Association of Admission Serum Glucose, Fasting Blood Sugar, and Glycosylated Hemoglobin in Non-Diabetic Patients with Acute Myocardial Infarction

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Background --- Diabetes mellitus increases the risk of ischemic stroke two-to-four-fold but also adversely influences the prognosis. (1-6) An established relationship exists between admission plasma glucose levels and hospital mortality among patients with myocardial infarction. (6) However, the relationship between admission glucose level, fasting blood sugar, glycosylated hemoglobin and long-term outcome after an acute myocardial infarction are less well explored.

Methods --- Forty-four diagnosed cases of acute myocardial infarction from June 2006 to August 2007 were gathered from the emergency room of the Philippine Heart Center. The patients had baseline serum glucose, glycosylated hemoglobin and fasting blood sugar taken. Subjects were divided into two categories: with diabetes, and without diabetes. Patients were followed up from 3 days to 14 months for occurrence of cardiovascular events.

Results --- The majority (82%) of the patients were males. Mean age was 55 years, with age range of 27 to 78 years. Most patients (86%) had conservative medical management. The mean ASG levels for the diabetics and non-diabetics were 12.16 (SD +/- 4.14) mmol/L and 7.29 (SD +/- 2.02) mmol/L. The mean FBS levels were 6.77 (SD +/- 1.33) and 6.16 (SD+/- 0.96) mmol/L, and mean HBA1c levels were 8.26 (SD +/- 2.54) mmol/L and 5.46 (SD +/- 0.96) mmol/L respectively. Among 36 patients without recognized diabetes mellitus, 13 had normal FBS levels. Eight had borderline FBS and 3 had diabetic range FBS levels. These patients had impaired glucose metabolism or ongoing diabetes mellitus. During the follow-up, twelve (33%) non-diabetic patients died or were readmitted due to reinfarction.

Conclusion --- Admission serum glucose and glycosylated hemoglobin were not associated with long-term prognosis. The proportions of elevations were higher in diabetic than in non-diabetic patients. Normal fasting blood sugar was not associated with long-term adverse cardiovascular event. Elevated fasting blood sugar may predict the likelihood of cardiovascular event but only in non-diabetics. The mean FBS showed a trend in mortality among non-diabetic patients. As high as 32% have unrecognized impaired glucose metabolism and needed further evaluation. ***Phil Heart Center J 2008; 14(1):48-55.***

Key Words: Admission Serum Glucose ■ Fasting Blood Sugar ■ Glycosylated Hemoglobin ■ Acute Myocardial Infarction ■ Reinfarction ■ Mortality ■ Prospective Cohort study

Diabetes mellitus (DM) is associated with a high risk of coronary heart disease,[1-6] and subjects with diabetes have a substantially increased risk of death after acute myocardial infarction, as compared with nondiabetic age-matched controls.[7,8] DM also confers a poor prognosis following stroke in terms of increased mortality, stroke recurrence and impaired neurological recovery.[9,10] The prevalence of recognized diabetes mellitus in acute stroke patients is between 8 and 20%, but between 6 and 42% of patients may have undiagnosed diabetes mellitus before presentation.[11-14] Post-stroke hyperglycemia is common and associated with an increased risk of death in subjects with and without diabetes.[15-17] Recent data indicate a high prevalence of abnormal glucose metabolism in patients with unknown diabetes at the time of acute myocardial infarction (AMI).

In the study of Norhammar et al, 40% of AMI patients showed impaired glucose tolerance and 25% have diabetes when tested three months after discharge. These patients have no known diabetes at the time of AMI and whose admission plasma glucose levels are less than 200 mg/dl (11.1 mmol/L).[4] The high prevalence of undiscovered abnormal glucose metabolism

Accepted paper for PHC 16th Annual research Paper Competition 2008 and for 38th PHA Annual Convention held on May 2008 at Edsa Shangrila Hotel, Philippines

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among patients with AMI, compatible with the prediabetic state as well as frank diabetes, may in part explain the association between admission glucose levels and mortality, especially in subjects who are not diagnosed as having diabetes at the time of the AMI.[18, 19]

Glycosylated hemoglobin is not used to diagnose diabetes mellitus because it is not recommended by the recent guidelines.[20, 21] However, there are studies on this reflecting an associated risk. In a 3-year follow-up study by Khaw et al, the authors showed that glycosylated hemoglobin (HbA1c) concentrations are related to cardiovascular disease and all- cause mortality.[18] However, it has insufficient power to examine risk relationships at concentrations close to the diagnostic threshold of 7% or to examine the relationship in women.

