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Stress Hyperglycemia And Coronary Artery Disease in Patients With Acute Myocardial Infarction

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ABSTRACT

Aim: The aim of this study was to assess the incidence of stress hyperglycemia in patients with acute myocardial infarction (AMI) in non diabetic patients and to compare the severity of coronary artery disease in patients with stress hyperglycemia to those with normal glucose tolerance and those known to have diabetes mellitus (DM) in the setting of AMI. . Design/Methods: A total of 144 patients both diabetics and non diabetics were studied. of these, 61 patients were being treated for diabetics, the remaining 83 patients were classified based on the results of 75gm oral glucose tolerance test before discharge in to normal glucose tolerance (NGT) (n=36) and stress hyperglycemia SH (n=36) . Results: In 33.8 % patients with stress hyperglycemia, 54.1 % diabetic patients and 12.2 % patients with normal glucose tolerance had multi vessel disease with significant P value of <.001 Conclusions: We conclude that stress hyperglycemia is common in AMI in non diabetic patients and also suggests that the severe coronary artery disease is present not only in the diabetes group but also in the stress hyperglycemia group.

KEYWORDS : Hyperglycemia, Diabetes Mellitus and Acute Myocardial Infarction.

INTRODUCTION:

Diabetes Mellitus (DM) is an established major cardio vascular risk factor for coronary artery disease. Patients with DM have higher incidence of acute myocardial infarction and congestive cardiac failure[1]

Abnormally elevated blood glucose is a common finding in patients with acute myocardial infarction and has been referred to as stress hyperglycemia[2] .The significance of hyperglycemia observed after AMI has stimulated renewed interest .Studies done earlier show the short term and long term prognosis associated with hyperglycemia in AMI patients[3].

But data regarding the relationship between stress hyperglycemia and extent of coronary artery disease in non diabetic patients with AMI are limited.

The present study was done to assess the incidence of stress hyperglycemia in patients with AMI in non diabetic patients and to compare the severity of coronary artery disease in patients with stress hyperglycemia to those with normal glucose tolerance and those known to have DM in the setting of AMI.

MATERIALS AND METHODS

I. Experimental Design

Patients who presented with AMI and were admitted in the coronary care unit of our hospital were included in the study. A total of 144 patients both diabetics and non diabetics were studied. of these 61 patients were being treated for diabetics, the remaining 83 patients were classified based on the results of 75gm oral glucose tolerance test before discharge into, normal glucose tolerance (NGT) (n=36) and stress hyperglycemia SH (n=47).All the patients in the non diabetic group had HbA1C < 6.5 % at the time of admission and also their glucose levels were within normal range at the end of one month

The patients were treated as per ACC/AHA guidelines.

The patients were diagnosed as having AMI if [4]

1. They have 2 values of serum Trop I >0.2g/dl or CK-MB >20ug/L
2. Chest pain >20 mins
3. Pulmonary edema in the absence of valvular heart disease, cardiogenic shock, arrhythmias such as ventricular fibrillation (VF) or ventricular tachycardia(VT)
4. New Q waves in at least 2 of the 12 standard electrocardiographic(ECG) leads
5. ECG changes indicating acute ischemia (STelevation, ST depression, T wave inversion).

OTHER DATAS COLLECTED

Patients cardio vascular history, their medications at the time of admission, their risk factors, in hospital course including killips class, initial diagnostic and therapeutic management were recorded. Left ventricular ejection fraction (LVEF) was measured on 3 – 5 days of admission.

II. ETHICAL CONCERN

Ethical clearance was obtained from the Ethical committee meeting conducted at Meenakshi Medical College, Kanchipuram, Tamil Nadu.

III. ASSESSMENT OF TRADITIONAL RISK FACTORS

IIIa. Glucose tolerance test

A total of 144 patients studied. Of these, 61 patients were being treated for diabetes mellitus. In all patients except those with diabetics an oral glucose tolerance test (glucose load of 75g) was performed between 8.00am and 10.00am. After 8 hours fasting within 5 days of the admission. Blood was sampled before and 2h after the glucose loading and the plasma glucose concentration was determined by the glucose oxidase method. The results of the test were analyzed according to the World Health Organization criteria and the patients were classified into three groups

- Normal glucose tolerance, defined as a fasting plasma glucose concentration <110 mg/dl and a 2 h plasma glucose concentration <140 mg/dl
- Stress hyperglycemia, defined as a fasting plasma glucose >110 mg% and a 2 h plasma glucose concentration >140mg% and
- Patients with DM.

