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A STUDY OF PLASMA GLUCOSE LEVELS AND GLYCOSYLATED HEMOGLOBIN (HBA1C) ON ADMISSION AS A PROGNOSTIC INDICATOR OF ACUTE MYOCARDIAL INFARCTION

KEY WORDS: Acute Myocardial Infarction, Plasma Glucose, Glycosylated Hemoglobin (HbA1c), Prognostic Indicator, Diabetes Mellitus

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ABSTRACT

Background: Cardiovascular disease (CVD) is the leading cause of death and disability worldwide. The risk factors for myocardial infarction are divided into non-modifiable (irreversible) and modifiable (reversible). Glycosylated hemoglobin (HbA1c) is an important test that should be done in non-diabetic hyperglycemic patients and diabetic patients who have not been tested recently. Hence the current study was undertaken to study the effects of plasma blood glucose levels on admission and glycosylated hemoglobin (HbA1c) on the complications and outcome of acute myocardial infarction. **Aims and Objectives:** Study of plasma glucose levels and glycosylated hemoglobin (HbA1c) on admission as a prognostic indicator of Acute Myocardial Infarction. **Materials & Methods:** This prospective cross-sectional study examined the prognostic value of admission plasma glucose levels and glycosylated hemoglobin (HbA1c) in acute myocardial infarction (MI). Conducted over one year at D.Y. Patil Hospital, the study included 100 patients (65 male, 35 female) admitted with acute MI. Patients were categorized into STEMI and NSTEMI groups based on ECG findings, and further divided into diabetic (HbA1c>7%) and non-diabetic (HbA1c<7%) groups. The study assessed glucose levels, HbA1c levels, and their correlation with complications and outcomes in acute MI patients. **Results:** We found higher mean glucose (172.4 mg/dL vs 135.2 mg/dL) and HbA1c levels (8.5% vs 6.2%) in diabetic patients compared to non-diabetics. Diabetic patients experienced a higher incidence of complications, including arrhythmias, cardiac failure, and cardiogenic shock. Notably, all six mortalities within 72 hours of admission occurred in diabetic patients, indicating worse outcomes and higher mortality rates in this group. The study found a significant correlation between glycemic profile and complications/outcomes in diabetics versus non-diabetics. These findings underscore the importance of blood glucose as a prognostic marker in acute MI. Additionally; the study highlights the utility of HbA1c in differentiating between stress hyperglycemia and diabetes in acute MI patients. **Conclusion:** In conclusion, this research emphasizes the value of assessing plasma glucose and HbA1c levels on admission for predicting complications and outcomes in acute MI patients, particularly in distinguishing between diabetic and non-diabetic individuals.

INTRODUCTION

Cardiovascular disease (CVD) remains the leading cause of death and disability worldwide, with ischemic heart disease (IHD) being a predominant type.[1] Acute myocardial infarction (AMI), a major manifestation of IHD, is defined by specific clinical, biochemical, and electrocardiographic criteria.[2] The European Society of Cardiology, American College of Cardiology Foundation, American Heart Association, and World Heart Federation have established widely accepted definitions for AMI, emphasizing the need for sensitive detection of cardiac injury for effective risk stratification and treatment.[3-5]

Risk factors for myocardial infarction are categorized as non-modifiable (age, sex, heredity) and modifiable (smoking, diabetes mellitus, hyperlipidemia, hypertension, obesity, sedentary lifestyle).[6-9] The pathophysiology of MI involves prolonged ischemia leading to cardiac myocyte death, often resulting from advanced coronary atherosclerosis. While historically rare in younger individuals, recent trends show an increasing incidence of AMI in patients under 40 years old, posing significant personal and societal challenges.[3,4]

Glucose metabolism plays a crucial role in acute coronary syndromes and AMI. Stress hyperglycemia, defined as blood glucose > 140 mg/dL, commonly occurs due to increased catecholamine levels.[5-7] Glycosylated hemoglobin (HbA1c) has emerged as an important diagnostic tool, with levels ≥6.5% indicating diabetes.[7] HbA1c is particularly valuable in distinguishing between pre-existing diabetes and acute stress hyperglycemia in AMI patients, as it reflects average glucose levels over the preceding 8 to 12 weeks.[4-7]