In the study by Stranders et al, [22] an increase of 18 mg/dl (1 mmol/L) in glucose level is associated with a 4% increase of mortality risk in non-diabetic patients and 5% in diabetic patients (both $P < 0.05$). There are 737 previously non-diabetic subjects, 101 had admission blood glucose levels of 200 mg/dl (11.1 mmol/L) or more and mortality in these patients was comparable to that with patients who had established diabetes (42.6% vs. 43.1%). They concluded that admission blood glucose level after AMI is an independent predictor of long-term mortality among patients with and without known diabetes. Weir et al[23] reported that admission plasma glucose level independently predicted short and long-term outcome after stroke.

On the other hand, Mak et al3 did not find an association between fasting blood glucose level and long-term outcome in 44 non-diabetic post-infarction patients. The study of Aronson et al [24] found a graded independent association between glucose levels at admission and long-term mortality in non-diabetic patients. Both the admission and fasting glucose levels provided incremental prognostic information with regard to long-term mortality when added to the GRACE score.[25] GRACE score was defined as risk scores associated with acute coronary events. It was based on a large multinational observational global registry on acute coronary events. It included the age, heart rate, systolic BP, creatinine level, Killip class, cardiac arrest at admission, elevated cardiac markers and ST segment elevation. The study concluded that FBS was better than admission glucose for the prediction of 30-day mortality in non-diabetic patients.

In the light of the variable results of these studies, the authors have undertaken this study to determine the association between abnormal admission serum glucose (ASG), fasting blood sugar (FBS) and glycosylated hemoglobin (HbA1c) levels with long-term prognosis in acute myocardial infarction patients. Also, the study aims to determine the prevalence of impaired glucose metabolism among non-diabetic patients with acute myocardial infarction.

Methods

This was a prospective Cohort study involving consecutive patients with acute myocardial infarction seen at the emergency room of the Philippine Heart Center from June 1, 2006 to August 30, 2007. Excluded were patients with chronic renal failure, cardiomyopathy and cerebrovascular infarct and > 80 years old. The definition of myocardial infarction was based on the European Society of Cardiology and American College of Cardiology (ESC/ACC) criteria:[5] increased creatine kinase (predominantly in MB fraction), and / or increased troponin Ic or troponin t (creatine kinase > 400 IU/l and/or troponin I c > 0.16 ng/ml, and/or troponin T >1 ng/ml, and ischemic symptoms (mainly constrictive chest pain, lasting more than 30 min), and/ or abnormal ECG (ST elevation > 1 mm on at least two derivations). It was defined as acute if the elapsed time between first symptoms and admission was 48 hours or less.

The following variables were obtained through chart review: age, gender, presence of co-morbidities like history of previous myocardial infarction, hypertension, lipid disorders, smoking history, intake of alcoholic beverages, location of infarction, and treatment. Subjects were divided into two categories: with diabetes mellitus and without diabetes mellitus. With diabetes mellitus was defined as presence of symptoms such as polydypsia, polyphagia and polyuria and diagnosed by their physicians as diabetics regardless of medications or treatment received. Without diabetes mellitus was defined as absence of symptoms of diabetes such as polydypsia, polyphagia, and polyuria. Impaired glucose tolerance was defined as a FBS of >6.10-6.9 mmol/L (>110-125 mg/dl).

