Original Article

ASSOCIATION OF ACUTE HYPERGLYCEMIA WITH MORTALITY DURING HOSPITAL STAY IN PATIENTS PRESENTING WITH ACUTE MYOCARDIAL INFARCTION

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Author's Contribution

MAR:Conducted the study and wrote the article. TN: Helped in review the article. NAS: Re-arranged data and corrected article. MAI: Tables and figures. ZM and MITK made corrections and did the proof reading.

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ABSTRACT

INTRODUCTION: There is significant effect on morbidity and mortality of acute myocardial infarction with metabolic abnormalities. Out of which most common and easily detectable abnormality is raised plasma glucose level which may be associated with poor outcome of patients with acute coronary syndrome frequently it has been seen that patients with myocardial infarction has abnormal glucose tolerance. This study was planned to determine the association acute hyperglycemia with mortality during hospital stay in patients with acute myocardial infarction.

MATERIAL AND METHODS: This was an observational, Cohort study conducted at Department of Cardiology, PIC, Lahore. The duration of study was six months after the approval of ethical committee. 310 patients fulfilling the selection criteria were included in the study. The patients were divided in two groups i.e. group I with acute hyperglycaemia and group II with normal glycaemic level. The patients were evaluated after 5 days. If patient died during hospital stay, inhospital mortality was labeled. The association between acute hyperglycaemia and mortality during hospital stay was calculated as Relative risk (RR). RR>1 was considered as significant.

RESULTS: The mean age of patients with hyperglycaemia was 57.71±11.64years. The mean age of patients with normal glycaemia level was 58.25±11.84years. There were 101 (65.2%) males and 54 (34.8%) females in hyperglycemia group. There were 93 (60.0%) males and 62 (40.0%) females in normal glycemic group. In hyperglycemia group, 24 (15.5%) patients had mortality during hospital stay while in normal glycemic group, 8 (5.2%) patients had in-hospital mortality. There were 3.0 times more chances of mortality during hospital stay in hyperglycemic patients i.e. RR= 3.0 (95% CI; 1.391, 6.470, $p<0.05$).

CONCLUSION:In-hospital mortality is three times more in patients with hyperglycemia admitted with acute myocardial infarction.

KEY WORDS: Acute hyperglycemia, in-hospital mortality, acute myocardial infarction

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INTRODUCTION

The raising prevalence of cardiovascular disease during these days is the major cause of mortality. The major factor leading to development of cardiovascular disease is glucose intolerance and diabetes. Diabetes leads to three times increase in cardiovascular disease in both males and females. Different studies have shown elevated level in of glucose 51-58% patients admitted with ACS.[1] Elevated blood glucose is linked with poor outcome in patients with acute myocardial infraction and it has been observed that raised blood glucose level on admission is associated with increased mortality and morbidity during hospital stay.[2] It is unclear that whether myocardial injury leads to development of hyperglycemia or hyperglycemia is a precipitating cause for AMI.[3] It may be recommended to evaluate the patient with AMI for the presence of elevated glucose level to risk stratify these patients to make decision about management which will improve survival.[4] Pervious study has shown increased risk of mortality in patients with hyperglycemia even after revascularization.[5] Another study showed that mortality during hospital stay occurred in 11.3% in hyperglycemic patients while 4.5% patients with normal glycemic level ($p<0.0001$).[8] This study was performed to determine the association of acute hyperglycemia with increased mortality in patients presenting with AMI. However, the consequence of acute hyperglycemia at presentation of AMI patients, is significantly hazardous. This will help us to execute the early screening of AMI patients for acute hyperglycemia and for early management to prevent the hazardous consequences and can save the patients' life.

MATERIAL AND METHODS:

This was an observational, Cohort study conducted at Department of Cardiology, Punjab Institute of Cardiology, Lahore over a duration of six months after the approval of ethical committee i.e. from January 2016 to June 2016. The sample size was 310 cases; it was divided equally in two groups. 155 cases in each group was calculated with power of test 80%, level of significance 5% and taking expected percentage of mortality during hospital stay i.e. 16% with hyperglycaemia and 6% with normal glycaemic level in patients presenting with AMI.[7] It was a non-probability, consecutive sampling.

Patients of age 40-80 years of either gender presenting with AMI (It was labeled as STEMI if ST elevation >2 mm in precordial leads and >1 mm in limb leads on ECG and troponin-T>100. NSTEMI was labeled if ST elevation <2mm in precordial leads on ECG but trop-T>100) were included. They were divided into two groups.

Group I: patients with hyperglycaemia (Fasting Blood Sugar > 11.0mmol/L)

Group II: patients with normal glycaemic level (admission glucose≤11.0mmol/L)

The patients already diagnosed as diabetic (BSR>180mg/dl) , patients with previous MI, bypass, angiography or angioplasty and patients having liver problem (ALT>40 IU, AST>40 IU), abnormal kidney function (creatinine>1.2mg/dl) or asthma were excluded.

