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A STUDY ON PROGNOSTIC VALUE OF GLYCOSYLATED HEMOGLOBIN AND BLOOD GLUCOSE IN PATIENTS WITH ST SEGMENT ELEVATION MYOCARDIAL INFARCTION

Cardiology

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ABSTRACT

Hyperglycaemia during acute myocardial infarction (AMI), particularly in ST-segment elevation myocardial infarction (STEMI), presents a significant prognostic challenge. We aimed to determine the predictive significance of admission blood glucose and glycated haemoglobin (HbA1c) levels in these STEMI (mortality and unfavourable cardiovascular events). A prospective cohort study at the Mahatma Gandhi Medical college and hospital, involving 90 patients diagnosed with STEMI on Electrocardiogram (ECG). Blood glucose and HbA1c levels were measured upon admission, and correlations with 30- day mortality and cardiovascular events were analyzed using high- performance liquid chromatography and digital glucometers. Admission blood glucose and HbA1c levels serve as critical prognostic tools in managing STEMI patients. Immediate hyperglycaemia is a potent indicator of short-term outcomes, while HbA1c guides long-term management strategies. This study advocates for standardised definitions of hyperglycaemia and the integration of HbA1c in routine assessments to enhance prognostic accuracy and improve therapeutic approaches in the management of STEMI.

KEYWORDS

AMI- acute myocardial infarction, HBA1c- Glycated haemoglobin A 1c

INTRODUCTION-

Diabetes mellitus (DM) represents a pervasive health concern worldwide, significantly increasing the susceptibility to vascular complications, including acute myocardial infarction (AMI). Its multifaceted nature implicates various factors, encompassing personal choices such as smoking, poor dietary habits, and sedentary behaviour, as well as physiological conditions like hypertension, obesity, and hyperlipidemia.

Factors such as acute fluctuations in blood glucose levels, particularly during critical events like AMI, may exert a more immediate influence on patient outcomes. The relationship between poor diabetes management and long- term prognosis remains multifactorial (co-morbidities, treatment adherence, and lifestyle modifications) and these may also significantly impact patient outcomes. Therefore, we must consider broader array of factors, including acute blood glucose levels, to accurately assess cardiovascular risk and tailor treatment strategies accordingly.

The current study examines the relationship between admission glucose levels and short-term outcomes in patients aged 65–84 years who are receiving both non-invasive and invasive therapy for AMI. These outcomes include in-hospital death and cardiac problems. By using analyses stratified by age, type of infarction, and diabetes status, this study will be able to provide insights into the complex function that admission blood glucose levels play in predicting short-term prognosis among particular subgroups of AMI patients. By elucidating these relationships, the study endeavours to inform tailored therapeutic strategies and refine risk stratification protocols, ultimately optimizing outcomes for older individuals navigating the complexities of AMI.

In the management and treatment of ST-segment Elevation Myocardial Infarction (STEMI), the role of glycemic control concerning the prognostic implications of both acute and chronic hyperglycaemia are important. The distinct impact of acute hyperglycaemia, termed as stress hyperglycemias, versus chronic hyperglycemias, typically assessed through HbA1c levels, could significantly influence treatment protocols and potentially improve clinical outcomes in STEMI patients. Acute hyperglycaemia may exacerbate myocardial damage through increased oxidative stress and inflammatory responses, while chronic hyperglycemias, as reflected by HbA1c levels, could indicate underlying vascular complications or a predisposition to more severe cardiac events. By distinguishing the impacts of acute versus chronic hyperglycaemia, the study seeks to provide a more nuanced approach to managing STEMI patients based on their glycemic status at the time of the event and their historical glycemic control.

AIM:

- To study prognostic value of HbA1c and blood glucose in cases with ST
- segment elevation myocardial infarction.

OBJECTIVES:-

- To determine the association between both acute hyperglycaemia or stress hyperglycaemia and chronic hyperglycaemia in patients with STEMI.

MATERIALS AND METHOD-

Study Place: The study was conducted on patients attending the OPD & IPD in the Department of cardiology, Mahatma Gandhi Medical college and Hospital.

Inclusion Criteria:
1. A 12-lead ECG was used to diagnose the patient with acute STEMI.

