American Journal of Biomedical and Life Sciences
2022; 10(4): 119-124
http://www.sciencepublishinggroup.com/j/ajbls
doi: 10.11648/j.ajbls.20221004.14
ISSN: 2330-8818 (Print); ISSN: 2330-880X (Online)

A Comparative Study of the Outcome of Hyperglyceamia and Normoglycaemia in Patients with ST-Segment Elevation Acute Myocardial Infarction

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To cite this article:

Musammat Sufia Akhter, Mirza Abdul Kalam Mohiuddin, Shamshad Khan, Ratul Sakaobe Shefa, Ayesha Mubashsbira Labiba. A Comparative Study of the Outcome of Hyperglyceamia and Normoglycaemia in Patients with ST-Segment Elevation Acute Myocardial Infarction. *American Journal of Biomedical and Life Sciences.* Vol. 10, No. 4, 2022, pp. 119-124. doi: 10.11648/j.ajbls.20221004.14

Received: September 6, 2021; **Accepted**: January 24, 2022; **Published**: July 29, 2022

Abstract: *Introduction*: Acute myocardial infarction (AMI) is an important cause of acute emergencies and is on the rise in the developing countries like Bangladesh. Patients with hyperglyceamia are at more risk than non-diabetic patients. Hyperglyceamia is pre-diabetic state. *Aim of the study*: The aim of this study was to compare the outcome of hyperglyceamia and normoglycaemia in patients with ST-segment elevation Acute Myocardial Infarction. *Methods*: This prospective prognostic cohort research was conducted at 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. *Result*: In this study, number of patients improvement in group-1 was significantly ($p < 0.01$) higher 90 (90%), in group-2 was 73 (73%). But death ($p<0.01$) was more 27 (27%) in group-2 and in group-1 was 10 (10%). The number of patients developed morbidity like (Cardiogenic shock, Congestive cardiac failure, hypotension, Thromboembolism and arrhythmia) were less in group-1 (44%) but more common in group-2 (70%). The result was statistically very significant ($p < 0.01$). Number of patients improvement in group-1 was significantly ($p < 0.001$) higher 90 (90%) than in group II-A 31 (62%). But death ($p < 0.001$) was more 19 (38%) in group-2A than in group-1 10 (10%). The number of patients developed morbidity like (Cardiogenic shock, Congestive cardiac failure, hypotension, Thromboembolism and arrhythmia) were 44 (44%) in group-1 and 30 (60%). There was no statistical significance. *Conclusion*: There is difference in the in-hospital outcome of hyperglyceamia and normoglycaemia in patients with ST-segment elevation Acute Myocardial Infarction. Improvement and morbidity were higher in the normoglycaemia patients than hyperglyceamia patients and death rate is higher is the hyperglyceamia patients. But there is no difference in normoglycaemia and diabetic hyperglyceamia patients.

Keywords: Hayperglycemia, Normoglycaemia, STEMI, Diabetic

1. Introduction

An acute ST-elevation myocardial infarction (STEMI) is an event in which transmural myocardial ischemia results in myocardial injury or necrosis. [1] The major risk factors for ST-elevation myocardial infarction are dyslipidemia, diabetes mellitus, hypertension, smoking, and family history of coronary artery disease. [2-3] Patients with acute myocardial infarction (AMI) and diabetes mellitus (DM) show a more than two-fold higher risk for recurrent MI (Re-MI) and long-term mortality than patients without DM. [4-5] The adult diabetes is predicted to increase from 2.8% in 2000 to 4.4%

in 2030. [6] The clinical symptoms of AMI differ between diabetic and non-diabetic, as less intense pain or asymptomatic infarction is more common in diabetic patients. [7-8] Hyperglyceamia refers to high levels of sugar, or glucose, in the blood. It occurs when the body does not produce or use enough insulin, which is a hormone that absorbs glucose into cells for use as energy. [9] High blood sugar is a leading indicator of diabetes. Hyperglyceamia can be seen in patients with AMI, irrespective of DM history. [10-12] A relation has, however, been described in patients with acute myocardial infarction between hyperglycaemia on admission and the development of cardiogenic shock independent of the state of premorbid glucose tolerance. [13] Thus hyperglycaemia alone might possibly contribute to poor outcome in patients both with and without known diabetes. A recent report showed that in patients without a history of DM, there was a near linear relation between admission glucose and in hospital mortality Nondiabetic patients with a glucose level <6 mmol/l had the lowest mortality (25%). As admission glucose increased by 1 mmol/l, mortality increased by (13% to 21%). In patients with a history of DM, however, there was a U-shape relation between glucose and mortality. Mortality was lowest in diabetic patients with moderate hyperglyceamia. Not only severe hyperglyceamia but also euglycemia were associated with higher mortality than moderate hyperglyceamia in patients with diabetes. [14] A higher percentage of the hyperglycemic non-diabetic suffered cardiac arrest before admission compared with hyperglycemic DM (15% and 29% respectively). [15] A recent report showed that, of patients who had no known diabetes at the time of AMI and whose admission blood glucose levels were less than 200 mg/dl (<11.1 mmol/l), up to 40% were diagnosed as having impaired glucose tolerance and 25% as having diabetes when tested 3 months after discharge. [16] There are very few studies to see the comparison of the outcome of hyperglyceamia and normoglycaemia in patients with ST-segment elevation Acute Myocardial Infarction. Thus, this present study is conducted to compare the outcome of hyperglyceamia and normoglycaemia in patients with ST-segment elevation Acute Myocardial Infarction.

