glucose level at admission that predicts short-term mortality after AMI and not the HbA1C level. The association between poor diabetes control and bad long-term prognosis is still uncertain [6].

Aim

The aim was to detect the correlation between HbA1C level and risk factors in patients with AMI and its relation to the severity and prognosis.

Patients and methods

Type of the study

This study is a single-center, prospective, cohort, observational study.

Target population

A total of 80 consecutive patients presenting with acute ST elevation myocardial infarction (STEMI) at National Heart Institute and were managed with primary percutaneous coronary intervention (PCI) represent the target population.

Inclusion criteria

The following were the inclusion criteria:

(1) Patients with STEMI candidate for primary PCI.
(2) Patients with sinus rhythm only.

Exclusion criteria

The following were the exclusion criteria:

(1) Patients with previous left ventricular systolic dysfunction.
(2) Patients with previous coronary artery bypass grafting (CABG).
(3) Patients with bundle branch block.
(4) Patients with history of recent gastrointestinal bleeding, bleeding disorder, or major surgery within the previous 6 weeks.
(5) Severe hypertension, history of stroke, or other nervous system abnormality.

Methods

The following items were assessed to all patients:

(1) Full history taking, including the following:
   (a) Personal data (age and sex).
   (b) History of cardiovascular disease and risk factors such as smoking, dyslipidemia, DM, hypertension, and positive family history for ischemic heart disease.
   (c) Previous history of coronary artery disease, PCI, or CABG.
(2) Complete clinical examination with emphasis on the following:
   (a) General examination regarding vital signs (arterial blood pressure, pulse, temperature, and respiratory rate).
   (b) Local cardiac examination (S3 gallop, bilateral basal crepitation, elevated jugular venous pressure, hemodynamic instability, and others).
(3) Type of STEMI diagnosed from the electrocardiogram upon admission as follows:
   (a) ST segment elevation and the affected leads.
   (b) Rhythm presentation (sinus, atrial fibrillation, ventricular arrhythmia, or asystole).
   (c) Conduction disturbances:
      (i) LBBB or RBBB whether old, new, or unknown.
      (ii) First-, second-, or third-degree A-V block.
(4) Laboratory workup:
   (a) Cardiac enzymes, namely, CPK-MB on respons 920 and troponin on admission by immunoassay on Alere Triage.
   (b) Random blood glucose (RBG) and creatinine levels on admission on respons 920 automated chemistry analyzer.
   (c) Complete lipid profile, liver function test (SGOT and SGPT)], and creatinine level on BioMajesty automated chemistry analyzer.
   (d) Complete blood picture on Swelab alfa blood cell counter.
   (e) HbA1C level on Mispa i2 using nephlometric technology:
   (i) Principle: whole blood is lysed using hemolyzing reagent. The lysed sample contains HbA1C along with other hemoglobins that compete to adsorb to unsensitized latex particles, with the addition of mouse antihuman HbA1C monoclonal antibody into the reaction. The latter specifically binds to the human HbA1C molecules forming latex HbA1C – mouse antihuman HbA1C antibody complex. Another antibody, goat anti-mouse polyclonal antibody, will then react with the formed complex to give agglutination. The amount of HbA1C adsorbed on to the surface of latex particles is proportional to the amount of agglutination formed [7].

(ii) Procedure:
1. Whole blood sample was withdrawn on EDTA anticoagulant and analyzed by the kits supplied from Agappe Switzerland.
2. Hemolysate was prepared by adding part of the sample to the lytic reagent.
3. The hemolysate was then used to determine the HbA1C level [7].

(5) In-hospital management:
(a) All patients received the following drugs:
(i) Aspirin 300 mg as loading dose followed by 150 mg daily.
(ii) Unfractionated heparin 70 IU/kg.
(iii) Clopidogrel 600 mg followed by 75 mg daily, or Ticagrelor 180 mg followed by 90 mg twice daily.
(iv) Conventional treatment (β-blocker, ACEL and Statin).
(b) Coronary angiography and primary PCI.

