Original Article

Association of Admission Glucose Level with Arrythmia and Heart Failure in Hyperglycemic Patients with Non-ST-Segment Elevation Myocardial Infarction

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Abstract

Background: Observetion of admission blood glucose level in non-ST elevation myocardial infarction is crucial to predict its outcome. ***Objective:*** To find out correlation of plasma glucose level with adverse events like arrythmia and heart failure in hyperglycemic patients with non-ST-segment elevation myocardial infarction (NSTEMI). ***Methods:*** This prospective analytical study was conducted in the Department of Cardiology, Mymensingh Medical College Hospital, Mymensingh, Bangladesh, between June 2016 and May 2017. A total of 130 (95 males and 35 females) patients having NSTEMI participated in the study. Detail history was taken and physical examination was done. Venous blood samples were obtained from all patients to determine their cardiac troponins, plasma blood glucose, HbA1C, lipid profile, serum creatinine, and other cardiac enzymes. Then, the study participants were categorized into two groups. A total of 67 included (44 males and 23 females) in Group I, as having NSTEMI with plasma glucose level 7.8-9.3 mmol/l. In Group II, 63 were included (51 males and 12 females) having NSTEMI with plasma glucose level ≥9.4 mmol/l. Follow up was done according to the standard protocol,i.e. serial ECG, echocardiography, monitoring pulse, blood pressure, and auscultation of the lungs' base. ***Results:*** The mean age of the patients was 49.68±3.12 years. Incidence of arrhythmia was observed in 4(5.97%) and 20(31.75%) cases in group I and group II respectively, while heart failure was found in 6(8.96%) and 48(76.19%) cases respectively (P<0.001). A statistically significant moderate negative correlation with medium strength of association (r = -0.056) was observed between heart failure (as measured by LVEF and clinical status) and admission plasma glucose levels of the study participants suggesting that the higher was admission plasma glucose level (8.27±1.03 vs. 13.34±3.65; P<0.001),the lower was the LVEF (54.19±7.13 vs. 44.21±7.36; P<0.001), i.e. higher risks of heart failure. ***Conclusion:*** A higher admission plasma glucose level relates to a lower LVEF,i.e. higher incidence of arrythmia and heart failure in non ST-elevation MI patients.

Keywords: Plasma glucose, arrythmia, heart failure, left ventricular ejection fraction, myocardial infarction

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Introduction

Acute coronary syndrome encompasses different clinical presentations resulting from myocardial ischemia and includes silent angina, stable and unstable angina (UA), acute myocardial infarction [both non-ST segment elevation myocardial infarction (NSTEMI) and ST-elevation myocardial infarction (STEMI)].[1]Among the non-ST segment elevation acute coronary syndromes,unstable angina (UA) and non-ST segment elevation

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myocardial infarction (NSTEMI) are common.[2] Non-ST segment elevation coronary syndrome usually results from instability of an atherosclerotic plaque, with subsequent activation of platelets and several coagulation factors.[2]Non-ST elevation myocardial infarction (NSTEMI) is a recognized diagnostic entity that has an unacceptable mortality rate when it goes unrecognized.[1]Research revealed that South Asian populations have high cardiovascular disease (CVD) burden in the world.[3] However, recent advances in diagnostic tools have led to utilization of different biomarkers to detect and treat myocardial infarction (MI) at an early stage. These biomarkers have tremendous diagnostic and prognostic values, e.g.cardiac troponins, CK-MB,natriuretic peptide, lipoproteins, and other inflammatory acute phase proteins.[4-6]

The role of hyperglycemia in the development of cardiovascular complications in MI patients is often overlooked, and thus, remains unclear. Surprisingly, hyperglycemia, as determined by using a simple, low-cost laboratory test, has been associated with a worse prognosis in MI patients, even in the absence of diabetes.[7,8]Patients either with or without a prior history of diabetes mellitus may present with hyperglycemia during acute myocardial infarction. Among patients with no prior history of diabetes, hyperglycemia may reflect previously undiagnosed diabetes, preexisting carbohydrate intolerance, stress-related carbohydrate intolerance, or a combination of these.[9,10]Several studies have reported an association between elevated blood glucose upon admission and subsequent increased adverse events, including congestive heart failure, cardiogenic shock, and death.[7-11]Hence, observationof admission blood glucose level in non-ST elevation myocardial infarction is also crucial.

