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Effect of Admission Hyperglycemia on Short Term Outcomes of Non-ST Elevation Myocardial Infarction

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Abstract

Aim: This study was undertaken to assess the impact of acute hyperglycemia (Admission Hyperglycemia) on short-term outcomes during hospitalization in patients with Non-ST elevation myocardial infarction (NSTEMI).

Patients and Methods: We analyzed 59 consecutive patients admitted for NSTEMI to the Coronary Care Unit of in Tishreen University Hospital. Patients were classified according to their admission blood glucose into two groups, the first group was admission hyperglycemia (defined ≥ 200 mg/dl), whereas the second group was without admission hyperglycemia, to assess its impact on In-hospital mortality and complications (Acute heart failure, Cardiogenic shock and Bleeding).

Results: In univariate analysis, in-hospital mortality was more prevalent in hyperglycemic individuals compared to non-hyperglycemic ones but without statistical significance (9.1% vs. 0%, p=0.07). In addition, patients with admission hyperglycemia developed acute heart failure (54.6% vs. 0%, p=0.0001) and cardiogenic shock (9.1% vs. 0%, p=0.0001) more than patients without admission hyperglycemia. In multivariate analysis, Admission Hyperglycemia was an independent risk factor for in-hospital mortality (OR: 2.3, 95% CI: 2-4.1, p=0.01) and acute heart failure (OR: 4.7, CI 95%:2.3-7.8, p=0.0001).

Conclusion: Admission hyperglycemia was an independent risk factor for in-hospital death and acute heart failure in STEMI patients.

Keywords: Myocardial infarction; Acute hyperglycemia; Mortality; Acute heart failure; Cardiogenic shock

Introduction

Cardiovascular disease is the leading cause of mortality in Europe and it is constantly increasing [1]. The mortality and morbidity of myocardial infarction remains high despite all progress in prevention, diagnosis, and treatment. Various studies have proved that hyperglycemia is prevalent in critically ill patients, even in those without diabetes mellitus [2] and there is increasing evidence supports the idea that hyperglycemia decreases endothelium-derived NO availability and affects vascular function [3]. We prospectively studied the relationship between hyperglycemia at admission with morbidity and mortality in NSTEMI patients.

Patients and Methods

Study population and design

This was a prospective, cohort, hospital based, study, conducted on fifty-nine patients admitted to the coronary care unit (CCU) at Tishreen University Hospital in Lattakia, Syria, with the diagnosis of Non-ST elevation myocardial infarction (NSTEMI). The study was conducted between February 2018 and February 2019.

The diagnosis of NSTEMI was based on detection of a rise and/or fall of cardiac biomarker (CK-MB and cT I or T) with at least one value above the 99th percentile upper reference limit (URL) and characteristic chest pain (more than 20 min) with or without ECG abnormalities, which is in agreement with the 2015 ESC guidelines [4]. Patients baseline characteristics as gender, age, cardiovascular risk factors (smoking, hypertension, diabetes mellitus, etc.) were reported. Admission hyperglycemia was defined as admission glucose level ≥ 200 mg/d (11.0 mmol/L) according to NICE guidelines [5] and several previous studies [6,7].

Patients were categorized into two groups, the first one was with admission hyperglycemia (admission glucose ≥ 200 mg/d) while the second group without (admission hyperglycemia <200 mg/d) and followed up during the hospital stay.

Outcomes

The primary end point of this study was in-hospital mortality and complications. In-hospital mortality was defined as all cause death (cardiogenic and non-cardiogenic). In-hospital complications were cardiogenic shock defined according to 2016 ESC guidelines on heart failure [8], acute heart failure (KILLIP III), and life-threatening bleeding (intracranial hemorrhage or decreased Hb ≥ 5 g/dL) [9].

Statistical Analysis

Categorical variables were expressed as frequencies and percentages and continuous variables as mean ± SD. At first, univariate analysis is done and p value <0.05 was considered statistically significant. Then, factors with p value <0.05 are put into covariate and multivariate analysis is done. Odd ratio (OR) was determined to study risk factors and considered significant when it was more than 2.

Results

Baseline characteristics

A total of 59 patients were admitted to our coronary care unit with the diagnosis of NSTEMI and enrolled in our study, including 22 patients with admission hyperglycemia and 37 without. The baseline characteristics of the population and their treatment strategy are presented in Table 1.