Informed written consent was obtained for all patients.

Glycoprotein IIb/IIIa receptor antagonists may be given according to the patient.

Sterilization and local infiltration of anesthesia of the site of puncture was routinely undertaken.

Right femoral or right radial artery approach was done.

Selective left and right coronary angiographies in different views were done, starting with the noninfarct related artery.

PTCA was optionally done using a suitable balloon (usually undersized).

A stent suitable in diameter and length was inserted according to the angiographic findings in each case to the left anterior descending (LAD) artery.

The sheath removal was undertaken after normalization of the ACT or APTT.

TIMI flow before and after PCI was evaluated and graduated 0, 1, 2, and 3 according to distal penetration of the dye, and rate of clearance [8].

(c) Transthoracic echocardiography after PCI was done, stressing on left ventricular ejection fraction, which was calculated using the following formula:

$EF\%=(EDV\text{-}ESV)/EDV\times100=SV/EDV\times100$ (where SV is stroke volume).

(6) Clinical follow-up of MACE:
(a) Cardiovascular mortality: unexpected sudden death or death related to AMI, heart failure, or others.
(b) Morbidity:
(i) Hospital readmission for major arrhythmias, heart failure, or others.
(ii) Reinfarction after PCI: the term reinfarction is used for an AMI that occurs within 28 days of an incident or recurrent MI [9].
(iii) Target vessel revascularization: it is defined as repeated PCI or CABG due to stenosis or occlusion in the IRA.

(7) Patients were classified according to HbA1C level into three groups:
(a) Group 1: HbA1C less than 5.7%, group 2: HbA1C 5.7–6.4%, and group 3: HbA1C more than 6.4%.
(b) Comparison among the three groups was done regarding the risk factors, troponin level, blood glucose level, lipid profile, kidney function, number of affected vessels, type of MI, EF, morbidity, and mortality.

Ethical considerations

(1) All the steps of the study were explained to the participants with its possible complications stressing on the importance of data they were going to offer.
(2) Written informed consent was taken from patients regarding the data shared in the study; this meant that the participants in the prospective study were fully informed about the procedures and risks involved in the study.
(3) All data and results of the study of the participants were confidential and were not being made available to anyone who was not directly involved in the study.
(4) Patients were informed about any abnormal results of procedures and tests performed.
(5) The patients had the right to refuse participation without affecting the medical care expected to be offered to the patients.

Data management and analysis

The collected data was revised, coded, tabulated, and introduced to a PC using Statistical package for the Social Sciences (SPSS 20, IBM Corp. Releases 2011, IBM SPSS Statistics for Windows, Armonk, NY: IBM Corp.). Data were presented, and suitable analysis was done according to the type of data obtained for each parameter.

(1) Descriptive statistics:
(a) For numerical data, mean and SD.
(b) For non-numerical data, frequency, and percentage.
(2) Analytical statistics:
(a) To assess the statistical significance of the difference between two study group means, we used Student *t* test.
(b) To assess the statistical significance of the difference between more than two study group means, analysis of variance test was used.
(c) To compare all possible pairs of group means, post-hoc test was used.
(d) To examine the relationship between two qualitative variables, we used χ^2 test.
(e) To examine the relationship between two qualitative variables when the expected count is less than 5 in more than 20% of cells, Fisher's exact test was used.
(f) To assess the strength of association between two quantitative variables, we used correlation analysis (using Pearson's method).

(g) The correlation coefficient denoted symbolically as *r* defines the strength (magnitude) and direction (positive or negative) of the linear relationship between two variables.
   (i) $r = 0–0.19$ is regarded as very weak correlation.
   (ii) $r = 0.2–0.39$ as weak correlation.
   (iii) $r = 0.40–0.59$ as moderate correlation.
   (iv) $r = 0.6–0.79$ as strong correlation.
   (v) $r = 0.8–1$ as very strong correlation.

Results

The study included 80 patients. They were classified into the following:

Group 1 (HbA1C level <5.7) included 41 patients, representing 51% of the total patients.