Exclusion Criteria:
1. Patients with Hb less than 7 mg/dl.

2. Patients with Haemoglobinopathy or Hypothyroidism.

Study Design: It was a Prospective cohort study.

Study Period: All prospective cases admitted in tertiary care hospital from January 2024 til December 2024.

Sampling Including Sample Size Calculation:
Sample size of 90 is obtained by the formula n=4pq/d2 with 95% confidence level, 10% and 5% alpha error. A pilot study was done to determine the total number of cases studied to obtain from the OPD and IPD the Department of Medicine. The total number of OPD and IPD of 20 cases was selected and there were 2-3 cases in each group of 20 selected cases. Thus, it was understood that within the period of 3 months, a total 90 cases sample size will be able to study.

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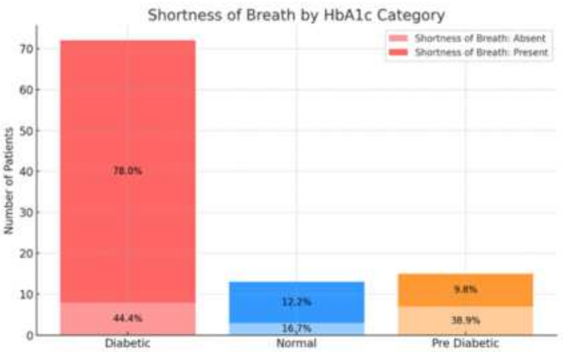
Source Of Data: All patients admitted to the Department of Cardiology IPD at with a diagnosis of STEMI, who met the inclusion and exclusion criteria, were consecutively included until the required sample size was achieved.

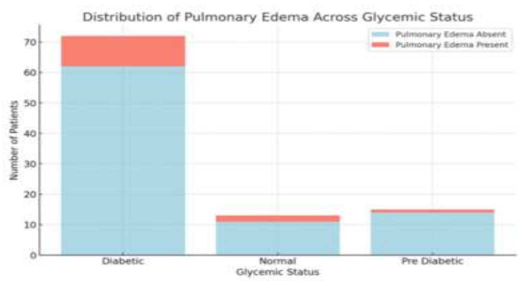
Tools: The primary tools for data collection included standardized digital glucometers for the measurement of blood glucose levels at admission, and high-performance liquid chromatography (HPLC) devices for the accurate determination of HbA1c levels.

Technique: Blood samples were collected from all study participants upon admission before any treatment was administered and were used to measure immediate blood glucose levels and to assess HbA1c.

RESULTS -

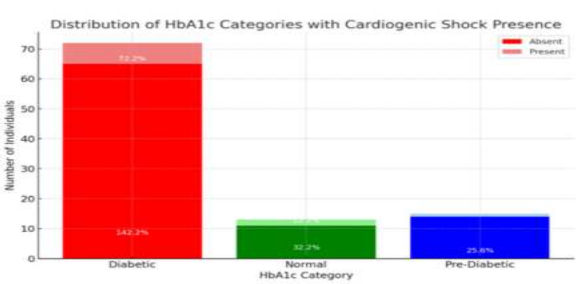


— The above histogram represents the association between shortness of breath and HbA1c levels among diabetic, pre-diabetic, and normal individuals. It reveals that among those with absent shortness of breath, there were 8 diabetic, 3 normal, and 7 pre-diabetic individuals, while among those with present shortness of breath, there were 64 diabetic, 10 normal, and 8 pre-diabetic individuals. Statistical analysis shows a significant association (p =. 004; χ^2 = 10.893) between shortness of breath and HbA1c levels.

