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A Study on the Correlation between Admission Day Glycemic Status and in - Hospital Outcome of Acute Coronary Syndrome in Diabetic and Non Diabetic Patients

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Abstract: ***Context: In Acute coronary syndrome, admission hyperglycemia is associated with adverse cardiovascular events in diabetes and non - diabetic patients. Background: Type 2 Diabetes mellitus is on increasing trend globally and specially in India. Incidence of Coronary artery disease is higher in diabetics. Incidence of morbidity and mortality are higher in first few days following Acute Coronary Syndrome requiring hospitalisation. Hyperglycaemia on admission is a common observation in both diabetics and non diabetics. Admission hyperglycemia seems to be independent predictor of adverse outcome. Objective: To assess the prognosis of patients with acute coronary syndrome comparing admission blood sugar and HbA1c values. Method: The study group comprised of patients admitted in our ICU with acute coronary syndrome. The study included all patients who fulfilled the inclusion criteria irrespective of diabetic status. The study group included patients both known diabetics and patients who were not known diabetic. They were closely monitored during hospital stay. Result: The mean blood sugar, on admission, in diabetic patients was 246.94 mg/dL and in non diabetic patients was 192.58 mg/dL. The mean HbA1c level in diabetic patients was 7.36% and in non diabetic patients was 6.37%. In our study group 51% had STEMI, 32% had NSTEMI, and 17% had Unstable Angina. The mean RBS in the patients who recovered completely was 191.15 mg/dL, while in patients with poor outcome was 297.61 mg/dL. The mean HbA1c in patients recovered completely was 6.6% while in patients with poor outcome was 7.76%. In patients presented with high RBS and HbA1c, 45% had adverse cardiac events (ACE). In our study, in diabetic patients with RBS≥140 mg/dL, total of 30 patients had ACE, while only 3 patients with RBS< 140mg/dL had ACE. With HbA1c levels in diabetic patient similar statistics were seen. In not a known case of diabetic patients, 11 patients who had ACE presented with RBS≥ 140 mg/dL, while 1 patient presented with RBS<140 mg/dL.6 ACS patient presented with HbA1c ≥ 6.5% had ACE while 6 patient presented with HbA1c <6.5 %. Conclusion: Admission RBS and HbA1c were significantly high in patients with adverse cardiac events irrespective of history of diabetes. Patients with no history of diabetes when presented with an elevated admission RBS have significant adverse cardiac events. Higher HbA1c value in a diabetic population is a predictor of adverse cardiac event in acute coronary syndrome. Admission hyperglycemia seems to be a powerful predictor of ACE in ACS patients even in subjects without diabetic history. Acute disturbances in glucose levels as indicated by high admission RBS appears to be of greater importance in predicting short term outcome. Hence admission blood sugar value in ACS patients can be taken as an indicator of high risk subjects so that close monitoring for early detection of ACE and appropriate measures are taken.***

Keywords: Diabetes; Acute Coronary Syndrome; HbA1c; Admission blood sugar; Adverse Cardiac Event

1. Introduction

Coronary artery disease has emerged as a leading cause of morbidity and mortality worldwide over and more so in developing countries like India.

Acute coronary syndrome (ACS) includes STEMI and NSTEMI and unstable angina. Coronary heart disease prevalence rates in India have been estimated over the past several Decades and have ranged from 1.6% to 7.4% in rural populations and from 1% to 13.2% in urban population. Major risk factors for coronary artery disease include smoking, hypertension, diabetes mellitus, dyslipidemia, family history of coronary artery disease and obesity (1). Diabetes is one of the important and independent predictors of mortality in coronary artery disease (2).

Diabetes mellitus (especially type 2 diabetes mellitus) is associated with clustered risk factors for cardiovascular disease

Uncontrolled diabetes has higher incidence of acute coronary syndrome and poor prognosis. Higher blood sugar value during admission for acute coronary syndrome carries grave prognosis not only in diabetics but also in non diabetic patients.

Hyperglycemia on admission in patients with acute myocardial ischemia is a negative predictor of short and long term clinical outcomes (8, 9). On - admission hyperglycemia is also associated with poor clinical outcomes among non - diabetic patients and risk of mortality is higher in these patients. (8, 10, 11, 12)

Glycosylated hemoglobin A1c (HbA1c) is a marker of long term glycemic control and elevated HbA1c is associated with increased risk of cardiovascular disease in patients with diabetes (8, 13). Elevated HbA1c is also associated with increased mortality and cardiovascular diseases even in patients who were not previously diagnosed as diabetic. (8, 14)

Both admission day glucose and HbA1c values are associated with poor clinical outcomes in patients with acute myocardial ischemia (15).