Group 2 (HbA1C level between 5.7 and 6.4) included 14 patients, representing 18% of the total patients.

Group 3 (HbA1C level >6.4) included 25 patients, representing 31% of the total patients (Table 1).

The mean age was 54.5 ± 11.5 years for group 1, 59.2 ± 7.8 years for group 2, and 56.4 ± 8.6 years for group 3. No significant statistical differences were noted among the three groups (Table 4).

Table 1: Patient distribution in the three groups

	Number of patients	HbA1C [*n* (%)]		
		<5.7	5.7-6.4	>6.4
Total number	80	41 (51)	14 (18)	25 (31)

HbA1C, glycated hemoglobin.

Regarding sex, the study included 72 (90%) male patients and eight female patients (10%). All the patients in group 1 were male, whereas 78.6% of group 2 and 80% of group 3 were male. No significant statistical differences were noted among the three groups (Table 2).

Regarding the risk factors, the most common risk factor in our study was smoking (53%), followed by hypertension (26%), whereas diabetic patients represented only 23% of the total number (Table 2).

Group 1 included 58.5% patients with smoking, 7.3% were hypertensive, and 7.3% were diabetic. In group 2, 57.1% of patients were smokers, 42.9% were hypertensive, and 28.6% were diabetic. In group 3, 44% of patients were smokers, 48% were hypertensive, and 48% were diabetic. Although there was no significant difference among the three groups regarding smoking, group 3 had more incidences of diabetes and hypertension ($P = 0.001$ for diabetes and 0.000 for hypertension) (Table 2).

From 19 diabetic patients, 12 (63%) patients were not controlled. On the contrary, from 61 patients with no past history of diabetes, 13 (21%) patients had elevated HbA1C level (Table 2).

Most of the patients in group 3 (80%) had elevated RBG (>200 mg/dl), whereas most of the patients in group 1 (81%) had low RBG (<200 mg/dl) (statistically significant) (Table 3).

Regarding other laboratory findings in our study, the mean creatinine was 1.2 ± 0.7 mg/dl for group 1, 1.1 ± 0.2 years for group 2, and 1.4 ± 0.2 years for group 3. No significant statistical differences were noted among the three groups (Table 3). Other laboratory findings including liver function, complete blood picture, and lipid profile showed no significant difference

Table 2: Sex and risk factor distribution of the study group

	HbA1C [*n* (%)]			Test of significance		Significance
	<5.7	5.7-6.4	>6.4	Value	*P*	
Sex						
Male	41 (100.0)	11 (78.6)	20 (80.0)	Fisher exact test=10.58	0.002	NS
Female	0	3 (21.4)	5 (20.0)			
Smoking						
No	17 (41.5)	6 (42.9)	14 (56.0)	χ^2=1.4	0.497	NS
Yes	24 (58.5)	8 (57.1)	11 (44.0)			
HTN						
No	38 (92.7)	8 (57.1)	13 (52.0)	χ^2=15.7	0.000	S
Yes	3 (7.3)	6 (42.9)	12 (48.0)			
DM						
No	38 (92.7)	10 (71.4)	13 (52.0)	χ^2=14.41	0.001	S
Yes	3 (7.3)	4 (28.6)	12 (48.0)			
No of risk factors						
0	16 (39.0)	3 (21.4)	5 (20)	Fisher exact test=11.62	0.053	NS
1	21 (51.2)	6 (42.9)	9 (36)			
2	3 (7.3)	3 (21.4)	7 (28)			
3	1 (2.4)	2 (14.3)	4 (16)			

DM, diabetes mellitus; HbA1c, glycated hemoglobin; HTN, hypertension; S, significance.

Table 3: Distribution of the patients according to random blood glucose

	HbA1C [*n* (%)]			Test of significance		Significance
	<5.7	5.7-6.4	>6.4	Value	*P*	
RBG						
<200 mg	35 (81)	7 (50)	15 (80)	χ^2=15.5	0.001	S
>200 mg	6 (19)	7 (59)	5 (20)			

HbA1C, glycated hemoglobin; RBG, random blood glucose; S, significance.