2. Objectives

Find out the Outcome of Hyperglyceamia and Normoglycaemia in Patients with ST-Segment Elevation Acute Myocardial Infarction.

3. 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 1 (100)-Normoglycaemia (Random blood sugar <200 mg/dl/<11.1 mmol/l) and Group 2 (100)- Hyperglycaemia (Random blood sugar ≥200 mg/dl/≥11.1 mmol/l). Group 2 (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). 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<0.2 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:

1. AMI without thrombolytic
2. Non-ST segment elevation AMI
3. Unstable angina
4. Patients with history of previous PTCA or CABG
5. History of Cerebrovascular diseases
6. Severe concomitant disease (Cardiac and Non-cardiac Diseases)
7. Previous history of MI
8. Previous history of CHF.

Table 1 shows that in Group 1- highest (31%) in the age 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. In Group 2- highest (38%) 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 1- 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 1- the number of male patients were 86 (86%) and female patients were 14 (14%), in Group 2- 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 2 shows that smoking was the most common risk factor among two groups. There were 73 smokers in group-1 and in group-2. Hypertension was the second risk tactors among both groups. There were 21 hypertensive patients in group -I and 25 in group-2. Dyslipidaemia was the third risk factor among two groups, 7 were in group-1 and 10 in group -2. Positive family history was present 5 in group-1 and 9 in group-2. There was no statistically (p>0.05%%) Significant difference regarding risk factors among the study groups. Table 3 shows that in group -I patients mean ejection fraction was (47.37±6.07), in group -2 patients mean ejection fraction was (43.44±7.79). So, it was significantly (p<0.001) lower in group-2 than in group-1. There was no significant difference in blood pressure measurement of the studied population. Regarding pulse, in group-2 mean value was (90.99±23.06) and in group- 1 it was (84.90±20.03). So, it was significantly (p<0.05) higher in group-2 than in group-1. Table 4 shows that regarding in-hospital outcome, number of patients improvement in group -1 was significantly (p<0.01) higher 90 (90%), in group-2 was 73 (73%). But death (p<0.01) was more 27 (27%) in group-2 and in group-1 was 10 (10%). So, the result was statistically very significant. The number of patients developed morbidity like (Cardiogenic shock, Congestive cardiac failure, hypotension, Thromboembolism and arrhythmia) were less in group-1 (44%) but more common in group-2 (70%). So, the result was statistically very significant (p<0.01). Table 5 shows that regarding in-hospital outcome, number of patients improvement in group-1 was significantly (p<0.001) higher 90 (90%) than in group II-A 31 (62%). But death (p<0.001) was more 19 (38%) in group-2A than in group I- 10 (10%). So, the result was statistically highly significant. The number of patients developed morbidity like (Cardiogenic shock, Congestive cardiac failure, hypotension, Thromboembolism and arrhythmia) were 44 (44%) in group-1 and 30 (60%) (Table 5). There was no statistical significance.

Table 1. *Distribution of study population by age groups (n=200).*

Age groups (yrs)	Group I (N=100)		Group II (N=100)		Total (N=200)		P value
	No	%	No	%	N	%	
<45	11	11	12	12	23	11.5	0.824^{ns}
45-54	31	31	26	26	57	28.5	0.433^{ns}
55-64	30	30	38	38	68	34.0	0.232^{ns}
≥65	28	28	24	24	52	26.0	0.519^{ns}
Total	100	100	100	100	200	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

Table 2. *Risk factors distribution of study population (n=200).*

Risk factors	Group I (N=100)		Group II (N=100)		Total (N=200)		P value
	No	%	No	%	N	%	
Smoking	73	73	73	73	146	73.5	0.533^{NS}
HTN	21	21	25	25	46	23.0	0.502^{NS}
Dyslipidaemia	07	07	10	10	17	8.5	0.502^{NS}
Family history	05	05	09	09	14	7.0	0.316^{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
N=sample size