Recording of plasma glucose level at admissionis a cheap and easily available test, which has a significant valueto predict outcome of NSTEMI. The value suggests which of thepatients need to be managed urgently with pharmacological or interventional therapy to achieve a better outcome.[12]Many studies were conducted to see the impact of admission blood glucose level in patients with first attack of non-ST segment elevation myocardial infarction in many countries across the globe. However, no report has been found in our country to date. Hence, we proposed the present study to see the association of admission glucose level with adverse events like arrythmia and heart failure in a tertiary level healthcare facility in the country where patients hailing from both urban and rural communities are admitted and treated.

Methods

This prospective, analytical study was conducted in the Department of Cardiology, Mymensingh Medical College Hospital, Mymensingh, Bangladesh, between June 2016 and May 2017. A total of 130 patients were included in this study.

Inclusion criteria:

i) Patients with first attack of non-ST elevation myocardial infarction (the diagnosis of acute non-ST-elevation myocardial infarction was done according to the 'third universal definition of myocardial infarction')[13]with no history of diabetes mellitus; and

ii) Patients provided consent to be enrolled in the study.

Exclusion criteria:

i) Patients having previous history of myocardial infarction;

ii) Patient having latent diabetes (previously undiagnosed), as excluded by determining HbA1Clevel;

iii) Patients with valvular heart disease, congenital heart disease and cardiomyopathy; and

iv) Patients having major non cardiovascular disorder which causes ST elevation.

After taking detailed medical history and complete physical examination, data were recorded for the major cardiovascular risk factors such as age, sex, smoking, diabetes mellitus, hypertension, and family history of coronary artery disease. In addition, body mass index (BMI), pulse, systolic and diastolic blood pressure were recorded. Venous blood samples were obtained from all patients to determine their cardiac troponins, plasma blood glucose, HbA1C, lipid profile, serum creatinine, and other cardiac enzymes.Then, the study participants were categorized into two groups. A total of 67 included (44 males and 23 females) in Group I, as having NSTEMI with plasma glucose level 7.8-9.3 mmol/l. In Group II 63 were included (51 males and 12 females), as having NSTEMI with plasma glucose level ≥9.4 mmol/l.Follow up was done according to the standard protocol,[14] as

we adopted serial ECG, echocardiography, and clinical examinations like monitoring pulse, blood pressure, and auscultation of the lungs' base.Heart failure was determined by left ventricular ejection fraction (LVEF) and clinical status of the patient as per standard guideline.[14]The sequence of the study procedure is shown below in figure 1.