Table 4: Correlation between glycated hemoglobin level and age, laboratory parameters, ejection fraction, and stent length

	HbA1C						ANOVA		
	<5.7		5.7-6.4		>6.4				
	Mean	SD	Mean	SD	Mean	SD	Value	*P*	Significance
Age	54.5	11.5	59.2	7.8	56.4	8.6	*F*=1.17	0.317	NS
Creatinine	1.2	0.7	1.1	0.2	1.4	2.2	*F*=0.21	0.812	NS
SGPT (ALT)	93.1	68.4	48.6	17.0	58.0	32.9	*F*=2.47	0.101	NS
SGOT (AST)	202.5	144.0	168.5	297.6	139.8	125.8	*F*=0.78	0.463	NS
HB	13.9	1.3	11.5	3.9	13.9	1.5	*F*=3.93	0.922	NS
RBC	5.1	1.7	5.0	0.7	5.2	1.1	*F*=0.08	0.926	NS
WBC	10.9	5.0	9.5	2.2	11.1	3.7	*F*=0.65	0.527	NS
PLAT	231.5	58.2	268.2	73.0	244.9	70.8	*F*=1.47	0.237	NS
Troponin	17.7	9.9	18	4.5	19	5.4	*F*=4.05	0.464	NS
CK-MB	78.0	98.6	42.0	35.3	117.2	100.0	*F*=0.69	0.524	NS
Total cholesterol	181.8	28.8	162.2	27.5	161.8	33.2	*F*=2	0.151	NS
LDL	109.0	22.8	101.7	18.4	98.2	34.2	*F*=0.65	0.530	NS
HDL	44.7	6.4	45.6	12.8	40.8	5.4	*F*=1.36	0.269	NS
TRIG	126.5	45.8	113.5	41.6	166.2	109.2	*F*=1.45	0.249	NS
EF%	49.6	7.5	42.0	11.3	52.8	11.1	*F*=1.2	0.319	NS
Stent area length	30.3	12.1	33.3	12.8	33.9	21.4	*F*=0.36	0.697	NS

ALT, alanine aminotransferase; ANOVA, analysis of variance; AST, aspartate aminotransferase; EF, ejection fraction; HB, hemoglobin; HbA1C, glycated hemoglobin; HDL, high-density lipoprotein; LDL, low-density lipoprotein; PLAT, platelet; RBC, red blood cell; WBC, white blood cell.

Table 5: Correlation between glycated hemoglobin level and laboratory parameters

	HbA1C		
	r	*P*	Significance
Creatinine	0.026	0.825	NS
SGPT (ALT)	−0.077	0.665	NS
SGOT (AST)	0.011	0.929	NS
HB	0.063	0.607	NS
RBC	0.042	0.732	NS
WBC	0.121	0.325	NS
PLAT	0.142	0.244	NS
Troponin	−0.619	0.056	NS
CK-MB	0.387	0.191	NS
Total cholesterol	−0.038	0.822	NS
LDL	0.186	0.271	NS
HDL	−0.252	0.132	NS
TRIG	0.144	0.394	NS

ALT, alanine aminotransferase; AST, aspartate aminotransferase; HB, hemoglobin; HbA1C, glycated hemoglobin; HDL, high-density lipoprotein; LDL, low-density lipoprotein; PLAT, platelet; RBC, red blood cell; WBC, white blood cell.

among the three groups. There was no association between cardiac enzymes and HbA1C level (Table 4).

No correlation was found between HbA1C level and all laboratory parameters (apart from RBG) (Table 5).

Regarding infarction type, 21 (51.2%) patients from group 1 presented with anterior infarction, 19 (46.3%) patients had inferior infarction, whereas one (2.4%) patient presented with lateral infarction. A total of nine (64.3%) patients from group 2 presented with anterior infarction, four (28.6%) patients had inferior infarction, whereas one (7.1%) patient presented with lateral infarction. In group 3, 17 (68%) patients presented by anterior infarction, and eight (32%) patients had inferior infarction. No significant statistical differences were noted among the three groups (Table 6).