Patients' admission serum glucose and glycosylated hemoglobin were taken and analyzed at the Division of Biological and Clinical Laboratory (Pathology) by means of a glucose oxidase method (Vitros 500) for serum glucose and turbidimetric immunoassay (Cobas Mira) for glycosylated hemoglobin. FBS was extracted after 8 hours of fasting and analyzed at the laboratory by glucose oxidase method (Vitros 500). Classification of normal fasting glucose and admission glucose levels in patients without diabetes mellitus was based on the criteria of the American Diabetes Association [26] and the 1999 report of the World Health Organization.(21) A normal fasting glucose has a cutoff level of <6.10 mmol/L (<110 mg/dl). Elevated fasting glucose

levels was defined as > 6.1 mmol/L (>110 mg/dl). Patients with elevated fasting glucose were further divided into borderline 6.2 – 6.9 mmol/L (110 – 125 mg/dl) and diabetic range if > 7.0 mmol/L (> 126 mg/dl) based on the report of Japan Diabetes Society.[27] On the basis of admission (random) serum glucose, patients were classified as normal with a cut-off level of < 7.8 mmol/L (< 140 mg/dl) and elevated admission (random) serum glucose if > 7.8 mmol/L (> 140 mg/dl). Glycosylated hemoglobin was not used to diagnose diabetes mellitus because it was not recommended by the recent guidelines.(20, 21) Glycosylated hemoglobin normal value was < 6.50 % and elevated if > 6.50 %. "Diabetic range" was defined as fasting glucose of >7.0 mmol/L (>126 mg/dl), or casual (random) blood glucose >11.1 mmol/L (>200 mg/dl), or 2-hr plasma glucose of >11.1 mmol/L (>200 mg/dl). Normal type was defined as fasting glucose <6.1 mmol/L (<110 mg/dl), or 2 hr plasma glucose < 7.8 mmol/L. Borderline type included values that were neither diabetic nor normal types. To determine the prevalence of diabetes in a population, the "diabetic type" may be regarded as diabetes and a 2 hr plasma glucose of >11.1 mmol/L (>200 mg/l) was recommended. But a FBS cutoff level of >7.00 (>126 mg/dl) may be used if 2 hr PG was difficult to obtained.[27] Diabetes mellitus was diagnosed when hyperglycemia meeting the criteria for "diabetic range" was shown on two or more occasions examined on separate days.[27]

Follow-up of patients was done through telephone interview or through their follow–up consultation at the out-patient department. Patients' follow-up was terminated on October 14, 2007. Patients' outcome was determined as to with or without cardiovascular event. With cardiovascular event was defined as occurrence of reinfarction, readmission due to congestive heart failure or death. Without cardiovascular event was defined as alive on follow-up with no hospitalization or reinfarction.

Sample size calculation

Sample size was computed at n= 52 using an α of 0.05, β of 0.20 and the difference in glucose level of 1.6 +/- 2 mmol/L between those with and without cardiovascular event. This was based on the study of Norhammar et al wherein the glucose mean level was 9.1 +/- 3.7 among those with cardiovascular event and 7.5 +/- 2.4 among those without. However, due to the time constraint, 51 subjects were screened and 7 were excluded in the study.

Data Analysis and Statistical Methods

All statistical analysis were performed with SPSS Inc, Chicago, III). Continuous data were presented as means and standard deviation while nominal data were summarized as frequency and percent distribution. The homogeneity of diabetes mellitus and non-diabetes mellitus in terms of demographic and clinical characteristics were determined using the t-test and chi-square test. Chi square was used to compare the prevalence of elevated glucose in the two groups (with diabetes mellitus and without diabetes mellitus). A p value of < 0.050 was considered statistically significant. Kaplan Meier was applied to the data to determine the survival of patients.

Results

Forty-four patients admitted with acute myocardial infarction at Philippine Heart Center were evaluated. The majority (82%) of the patients were male. Mean age was 55 years (27 to 78 years) for both the diabetics and non-diabetics. On admission, no known maintenance medications affected the glucose levels. The mean ASG levels for the diabetics and non-diabetics were 12.16 (SD 4.14) mmol/L and 7.29 (SD 2.02) mmol/L respectively. The mean FBS levels were 6.77 (SD 1.33) and 6.16 (SD 0.96) mmol/L, and the mean HBA1c were 8.26 (SD 2.54) mmol/L and 5.46 (SD 0.96) mmol/L respectively. The ASG and HBA1c levels were statistically significant among the two groups, higher levels in diabetics than non-diabetics but the FBS level was not statistically different (ASG p-value = 0.000)

Charts review showed that 8 were previously diagnosed with diabetes mellitus, 11 (25%) with previous MI, 32 (73%) smokers, 25 (57%) alcohol beverage drinker, 28 (64%) with hypertension and 15 (34%) with lipid disorder. Most patients (86%) had conservative medical management, 3 received thrombolysis and 3 underwent an acute PTCA (Table 1). At discharge, most were taking combination drugs. Sixty-four percent were taking aspirin (ASA), 36% were taking other anticoagulants, 57% were taking beta-blockers, 45% were taking ACE inhibitors, 66% were taking lipid lowering drugs, 20% were taking diuretics and 14% were taking angiotensin II antagonist.