Demographics	With hyperglycemia (n= 22)	Without hyperglycemia (n=37)	p-value
Gender (male %)	14 (63.6%)	28 (75.6%)	0.3
Age (year)	61.4 ± 8.1	56.2 ± 10.3	0.04
Risk factors			
Diabetes	15 (38.2%)	2 (5.4%)	0.0001
Hypertension	9 (40.9%)	22 (59.4%)	0.01
Dyslipidemia	9 (40.9%)	10 (27%)	0.2
Obesity	6 (27.3%)	7 (18.9%)	0.4
Tobacco use	16 (72.7%)	32 (56.5%)	0.1
Previous CAD	6 (27.3%)	8 (21.6%)	0.6
Previous PAD	2 (9.1%)	6 (16.2%)	0.4
Family history	9 (40.9%)	13 (35%)	0.6
Lab values			
ABG	316.5±89.7	135.7±26.03	0.0001

Note: CAD: Coronary Artery Disease; PAD: Peripheral Artery Disease; ABG: Admission Blood Glucose; PCI: Percutaneous Coronary Intervention

Table 1: Baseline characteristics of STEMI patients.

Regarding risk factors, diabetes was more prevalent in hyperglycemic patients whereas hypertension was more prevalent in non-hyperglycemic patients with significantly statistical differences (p value <0.05). Other risk factors did not show any significantly statistical differences between the two groups.

In-hospital mortality and complications

All- cause death and complications were evaluated for all NSTEMI patients including hyperglycemic and non-hyperglycemic patients during hospitalization period (Table 2). In-hospital complications include cardiogenic shock, acute heart failure and life-threatening bleeding. In univariate analysis, cardiogenic shock was more prevalent in hyperglycemic patients compared to non-hyperglycemic (9.1% vs. 0%, p=0.04), also acute heart failure was more prevalent in hyperglycemic patients (54.6% vs. 0%, p=0.0001) as shown in Table 2.

Variables	With hyperglycemia (n=22)	Without hyperglycemia (n=37)	p-value
Cardiogenic shock	2 (9.1%)	0 (0%)	0.04
Acute heart failure	12 (54.6%)	0 (0%)	0.0001
Bleeding	1 (4.5%)	0 (0%)	0.1
Mortality	2 (9.1%)	0 (0%)	0.07
Length of stay	5.8 ± 2.4	4.3 ± 1.1	0.02

Table 2: In-hospital complications and mortality.

In-hospital mortality was more prevalent in hyperglycemic individuals compared to non-hyperglycemic ones but without statistical significance (9.1% vs. 0%, p=0.07). There were not any significantly statistical differences between the two groups with regard to life threatening bleeding.

Predictors of in-hospital mortality and complications

In multivariate analysis, considering treatment strategies and risk factors including diabetic status, admission hyperglycemia (ABG ≥ 200 mg/d) was independently associated with in-hospital mortality (OR: 2.3, 95% CI: 2-4.1, p=0.04) as shown in Table 3. Regarding in-hospital complications, admission hyperglycemia was an independent predictor of acute heart failure (OR: 4.7, 95% CI 2.3-7.8, p=0.0001) but it was not an independent predictor of cardiogenic shock, and life-threatening bleeding as illustrated in Table 3.

Variables	Confidence interval (95%)	Odd ratio	p-value
In-hospital mortality	[2-4.1]	2.3	0.04
Bleeding	[0.8-1.04]	0.9	0.1
Acute heart failure	[2.3-7.8]	4.7	0.0001
Cardiogenic shock	[0.7-1.03]	0.9	0.07

Table 3: Multivariate logistic regression analysis of hyperglycemia as a prognostic factor for mortality and complications in STEMI patients.

Discussion

The incidence of hyperglycemia on admission was 37%. Higher prevalence of (mortality, cardiogenic shock and acute heart failure) has been reported in hyperglycemic patients. Hyperglycemia is prognostic factor for mortality and acute heart failure in NSTEMI patients.

There are multiple pathophysiological mechanisms by which hyperglycemia may alter the prognosis in NSTEMI patients. First, hyperglycemia reduces the availability of nitric oxide (NO) because superoxide radical (produced from endothelium in response to hyperglycemia) combines with NO to form the strongest toxic ion peroxynitrite, which inactivate function of free radicals' scavengers [10]. Furthermore, admission hyperglycemia changes the functional properties of platelets producing changes in their structure, altered Ca homeostasis, increased expression of adhesion molecules (GPIIb/IIIa

and P2Y12) and increases serum plasminogen activator inhibitor 1 (PAI-1) levels [11].

Admission hyperglycemia reduces coronary collateral blood flow and produces a significant prolongation of the QT interval [12]. Although admission hyperglycemia is a well-known risk factor in STEMI patients, its impact on NSTEMI is controversial. Correia et al., showed that admission hyperglycemia was an independent risk factor in NSTEMI patients, which was associated with increased mortality and acute heart failure [13]. In contrast, Zaheer et al, concluded that admission hyperglycemia was not a prognostic factor in NSTEMI patients [14].

Conclusion

Admission hyperglycemia was an independent risk factor for in-hospital death and acute heart failure in STEMI patients. This study demonstrated that admission hyperglycemia is a prognostic factor in NSTEMI patients, which was associated with increased in hospital mortality and acute heart failure.

Conflicts of Interest

There are no conflicts of interest for the present study.

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