Regarding the angiographic data and affected vessel, 36 patients from group 1 (87.7%) had LAD affected, 23 (56.1%) patients had right coronary artery (RCA), whereas 11 (62.8%) patients had left circumflex artery (LCX) affected. A total of 12 (85.7%) patients from group 2 had LAD affected, nine (64.3%) patients had RCA affected, whereas five (35.7%) patients had LCX affected. In group 3, 21 (84%) patients had LAD affected, 12 (48%) patients had RCAs affected, and seven (28%) patients had LCX affected. Most of the patients in the three groups had one-vessel disease only. No significant statistical differences were noted among the three groups (Table 7).

Table 6: Correlation of glycated hemoglobin with type of infarction and RWMA finding

	n (%)	*n* (%)	*n* (%)	Value	*P*	Significance
Anterior	21 (51.2)	9 (64.3)	17 (68.0)	Fisher exact test=6.68	0.261	NS
Inferior	19 (46.3)	4 (28.6)	8 (32.0)			
Lateral	1 (2.4)	1 (7.1)	0			

Table 7: Correlation of glycated hemoglobin with angiographic finding

	HbA1C [*n* (%)]			Test of significance		Significance
	<5.7	5.7-6.4	>6.4	Value	*P*	
Vessel affected						
LAD	36 (87.8)	12 (85.7)	21 (84.0)	Fisher exact test=0.39	0,911	NS
RCA	23 (56.1)	9 (64.3)	12 (48.0)	χ^2=1	0.606	NS
LCX	11 (26.8)	5 (35.7)	7 (28.0)	χ^2=0.41	0.814	NS
Vessel number						
1	20 (48.8)	5 (35.7)	14 (56.0)	Fisher exact test=1.7	0.816	
2	13 (31.7)	6 (42.9)	7 (28.0)			NS
3	8 (19.5)	3 (21.4)	4 (16.0)			
Strategy of PCI						
Culprit vessel	36 (87.8)	13 (92.9)	24 (96.0)	Fisher exact test=2.5	0.681	
Total revascularization	2 (4.9)	1 (7.1)	1 (4.0)			NS
Elective CABG	3 (7.3)	0	0			
Technique used						
Direct stenting	18 (43.9)	3 (21.4)	12 (48.0)	χ^2=2.86	0.239	
Predilatation stenting	23 (56.1)	11 (78.6)	13 (52.0)			NS
TIMI flow						
0	0	0	1 (4)	Fisher exact test=3.4	0.538	NS
1	0	0	1 (4)			NS
2	1 (2.4)	1 (7.1)	2 (8)			
3	41 (97.6)	13 (92.9)	21 (84)			
Heart failure	0	1 (7.1)	1 (4)	Fisher exact test=3.4	0.134	NS

CABG, coronary artery bypass grafting; HbA1C, glycated hemoglobin; LAD, left anterior descending; LCX, left circumflex artery; PCI, percutaneous coronary intervention; RCA, right coronary artery.

Culprit vessel PCI was the strategy used for 36 (87.8%) patients in group 1, whereas it is used in 13 (92.9%) patients in the second group and 24 (96%) patients in the third group. No significant statistical differences were noted among the three groups (Table 7).

Predilatation technique was used in 23 (56.1%) patients in group 1, 11 (78.6%) patients in group 2, and 13 (52%) patients in group 3. No significant statistical differences were noted among the three groups (Table 7). The length of the stented area was 30.3 mm in group 1, 33.3 mm in group 2, and 33.9 mm in group 3. No significant statistical differences were noted among the three groups (Table 4).

Most of the patients had TIMI 3 flow postprocedurally (97.6% in group 1, 92.9% in group 2, and 84% in group 3). No significant statistical differences were noted among the three groups (Table 1).