310 patients fulfilling the selection criteria were included in the study. Informed consent was obtained. Demographic data (name, gender, age, BMI, duration of symptoms, type of AMI (STEMI/NSTEMI)) was also noted. The patients were divided in two groups i.e. group I with acute hyperglycaemia and group II with normal glycaemic level. The patients were evaluated after 5 days and were observed for mortality during hospital stay.

DATA ANALYSIS:

The collected data was analyzed statistically by using version 21 of SPSS. Quantitative variables like age, BMI and duration of symptoms were presented as mean ± S.D. Qualitative variables like gender, type of AMI and mortality during hospital stay were presented as frequency and percentage.

The association between acute hyperglycaemia and mortality during hospital stay was assessed with relative risk. RR>1 was considered as significant. Data was stratified for age, gender, BMI, duration of symptoms and type of AMI. Post-stratification, adjusted RR was calculated to check significance in stratified groups. RR >1 was considered as significant.

RESULTS:

The mean age of patients with hyperglycaemia was 57.71±11.64years. The mean age of patients with normal glycaemia level was 58.25±11.84years. There were 101 (65.2%) males and 54 (34.8%) females in hyperglycemia group. There were 93 (60.0%) males and 62 (40.0%) females in normal glycemic group. The average BMI of patients with hyperglycaemia was 26.98±4.41kg/m2. The average BMI of patients with normal glycaemia level was 26.77±4.51kg/m2. The mean duration of symptoms in hyperglycaemia group was 6.66±3.30hours. The mean duration of symptoms with normal glycaemia group was 6.53±3.51hours. In hyperglycemia

group, 105 (67.7%) patients had STEMI while 50 (32.3%) patients had NSTEMI. In normal glycemic group, 104 (67.1%) patients had STEMI while 51 (32.9%) patients had NSTEMI. In hyperglycemia group, 24 (15.5%) patients mortality during hospital stay while 131 (84.5%) were discharged alive. In normal glycemic group, 8 (5.2%) patients had mortality during hospital stay while 147 (94.8%) were discharged alive. There was 3.0 times more in-hospital mortality in hyperglycemic patients as carped to patients with normal glycemic level i.e. RR= 3.0 (95% CI; 1.391, 6.470, $p<0.05$). Data was stratified for age of patients. In patients aged 40-60 years, there were 3.015 (95% CI; 1.021, 8.909) chances of mortality during hospital stay in hyperglycemic patients as compared to patients with normal glycemic level ($p<0.05$). In patients aged 61-80years, there were 3.082 (95% CI; 1.038, 9.15) chances of mortality during hospital stay in hyperglycemic patients as compared to patients with normal glycemic level ($p<0.05$). Data was stratified for gender of patients. In male patients, there were 3.453 (95% CI; 1.189, 10.03) chances of mortality during hospital stay in hyperglycemic patients as compared to patients with normal glycemic level ($p<0.05$). In female patients, there were 2.583 (95% CI; 0.843, 7.916) chances of mortality during hospital stay in hyperglycemic patients as compared to patients with normal glycemic level ($p>0.05$). Data was stratified for BMI of patients. In normal weight patients, there were 6.661 (95% CI; 2.081, 21.32) chances of mortality during hospital stay in hyperglycemic patients as compared to patients with normal glycemic level ($p<0.05$). In overweight and obese patients, RR could not be calculated.

Data was stratified for duration of symptoms. In patients with duration 1-3 hours, there were 2.933 (95% CI; 0.8101, 10.62) chances of mortality during hospital stay in hyperglycemic patients as compared to patients with normal glycemic level ($p>0.05$). In patients with duration 4-6 hours, there were 2.936 (95% CI; 1.129, 7.638) chances of mortality during hospital stay in hyperglycemic patients as compared to patients with normal glycemic level ($p<0.05$). Data was stratified for type of ACS. In patients with STEMI, there were 2.773 (95% CI; 1.036, 7.422) chances of mortality during hospital stay in hyperglycemic patients as compared to patients with normal glycemic level ($p<0.05$). In patients with NSTEMI, there were 3.400 (95% CI; 0.994, 11.63) chances of in-hospital mortality in hyperglycemic patients as compared to patients with normal glycemic level ($p<0.05$).