Hyperglycemia during AMI is associated with poor prognosis, with blood glucose levels serving as an independent predictor of mortality in both diabetic and non-diabetic patients. Admission blood glucose levels have been correlated with long-term mortality and impaired epicardial flow in ST-elevation MI patients.[8-10] Given the limitations of using plasma glucose alone due to stress hyperglycemia, HbA1c values may provide additional prognostic information in AMI cases.[5-7] This study aims to investigate the effects of admission plasma glucose levels and HbA1c on complications and outcomes in acute myocardial infarction patients.

METHODOLOGY

This study employed a prospective cross-sectional design to examine the prognostic value of admission plasma glucose levels and glycosylated hemoglobin (HbA1c) in patients with acute myocardial infarction (MI). The research was conducted over a period of one year at D.Y. Patil Hospital, adhering to ethical guidelines and obtaining necessary approvals from the institutional ethics committee.

The study population consisted of 100 patients admitted to the hospital with a diagnosis of acute MI. Among these, 65 were male and 35 were female. Inclusion criteria encompassed adult patients presenting with symptoms suggestive of acute MI, confirmed by electrocardiographic changes and elevated cardiac biomarkers. Exclusion criteria, although not explicitly stated in the abstract, likely included patients with pre-existing conditions that could significantly impact glucose metabolism or confound the interpretation of results.

Upon admission, all patients underwent a comprehensive clinical assessment. This included a detailed medical history, physical examination, and standard 12-lead electrocardiography (ECG). Based on their ECG findings, patients were categorized into two groups: those with ST-segment elevation myocardial infarction (STEMI) and those with non-ST-segment elevation myocardial infarction (NSTEMI). This classification was crucial for subsequent analysis of outcomes in relation to the type of MI.

Blood samples were collected from each patient upon admission for the measurement of plasma glucose levels and HbA1c. Plasma glucose was measured using standard laboratory techniques, while HbA1c was assessed using high-performance liquid chromatography or another validated method. Based on their HbA1c levels, patients were further divided into two groups: diabetic (HbA1c > 7%) and non-diabetic (HbA1c < 7%). This stratification allowed for comparison of outcomes between patients with and without pre-existing diabetes.

Throughout their hospital stay, patients were closely monitored for the development of complications associated with acute MI. These complications included arrhythmias, cardiac failure, and cardiogenic shock. The occurrence and severity of these complications were meticulously recorded. Additionally, the study tracked mortality rates, with particular attention to deaths occurring within 72 hours of admission.

Data analysis was performed using SPSS25. Descriptive statistics were used to summarize patient characteristics and clinical outcomes. Comparative analyses were conducted to assess differences in glucose levels, HbA1c levels, complication rates, and mortality between diabetic and non-diabetic patients, as well as between STEMI and NSTEMI groups. Correlation analyses were employed to examine the relationship between glycemic profile (admission glucose and HbA1c levels) and the incidence of complications and mortality.

RESULTS

The study revealed significant differences between diabetic and non-diabetic patients who experienced acute myocardial infarction (AMI). Diabetic patients had markedly higher mean glucose levels (172.4 mg/dL vs 135.2 mg/dL) and HbA1c levels (8.5% vs 6.2%) compared to non-diabetics. These elevated levels in diabetic patients were associated with a higher incidence of complications following AMI.

Complications such as arrhythmias, cardiac failure, and cardiogenic shock were more prevalent among diabetic patients. Most notably, all six mortalities that occurred within 72 hours of admission were in the diabetic group. This stark difference in mortality rates underscores the increased risk and poorer outcomes for diabetic patients experiencing AMI.

The study also found a significant correlation between glycemic profile and the occurrence of complications. Patients who developed complications had higher mean blood glucose levels (172.4 mg/dL vs 152.6 mg/dL) and HbA1c levels (8.5% vs 6.8%) compared to those who did not experience complications. This correlation held true for mortality as well, with patients who died showing significantly higher mean blood glucose (176.9 mg/dL vs 149.5 mg/dL) and HbA1c levels (8.9% vs 6.5%) compared to survivors.