Duration of follow-up of patients were from 5 days to 6 months (mean = 7.28 months) among those without cardiovascular event. Cardiovascular events were noted from 3 days to 12 months (mean = 4.68 mo) after admission. Deaths were seen as early as 3 days due to fatal acute myocardial infarction. Readmission due to reinfarction or other cardiac problems were from 7 days to 12 months.

Statistical analysis using t-test showed that the admission serum glucose and glycosylated hemoglobin

were statistically different among patients with and without diabetes mellitus (ASG p-value = 0.001 and FBS p-value = 0.005). FBS, troponin T and troponin I were not different among the two populations. Also, the age, gender, previous myocardial infarction, smoking history, alcoholic beverage consumption, hypertension and lipid disorders were statistically not different among the two groups. Even the treatment received was not statistically different. The baseline demographics of patients with and without diabetes were also similar with the studies of Aguilar et al.[28]

Among the 36 patients without recognized diabetes mellitus, 24 (67%) had normal ASG levels and 12 (33%) had elevated ASG levels, in contrast with diabetic patients with 1 and 7 patients having normal and elevated ASG levels respectively. This was also reflected in their HbA1c levels; 5 diabetics had elevated HbA1c levels while 3 had normal levels. Thirty-two (89%) non-diabetics had normal HbA1c levels while 4 (11.1%) had elevated levels. The proportion of patients with elevated ASG and HbA1c levels in these two groups were statistically significant. The diabetic patients significantly had hyperglycemia at the time of myocardial infarction (p = 0.001) and had poor glycemic control inspite of their medications (p = 0.005). For FBS levels, there were 2 with elevated FBS levels in the diabetic group while there were 11 non-diabetics with elevated FBS levels (32% with borderline FBS levels and 12% with diabetic levels). The values of FBS was not statistically different between the two populations (Table 2).

As to the outcome after the AMI admission in non-diabetic patients, no cardiovascular event was observed in 18 (50%) patients with normal ASG levels and in 13 (52%) with normal FBS levels. However, 16% of those with normal ASG and 4% with normal FBS had cardiovascular events. Comparing the ASG and FBS levels, a statistically significant difference was observed in the FBS elevation among the patients with and without cardiovascular event (p = 0.021). Those with borderline FBS or impaired glucose tolerance, five had cardiovascular event. Three (12%) died within 5 days to 6 months and 2 (8%) were readmitted due to reinfarction within 8 to 12 months. The mean values of ASG, FBS, and HbA1c were not statistically significantly different, but the mean values of ASG and FBS were relatively higher among those with cardiovascular event. The mean FBS values showed a trend in predicting a cardiovascular event among the non-diabetic patients with AMI as reflected by occurrence of cardiovascular events in 6 (24%) patients.

The rest of the variables were also not statistically significant. However, there was a trend that patients younger than 65 years were without cardiovascular events as compared to older patients. Gender, smoking history, alcoholic beverage consumption, hypertension, lipid disorder and conservative treatment did not increase the risk for an adverse cardiovascular event. Total adverse cardiovascular events were noted in 12 (33%) nondiabetic patients. The mean follow-ups were 4.68 and 7.28 months in patients with and without cardiovascular event (Table 3).

There were eight patients with diagnosed diabetes mellitus. Two had cardiovascular event within 6 days to 3 months (mean = 1.60 mo) and both patients died. It was also observed that patients with normal ASG, FBS and HbA1c levels had less cardiovascular events. The mean ASG and FBS were slightly higher among those with cardiovascular event (Table 4). Among the different variables, previous myocardial infarction showed a statistically significant association with an adverse cardiovascular event among the diabetic patients (p- 0.036). The rest of the variables were not associated with a long-term adverse outcome. This was probably due to the limited sample of patients with diabetes mellitus.