Regarding echocardiographic finding, mean EF% was 49.6 ± 7.5 in group 1, 42 ± 11.3 in group 2, and 52.8 ± 11.1 in group 3. No significant statistical differences were noted among the three groups (Table 4).

However, one patient developed heart failure in group 2, and another patient in group 3; no patient developed arrhythmia. No patient died until hospital discharge (Table 7).

Discussion

DM is a major predictor for atherosclerosis and AMI. Managing DM mainly aims to decrease the risk of coronary artery disease (CHD) and other complications. However, it is unknown if HbA1C level can predict the incidence or severity of CHD. The present study aims to detect if HbA1C level can predict incidence or severity of AMI [10].

In our study, nearly all the patients were males (90%). This agrees with many studies [11], which support that CHD is more common in males, probably owing to increased risk factors like DM and hypertension.

Most patients in our study aged between 54 and 59 years. This agrees with most previous studies such as AIR study [12]. This may be explained by that this age is associated with increased risk factors, and physical stress, which result in increased risk of developing CHD.

The most common risk factor in our study was smoking (53%), followed by hypertension (26%), whereas diabetic patients represented only 23% of the total number. Smoking is the most common risk factor in many trials [11]. Smoking acts by several mechanisms like sympathetic stimulation and increased clotting [13].

Diabetic patients and increased RBG level were more common in group 3. This is in accordance with most trials [14].

In our study, no statistically significant difference was found in lipid profile, liver function, kidney function, and complete blood picture. A study done by Alzahrani *et al*. [15] revealed no association between HbA1C and total cholesterol, low-density lipoprotein, and high-density lipoprotein, whereas there was a significant correlation with triglycerides level. The negative correlation in our study may be explained by the low number of uncontrolled diabetic patients.

Most of the patients in our study were presented with anterior myocardial infarction, and of course the LAD artery was the most affected artery. Most patients had one-vessel disease. Culprit vessel PCI was done in most of the patients. Predilatation technique was the most common technique used in our study. These ECG and angiographic data show no significant difference among the three groups in our study. These results were opposite to most studies that revealed strong correlation between HbA1C level and severity of angiographic findings [16]. However, some studies agree with our results and concluded that HbA1C in nondiabetic adult patients is not an independent predictor of the severity of coronary artery disease [17]. This controversy may be explained as most of our patients were nondiabetic and most other studies evaluated the effect of HbA1C in diabetic patients.

No reflow occurred in only one patient in group 3, whereas no patients developed no reflow in groups 1 and 2. Heart failure developed in one patient in group 2, and one patient in group 3. These results of prognostic effect of HbA1C agree with some studies and disagree with others. In a study done by Zaghla *et al*. [18], there was no association between HbA1C and these parameters. Another study concluded that AGP has higher predictability as compared with HbA1C [19]. In our study, owing to low incidence of complications, the effect of HbA1C in predicting complications could not be assessed accurately, owing to their low incidence.

Limitations

The study has obvious limitations, such as the relatively small sample of patients with increased or borderline HbA1C as compared with the patients with low HbA1C. Another limitation is that follow-up of the patients was done until hospital discharge only. Other studies are needed with long-term follow-up. Further studies are also required to assess the significance of RBG versus HbA1C in prediction of future cardiovascular events in diabetic patients.

Conclusion

Our conclusion is that although diabetes is a risk factor for atherosclerotic and arterial disease, HbA1C level has no correlation with severity and short-term prognosis. Our findings may help in the control of diabetic patients, especially those with STEMI in the early stages of their presentations.