2. Aims and Objectives

Aim:
To assess the prognosis of patients with acute coronary syndrome comparing admission blood sugar and HbA1c values.

Objectives:
1) To find blood sugar levels and HbA1c levels at the time of admission in acute coronary syndrome.
2) To compare blood sugar and HbA1c values with patient outcome.

3. Methodology

All patients admitted to AL - AMEEN MEDICAL COLLEGE HOSPITAL VIJAYAPUR from FEB 2021 TO SEP 2022, with Acute Myocardial ischemia (ACS patients) with or without type 2 Diabetes was taken for the study considering the inclusion and exclusion criteria.

In this study, 100 patients were taken with acute myocardial infarction admitted in Al Ameen Medical College hospital. The study group included ACS patients with both known diabetic and patients whose diabetic status was not known. The study protocol was approved by the ethical committee.

The Inclusion Criteria:
Acute coronary syndrome diagnosed in patients presenting with chest pain and or dyspnea for> 30 minutes and not more than 24 hours with ECG changes. It included STEMI - ST - segment elevation at the J point in 2 contiguous leads with cut off point as greater than 1mm in all leads other than V2 and V3. In leads V2 andV3, the cutoff point is greater than 2 mm in men older than 40 years and greater than 2.5mm in men younger than 40 years old, or greater than 1.5mm in women, followed (if acute reperfusion is not achieved) by T - wave inversion, then Q wave development over few hours. NON - STEMI – ST deviation in ECG with elevated cardiac biomarker. Unstable Angina – with ST deviation in ECG without elevation of cardiac biomarkers.

Exclusion Criteria:
All those who did not consent to participate were not included. Age >75 years, Pre - existing renal disease, Concurrent systemic infections, Past history of acute coronary syndrome and cardiac events and Recent cerebro - vascular accidents (< 1 week)

Methodology
Detailed physical and systemic examination was carried out. All patients included in study were evaluated with ECG, cardiac markers, admission blood sugar, HbA1c levels lipid profile, renal function test. All base line investigations were done. Patients were given initial treatment as per ICU protocol. ECHO evaluation was done.

Based on admission day RBS levels and HbA1c levels, patients are categorized in 2groups. (RBS<140mg/dL and RBS ≥140mg/dL and HbA1c<6.5% and HbA1c ≥6.5% - cutoff according to American Heart Association.)
ECHO was repeated at the time of discharge

Data analysis
Data collected from the study participants were entered in Microsoft excel - 2010 and were analyzed by using SPSS version 22. Descriptive analysis was done. Categorical variables were expressed in frequency and proportions, continuous variables were expressed in mean and standard deviations. Qualitative data were expressed as bar graphs and pie charts. Inferential analysis was done. Proportions were compared using Chi - squared test and means were compared using unpaired t test. Finally data was summarized in frequency distribution tables.

4. Results

In our study of 100 patients, 62 patients were known diabetics. All of them were treated with oral hypoglycemic drugs (N= 62) and 1 patient was treated with both oral hypoglycemic drug and insulin. Complications related to diabetes were 6%. Mean HbA1c among diabetics was 7.36% which means in our study group the diabetic control was found to be poor and it may be due to poor compliance to treatment, lack of follow up with physicians.

Clinical Finding in ACS
Most of the patients had around 2 - 3 risk factors for ACS excluding diabetes. These included hypertension, dyslipidemia, obesity, smoking mainly. Also to some extent life stress was also seen in some patients. Various studies have shown that these risk factors are frequently seen with diabetes. Mean heart rate in our patients was 90 Beats/min.

The Blood Sugar Values

Table 1: Admission RBS and HbA1c

Admission Day Random blood sugar (RBS)	N=100 Mean=226.28 mg%	Range= 90 - 450 mg% SD= 101.66mg%
Admission	RBS≥140mg%	N=67 Mean = 280.28mg% 42 were known diabetic (mean =284.54 mg%) 25 were non - Diabetic (mean=275.62 mg%)
Admission	RBS<140 mg%	N=33 Mean=116.63mg% 20 were known diabetic (mean=118.65 mg%) 13 were non diabetic (mean =113.53 mg%)
Admission	HbA1c	N=100 Range= 4.3% - 9.6% Mean (SD) = 7.36 % (1.14%)
Admission	HbA1c ≥ 6.5%	N=61 Mean =7.80% 48 were diabetic (mean=8.06%)

		13 were non diabetic (mean=7.57%)
Admission	HbA1c < 6.5%	N= 39 Mean =5.71% 14 were known diabetic (mean=5.71%) 25 were non diabetic (mean=5.70%)

In our study, the patients with ACS were divided based on admission RBS <140mg/dL and ≥140 mg/dL.67 patients were admitted with RBS ≥ 140 mg/dL, among which 42 patients were known diabetics, while 25 patients were not a known case of diabetes. Mean RBS was 280.28 mg%. This showed that the sugars levels were found to be high in patients with ACS irrespective of their diabetic status. In patients with RBS< 140 mg/dL on admission, 20 were diabetic, while 13 were not a known case of diabetes.