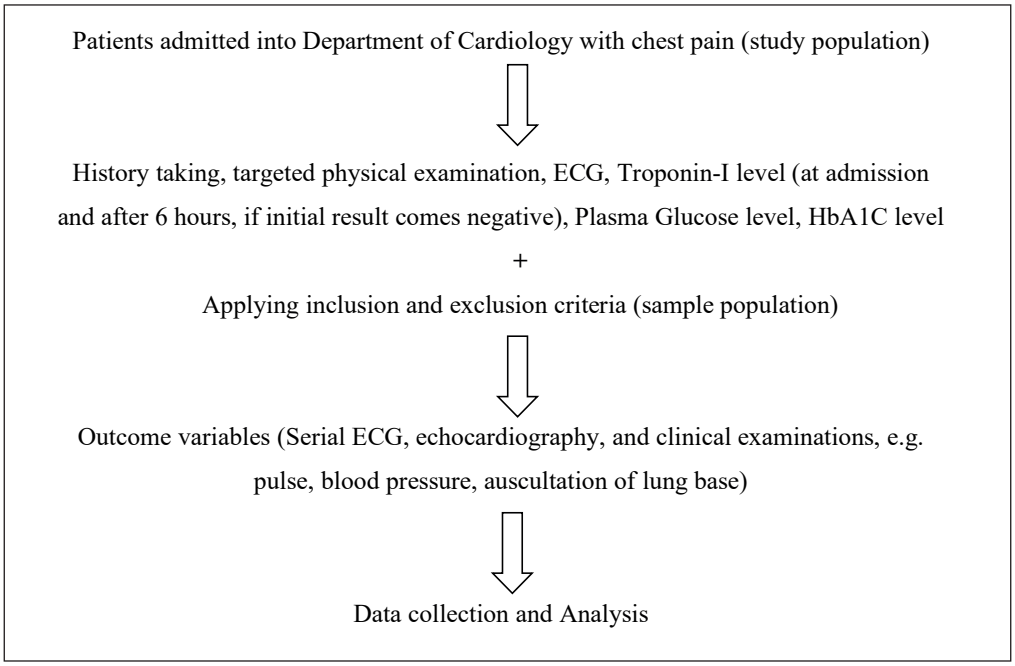

Figure 1. Flow chart of study design.

Data were collected and recorded in the structured case record form. Statistical analyses were done using the SPSS version 20.0 for Windows (SPSS Inc., Chicago, Illinois, USA). The mean±SD values were calculated for continuous variables. The qualitative observations were expressed by frequencies and percentages. Chi-Square test was used to analyze the categorical variables, while Student t-test was used for continuous variables. P value <0.05 was considered as statistically significant.Correlation between admission plasma glucose levels and subsequent development of heart failure was determined using Pearson's correlation test.

Results

The mean age of study participants was 49.68±3.12 years. No statistically significant difference was found in age, sex, BMI, living and risk factors (P>0.05) (Table 1).Mean plasma glucose level at admission was 8.27±1.03 and 13.34±3.65 in group I and group II respectively, while cardiac troponin I was found 9.39±1.04 and 11.58±2.86 respectively (P<0.001). However, no difference was observed in lipid profile and serum creatinine levels (P>0.05)(Table 2). Incidence of arrhythmia

Table 1. Demographic profile of the study participants (n=130)

Variables	Group I (n=67)	Group II (n=63)	P value
Age group			
21-30	4	3	>0.05
31-40	11	9	
41-50	28	31	
51-60	12	9	
61-70	7	6	
71-80	2	3	
81-90	3	2	
Mean±SD	49.68±3.12		
Sex			
Male	44	53	>0.05
Female	23	12	
BMI	24.53±4.03	24.50±4.09	>0.05
Living area			
Rural	38	40	>0.05
Urban	29	25	
Risk factors			
Smoking	38	46	>0.05
Hypertension	53	59	
Family history	31	37	

was observed in 4(5.97%) and 20(31.75%) cases in group I and group II respectively, while heart failure was found in 6(8.96%) and 48(76.19%) cases respectively (P<0.001). Heart failure was

measured based on LVEF, which was found 54.19±7.13% and 44.21±7.36% in group I and group II respectively (P<0.001) (Table 3).

Pearson's correlation test revealed a statistically significant moderate negative correlation with medium strength of association (r = -0.056) between heart failure (as measured by LVEF and clinical status) and admission plasma glucose levels of the study participants suggesting that the higher was admission plasma glucose level the lower was the LVEF in echocardiography i.e. higher chance of heart failure (Figure2).

Table 2. Biochemical markers of the patients during admission

Variables	Group I (n=67)	Group II (n=63)	P value
Plasma glucose	8.27±1.03	13.34±3.65	<0.001
Troponin I	9.39±1.04	11.58±2.86	<0.001
Lipid Profile			
TC	183.04±49.72	184.58±50.80	
TG	189.09±119.18	194.82±124.82	>0.05
HDL-c	34.88±7.64	34.72±7.59	
LDL-c	114.83±39.95	115.53±41.55	
Serum creatinine	1.06±0.08	1.09±0.09	>0.05

Table 3. Incidence of arrythmia and heart failure in patients (n=130)

Variables	Group I (n=67)	Group II (n=63)	P value
Arrhythmia	4 (5.97%)	20 (31.75%)	<0.001
Heart failure	6 (8.96%)	48 (76.19%)	<0.001
LVEF	54.19±7.13	44.21±7.36	<0.001