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Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Ashraf BK, Jacob JK, George J, Samuel S, Bhagyanath T. A study of the relation of HbA_1C level in acute coronary syndrome and its complications. J Med Sci Clin Res 2019; 7:324–331.
2. ADA Workshop Report. International expert committee report on the role of the A1c assay in the diagnosis of diabetes. Diabetes Care 2009; 32:1327–1334.
3. Buse JB, Ginsberg HN, Bakris GL, Clark NG, Costa F, Eckel R, *et al*. Primary prevention of cardiovascular diseases in people with diabetes mellitus: scientific statement from the American heart association and the American Diabetes Association. Diabetes Care 2007; 30:162–172.
4. Care Kaneto H, Katakami N, Matsuhisa M, Matsuoka T. Role of reactive oxygen species in the progression of type 2 diabetes and atherosclerosis. Mediators Inflamm 2010; 2010:453892.
5. Singh KP, Shaini L, Singh TSD, Kshetrimayum V, Sadanandam S and Diana W. Evaluation of glycated haemoglobin (HbA_1C) in acute coronary syndrome (ACS). Int J Biochem Res Rev 2019; 27:1–9.
6. Hadjadj S, Coisne D, Mauco G, Ragot S, Duengler F, Sosner P, *et al.* Prognostic value of admission plasma glucose and HbA_1C in acute myocardial infarction. Diabet Med 2004; 21:305–310.
7. Tietz NW. *Textbook of clinical chemistry*. W.B. SaundersCompany; Philadelphia: 1999. 794–795.
8. Gibson CM, Cannon CP, Murphy SA, Ryan KA, Mesley R, Marble SJ, *et al*. Relationship of TIMI myocardial perfusion grade to mortality after administration of thrombolytic drugs. Circulation 2000; 101:125–130.
9. Mendis S, Thygesen K and Writing group on behalf of the participating experts of the WHO consultation for revision of WHO definition of myocardial infarction. World Health Organization definition of myocardial infarction. Int J Epidemiol 2011; 40:139–146.
10. Saydah S, Tao M, Imperatore G, Gregg E. GHb level and subsequent mortality among adults in the U.S. Diabetes Care 2009; 32:1440–1446.
11. Singh KP, Shaini L, Singh TSD, Kshetrimayum V. Evaluation of glycated hemoglobin (HbA_1C) in acute coronary syndrome (ACS) Community Health Centre, Sagolmang, Imphal, India. Department of Biochemistry, RIMS, Imphal, India. Department of Cardiology, RIMS, Imphal, India. 27 (1): 1–9, 2019.
12. Ranjith N, Pegoraro RJ, Zaahl MG. Risk factors associated with acute coronary syndromes in South African Asian Indian patients [The AIR Study]. J Clin Exp Cardiol 2011; 10:1–5.
13. Yathish TR, Manjula CG, Srinivas RD, Gayathree L. A study on the association of coronary artery disease and smoking by a questionnaire method. J Clin Diagn Res 2011; 5:264–268.
14. Jain S, Chauhan VS, Nayak R. Glycoslated haemoglobin as a diagnostic marker of diabetes mellitus in acute myocardial infarction and association with obesity. Int Res J Med Sci 2015; 3:7–10.
15. Alzahrani SH, Baig M, Aashi MM, Al-Shaibi FK, Alqarni DA, Bakhamees WH. Association between glycated hemoglobin (HbA_1C) and the lipid profile in patients with type 2 diabetes mellitus at a tertiary care hospital: a retrospective study diabetes, metabolic syndrome and obesity. Targets Ther 2019; 12:1639–1644.
16. Mahmoud HE, Elsaied AR, Hassan MH. Correlation of glycosylated hemoglobin level with the severity of coronary artery disease in diabetic

patients. J Biol Med 2020; 4:001–005.
17. Habib S, Ullah SZ, Saghir T, Muhammad AS, Deen ZU, Naseeb K, Sherwani R. The association between hemoglobin A1c and the severity of coronary artery disease in non-diabetic patients with acute coronary syndrome. Cureus 2020; 12:e6631.
18. Zaghla HE, Elbadry MA, Ashour AM, Abdelfatah MM. Influence of admission blood glucose and hemoglobin A1c on outcome of acute myocardial infarction. Egypt J Intern Med 2014; 26:21–26.
19. Vujosevic S, Radojevic N, Belada N. Influence of admission glucose profile and hemoglobin A1c on complications of acute myocardial infarction in diabetic patients. Eur Rev Med Pharmacol Sci 2013; 17:1252–1257.