Table 3. *Mean Hemodynamic and Echocardiographic parameters of study patients (n=200).*

Parameter	Group I (N=100)	Group II (N=100)	Total (N=200)	P value
	Mean±SD	Mean±SD	Mean±SD	
Systolic BP (mmHg)	104.35±25.87	105.40±29.33	104.88±27.59	0.789^{NS}
Diastolic BP (mmHg)	68.10±16.17	68.65±18.20	68.37±17.17	0.822^{NS}
Pulse/min	84.90±20.03	90.99±23.06	87.95±21.76	0.048^{S}
Ejection fraction	47.37±6.07	43.44±7.79	45.40±7.24	0.0001^{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 4. *In-hospital outcome of study patients (n=200).*

Outcome	Group I (N=100)		Group II (N=100)		Total (N=200)		P value
	No	%	No	%	N	%	
Improved	90	90	73	73	163	81.5	0.002^{S}
Morbidity	44	44	70	70	114	42.5	0.001^{S}
Death	10	10	27	27	37	18.5	0.002^{S}

Group I: Patients with Normoglycaemia and RBS <11.1 mmol/l
Group II: Patients with Hyperglycaemia and RBS ≥11.1 mmol/l
P value reached from Chi-square test
S=Significant
N=sample size

Table 5. *Comparison of In-hospital outcome of 'Normoglycaemia' and 'Diabetic hyperglyceamia' (n=150).*

Outcome	Group I (N=100)		Group IIB (N=50)		Total (N=150)		P value
	No	%	No	%	N	%	
Improved	90	90	42	84	132	88.0	0.286^{NS}
Morbidity	44	44	30	60	74	50.0	0.155^{NS}
Death	10	10	08	16	18	12.0	0.286^{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

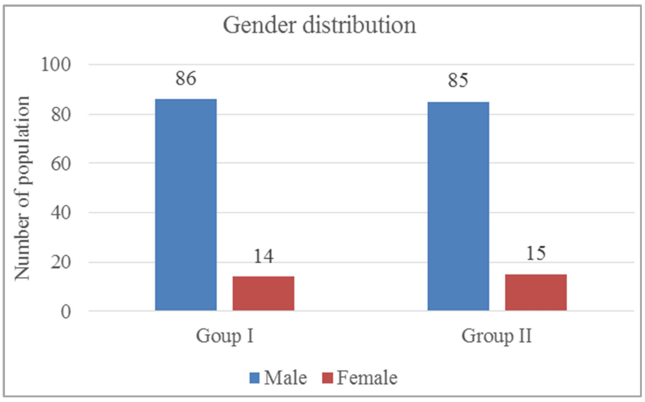

Figure 1. *Gender distribution of the study people.*

4. Discussion

In this study, a total of 200 ST-segment elevation AMI patients with or without history of diabetes who received thrombolytic were studied. Mean age of in group 1- were 56.20±12.63 and in group 2- were 56.50±11.68. So, the mean age was almost identical among the study population. There was no statistically (p>0.05) significant difference among the study population. The mean age of all groups was around 60 years. In Group 1-highest (31%) in the age of (45-54) years, and in Group 2-highest (38%) in the age of (55-64) years. The lowest percentage of patients were <45 years in both groups. Malik [18] reported the age of Ischemic Heart Disease (IHD) was 23-60 years and peak age incidence was 51-60 years. In patients with AMI, Wahab et al. [19] found that the mean age of group -1 (No previous diagnosis of diabetes and RBS 11 mmol/l) were 64.7 years, in group-2 (No previous diagnosis of diabetes and RBS >11 mmol/l) were 69.9 years, in group-3 (Known diabetes and RBS ≤11 mmol) were 68.6 years and in group -4 (Known diabetes and RBS ≤11 mmol/l) were 68.2 years. In patients with AMI, Ishihara et al. [14] found that the mean age of AMI without DM were 68±13 years and AMI with DM were 67±11 years. All the results were comparable with the present study. In this study, in Group I-the number of male patients were 86 (86%) and female patients were 14 (14%), in Group 2- the number of male patients were 85 (85%) and female patients were 15 (15%). In Bangladesh, almost all of the study reported an overwhelming majority of male patients. Amanullah [20] reported 11.0% female patient in their studies. Outside the country, Petursson et al. [15] (2006) found 33% female patients and another recent study reported in patients with AMI. Smoking was the most common risk factors among two groups. There were 73 smokers in group-1 and in group -2. Positive family history was present 5 in group-1 and 9 in group-2. There was no statistically (p>0.05%) significant difference regarding risk factors among the study groups. In patients with AMI, Ischa et al. [21] found that smoker in nondiabetic were (55.6%) and in diabetic were (37 6%). Another recent study reported in patients with AMI, Judith et al. [22] found that smoker in nondiabetic was (44%) and in diabetic were (33%). Hypertension was the second risk factors among both groups. There were 21 hypertensive patients in group -1 and 25 in group-2. It was present in 23% of our study population. Asaduzzaman [23] found that hypertension was present (35.1%) in IFG group and (25. 39%) NFG. This was also close to our study. The research population's hemodynamic and echocardiographic characteristics revealed that group-1 patients had a mean ejection fraction of (47.3716.07), whereas group -2 patients had a mean ejection fraction of