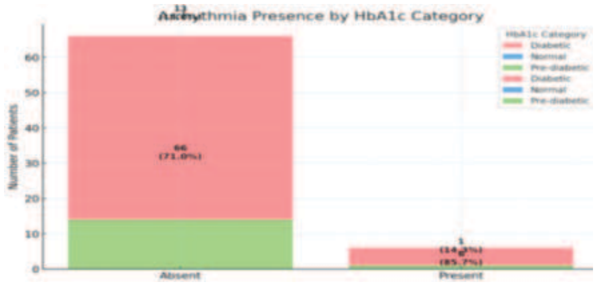


— The distribution of individuals based on their jugular venous pressure (JVP) levels, haemoglobin A1c (HBA1c) status, and diabetic condition. The histogram is structured into three main categories: diabetic, normal, and pre-diabetic, further classified by the absence or presence of JVP. Among individuals with absent JVP, the majority fall into the diabetic category (71.6%), followed by pre-diabetic (15.9%) and normal (12.5%). Conversely, among those with present JVP, the distribution is more evenly spread, with 75.0% classified as diabetic, 16.7% as normal, and 8.3% as pre-diabetic.

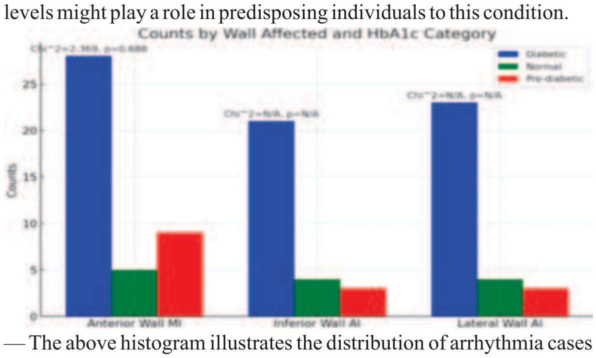
Overall, the total distribution shows 72.0% diabetic, 13.0% normal, and 15.0% pre-diabetic individuals. The P value (.755) and chi-square value (.562a) indicate the statistical significance of the observed distribution.



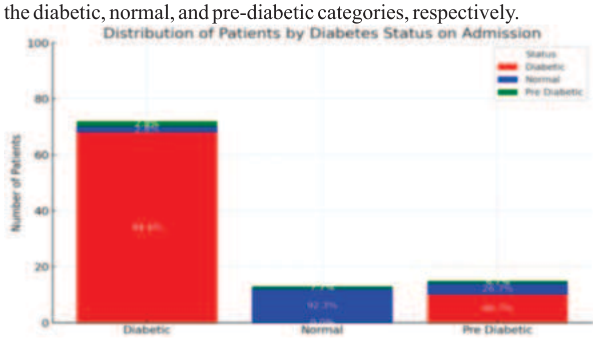
— The above histogram represents the distribution of individuals based on the presence of pulmonary edema, HbA1c levels (categorised as diabetic, normal, or pre-diabetic), and the corresponding statistical analysis including P-value and Chi-square. Among those with absent pulmonary edema, the majority fall under the normal HbA1c category (71.3%), followed by diabetic (12.6%) and pre-diabetic (16.1%). Conversely, among those with present pulmonary edema, a similar trend is observed with the majority having normal HbA1c levels (76.9%), followed by diabetic (15.4%) and pre-diabetic (7.7%). The total distribution across all categories indicates a similar pattern, with the majority having normal HbA1c levels (72.0%), followed by diabetic (13.0%) and pre-diabetic (15.0%). Statistical analysis, indicated by the P-value and Chi-square, further supports these findings.



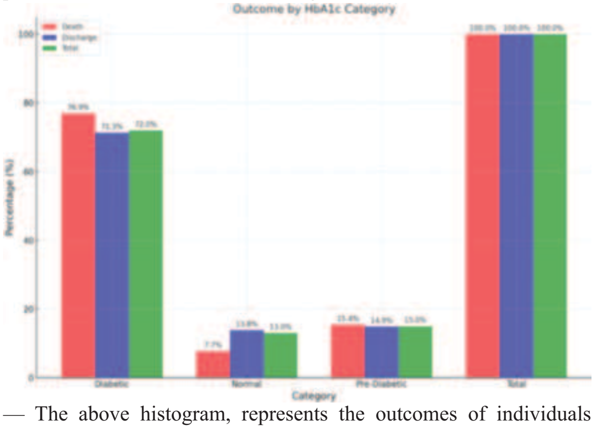
—- The above histogram represents the distribution of patients with cardiogenic shock based on their HbA1c levels, categorized into diabetic, pre-diabetic, and normal, with respect to the presence or absence of cardiac shock. Among those without cardiogenic shock, the majority exhibited normal HbA1c levels (72.2%), followed by pre-diabetic (15.6%) and diabetic (12.2%) categories. Conversely, among patients with cardiogenic shock, similar trends were observed, with the majority having normal HbA1c levels (70.0%), followed by diabetic (20.0%) and pre-diabetic (10.0%) categories. The chi-square test indicated a significant association between HbA1c levels and the presence of cardiogenic shock (p = 0.610), suggesting that HbA1c levels might play a role in predisposing individuals to this condition.