Discussion

The admission serum glucose and glycosylated hemoglobin were statistically different among those AMI patients with and without diabetes mellitus. The mean value of ASG and HbA1c were relatively higher among those with diabetes mellitus as compared with the non-diabetics. This was reflective of poor glycemic control seen in diabetic patients at the onset of AMI. This was consistent with the study of Stranders et al, (22) wherein the mean ASG was 15.16 mmol/L (275.7mg/dl) and 8.82 mmol/L (160.4 mg/dl) among the known diabetics and non-diabetics respectively. The study of Gray et al, (11) had higher HBA1c levels among the diabetics compared with the non-diabetics (6.23 mmol/L and 5.56 mmol/L respectively).

Among the non-diabetic patients, 18 (50%) patients with normal admission serum glucose levels had no cardiovascular event. There were 12 (33%) patient with elevated ASG with 6 (17%) patients had no cardiovascular event observed. Elevated ASG was not a significant risk factor for a future cardiovascular event. The high blood glucose levels after AMI were most likely a reflection of high levels of circulating stress hormones[29, 30] or an indicator of incipient pancreatic B-cell failure that was unmasked in stressful conditions.[31]

The studies of Oliver and Bellodi [32, 33] showed hyperglycemia alone was detrimental for the ischemic myocardium and, in many patients, is associated with

high risk of cardiovascular disease. [32, 34] Similarly, patients with normal FBS have no risk of having cardiovascular event in the future. This was reflected by the 13 (52%) patients without cardiovascular event as compared with 1 (4%) with cardiovascular event in our study. This was consistent with the study of Suleiman et al[35] wherein the risk for 30-day mortality among non-diabetic patients with fasting glucose within the normal range was very low. There were 8 (32%) with impaired glucose tolerance and 3 (12%) with undiagnosed diabetes mellitus. These patients were not recognized nor treated as diabetics or with impaired glucose tolerance. The FBS levels or 2-hr plasma glucose did not qualify patients as diabetics if they were not clinically stable even if the FBS level was > 6.1 mmol/L. [27] Unfortunately, three (12%) among those with impaired glucose tolerance died and the other two (8%) were readmitted due to reinfarction. These patients had values above normal but below the diagnostic cut-off for diabetes. They fell short for the criteria of diabetes but should be categorized as impaired glucose tolerance already.

Norhammar et al [4] reported that 40% of non-diabetic patients with AMI had unobserved impaired glucose tolerance and 25% had undiagnosed diabetes mellitus. Other studies [36, 37] reported that in the general population, half of all the subjects with type 2 diabetes mellitus were undiagnosed. The study of Tamita et al (38) showed a persistent and significant increase in the risk of major adverse cardiovascular event in patients with abnormal glucose tolerance and those with previous DM. The cardiovascular event-free survival rate was similar between IGT and the newly diagnosed DM subgroups (73% and 67%, p=0.99) at 5-year follow-up among the abnormal glucose tolerance group.

Our study showed that 8 (32%) of the non-diabetic group had borderline FBS with 5 had cardiovascular event. Among the three patients with diabetic range FBS, two had cardiovascular event. Using the ADA (26) and WHO classification of diabetes mellitus (21), the former patients had undiagnosed impaired glucose tolerance already while the latter patients had ongoing diabetes mellitus. These patients were probably undetected for years and had increased their risk for cardiovascular events

No statistically significant difference was observed in the FBS levels between the two groups, but a trend in predicting a cardiovascular event among the non-diabetic patients with AMI was seen. Statistical significant difference could have been achieved if the other 15 patients had an available fasting blood sugar determination. The admission serum glucose was not associated with adverse cardiovascular event. It could

Table 1. Clinical Characteristics and Laboratory Profile of Acute Myocardial Infarction Patients With and Without Previously Diagnosed Diabetes Mellitus