Patients HbA1c levels were also measured and were divided by HbA1c ≥6.5% and <6.5%.61 patients were admitted with high HbA1c. In patients admitted with HbA1c ≥6.5%, 48 were diabetic, while 13 were not a known case of diabetes. This also showed that most patients had poor glycemic control in life. In patients admitted with HbA1c< 6.5% 14 patients were diabetic and 25 were not a known case of diabetes.

Table 2: Admission RBS and HbA1c in Diabetic and Non Diabetic Population

		N	Mean	Std Deviation	Std. Error Mean	*P Value
RBS (mg/dL)	NDM DM	38 62	192.58 246.94	82.42 107.29	13.37 13.62	0.004
HbA1c (%)	NDM DM	38 62	6.37 7.36	1.14 1.14	0.18 0.14	0.001

The mean blood sugar in diabetic patients was 246.94 mg/dL and in non diabetic patients was 192.58 mg/dL. The mean HbA1c level in diabetic patients was 7.36% and in non diabetic patients was 6.37%. This shows that the admission RBS and HbA1c was found to be high in diabetic patients presented with ACS. It shows that glycemic control was poor in these patients and they also had higher admission blood sugar.

Among the non diabetic patients, some presented with higher HbA1c level which indicates their blood sugar levels were high for the last 3 months and they were not diagnosed as diabetic patients till now. Various studies are consistent with the fact that cardiovascular death rates are 1.7 times higher among adults with diabetes mellitus than those without diagnosed diabetes mellitus.

A cross - sectional study carried out in Dhaka, Bangladesh on 100 patients who were divided in to 2 groups, HbA1c>6.5% and less than 6.5%. Here in patients with HbA1c level>6.5 had 6 times more prevalence of ACS.

ACS and Clinical Outcome

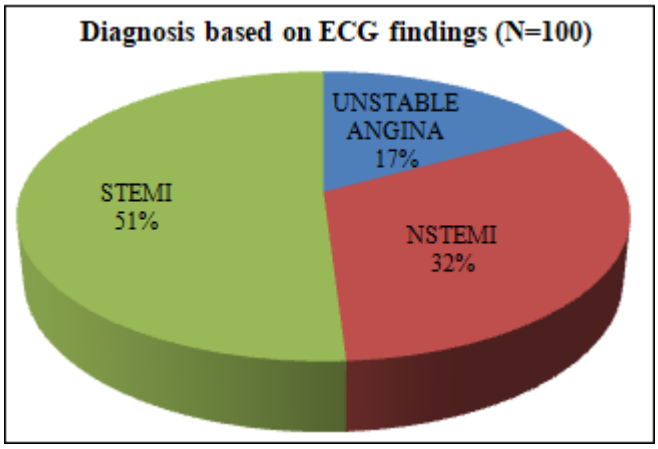

Figure 1

In our study, out of 100 patients, 51% had STEMI, 32% had NSTEMI, and 17% had Unstable Angina. More cases of STEMI were seen when compared to other types of ACS.

A study done in the emergency department in Taiwan, showed that in 168 patients, they had 104 patients (61.9%) with STEMI and 64 (38.1%) with NSTEMI.

Adverse cardiac events seen in our study includes arrhythmia, cardiogenic shock and acute left ventricular failure. Our study had 67% patients who recovered completely without any residual dysfunction, while 29% patients had residual dysfunction (left ventricular failure) present.4 people had outcome of death. Studies have shown that substantial proportions of hospitalized ACS patients develop acute heart failure during their hospital course. This rate is seen to be increased in diabetic patients

Admission Blood Sugar, HbA1c and Clinical Outcome

The mean RBS in the patients who recovered completely was 191.15 mg/dL, while in patients with poor outcome was 297.61 mg/dL. This shows that high admission RBS (hyperglycemia at admission) in patients with ACS had poor outcome.

The mean HbA1c in patients recovered completely was 6.6% while in patients with poor outcome was 7.76%, thus showing poor glycemic control was also responsible for adverse cardiac events in patients with ACS.