All the patients in the stress hyperglycemia group had normal plasma glucose values at one month of follow up and it indicates hyperglycemia only secondary to stress myocardial infarction.

IIIb. Systemic hypertension

Systemic hypertension was considered to be present if the patients had been taking antihypertensive drugs or if their systolic blood pressure was ≥ 140mmHg or the diastolic blood pressure was ≥ 90 mmHg on two measurements of their blood pressure during hospitalization.

IIIc. Evaluation of smoking

The amount of smoking expressed as smoking index was calculated by the number of cigarettes smoked daily multiplied by the number of years the patients had been smoking.

IIId. Measurement of serum lipids

Blood was sampled after 8 hr fasting on the second hospital day. Serum concentration of total cholesterol, triglyceride (TGL), and high density lipoprotein cholesterol (HDLc) and low density lipoprotein (LDLc) were determined enzymatically.

IIIe. Evaluation of the severity of coronary artherosclerosis

Selective coronary angiograghy was performed in multiple projections. Analyses of coronary angiogram showed the presence of minor coronary artery disease defined if the internal luminal diameter narrowing was less than 70 %. Internal luminal diameter narrowing more than 70 % was considered significant coronary artery disease. The percent diameter stenosis was obtained by comparing the diameter of an obstructed segment with the nearest normal vessel diameter on a projection view that showed the obstruction in its maximum severity[3]. Based on the coronary angiography, to classify the extent of coronary artery disease, patients were divided into three categories

Category 1. Normal or minor coronary artery disease (< 70 % stenosis)

Category 2. Significant single coronary artery disease (> 70 % stenosis)

Category 3.Multi vessel coronary artery disease (significant stenosis > 70 % in more than one vessel)

IV. Statistical Analysis

To evaluate the relationship of stress hyperglycemia with multi vessel disease, statistical analyses were performed using SPSS 11. A p value <0.01 was considered statistically significant. All the Data for both continuous and categorical variables were presented as proportions and counted in terms of absolute and relative frequency distributions. Both continuous and discrete variables were compared with Chi-square test. The Multiple logistic regression analysis was performed to assess independent predictors of multi vessel disease after adjusting for baseline characteristics and variables.

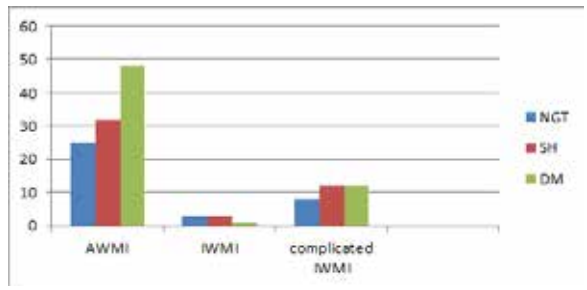
Table 1: Base line characteristics

Variables	NGT (n)	SH (n)	DM (n)	P value
Age > 55	30	28	30	.004
Male sex	33	39	49	.329
Hypertensive	13	18	34	.089
Smokers	18	12	14	.044
HDL < 40	31	41	49	.577
LDL > 130	30	27	38	.035
TGL > 160	32	38	48	.439
Anterior wall MI	25	32	48	.506
Inferior wall MI	3	3	1	.506
Complicated inferior wall MI	8	12	12	.506

There was no significant difference among the patients in the three groups as regards the variables.

Figure.1. Comparison of NGT, SH, DM, in patients with anterior wall, inferior wall, and complicated inferior wall MI

NGT, SH, DM was noticed 23.8 %, 30.8%, and 45.7 % respectively in patients with anterior wall myocardial infarction. Similarly, 42.9 %, 42.9%, 14.3% in inferior wall myocardial infarction patients and 25 %, 32.6 %, and 37.5 % in patients with complicated inferior wall MI



Association between the glucose metabolism and coronary artheroclerosis :

In our study, 33.8 % patients with stress hyperglycemia (n = 25), 54.1 % diabetic patients (n = 40) , and 12.2 % patients with normal glucose tolerance (n= 9) had multi vessel disease with significant P value of <.001.

These results indicate that prevalence of multi vessel disease in stress hyperglycemia was similar to that in diabetic patient but differ from that in patients with normal glucose tolerance.