Characteristics	With DM N = 8	Without DM N = 36	p-value
	N	N (%)	
Gender			
Male	6	30 (83)	0.623
Female	2	6 (17)	
Previous myocardial infarction	2	9 (25)	1.000
Hypertension	3	25 (69)	0.117
Lipid disorder	2	13 (36)	0.665
Smoker	4	28 (78)	0.185
Alcoholic beverage drinker	5	20 (56)	1.000
Treatment			
Conservative	6	32 (89)	0.297
Thrombolytic	1	2 (6)	0.461
Primary TCA	1	2 (6)	0.461
	Mean (SD)	Mean (SD)	
Age (years)	55 (15.31)	55 (10.86)	0.887
Admission serum glucose (ASG)*	12.16 (4.14)	7.29 (2.02)	**0.000**
Fasting blood sugar (FBS)*	6.77 (1.33)	6.16 (0.96)	0.269
Glycosylated hemoglobin (HbA1C)*	8.26 (2.54)	5.46 (0.96)	**0.000**
Cardiac markers			
Troponin T	0.82 (0.54)	0.71 (0.70)	0.713
Troponin I	9.02 (10.18)	7.97 (8.93)	0.902

*units in mmol/L

Table 2. Sugar Level of Patients with Acute Myocardial Infarction by Group (With and Without Diabetes Mellitus)

Characteristics	With DM N = 8	Without DM N = 36	p-value
Admission serum glucose*	N	N (%)	
Normal (<7.8)	1	24 (67)	**0.001**
Elevated (≥7.8)	7	12 (33)	
Fasting blood sugar±*			
Normal (<6.10)	*2*	*14 (56)*	*0.123*
Elevated (≥6.10)	*2*	*11 (44)*	
Borderline(≥6.10-6.9)	*0*	*8 (32)*	
Diabetic range (≥7.0)	*2*	*3 (12)*	
Glycosylated hemoglobin*			
Normal	3	32 (89)	**0.005**
Elevated (> 6.5)	5	4 (11)	
Outcome			
With cardiovascular event	2 (25)	12 (33)	1.000
Follow-up in days (mean , SD)	6.49 (6.35)	6.45 (5.11)	0.985

not predict the long-term prognosis of patients with AMI. These results were also reflected in the study of Aronson et al.[24] They concluded that FBS was a better predictor of 30-day mortality in non-diabetic patients compared with admission glucose. This was consistent with the study of Suleiman et al[29] wherein elevated fasting glucose concentrations were better predictors of mortality than admission glucose.

Among patients with diabetes mellitus, previous myocardial infarction was the only significant factor in determining a future cardiovascular event. The ASG, FBS and HbA1c were not associated with long-term prognosis. However, the proportion of elevation was higher compared to the non-diabetics. Based on the HbA1c levels, these diabetic patients have poor glycemic control in spite of the oral hypoglycemic agents used.

Table 3. Outcome and Clinical Characteristics of Non-Diabetic Patients with Acute Myocardial Infarction

Characteristics	Follow-Up Without Cardiovascular Event N=24	Follow-Up With Cardiovascular Event N=12	p-Value
Admission Serum Glucose	**N(%)**	**N (%)**	
Normal (< 7.8 mmol/L)	18 (50)	6 (17)	0.156
Elevated (≥7.8 mmol/L)	6 (17)	6 (17)	
Mean (SD)	**6.93 (2.08)**	**8.02 (1.75)**	0.130
Fasting blood sugar *(N = 25)			
Normal (< 6.1 mmol/L)	**13 (52)**	**1 (4)**	**0.021**
Elevated (≥6.10 mmol/L)	**5 (20)**	**6 (24)**	
Borderline(≥6.10-6.9 mmol/L)	3 (12)	5 (20)	
Diabetic range (≥7.0 mmol/L)	2 (8)	1 (4)	
Mean (SD)	**5.98 (0.97)**	**6.60 (0.86)**	0.157
HBA1c			
Normal	22 (61)	11 (30)	1.000
Elevated (> 6.5%)	2 (6)	1 (3)	
Mean (SD)	**5.46 (1.08)**	**5.48 (0.71)**	0.958
Troponin T *(N = 32)	21 (66)	11 (35)	0.263
Mean (SD)	**0.70 (0.75)**	**0.71 (0.59)**	0.813
Age			
Age < 65	21 (58)	9 (25)	0.378
Age ≥ 65 yr	3 (8.3)	3 (8.3)	
Mean +/-	**54.63 (10.82)**	**56.58 (11.29)**	**0.800**
Gender			
Male	20 (56)	10 (28)	1.000
Female	4 (11)	2 (6)	
Previous myocardial infarction			
With previous MI	5 (14)	4 (11)	0.443
Without previous MI	19 (53)	8 (22)	
Smoking history			
Smoker	18 (50.0)	10 (27.8)	0.691
Non-smoker	6 (16.7)	2 (5.5)	
Intake of alcoholic beverages			
Alcoholic beverage drinker	13 (36.1)	7 (19.4)	1.000
Non-alcoholic beverage drinker	11 (30.6)	5 (13.9)	
Hypertension			
With hypertension	17 (47.2)	8 (22.2)	1.000
Without hypertension	7 (19.5)	4 (11.1)	
Lipid disorder (N =27)			
With lipid disorder	9 (33.3)	4 (14.9)	0.678
Without lipid disorder	11 (40.7)	3 (11.1)	
Treatment			
Conservative	22 (61)	10 (27.8)	0.486
Thrombolytic	1 (2.8)	1 (2.8)	
PTCA	1 (2.8)	1 (2.8)	
Outcome	**24 (67)**	**12 (33)**	
Follow-up in months (mean,SD)	**7.28 (5.57)**	**4.68 (4.22)**	**0.129**