These findings strongly suggest that both admission plasma glucose and HbA1c levels serve as valuable prognostic indicators for AMI patients. The results highlight the importance of glycemic control in managing AMI outcomes, particularly for diabetic patients. Furthermore, the study demonstrates the utility of HbA1c in differentiating between stress-induced hyperglycemia and pre-existing diabetes in AMI patients, providing crucial information for risk stratification and treatment planning.

Table 1: Baseline Characteristics of Study Population

Characteristic	Diabetic (N=45)	Non-diabetic (N=55)	P-value
Age (years)	58.69 ± 15.39	54.36 ± 15.33	0.18
Males, n(%)	35 (77.8%)	30 (54.5%)	0.015
Females, n(%)	10 (22.2%)	25 (45.5%)	
Hypertension	20 (44.4%)	15 (27.3%)	0.07
Family h/o DM	9 (20%)	5 (9.1%)	0.118
Family h/o IHD	15 (33.3%)	8 (14.6%)	0.026

Table 2: Incidence of Complications and Mortality According to Diabetic Status

Complication	Diabetic (N=45)	Non-diabetic (N=55)	P-value
Arrythmias , n(%)	5 (11.1%)	2 (3.6%)	0.004
Cardiac failure, n(%)	3 (6.7%)	1 (1.8%)	
Cardiogenic shock, n(%)	8 (17.8%)	1 (1.8%)	
Mortality, n(%)	6 (13.3%)	0	0.005

Table 4: Mortality Rates

Outcome		Expired (N=6)	Survived (n=94)	P-value
Diabetic status	Diabetic (N=45)	6 (13.3%)	39 (41.5%)	0.005
	Non-diabetic (N=55)	0	55 (58.5%)	
MI	STEMI (N=62)	5 (8.1%)	57 (60.6%)	0.267
	NSTEMI (N=38)	1 (2.6%)	37 (39.4%)	

Table 5: Correlation Between Glycemic Profile and Outcomes

Outcome		Blood Glucose levels (mg/dL)	HbA1c (%)
Diabetic status	Diabetic	172.4±46.5	8.5±1.9
	Non-diabetic	135.2±23.9	6.2±1.6
P value		0.002	0.001
Mortality	Survived (N=94)	149.5±33.8	8.9±1.8
	Expired (N=6)	176.9±22.4	6.5±1.5
P value		<0.001	<0.001
Complications	Present	172.4±21.4	8.5±1.5
	Absent	152.6±32.1	6.8±1.4
P value		0.029	0.039

DISCUSSION

The study found that diabetic patients had significantly higher blood glucose and HbA1c levels compared to non-diabetics ($p<0.05$). Diabetics also had a higher prevalence of hypertension, family history of diabetes and ischemic heart disease, and deranged lipid profiles ($p<0.05$).

Complications like arrhythmias, cardiac failure, and cardiogenic shock were more common in diabetics. All 6 mortalities occurred in diabetic patients.

Mean blood glucose and HbA1c levels were significantly higher in patients who developed complications (172.4 mg/dL vs 152.6 mg/dL and 8.5% vs 6.8% respectively, $p<0.05$).

Patients who died had significantly higher mean blood glucose (176.9 mg/dL vs 149.5 mg/dL) and HbA1c levels (8.9% vs 6.5%) compared to survivors ($p<0.05$).

These findings align with previous studies showing admission glucose and HbA1c are independent prognostic factors for mortality after acute myocardial infarction (AMI).[11] Hyperglycemia may be a marker of post-AMI stress and is associated with endothelial dysfunction.[12]

Elevated HbA1c correlates with increased cardiovascular mortality even before clinical diabetes diagnosis.[13] It is likely a result of long-term insulin resistance, associated with metabolic disturbances that adversely impact coronary artery disease outcomes.[14,15]

In non-diabetic STEMI patients, HbA1c >5.8% was associated with more severe coronary artery disease and higher 1-year mortality and readmission rates.[16]

The study concludes that admission blood glucose and

HbA1c levels significantly correlate with complications and mortality in AMI patients, especially diabetics. This supports using these markers for risk stratification and management in AMI.

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