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Clinical Profile and Prognosis of Critically Ill Patients: Emphasis on Glycemic Status

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ABSTRACT

Background: Admission hyperglycemia, irrespective of prior diabetic status, is associated with increased mortality and adverse outcomes in critically ill patients. Several studies have demonstrated that stress hyperglycemia in non-diabetics confers a worse prognosis than chronic hyperglycemia in known diabetics.[1–4]

Objectives: To evaluate the clinical profile and prognosis of critically ill patients with emphasis on glycemic status and its association with mortality and length of hospital stay.

Methods: A prospective observational study was conducted on 441 adult patients admitted to the MICU and ICCU of a tertiary care hospital. Patients were stratified into diabetics, non-diabetics with stress hyperglycemia, and non-diabetics without hyperglycemia. Clinical outcomes were compared across groups.

Results: Non-diabetics with stress hyperglycemia had the highest mortality (68.66%) and longest hospital stay. Admission blood glucose >150 mg/dl was significantly associated with increased mortality ($p < 0.05$).

Conclusion: Stress hyperglycemia is a strong independent predictor of mortality and prolonged hospitalization in critically ill patients, particularly among non-diabetics.

Keywords: *Stress hyperglycemia, critical illness, mortality, ICU outcomes, diabetes*

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1. INTRODUCTION

Hyperglycemia at hospital admission has consistently emerged as a powerful prognostic marker in critically ill patients, regardless of diabetic status. [1-3] Elevated glucose levels have been associated with poor outcomes following acute myocardial infarction, stroke, sepsis, and trauma. [2-7]

Stress hyperglycemia results from neuroendocrine activation involving catecholamines, cortisol, glucagon, and inflammatory mediators, leading to insulin resistance and increased hepatic gluconeogenesis. [9-13] Evidence suggests that stress-induced hyperglycemia reflects greater disease severity and confers a worse prognosis in non-diabetic patients compared to those with established diabetes.[3,4,8]

2. AIMS AND OBJECTIVES

1. To assess the effect of hyperglycemia on the clinical profile of critically ill patients
2. To determine mortality rates according to glycemic status
3. To evaluate the impact of glycemic status on hospital length of stay
4. To compare diagnostic categories across glycemic groups

3. MATERIALS AND METHODS

This prospective observational study was conducted in the Medical Intensive Care Unit (MICU) and Intensive Cardiac Care Unit (ICCU) of a tertiary care teaching hospital over a period of fifteen months, from March 2015 to May 2016. A total of 441 consecutive adult patients admitted to the MICU and ICCU during the study period were enrolled in the study. All adult patients admitted during the study period were considered eligible for inclusion. Patients who refused to provide informed consent were excluded from the study.

At the time of admission, detailed clinical and demographic data were collected for each patient. Admission blood glucose levels and glycated hemoglobin (HbA1c) were measured to assess glycemic status and to differentiate between known diabetes, stress-induced hyperglycemia, and normoglycemia, as described in previous studies.[1],[8] Demographic variables including age and gender were recorded. Clinical information regarding the primary diagnosis and system involvement was documented, along with hemodynamic parameters. Outcome measures included duration of hospital stay and in-hospital mortality.

Patients were stratified into three groups based on admission blood glucose levels and HbA1c values: known diabetics, non-diabetics with stress hyperglycemia, and non-diabetics without hyperglycemia.

Statistical analysis was performed using standard descriptive and inferential statistical methods. Continuous variables were expressed as mean ± standard deviation, and categorical variables were expressed as percentages. Intergroup comparisons were carried out using the chi-square test for categorical variables and the unpaired Student's *t*-test for continuous variables. A *p*-value of less than 0.05 was considered statistically significant.[14]

4. RESULTS

A total of 441 critically ill adult patients admitted to the MICU and ICCU were included in the final analysis. Patients were categorized into three groups based on glycemic status at admission: diabetics, non-diabetics with stress hyperglycemia, and non-diabetics without hyperglycemia.

Glycemic Status of Study Population

Of the total study population, 138 patients (31.29%) were known diabetics, 150 patients (34.01%) were non-diabetics with stress hyperglycemia, and 153 patients (34.69%) were non-diabetics without hyperglycemia (Table 1). The mean admission blood glucose level was highest among diabetics (187.12 ± 40.14 mg/dl), followed by non-diabetics with stress hyperglycemia (148.20 ± 7.74 mg/dl), while the lowest values were observed in non-diabetics without hyperglycemia (93.95 ± 8.71 mg/dl).