(43.446.79). So, it was significantly ($p<0.001$) lower in group- 2 than in group-1. There was no significant difference in blood pressure measurement of the studied population. Regarding pulse, in group-2 mean value was (90.99±23.06) and in group-1 it was (84.90±20.03). So. it was significantly ($p<0.05$) higher in group-2 than in group-1. Mamun [24] 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 in group 2-A had lower percentage of mean ejection fraction. Regarding in-hospital outcome, number of patients improvement in nonmoglycaemic (group-1) was significantly ($p<0.01$) higher 90 (90%) than in hyperglycemic (group-2) was 73 (73%). But death ($p<0.01$) was more 27 (27%) in hyperglycemic than in normoglycemic 10 (10%). So, the result was statistically very significant. It was about 2.7-fold higher in hyperglycemic patients than normoglycaemic patient's. The number of patients developed morbidity like (Cardiogenic shock, Congestive cardiac failure, hypotension, Thromboembolism and arrhythmia) were less in group-1 (44%) but more common in group-2 (70%). So, the result was statistically very significant ($p<0.01$). The number of patients developed morbidity like (Cardiogenic shock, Congestive cardiac failure, hypotension, Thromboembolism and arrhythmia) were more in stress hyperglycemic (group-2A) 40 (80%) but less common in normoglycaemic patients (group-1) 44 (44%). So, the result was statistically highly significant ($p<0.001$). Again, comparison of in-hospital outcome, among normoglycaemic and diabetic hyperglycemic patients, number of patients improvement in normoglycaemic (group-1) was ($p>0.05$) 90 (90%) and in group II-B 42 (84%). There was no statistically significant difference between normoglycaemia and diabetic hyperglyceamia. Death ($p>0.05$) was 8 (16%) in group-2B and in group 1- 10 (10%). So, there was no statistically significant difference between normoglycaemia and diabetic hyperglyceamia. The number of patients developed morbidity like (Cardiogenic shock, Congestive cardiac failure, hypotension, Thromboembolism and arrhythmia) were 44 (44%) in group-1 and 30 (60%). So, there was no statistically ($p>0.05$) significant difference between normoglycaemia and diabetic hyperglyceamia. In patients with AMI, Wahab et al. [19] found that the death was occurred in group-1 (No previous diagnosis of diabetes and RBS (≤11 mmol/l) was (81%), in group-2 (No previous diagnosis of diabetes and RBS (>11 mmol/l) was (23.7%), in group-3 (Known diabetes and RBS ≤11 mmol/l) was (18.3%) and in group-4 (Known diabetes and RBS >11 mmol/l) was (18.8%).

Limitations of the study

Although the results of this study support the proposed hypothesis, the study still has some limitations. This was an observational non-randomized study. The number of people in the research was restricted. We were unable to ascertain the real prevalence of diabetes mellitus, particularly among people who had no prior history of the disease. Finally, no attempt was made to evaluate consecutive glucose readings in the hospital, so we don't know what happened to individuals who acquired hyperglycemia later in their hospital stay. Glycated hemoglobin (HbA1C) was not measured any further, especially in people without a history of diabetes mellitus. As a result, the real incidence of diabetes mellitus among those who were previously undetected diabetic mellitus could not be determined.

5. Conclusion and Recommendations

The current study concludes that there is difference in the in-hospital outcome of hyperglyceamia and normoglycaemia in patients with ST-segment elevation Acute Myocardial Infarction. Male prevalence was much higher in both groups compared to the female participants. The difference of Mean pulse/min between both groups were statistically significant, with hyperglyceaemia patients having higher pulse rate. Not much difference was found among the risk factors between the normoglycaemia and hyperglyceamia patients. Improvement and morbidity were higher in the normoglycaemia patients than hyperglyceamia patients and death rate is higher is the hyperglyceamia patients. But there is no difference in normoglycaemia and diabetic hyperglyceamia patients. Further study is needed with more population in large area. Follow up outcomes also need to be compared.

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