Table 2. Showing the angiographic profile among NGT, SH, DM

	Glucose tolerance NGT (n)	SH (n)	DM (n)	Total(n)	P value
Normal or minor	12	7	3	22	
Single vessel	15	15	18	48	
Multi vessel	9	25	40	74	**<.001**
Total	36	47	61	144	

Multi variate analysis

We performed univariate and multivariate analyses to investigate which of the clinical variables and risk factors were independently associated with multi vessel disease in acute MI. Age, male sex, LDL level, stress hyperglycemia; anterior wall myocardial infarction and inferior wall infarction were significant predictors of multivessel disease by univariate analysis. By multivariate analysis, age, male sex and stress hyperglycemia were independent predictors. Among these parameters, stress hyperglycemia were independently and significantly associated with multivessel disease (odds ratio 4.6,95 % confidence interval 1.17 to 18.7) with significant P value of 0.028

Table 3: Multivariate analysis shows stress hyperglycemia is independent predictor of multi vessel

Variables	Odds ratio		95 % confidence interval		P value
	Multivessel disease	Single vessel disease	Multivessel disease	Single vessel disease	
Age > 55	3.376	1.921	.869	13.109	.079
Male sex	6.223	6.282	1.488	26.027	.012
LDL > 130	1.982	.991	.272	3.612	.989
Stress hyperglycemia	4.6	2.1	1.177	18.752	.028
AWMI	.298	2.1	6.7 E	1.3	.110
IWMI	.189	1.117	.308	7.567	.186

VI. DISCUSSION

Patients with DM have numerous concomitant cardiac risk factors with a higer incidence of AMI and CHF[1]. Non- Diabetic patients with impaired glucose tolerance may also have an increased incidence of cardiovascular complications. So hyperglycemia at the time of MI in patients with and without DM may be an important and potentially modifiable risk factor for poor out come[1].

High prevalence of glucosuria in AMI patients without diabetes was noted as early as in 1931. Wahlberg in 1966 reported that patients with AMI may present with elevated blood glucose.[5]

The prevalence of stress hyperglycemia in patients without diabetes ranged from 5% - 71 % and the overall pooled prevalence was 13.7 % of the total number of the patients with MI [2]

Euro heart survey on diabetes and the heart reported that OGT identified 58 % of the 923 non diabetic patients with ACS as having SH[6]

In our study the prevalence of stress hyperglycemia in the absence of a history of diabetes was 57.8 % and appears to be similar to that seen in other patient populations. Stress hyperglycemia may reflect previously undiagnosed diabetes, pre exiting carbohydrate intolerance, stress related carbohydrate intolerance or a combination of these.[2] studies have reported an association between elevated blood glucose at hospital admission and increased adverse events including CHF, cardiogenic shock and death[7,8,9,10].

Several studies have shown that glucose levels at hospital admission may be associated with large infarct size [11], worse LV function [12]. Stress hyperglycemia could reduce collateral blood flow to the risk area and could abolish the effect of pre conditioning[13], or may be associated with no reflow phenomenon[13,]

Kowalska[11] showed that prevalence of stress hyperglycemia was significantly greater in patients with multi vessel disease than in those with zero vessel disease. In our study 53.2 % patients with stress hyperglycemia, 65.2 % patients with diabetes mellitus and 33.2% patients with normal glucose tolerance had multi vessel disease with significant P value of <0.001.By multivariate analysis stress hyperglycemia was shown to be independently associated with multi vessel disease .

Our results suggest that there is a strong correlation between stress hyperglycemia and severe coronary artery disease. Hence stress hyperglycemia in early phase of an acute myocardial infarction could be used as early marker for risk stratification.

VII. Clinical Implications:

Stress hyperglycemia can be detected early in the post infarction period by quick, inexpensive tests such as oral glucose tolerance test, which are seldom done in coronary care units. The findings underline the need for aggressive glucose management in this setting and may support a more vigorous strategy for early recognition of stress hyperglycemia. Hence oral glucose tolerance test should be considered in all non diabetic patients with acute myocardial infraction

Exercise training, dietary modification, and medical intervention reduce the risk of subsequent DM in these patients and may be of value. However, intervention during hospitalization may also be of benefit.

VIII. Study limitations:

We were of certain limitations: this study is observational, prospective and non – randomized and included only a limited number of patients from a single center. The majority of patients were men, so the degree to which the conclusion applies to women is unclear. However, it does reflect the real world population in that it includes all consecutive patients hospitalized with AMI

IX. Conclusion

The present study provides further evidence to support the previous finding that stress hyperglycemia is common in AMI in non diabetic patients

This study also suggests that the severe coronary artery disease is present not only in the diabetes group but also in the stress hyperglycemia group

Stress hyperglycemia is an early, simple and inexpensive marker of severe coronary artery disease in patients with AMI. Hence an oral glucose tolerance test can easily be added to the standard risk evaluation procedures in patients with acute myocardial infarction and may be of value for enhanced secondary prevention.

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