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An Observational Study of In-Hospital Complications in ST-Segment Elevation Acute Myocardial Infarction Patients with and without Admission Hyperglyceamia

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Abstract **Original Research Article**

Introduction: Hyperglyceamia accelerates the risk of death in patients with STEMI. Various complications associated with ST-Segment Elevation Acute Myocardial Infarction patients with and without admission hyperglyceamia show significant difference. ***Aim of the study:*** The aim of this study was to assess the complications in ST-Segment Elevation Acute Myocardial Infarction patients with and without admission hyperglyceamia. ***Methods:*** This prospective prognostic cohort study was conducted in the Department of Cardiology, NICVD, Dhaka from July 2010 to June 2011. Total 200 study populations were selected from STEMI patients with or without history of DM were included in this study. The patients were divided into two groups. Group I (100)-Normoglycaemia (Random blood sugar <200 mg/dl/<11.1 mmol/l) and Group II (100)- Hyperglycaemia (Random blood sugar ≥200 mg/dl/≥11.1 mmol/l). Group II (100)- (A) Stress Hyperglycaemia (50) Random blood sugar ≥200 mg/dl/≥11.1 mmol/l) and (B) Diabetic Hyperglycaemia (50) Random blood sugar ≥200 mg/dl/≥11.1 mmol/l). ***Result:*** Cardiogenic shock was most common in both group I and group II with 46% and 37% study people respectively. Followed by 41% in group I and 28% in group II had CHF, 11% in group I and 9% in group II had Bradyarrythmia, 6% in group I and 6% in group II had Tachyarrythmia and 4% in group I and 2% in group II had Thromboembolism. cardiogenic shock was most common in both group I and group IIA with 46% and 30% study people respectively. Followed by 41% in group I and 22% in group IIA had CHF, 11% in group I and 8% in group IIA had Bradyarrythmia, 6% in group I and 2% in group IIA had Tachyarrythmia and 4% in group I and 2% in group IIA had Thromboembolism. cardiogenic shock was most common in both group I and group IIB with 46% and 44% study people respectively. Followed by 41% in group I and 28% in group IIB had CHF, 11% in group I and 10% in group IIB had Bradyarrythmia, 6% in group I and 10% in group IIB had Tachyarrythmia and 4% in group I and 2% in group IIB had Thromboembolism. ***Conclusion:*** Cardiogenic shock and Congestive Heart Failure (CHF) were most common complications. The rate of complications was higher in patients with hyperglyceamia compared to non-diabetic patients. Hyperglyceamia was significantly associated with higher mortality.

Keywords: Complications, ST-Segment Elevation Acute Myocardial Infarction and Admission Hyperglyceamia.

INTRODUCTION

Acute myocardial infraction (AMI) is a term used for myocardial injury with necrosis in a clinical setting consistent with myocardial ischaemia [1]. Here myocardial injury is defined as an elevation of cardiac troponin values with at least one value above the 99th percentile upper reference limit [2]. The majority of patients with STEMI are classified as type 1 MI (with evidence of a coronary thrombus) and some fall into other MI types [2]. There has been significant reduction in the mortality of patients with ST-Segment Elevation Acute Myocardial Infarction using reperfusion therapy [3, 4]. Still, there is considerable early and later mortality rate of patients with STEMI. Patients with STEMI are seen to be presented with various complications. The complications of acute myocardial infraction includes: Ischaemic complication (angina, re-