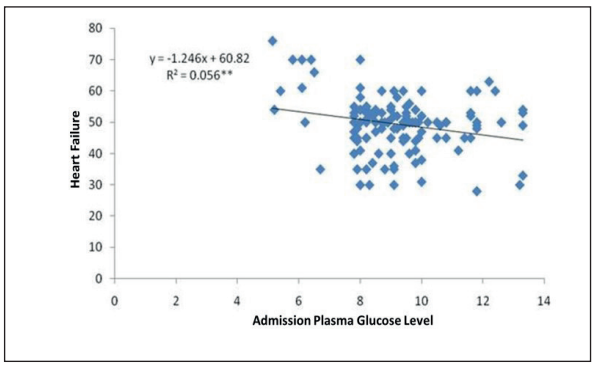

Figure 2. Correlation between heart failure (lower LVEF) and admission plasma glucose levels of the study population (n=130)

Discussion

Bangladesh has been experiencing epidemiological transition from communicable disease to non-communicable disease (NCD) over decades. The exact prevalence of coronary artery diseases in our country is not known. Only a limited number of small-scale epidemiological studies are available.[15-18]A prospective study at tertiary centre of the country showed the mean age of the patients 50.15±8.8 years,[17] which is very similar to our study. Most important risk factors identified by different research groups are smoking, hypertension, diabetes and dyslipidemia,[16-18] which arealso in congruence with our results.

Our study revealed that higher level of admission plasma glucose level in first attack of NSTEMI patients subsequently gives rise to lower LV ejection fraction (LVEF), which ultimately leads to arrythmia and heart failure. Hyperglycemia in those non-diabetic patients is more often a marker of stress response due to more extensive myocardial damage; in such cases a greater degree of stress is necessary to achieve the hyperglycemic state because their metabolic control is usually normal.[11]There is also a graded relationship between both elevated fasting glycemia and admission glycemia and 30-day mortality in nondiabetic patients with acute myocardial infarction, which suggests that fasting glycemia is a more important predictor of 30-day mortality than admission glucose alone.[19] Patients with both elevated admission glucose and elevated fasting glucosehavemultiple times increasedrisks of mortality.[19-21]There is also an important association between magnitude of glycemia variation and both post-discharge endpoints and mortality, unlike with in-hospital prognosis.[11,20,21]

Another study suggests that patients presenting with an acute MI, who are hyperglycemic upon admission represent a high-risk population. The worst outcomes occurred among those without a prior history of diabetes. This may relate to hyperglycemia being associated with several high-risk features, including older age, female gender, and a prior history of heart failure.[22]If stress hyperglycemia indeed reflects an underlying dysglycemic state, then this would be expected to correlate with a higher overall risk for more extensive coronary artery disease and would

explain a worse prognosis after acute MI.[23]Thus, elevated plasma glucose would both reflect the acute stress and predict an increased propensity for long-term cardiovascular events.[10] Several studies showed that an elevated admission blood glucose in myocardial infarction correlates with an increased incidence of congestive heart failure, cardiogenic shock, and inhospital mortality,[7-11,19-22] which support our findings.

The limitations of the study include smaller sample size as the study subjects were selected purposively, limited follow up of the patients due to time constraint, and unavailability of coronary angiogram to all the patients due to their financial problem. Hence, it is difficult to generalize our findings to the reference population.

Conclusion

To summarize, a higher admission plasma glucose level relates to a lower LVEF i.e. higher chance of arrythmia and heart failure in non ST-elevation MI patients. However, we propose that the result of this study needs further confirmation in a randomized large scale, multicentre prospective cohort study.

Conflict of interest: The authors declare no competing financial or personal interest.

Ethical approval issue: The study was approved by the Ethical Review Committee ofMymensingh Medical College, Mymensingh, Bangladesh.

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Authors' contribution: Conception and design of the study: MTIK; Patient selection, data collection and compilation: MTIK, MHK, MH, SMTM, FN; Data analysis: MTIK, MT; Critical writing, revision and finalizing the manuscript: MTIK, MHK, MT, MH, SMTM, FN.

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