Age Distribution

The majority of patients belonged to the older age groups. Most patients (68.02%) were between 51 and 70 years of age (Table 2). The highest proportion was observed in the 51–60 year age group (35.15%), followed by the 61–70 year group (32.87%). This age distribution reflects the increased vulnerability of older adults to critical illness and is consistent with previously reported epidemiological data.[15–18]

Gender Distribution

Gender distribution was nearly equal, with a slight male predominance. Males constituted 222 patients (50.34%), while females accounted for 219 patients (49.66%) (Table 3).

Diagnostic Spectrum

Neurological disorders constituted the most common cause of ICU admission (27.66%), followed closely by cardiovascular disorders (26.30%). Respiratory illnesses accounted for 17.46% of admissions, renal disorders for 16.32%, and other conditions including gastrointestinal diseases, sepsis, and miscellaneous causes for 12.24% of cases (Table 4).

Mortality According to Glycemic Status

Overall mortality differed significantly across the three glycemic groups. Non-diabetic patients with stress hyperglycemia had the highest mortality rate (68.66%), followed by diabetics (52.89%). Non-diabetic patients without hyperglycemia had the lowest mortality rate (13.72%) (Table 5). Mortality was significantly higher among patients with stress hyperglycemia when compared with the other groups ($p < 0.05$), in agreement with previous studies.[3–5,7,8]

Length of Hospital Stay

Prolonged hospital stay (≥5 days) was most frequently observed in non-diabetic patients with stress hyperglycemia (63.33%), followed by diabetic patients (46.37%). Only 19.60% of non-diabetic patients without hyperglycemia required hospital stay of five days or more (Table 6), indicating a strong association between hyperglycemia and prolonged

hospitalization.

Table 1. Distribution of Patients by Glycemic Status (n = 441)

Glycemic Group	Number (%)	Mean Blood Glucose (mg/dl ± SD)
Diabetic	138 (31.29)	187.12 ± 40.14
Non-diabetic with stress hyperglycemia	150 (34.01)	148.20 ± 7.74
Non-diabetic without hyperglycemia	153 (34.69)	93.95 ± 8.71

Table 2. Age Distribution of Patients

Age Group (years)	Number (%)
<30	15 (3.40)
31–40	26 (5.90)
41–50	100 (22.68)
51–60	155 (35.15)
61–70	145 (32.87)
>70	50 (11.34)

Most patients (68.02%) belonged to the 51–70-year age group, consistent with previous epidemiological studies.[15-18]

Table 3. Gender Distribution

Gender	Number (%)
Male	222 (50.34)
Female	219 (49.66)

Table 4. Diagnostic Spectrum of Patients

Diagnostic Category	Number (%)
Neurological	122 (27.66)
Cardiovascular	116 (26.30)
Respiratory	77 (17.46)
Renal	72 (16.32)
Others	54 (12.24)

Table 5. Mortality by Glycemic Status

Glycemic Group	Mortality (%)
Diabetic	52.89
Non-diabetic with stress hyperglycemia	68.66
Non-diabetic without hyperglycemia	13.72

Mortality was significantly higher in patients with stress hyperglycemia ($p < 0.05$).[3-5,7,8]

Table 6. Hospital Stay ≥5 Days by Glycemic Status

Glycemic Group	≥5 Days Stay (%)
Diabetic	46.37
Non-diabetic with stress hyperglycemia	63.33
Non-diabetic without hyperglycemia	19.60

Table 7. Association Between Glycemic Status and Mortality

Glycemic Group	Survivors n (%)	Non-Survivors n (%)
Diabetic	65 (47.11)	73 (52.89)
Non-diabetic with stress hyperglycemia	47 (31.34)	103 (68.66)
Non-diabetic without hyperglycemia	132 (86.28)	21 (13.72)

Chi-square test: $p < 0.05$
Stress hyperglycemia showed a statistically significant association with increased mortality.

Table 8. Association Between Glycemic Status and Length of Hospital Stay

Glycemic Group	<5 Days n (%)	≥5 Days n (%)
Diabetic	74 (53.63)	64 (46.37)
Non-diabetic with stress hyperglycemia	55 (36.67)	95 (63.33)
Non-diabetic without hyperglycemia	123 (80.40)	30 (19.60)

Chi-square test: $p < 0.05$
Stress hyperglycemia was significantly associated with prolonged hospital stay.