— The above histogram illustrates the distribution of arrhythmia cases across different HbA1c levels, categorized into diabetic, normal, and pre-diabetic groups. The data analysis was conducted using chi-square tests, revealing a significant association between arrhythmia and HbA1c levels (p = 0.555, χ^2 = 1.178). Among individuals without arrhythmia, the majority exhibited normal HbA1c levels (71.0%), followed by pre-diabetic (15.1%) and diabetic (14.0%) levels. Conversely, among those with arrhythmia, the prevalence was highest among individuals with normal HbA1c levels (85.7%), while no cases were observed in the normal group, and a small percentage was in the pre-diabetic category (14.3%). Overall, the analysis included 72 cases without arrhythmia and 28 cases with arrhythmia, comprising a total of 100 individuals, with a distribution of 72.0%, 13.0%, and 15.0% across the diabetic, normal, and pre-diabetic categories, respectively.



— The above histogram represents the distribution of patients with varying glycated haemoglobin (HbA1c) levels across different segments of the heart wall affected by myocardial infarction (MI). The data showcases the prevalence of diabetic, pre-diabetic, and normal HBA1C levels among individuals with MI in the anterior, inferior, and lateral walls. In the anterior wall MI group, out of a total of 42 patients, 28 were diabetic, 5 were normal, and 9 were pre-diabetic, with a chi-square value of 2.369 and a p-value of. 688. Similarly, the table presents corresponding percentages for each subgroup, revealing insights into the distribution patterns of HBA1C levels among MI patients across different heart wall segments.



— The above histogram, represents the outcomes of individuals categorized by their HbA1c levels into diabetic, pre-diabetic, and normal groups. The analysis examines the association between these categories and two outcomes: death and discharge. Among the diabetic group, 76.9% experienced death, while 7.7% were discharged, and 15.4% were pre-diabetic. Conversely, among the discharged individuals, 71.3% were diabetic, 13.8% were pre-diabetic, and 14.9% were normal. The total distribution shows 72.0% diabetic, 13.0% pre-diabetic, and 15.0% normal individuals, with p-values indicating no significant association between HbA1c categories and outcomes (p =. 829 for death and p =. 376 for discharge, Chi-square test).

—- The above histogram, represents the distribution of patients based on RBS (Random Blood Sugar) levels on admission and their corresponding HbA1c categories, categorized as diabetic, normal, and pre-diabetic. A statistical analysis was conducted using P-value and Chi-square tests to evaluate the association between RBS on admission and HbA1c levels. The histogram, illustrates that among the diabetic group, 87.2% had elevated RBS levels on admission, while none had normal RBS levels and 12.8% were in the pre- diabetic range. Conversely, in the normal group, 66.7% had normal RBS levels, with smaller proportions in the diabetic and pre-diabetic categories. In the pre-diabetic group, 50.0% had diabetic RBS levels, 25.0% had normal levels, and 25.0% had pre-diabetic levels. Overall, the analysis underscores a significant association between RBS on admission and HbA1c levels ($\chi2 = 63.635$, $p < 0.000$).

DISCUSSION -

A pivotal tool in the diagnostic armamentarium for DM is glycated haemoglobin (HbA1c). This biomarker provides a trustworthy assessment of the average blood glucose level over roughly three months and is produced by the hemoprotein beta- chain's fast glycation at its N terminus.

Since 2009, the American Diabetes Association and the Diabetes International Committee have both supported the use of HbA1c criteria of 6.5% or higher for diagnosing DM.