In patients presented with high RBS and HbA1c, 45% had adverse cardiac events. This is consistent with studies showing that higher RBS and HbA1c levels lead to adverse cardiac events following ACS.

In our study, in diabetic patients with RBS≥140 mg/dL, total of 30 patients had ACE, while only 3 patients with RBS< 140mg/dL had ACE. With HbA1c levels in diabetic patients, similar statistics were seen. This shows that in diabetic patients with raised admission blood glucose levels and with poor glycemic control had higher number of adverse cardiac events.

In our study, in not a known case of diabetic patients, 11 patients of ACS with ACE presented with RBS≥ 140 mg/dL, while 1 patient presented with RBS<140 mg/dL.6 ACS patient with ACE presented with HbA1c ≥ 6.5% and also 6 ACS patient with ACE presented with HbA1c <6.5 %. This showed that in a non diabetic patient presenting with higher admission RBS had significant adverse cardiac events.

Study done by Wenjun Pan and Haining Lu (16) shows HbA1c is a predictor of in - hospital mortality in ACS patients without diabetes mellitus history and also in patients without known diabetes mellitus. Here HbA1c has positive relation with increased short term mortality.

Study also shows that acute hyperglycemia have worse prognosis. Acute hyperglycemia is also a powerful predictor of adverse outcomes in patients with ACS with or without diabetes mellitus.

5. Summary

This was a prospective study conducted to analyze the association of admission day RBS and HbA1c to the outcome of ACS in patients who were hospitalized. The study was conducted in AL - AMEEN MEDICAL COLLEGE HOSPITAL. The study included 100 patients who were admitted in the hospital with ACS irrespective of diabetic status. The study group included both known diabetic and patients whose diabetic status was not known

Up to 60% of the patients in our study were diabetic and all of them were treated with oral hypoglycemic drugs. The mean HbA1c levels among the diabetic patients were 7.36% which indicated a poor control prior to ACS.

Most of the patients with ACS had more than 2 risk factors excluding diabetes. This includes hypertension, dyslipidemia, smoking, obesity.

The mean admission RBS among diabetic was 246.94mg/dL, non diabetic192.58 mg/dL. The mean HbA1c value in diabetic was 7.36% and in non diabetic 6.37%. The blood sugar among the diabetics had high admission RBS and HbA1c values when compared to the non - diabetics presenting with ACS.

51% patients presented with STEMI, 32% with NSTEMI, and 17% with Unstable Angina. Among these 45% patients had adverse cardiac events. This included arrhythmia, acute left ventricular failure, cardiogenic shock and death. Acute ventricular failure is the most common adverse cardiac event seen.67% patient recovered spontaneously with no residual dysfunction, 29% had residual dysfunction (heart failure) and 4 patients outcome was death due to acute heart failure and cardiogenic shock. Higher admission RBS and HbA1c was seen in the patients with ACS who had adverse cardiac events with poor outcome.

In diabetic patients both high admission RBS (>140 mg/dL) and high HbA1c (>6.5%) was significantly associated with adverse cardiac events. While in non diabetic patients high admission RBS was found to have statistically high significance with adverse cardiac events, while HbA1c was not.

Limitations of study

The study was done during the course of hospital stay of the patient with ACS. Follow - up study of patient was not done.

Suggestion

Similar study may be undertaken with larger group of patients comprising ACS with diabetes, newly diagnosed diabetes on admission and non diabetics with normal HbA1c and recent reports ruling out diabetes.

6. Conclusions

The following conclusions could be made out from this study

- More than 50% of the patients had known diabetes, indicating that the diabetic patients have a greater incidence of ACS
- Mean HbA1c among diabetics was 7.36% indicating a poor control prior to admission even though they were on treatment.
- The Diabetic patients had high admission RBS value and HbA1c values when compared to the non - diabetics presenting with ACS.
- Adverse cardiac events occurred in nearly 45% of ACS patients
- The most common adverse cardiac event is acute left ventricular failure.
- Admission RBS and HbA1c were significantly high in patients with adverse cardiac events.
- Patients with no history of diabetes when presented with an elevated admission RBS have significant adverse cardiac events.
- Admission hyperglycemia seems to be a powerful predictor of poor clinical outcomes even in subjects without a diabetic history.
- Uncontrolled diabetes as indicated by high HbA1c values is a strong predictor for development of Acute Coronary syndrome.
- However, acute disturbances in glucose levels as indicated by high admission RBS appears to be of greater importance in predicting short term outcome.
- Hence admission blood sugar value of MI can be taken as an indicator to find out high risk subjects so that preventive measures, careful monitoring is done to detect ACE at the earliest and treated immediately.

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