infarction, infarct extension), Mechanical complication (heart failure, cardiogenic shock, mitral valve dysfunction, aneurysms, cardiac rupture), Arrhythmic complication (atrial or ventricular arrhythmias, sinus or atrioventricular (AV) node dysfunction), Thrombosis and embolic complication (central nervous system or peripheral embolization), Inflammatory and Psychosocial complications (including depression) [5]. Stress hyperglyceamia occurs in 5-30% patients with myocardial infarction, sepsis, trauma and other critically illness and it correlates with poor outcome [6]. Hyperglycemic patients' present more extensive myocardial necrosis than normoglycemic [7]. Normoglyceamia refers to as a blood glucose concentration between 80 and 110 mg/dL [8]. It is defined as a transient increase in blood glucose concentration during acute critically illnesses, represents two distinct populations: those with undiagnosed diabetes or impaired glucose tolerance, and those who develop hyperglyceamia as the result of the severe stress and increased counter regulatory hormones [9]. Increased sympathetic nervous system activation and raised production of catecholamine's (adrenalin and noradrenalin), glucagon and cortisol that stimulates processes of glyconeogenesis, glycogenolysis and lipolysis. These hormones are responsible for insulin resistance, on receptor and post receptor level, so there are in the same time hyperglyceamia, hyperinsulinemia and insulin resistance [7, 10]. Numerous studies have shown that stress hyperglyceamia was common in acute critically illnesses even in patients without diabetes mellitus [11]. Admission hyperglyceamia has been associated with increased morbidity and mortality in patients with acute critical illnesses, such as myocardial infarction and stroke [12, 13]. In patients with acute myocardial infarction, hyperglyceamia has been associated with increased risk of mortality, congestive heart failure, and cardiogenic shock in patients with and without diabetes [12-16]. Acute blood glucose level increase in patients with AMI leads to electrophysiological alteration that may favour the occurrence of arrhythmia with potentially fatal outcome [17]. Hyperglyceamia itself is arrhythmogenic due to prolongation of QT interval, even in healthy subjects. Hyperglyceamia and insulin resistance increase lipolysis and free fatty acids generation (in excess) [18]. They are toxic to ischemic myocardium, damage cardiac cell membranes and cause calcium overload. In this way they reduce myocardial contractility and induce arrhythmias and heart failure that leads to poor outcome [19]. Hyperglyceamia activates thrombosis. Namely acute blood sugar level increase induces alteration in coagulation, such as shortening of fibrinogen of half- life, increases of pro thrombin fragments and factor VII, together with enhanced platelet aggregation resulting in thromboembolic manifestation. [17, 20]. There are no studies regarding the complications in ST-Segment Elevation Acute Myocardial Infarction patients with and without admission hyperglyceamia in Bangladesh. Thus, this study was conducted to assess the complications in ST-Segment Elevation Acute Myocardial Infarction patients with and without admission hyperglyceamia.

OBJECTIVES

To find out the complications in ST-Segment Elevation Acute Myocardial Infarction patients with and without admission hyperglyceamia.

METHODOLOGY & MATERIALS

This prospective prognostic cohort study was conducted in the Department of Cardiology, NICVD, Dhaka from July 2010 to June 2011. Total 200 study populations were selected from the ST- segment elevation Acute Myocardial Infarction patients with or without history of DM admitted in coronary care unit (CCU) of NICVD during the specified period of time on the basis of following inclusion and exclusion criteria. The patients were divided into two groups. Group I (100)-Normoglycaemia (Random blood sugar <200 mg/dl/<11.1 mmol/l) and Group II (100)-Hyperglycaemia (Random blood sugar ≥200 mg/dl/≥11.1 mmol/l). Group II (100)- (A) Stress Hyperglycaemia (50) Random blood sugar ≥200 mg/dl/≥11.1 mmol/l) and (B) Diabetic Hyperglycaemia (50) Random blood sugar ≥200 mg/dl/≥11.1 mmol/l). All patients were followed up maximum up to 7 days after admission to see the in-hospital adverse outcome likely mortality, morbidity (CHF, Cardiogenic shock/Hypotension, Arrhythmia, Thromboembolism). Non-randomized consecutive sampling method was applied to estimate minimum sample size [17]. The numerical data obtained from the study were analyzed and significance of differences was estimated by using statistical methods. Computer based SPSS (Statistical Package for Social Science) was used Data were expressed in percentage, frequencies, means and standard deviation, as applicable. The chi-square tests were used to assess the differences in the distribution of categorical variables, student's t test or analysis of variance was used to compare continuous variables. A significant level of $p<0.05$ in univariate analysis was specified for maintaining variables in the multivariate mode.