Glycated haemoglobin (HbA1c) values below 7% are advised by the American Diabetes Association (ADA) in order to reduce the risk of cardiovascular disease (CVD) in people with diabetes mellitus.3 By managing HbA1c levels and mitigating hyperglycaemia-induced oxidative stress, the progression of atherosclerosis and reduce the incidence of cardiovascular complications in diabetic individuals, particularly those at risk of ACS.4 While HbA1c remains a cornerstone in assessing long-term glycemic control, its direct association with cardiovascular outcomes may be less straightforward than previously assumed.5 Elevated blood glucose levels upon admission are a frequent observation among patients admitted for acute myocardial infarction (AMI), however numerous investigations and meta-analyses have underscored the independent association between hyperglycaemia on admission and adverse outcomes, including increased mortality rates, among individuals hospitalised with AMI.

Higher admission glucose levels have been correlated with a higher Killip class, indicative of greater mortality risk.

Additionally, elevated glucose levels have been implicated in larger infarct sizes and poorer left ventricular function, underlining the prognostic significance of blood glucose levels in AMI.

- In our study, we investigated the relationship between age and gender distribution among participants. Among individuals aged 20-29, there were 4 participants, with 25.0% being female and 75.0% male. In the age group of 30-39, out of 13 participants, 53.8% were female and 46.2% were male. Moving to the 40-49 age range, there were 40 participants, with 35.0% female and 65.0% male. In the 50-59 age bracket, out of 20 participants, 25.0% were female and 75.0% male. For those aged 60-69, out of 16 participants, 12.5% were female and 87.5% male. Lastly, among individuals aged 70-89, all 5 participants were male. The statistical analysis showed a significant relationship between age and gender distribution ($\chi^2 = 9.758$, p =. 135). This suggests that age influences gender distribution among participants in our study.

Our investigation examined the relationship between chest pain and HbA1c levels, classifying participants into diabetic, normal, and pre-diabetic cohorts. Among individuals presenting with chest pain, 72.0% were classified as diabetic, 13.0% exhibited normal HbA1c levels, and 15.0% fell into the pre-diabetic category. Diabetic patients reported lower levels of chest pain compared to their non-diabetic counterparts, with 27.3% experiencing low pain compared to only 3.6% in the non-diabetic group. This finding suggests that diabetes mellitus may influence the perception or severity of chest pain in ACS patients. Other factors such as chest pain trigger, duration, sensation, and history did not show statistically significant differences between the two groups. Our study reveals the importance of considering diabetic status in assessing chest pain severity and its potential impact on ACS management strategies.

- The results from our study reveal the correlation between different levels of HbA1c – a marker for blood sugar control – and two critical outcomes: death and discharge. We grouped individuals into diabetic, pre-diabetic, and normal categories based on their HbA1c levels. Among those identified as diabetic, a staggering 76.9% experienced death, with only 7.7% being discharged and 15.4% categorised as pre-diabetic. Conversely, among those discharged, the majority (71.3%) were in the diabetic category, while 13.8% were pre-diabetic, and 14.9% were classified as normal. Looking at the overall distribution, 72.0% were diabetic, 13.0% were pre-diabetic, and 15.0% were normal.

Importantly, statistical analysis using Chi-square tests revealed no significant association between HbA1c categories and outcomes, with p-values of 0.829 for death and 0.376 for discharge. These findings underscore the complexity of diabetes management and the need for comprehensive approaches beyond glycemic control alone.

- Al-Faraikh et al.,8 study, we delved into the relationship between glycosated hemoglobin (HbA1c) levels and patient outcomes. We found a correlation coefficient of 0.199, indicating a modest positive correlation between HbA1c levels and outcomes. To put it simply, as HbA1c levels increase, there's a tendency for certain outcomes to be affected. This correlation was statistically significant with a p-value of 0.05, reinforcing the reliability of our findings.