Table-1: Descriptive statistics of age of patients

		n	Mean	SD	Minimum	Maximum
Age	Hyperglycemia	155	57.71	11.64	40	80
	Normal glycemic level	155	58.25	11.84	40	80
BMI	Hyperglycemia	155	26.98	4.41	19.20	34.93
	Normal glycemic level	155	26.77	4.51	19.20	34.97
Duration	Hyperglycemia	155	6.66	3.30	1	12
	Normal glycemic level	155	6.53	3.51	1	12

Table-2:Distributions according by gender type of ACS

		Group		Total
		Hyperglycemia	Normal glycemic level	
Gender	Male	101 (65.2%)	93 (60%)	194 (62.6%)
	Female	54 (34.8%)	62 (40%)	116 (37.4%)
Type of ACS	STEMI	105(67.7%)	104(67.1%)	209(67.4%)
	NSTEMI	50(32.3%)	51(32.9%)	101(32.6%)

Table-3:In hospital mortality

		In-Hospital Mortality		Total
		Yes	No	
Group	Hyperglycemia	21 (15.5%)	131 (81.5%)	155 (100%)
	Normal glycemic level	8 (5.2%)	147 (94.8%)	155 (100%)
Chi-Square Test = 8.921, P-value = 0.003 (significant), RR=3.000 (95% CI: 1.391, 6.470)				

Table-4:Combined Data

			In-Hospital Mortality			
		Group	Yes	No	Total	P-Value
Age	**40-60**	Hyperglycemia	13(13.4%)	84(86.6%)	97	3.015
		Normal glycemic level	4(4.4%)	86(95.6%)	90	1.021, 8.909
	61-80	Hyperglycemia	11(19%)	47(81%)	58	3.082
		Normal glycemic level	4(6.2%)	61(93.8%)	65	1.038, 9.15
Gender	**Male**	Hyperglycemia	15 (14.9%)	86 (85.1%)	101	3.453
		Normal glycemic level	4 (4.3%)	89 (95.7%)	93	1.189, 10.03
	Female	Hyperglycemia	9 (16.7%)	45 (83.3%)	51	2.583
		Normal glycemic level	4 (6.5%)	58 (93.5%)	62	0.843, 7.916
BMI	**Normal**	Hyperglycemia	19 (32.8%)	39 (67.2%)	58	NA
		Normal glycemic level	3 (4.9%)	58 (95.1%)	61	NA
	Overweight	Hyperglycemia	5 (10%)	45 (90%)	50	NA
		Normal glycemic level	0 (0%)	48 (100%)	48	NA
	Obese	Hyperglycemia	0 (0%)	47 (100%)	47	NA
		Normal glycemic level	5 (10.9%)	41 (89.1%)	46	NA
Duration	**1-6**	Hyperglycemia	8 (11.4%)	62 (88.6%)	70	2.933
		Normal glycemic level	3 (3.9%)	74 (96.1%)	77	0.8101, 10.62
	7-12	Hyperglycemia	16 (18.8%)	69 (81.2%)	85	2.936
		Normal glycemic level	5 (6.4%)	73 (93.6%)	78	1.129, 7.638

DISCUSSION:

Mortality during hospital stay in patients with acute hyperglycemia and acute myocardial infarction is relatively high as compared to patients

with normal glucose level. In our study, among hyperglycemia group, 24 (15.5%) patients had mortality during hospital stay. In normal glycemic group, 8 (5.2%) patients had in-hospital mortality while 147 (94.8%) were discharged alive. There was three folds increase in mortality during hospital stay i.e. RR= 3.000 (95% CI; 1.391, 6.470, $p<0.05$). diabetic patients admitted with AMI and having glucose level more than 180mg/dL had a increased relative risk of in hospital death as compared with patients with normal glucose levels.[6] It has been observed in pervious study that acute hyperglycemia labeled as 11.0mmol/L is a predisposing factor for cardiovascular complications i.e. 16% vs. 6%, $P<0.001$.[7] Another data showed 11.3% vs 4.5% mortality in hyperglycemia patients with AMI ($p<0.0001$).[8]

Aronson et al. reported worse prognosis in patients with high glucose level and acute MI. He also reported that long term prognosis in also bad in patients with glucose intolerance and calculated hazard ratio for mortality during hospital stay in three tertiles was also significant (P 0.0001). Glucose levels measured after fasting and found to be raised were also associated with poor outcome in patients with acute coronary syndrome but the level cannot preidict the percentage of mortality.[9]

Svensson et al., observed increase in relative mortality at 30 days in patients with deranged blood glucose levels and conluded significant relationship of admission glucose levels with worse outcomes in patients with acute coronary syndrome.[10]

Similarly Marfella et al., performed study in 31 patients with glucose level more than 7mmol/l. He evaluated the patients by doing myocardial performance index and reduced Doppler flow across mitral valve and pulmonary flow analysis with ejection fraction of LV. In his study, he reported that patients with hyperglycemia had higher infarct segment length and are predispose to increased cardiovascular complications. The underlying mechanism for hyperglycemia and acute coronary events may be due to increased levels of IL-18 and CRP. The ratio of CD16+/CD56+ cells and CD4/CD8 ratio is found to be high hyperglycemia patients whereas CD 152 expression is found to be low in these patients.[11]

Determination of glucose level is also a key factor for calculating different risk scores in ACS patients. For example GRACE risk score have also included glucose as an important factor for risk stratifying ACS patients.

The limitations of this study were small sample size and standardization of diet may be required in future studies.

CONCLUSION:

Hyperglycemia is an important predisposing risk factor for the development of complications after acute myocardial infarction.

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