Inclusion Criteria

- Patients hospitalized for ST-segment elevation Acute Myocardial Infarction with or without history of diabetes mellitus who received I/V thrombolytic with normal SGPT & normal serum creatinine.

Exclusion Criteria

- AMI without thrombolytic
- Non-ST segment elevation AMI
- Unstable angina
- Patients with history of previous PTCA or CABG
- History of Cerebrovascular diseases

- Severe concomitant disease (Cardiac and Non-cardiac Diseases)
- Previous history of MI
- Previous history of CHF.

RESULT

Table-I shows that, majority of the study people (31%) in Group I were in the age group of 45-54 years, then 30% in the age of (55-64) years, then 28% in the age group of ≥65 years and lowest (11%) in the age <45 years. Majority of the study people (38%) in Group II were in the age group of 55-64 years, then 26% in the age group of (45-54) years, 24% in the age of ≥65 years and lowest (12%) in the age <45 years. Mean age of group I- was 56.20± 12.63 and in group 2- was 56.50± 11.68. So, the mean age was almost identical among the study population. There was no statistically ($p>0.05$) significance difference among the study population. Figure-1 shows that, in Group I- the number of male patients were 86 (86%) and female patients were 14 (14%), in Group II- the number of male patients were 85 (85%) and female patients were 15 (15%). In this study out of two hundred patients 171 (85.5%) were male and 29 (14.5%) were female (Figure-1). Table-II shows that in group -I patients mean ejection fraction was (47.37±6.07), in group -II patients mean ejection fraction was (43.44±7.79). So, it was significantly ($p<0.001$) lower in group-II than in group-I. There was no significant difference in blood pressure measurement of the studied population. Regarding pulse, in group-II mean value was (90.99±23.06) and in group- I it was (84.90±20.03). So, it was significantly ($p<0.05$) higher in group-II than in group-I. Mean hospital stay in group I was 4.98 (SD± 1.00) and mean hospital stay in group II was 4.7 (SD± 1.77). Hospital stay was statistically insignificant. Table-IV shows the complications and mortality of the patients with or without hyperglyceamia. Cardiogenic shock was most common in both group I and group II with 46% and 37% study people respectively. Followed by 41% in group I and 28% in group II had CHF, 11% in group I and 9% in group II had Bradyarrythmia, 6% in group I and 6% in group II had Tachyarrythmia and 4% in group I and 2% in group II had Thromboembolism. All complications were statistically insignificant. In group II, death was higher (27%) compared to group I (10%). Death was statistically significant ($p<0.05$) between both groups. Table-IV shows the comparison of the complications and mortality of patients with Normoglyceamia and patients with stress hyperglyceamia. Cardiogenic shock was most common in both group I and group IIA with 46% and 30% study people respectively. Followed by 41% in group I and 22% in group IIA had CHF, 11% in group I and 8% in group IIA had Bradyarrythmia, 6% in group I and 2% in group IIA had Tachyarrythmia and 4% in group I and 2% in group IIA had Thromboembolism. CHF was statistically significant ($p<0.05$) and other complications were statistically insignificant ($p>0.05$). Death rate was higher in group IIA (38%) compared to group I (10%). Death was statistically significant ($p<0.05$) between both groups. Table-V shows the comparison of complications and mortality of Normoglycaemia and Diabetic hyperglyceamia. Cardiogenic shock was most common in both group I and group IIB with 46% and 44% study people respectively. Followed by 41% in group I and 28% in group IIB had CHF, 11% in group I and 10% in group IIB had Bradyarrythmia, 6% in group I and 10% in group IIB had Tachyarrythmia and 4% in group I and 2% in group IIB had Thromboembolism. All complications were statistically insignificant ($p>0.05$). In group IIB, death was higher (16%) compared to group I (10%). Death was also statistically insignificant ($p>0.05$) between both groups.