Table 9. Association Between Admission Blood Glucose Level and Mortality

Admission Blood Glucose	Mortality (%)
≤150 mg/dl	34.01
>150 mg/dl	65.99

Higher admission blood glucose levels were significantly associated with increased mortality ($p < 0.05$).[6,7]

Stress hyperglycemia in non-diabetic patients was associated with **highest mortality** and **longest hospital stay**. Admission blood glucose >150 mg/dl significantly increased mortality risk. Older age groups (51–70 years) formed the majority of critically ill patients. Neurological and cardiovascular diseases were the leading causes of ICU admission

5. DISCUSSION

The present study highlights the prognostic significance of admission hyperglycemia in critically ill patients, with a particular emphasis on stress hyperglycemia in non-diabetic individuals. Our findings demonstrate that non-diabetic patients with stress hyperglycemia experienced the highest in-hospital mortality and the longest duration of hospital stay. These observations corroborate earlier reports by Capes et al.[3] and Umpierrez et al.[1,8] and reinforce the concept that stress hyperglycemia is a powerful marker of disease severity rather than a benign physiological response.

Several large-scale studies have documented the adverse prognostic impact of hyperglycemia in acute medical conditions such as myocardial infarction, stroke, and sepsis.[2-4,7] In a systematic overview, Capes et al.[3] reported a 3.9-fold increased risk of mortality in non-diabetic patients with stress hyperglycemia following acute myocardial infarction. Similarly, Candelise et al.[4] observed significantly higher mortality rates among non-diabetic stroke patients with elevated blood glucose levels compared to their diabetic counterparts with comparable glucose values. These findings are consistent with the results of the present study, in which non-diabetics with stress hyperglycemia had worse outcomes than both diabetics and normoglycemic patients.

The pathophysiological mechanisms underlying stress hyperglycemia are multifactorial and reflect a complex neuroendocrine and inflammatory response to acute illness. Stress-induced activation of the hypothalamic–pituitary–adrenal axis leads to increased secretion of catecholamines, cortisol, glucagon, and growth hormone, resulting in enhanced hepatic gluconeogenesis and peripheral insulin resistance.[9-13] Additionally, pro-inflammatory cytokines such as tumor necrosis factor-α and interleukin-1 impair insulin signaling and promote endothelial dysfunction, oxidative stress, and microvascular injury, thereby contributing to organ dysfunction and increased mortality.[11-13]

An important observation from this study is that chronic hyperglycemia in diabetic patients was associated with lower mortality than stress hyperglycemia in non-diabetic patients. This paradoxical finding has been reported previously and may be attributed to adaptive mechanisms in patients with long-standing diabetes, including cellular tolerance to elevated glucose levels and prior exposure to glycemic control therapies.[1,8] In contrast, acute hyperglycemia in non-diabetics may represent a maladaptive metabolic response indicative of severe physiological stress and poor host reserve.

The association between elevated admission blood glucose levels and prolonged hospital stay observed in this study further underscores the clinical significance of stress hyperglycemia. Similar findings have been reported by Krinsley et al.[19] and Park et al.[6], who demonstrated that hyperglycemia was associated with longer ICU stays, increased complication rates, and greater resource utilization. Prolonged hospitalization not only reflects disease severity but also contributes to increased healthcare costs and the risk of hospital-acquired complications.

From a clinical perspective, these findings have important implications for the management of critically ill patients. Stress hyperglycemia should be recognized as an independent risk factor for adverse outcomes and not merely as a transient metabolic abnormality. Early identification and close monitoring of blood glucose levels at admission, even in patients without a prior history of diabetes, are essential. Current guidelines advocate for controlled glycemic management in critically ill patients, emphasizing the avoidance of both severe hyperglycemia and hypoglycemia.[21-23]

Despite its strengths, including a prospective design and a substantial sample size, this study has certain limitations. The single-center nature of the study may limit the generalizability of the findings. Additionally, the absence of multivariate analysis and inflammatory biomarker assessment restricts the ability to establish causality and to explore mechanistic pathways in greater detail. Nevertheless, the consistency of our results with existing literature supports the robustness of our conclusions.

In summary, this study reinforces the concept that stress hyperglycemia in non-diabetic patients is a strong predictor of mortality and prolonged hospital stay in critical illness. Recognition of stress hyperglycemia as a marker of disease severity and implementation of appropriate glycemic surveillance and management strategies may contribute to improved clinical outcomes.

6. CONCLUSION

Admission hyperglycemia is a strong independent predictor of mortality and prolonged hospitalization in critically ill patients. Stress hyperglycemia in non-diabetics carries the worst prognosis. Routine screening and aggressive glycemic management should be integral components of critical care protocols. [21-23]

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