* FBS available in 25 nondiabetic and Troponin T in 32 patients. Trop I was used in 4 patients.

Conclusion

Admission serum glucose and glycosylated hemoglobin levels were not associated with long-term prognosis. The proportions of elevations seen were higher in diabetic than in non-diabetic patients. Normal fasting blood sugar was not associated with long-term adverse cardiovascular event. Elevated fasting blood sugar may predict the likelihood of cardiovascular event but only in non-diabetics. The mean FBS showed a trend in mortality among non-diabetic patients. As high as 32% patients have unrecognized impaired glucose metabolism and needed further evaluation.

Recommendation

Our study showed that the mean FBS showed a trend in predicting long-term mortality among the non-diabetic patients but the study was not powered to detect significant difference in FBS levels between those with and without cardiovascular events. Thus, we recommend that a larger sample be recruited in order to strengthen our hypothesis.

Table 4. Outcome and Clinical Characteristics of Diabetic Patients with Acute Myocardial Infarction

Characteristics	Follow-Up		p-Value
	Without Cardiovascular Event N=6	With Cardiovascular Event N=2	
Admission Serum Glucose			
Normal (< 7.8 mmol/L)	0	1	0.250
Borderline (≥7.8 mmol/L)	6	1	
Mean (SD)	**11.93 (2.93)**	**12.85 (8.70)**	0.809
Fasting blood sugar *(N = 4)			
Normal (< 6.1 mmol/L)	2	0	1.000
Elevated (≥6.10 mmol/L)	1	1	
Borderline(≥6.10-6.9 mmol/L)	0	0	
Diabetic range (≥7.0 mmol/L)	1	1	
Mean (SD)	**6.60 (1.56)**	**7.30**	0.735
HBA1c			
Normal	2	1	1.000
Elevated (> 6.5%)	4	1	
Mean (SD)	**8.48 (2.77)**	**7.61 (2.33)**	0.707
Troponin T *(N = 6)	4	2	0.503
Mean +/- SD	**0.71**	**1.03**	0.759
Age			
Age < 65	5	0	0.107
Age ≥ 65 yr	1	2	
Mean +/-	49.33 (13.88)	70.50 (2.12)	0.617
Gender			
Male	5	1	0.464
Female	1	1	
Myocardial infarction			
With previous MI	0	2	**0.036**
Without previous MI	6	0	
Smoking history			
Smoker	4	0	0.429
Non-smoker	2	2	
Intake of alcoholic beverages			
Alcoholic beverage drinker	5	0	0.107
Non-alcoholic beverage drinker	1	2	
Hypertension			
With hypertension	1	2	0.107
Without hypertension	5	0	
Lipid disorder			
With lipid disorder	1	1	1.000
Without lipid disorder	3	1	
Treatment			
Conservative	4	2	0.410
Thrombolytic	1	0	
PTCA	1	0	
Outcome	**6**	**2**	
Follow-up in months mean (SD)	**8.12 (6.55)**	**1.60 (1.97)**	**0.234**

*FBS was available in 4 patients while information on the history of dyslipidemia is present in 6 patients only.

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