Table I: Distribution of study population by age groups (n=200)

Age groups (yrs)	Group I (N=100)		Group II (N=100)		P value
	No	%	No	%	
<45	11	11	12	12	0.824^{ns}
45-54	31	31	26	26	0.433^{ns}
55-64	30	30	38	38	0.232^{ns}
≥65	28	28	24	24	0.519^{ns}
Total	100	100	100	100	
Mean± SD	56.20± 12.63		56.50± 11.68		0.862^{ns}

Group I: Normoglycaemia: Patients with RBS <11.1 mmol/l
Group II: Hyperglycaemia: Patients with RBS ≥11.1 mmol/l
P value reached from Chi-square test
α: P value reached from Student's t test
NS=not significant
N=sample size

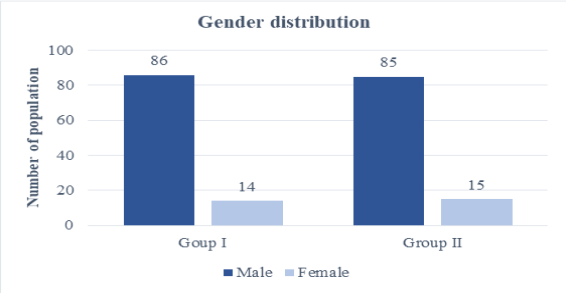

Figure-1: Gender distribution of the study people

Table-II: Mean Hemodynamic and Echocardiographic and other parameters of study patients (n=200)

Parameter	Group I (N=100)	Group II (N=100)	P value
	Mean± SD	Mean± SD	
Systolic BP (mmHg)	104.35± 25.87	105.40± 29.33	0.7890^{NS}
Diastolic BP (mmHg)	68.10± 16.17	68.65± 18.20	0.8220^{NS}
Pulse/min	84.90± 20.03	90.99± 23.06	0.0480^{S}
Ejection fraction	47.37± 6.07	43.44± 7.79	0.0001^{S}
Hospital stay (days)	4.98± 1.00	4.7± 1.77	0.1700^{NS}

Group I: Normoglycaemia: Patients with RBS <11.1 mmol/l
Group II: Hyperglycaemia: Patients with RBS ≥11.1 mmol/l
P value reached from Chi-square test
NS=not significant
S= Significant
N=sample size

Table-III: Comparison of the complications and mortality of the study people with normoglyceamia and hyperglyceamia (n=200)

Outcome	Group I (N=100)		Group II (N=100)		P value
	No	%	No	%	
CHF	41	41.00	28	28.00	0.0537^{NS}
Cardiogenic shock	46	46.00	37	37.00	0.1976^{NS}
Tachyarrythmia	6	6.00	6	6.00	1.000^{NS}
Bradyarrythmia	11	11.00	9	9.00	0.6382^{NS}
Thromboembolism	4	4.00	2	2.00	0.6382^{NS}
Death	10	10.00	27	27.00	0.0020^{S}

Group I: Normoglycaemia: Patients with RBS <11.1 mmol/l
Group II: Hyperglycaemia: Patients with RBS ≥11.1 mmol/l
P value reached from Chi-square test
NS=not significant
S= Significant
N=sample size

Table-IV: Comparison of the complications and mortality of patients with Normoglyceamia and patients with stress hyperglyceamia (n=150)

Outcome	Group I (N=100)		Group IIA (N=50)		P value
	No	%	No	%	
CHF	41	41.00	11	22.00	0.02160^{S}
Cardiogenic shock	46	46.00	15	30.00	0.0609^{NS}
Tachyarrythmia	6	6.00	1	2.00	0.2752^{NS}
Bradyarrythmia	11	11.00	4	8.00	0.5650^{NS}
Thromboembolism	4	4.00	1	2.00	0.5214^{NS}
Death	10	10.00	19	38.00	< 0.0001^{S}