Let's discuss the outcomes. Among the participants, 90% were discharged, while 10% unfortunately passed away. The data collected from our study provides insights into the relationship between Random Blood Sugar (RBS) levels upon admission and the corresponding categories of HbA1c levels: diabetic, normal, and pre-diabetic. Through statistical analysis utilising P-value and Chi-square tests, we aimed to discern any significant associations between these variables. Our findings reveal compelling patterns. Among the diabetic cohort, a striking 87.2% exhibited elevated RBS levels upon admission. Conversely, none displayed normal RBS levels, and 12.8% fell within the pre-diabetic range. This stark contrast highlights the strong correlation between diabetic status and elevated RBS levels. In contrast, within the normal HbA1c group, the majority (66.7%) displayed normal RBS levels. However, smaller proportions were observed in the diabetic and pre-diabetic categories. This suggests a trend where normal HbA1c levels are more likely to correspond with normal RBS levels. In the pre-diabetic category, a more nuanced picture emerges. Half of the patients exhibited diabetic RBS levels, while a quarter each fell into the normal and pre-diabetic RBS ranges. This distribution underscores the transitional nature of pre-diabetes and its potential variability in RBS levels.

- Subramanian K et al.,9 examined the demographic characteristics and health parameters of individuals based on their random blood sugar (RBS) levels, with a cutoff of RBS <180 indicating one group and RBS ≥180 indicating another. Let's delve into our findings. Firstly, looking at age distribution, we observed that the majority of participants in both RBS groups fell within the 41-60 age range, with 33.3% in the RBS <180 group and 54.3% in the RBS ≥180 group. Interestingly, there seemed to be no significant difference in age distribution between the two groups (p=0.357). When considering gender, a notable finding emerged. In the RBS <180 group, there were 66.7% males compared to 43.5% in the RBS ≥180 group, showing a statistically significant association between male gender and lower RBS levels (p=0.026). Regarding lifestyle factors, we analysed smoking and alcohol consumption. While there was no significant difference in smoking habits between the two groups (p=0.389), a striking observation was made in alcohol consumption. In the RBS <180 group, 27.8% were alcohol consumers compared to only 8.7% in the RBS ≥180 group, indicating a significant association between lower RBS levels and alcohol consumption (p=0.021). Moving on to medical history, the prevalence of diabetes mellitus stood out prominently. Only 16.7% of individuals in the RBS <180 group had diabetes mellitus compared to a staggering 65.2% in the RBS ≥180 group, indicating a strong association between higher RBS levels and diabetes mellitus (p=0.000). Additionally, the mean levels of glycated hemoglobin (HbA1C) were markedly different between the two groups, with the RBS <180 group showing a lower mean (5.24±0.17) compared to the RBS ≥180 group (8.07±1.39), which was statistically significant (p=0.0001).

CONCLUSION AND RECOMMENDATION -

- Significant variations in HbA1c levels are evident across different age groups, with the older age brackets showing a higher prevalence of diabetic levels
- Gender distribution across different HbA1c categories shows no significant association.
- Analysis of chest pain with HbA1c levels shows no significant difference across categories, with all participants distributed similarly across diabetic, normal, and pre-diabetic conditions.
- A significant association is observed between the presence of shortness of breath and varying HbA1c levels
- No significant association is detected between jugular venous pressure and HbA1c levels.
- Pulmonary edema shows no significant association with HbA1c levels; both absent and present cases show similar distributions across HbA1c categories.
- Cardiogenic shock analysis suggests no significant impact of HbA1c levels on the condition.
- Arrhythmia distribution across HbA1c levels does not show significant differences
- Myocardial infarction analysis shows no significant difference in HbA1c levels across different affected walls
- Outcomes of death and discharge among individuals show no significant association with HbA1c levels, with death and discharge
- There is a strong correlation between RBS on admission and HbA1c levels

Summary-

The study highlights the significant correlation between high admission glucose levels and increased adverse outcomes, such as congestive heart failure, cardiogenic shock, and death. Hyperglycaemia at admission often reflects a stress response, but can also indicate undiagnosed diabetes or impaired glucose tolerance. The study underscores the importance of HbA1c as a reliable biomarker for diagnosing diabetes and its potential in distinguishing between stress-induced and chronic hyperglycaemia. It emphasises the predictive value of admission glucose levels for both short-term and long-term mortality in STEMI patients, irrespective of their diabetic status. Additionally, the study explores the implications of elevated HbA1c levels on cardiovascular risks and the importance of managing these levels to improve patient outcomes.

Overall, the study advocates for rigorous glycemic control and the use of HbA1c as a screening tool to improve the management and prognosis of STEMI patients.

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