Group I: Patients with RBS<11.1 mmol/l (Normoglycaemic)
Group IIA: Nondiabetic patients with RBS≥11.1 mmol/l (Stress hyperglycemic)
P value reached from Chi-square test
S=Significant
NS= Not significant
N=sample size

Table-V: Comparison of complications and mortality of 'Normoglycaemia' and 'Diabetic hyperglyceamia' (n=150)

Outcome	Group I (N=100)		Group IIB (N=50)		P value
	No	%	No	%	
CHF	41	41.00	17	34.00	0.4082^{NS}
Cardiogenic shock	46	46.00	22	44.00	0.8172 ^{NS}
Tachyarrythmia	6	6.00	5	10.00	0.3773 ^{NS}
Bradyarrythmia	11	11.00	5	10.00	0.8521 ^{NS}
Thromboembolism	4	4.00	1	2.00	0.5214 ^{NS}
Death	10	10.00	8	16.00	0.2880 ^{NS}

Group 1: Patients with RBS<11.1 mmol/l (Normoglycaemic)
Group II-B: Diabetic patients with hyperglycaemia and RBS ≥11.1 mmol/l
P value reached from Chi-square test
NS=Not significant
N=sample size

DISCUSSION

In this present study, majority of the study people (31%) in Group I were in the age group of 45-54 years. Majority of the study people (38%) in Group II were in the age group of 55-64 years. Mean age of group I- was 56.20± 12.63 and in group 2- was 56.50± 11.68. So, the mean age was almost identical among the study population. There was no statistically (p>0.05) significance difference among the study population. Rahim (1993) reported a mean age of 52.5 years among the patients of AMI Malik (1987) reported the age of Ischemic Heart Disease (IHD) was 23-60 years and peak age incidence was 51-60 years. Haque (1983) also reported a mean age of 53.0±13.0 years. In this study, the number of male patients were 86 (86%) and female patients were 14 (14%) in group I and the number of male patients were 85 (85%) and female patients were 15 (15%) in group II. In this study out of two hundred patients 171 (85.5%) were male and 29 (14.5%) were female. In Bangladesh, almost all of the study reported an overwhelming majority of male patients. Chowdhury (1992) had 20% and Asaduzzaman (2008) found 22% female patient in their studies. Outside the country, Judith *et al*., (2009) found that 24% female patients in AMI without diabetes and in AMI with diabetes female patients were 28% So, distribution of female patient in the present study is comparable to other studies in home and abroad. In group -I, patients mean ejection fraction was (47.37±6.07), in group-II patients mean ejection fraction was (43.44±7.79). So, it was significantly (p<0.001) lower in group-II than in group-I. Mamun (2007) found that mean percentage of ejection fraction was (56.1±4.1) in diabetic men and (55.4±3.9) in diabetic women. So, it was higher than our study population because most of the patients. There was no significant difference in blood pressure measurement of the studied population. Regarding pulse, in group-II mean value was (90.99±23.06) and in group- I it was (84.90±20.03). So, it was significantly (p<0.05) higher in group-II than in group-I. Mean hospital stays in group I was 4.98 (SD± 1.00) and mean hospital stay in group II was 4.7 (SD± 1.77). Hospital stay was statistically insignificant. Cardiogenic shock was most common complication in both group I and group II with 46% and 37% study people respectively. Followed by 41% in group I and 28% in group II had CHF, 11% in group I and 9% in group II had Bradyarrythmia, 6% in group I and 6% in group II had Tachyarrythmia and 4% in group I and 2% in group II had Thromboembolism. All complications were statistically insignificant. In group II, death was higher (27%) compared to group I (10%). Death was statistically significant between both groups. In the study of Terlecki M *et al*., [27], among 246 patients with STEMI, 20% patients in normoglyceamia group and 44.1% patients of acute hyperglyceamia group had heart failure, 3.6% patients of normoglyceamia group and 11% patients of acute hyperglyceamia group had atrial fibrillation, 0.9% patients of normoglyceamia group and 10.3% patients of acute hyperglyceamia group had cardiogenic shock, 0.9% patients of normoglyceamia group and 5.9% patients of acute hyperglyceamia group had ventricular fibrillation and etc. Significantly higher in-hospital mortality (p = 0.0029) was noted in the acute hyperglycaemia group (11.8%) in comparison with the normoglycaemic group (1.8%). The comparison of the complications of patients with Normoglyceamia and patients with stress hyperglyceamia shows that, cardiogenic shock was most common in both group I and group IIA with 46% and 30% study people respectively. Followed by 41% in group I and 22% in group IIA had CHF, 11% in group I and 8% in group IIA had Bradyarrythmia, 6% in group I and 2% in group IIA had Tachyarrythmia and 4% in group I and 2% in group IIA had Thromboembolism. CHF was statistically significant (p<0.05) and other complications were statistically insignificant (p>0.05). Death rate was higher in group IIA (38%) compared to group I (10%). Death was statistically significant (p<0.05) between both groups. In the study of Khalfallah M *et al*., [28], among 660 patients 11.7% non-diabetic patients and 19.8% of stress hyperglycemic patients had contrast induced nephropathy, 8.6% non-diabetic patients and 13.5% of stress hyperglycemic patients had heart failure, 5.1% of non-diabetic patients and 14.4% of stress hyperglycemic patients had cardiogenic shock, 2.7% non-diabetic patients and 3.6% of stress hyperglycemic patients had cardiac arrest and death rate in non-diabetic patients was 3.5% and in stress hyperglycemic patients

was 8.1%. The comparison of complications of Normoglycaemia and Diabetic hyperglyceamia shows that, cardiogenic shock was most common in both group I and group IIB with 46% and 44% study people respectively. Followed by 41% in group I and 28% in group IIB had CHF, 11% in group I and 10% in group IIB had Bradyarrythmia, 6% in group I and 10% in group IIB had Tachyarrythmia and 4% in group I and 2% in group IIB had Thromboembolism. All complications were statistically insignificant ($p>0.05$). In group IIB, death was higher (16%) compared to group I (10%). Death was also statistically insignificant ($p>0.05$) between both groups. In a study of Iqbal MJ *et al*., [29], among 240 patients, 17% non-diabetic patients and 34.2% diabetic patients had left ventricular failure, 11.6% non-diabetic patients and 21.1 % diabetic patients had arrhythmias, 9.8% non-diabetic patients and 17.1 % diabetic patients had cardiogenic shock, 12.8% non-diabetic patients and 5.3% diabetic patients had post Myocardial Angina and no non-diabetic patients and 1.3% diabetic patients had Thrombo-embolic Phenomenon. Death rate in non-diabetic group was 8.75%, which is higher than death rate of diabetic group (7.92%).

Limitations of the study

Although the results of this study support the hypothesis, yet this has got some limitations. The study was a non-randomized and observational study. Number of study population was limited. We could not determine the true incidence of diabetes mellitus, especially among persons without a prior history of this condition. Finally, no attempt was made to analyze sequential glucose levels in the hospital, and thus we have no information on the outcome of patients who may have developed hyperglyceamia later in their hospital course. Further no attempt was made to measure glycated hemoglobin (HbA_1C), especially among persons without a prior history of diabetes mellitus. So, it was not possible to determine the true incidence of diabetes mellitus that who were previously undiagnosed diabetes mellitus.

CONCLUSION AND RECOMMENDATIONS

In overall, cardiogenic shock and Congestive Heart Failure (CHF) were most common complications. The rate of complications was higher in patients with hyperglyceamia compared to non-diabetic patients. Hyperglyceamia was significantly associated with higher mortality. This study may be the base of further clinical controlled studies with larger population to validate the findings.

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