ORIGINAL ARTICLE

Hospital Hyperglycemia is Associated with Adverse Short-term Metabolic and Mortality Outcomes

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Received: 15 July 2023; *Accepted:* 20 January 2026

Abstract

Introduction: Stress hyperglycemia has been implicated in acute illnesses, but the risk of future diabetes is seldom studied. Hospital hyperglycemia, as defined by in-hospital random blood glucose (RBG) >140 mg/dL, is much less studied. This study aimed to determine the profile and short-term outcome of hospital hyperglycemia patients.

Methods: A descriptive follow-up study was conducted in 50 patients with hospital hyperglycemia. Based on their HbA1c status, patients were categorized into known cases of diabetes (group A, $n = 12$, 24%), undiagnosed diabetes (group B, $n = 13$, 26%), prediabetes (group C, $n = 13$, 26%), and normoglycemic (group D, $n = 12$, 24%). Duration of hospital stay and in-hospital mortality were noted. At 4 weeks post-discharge, HbA1c, along with the glucose tolerance test, was performed for groups C and D, and outcomes were recorded.

Results: Half of the hospital hyperglycemia patients were diabetic, although 26% of the patients with hospital hyperglycemia were unaware of their diabetes status. Average age and BMI were found to be higher in diabetes patients (25.63 ± 5.25 kg/m^2) than prediabetes (22.98 ± 2.24 kg/m^2) and normoglycemic patients (21.38 ± 2.37 kg/m^2). Two deaths were encountered during hospital stay in the prediabetes group.

At 4 weeks post-discharge, in group C, 2 (8.7%) developed diabetes, 4 (17.4%) had impaired fasting glucose, and 3 (13%) had impaired glucose tolerance. One prediabetes patient became normoglycemic. All 12 patients of group D remained normoglycemic.

Conclusion: Hospital hyperglycemia in diabetics as well as prediabetes subjects is associated with a higher age and BMI compared to normoglycemic individuals. Hospital hyperglycemia in prediabetes subjects is associated with higher mortality and greater propensity to develop diabetes in the short-term, compared to normoglycemic individuals.

Journal of The Association of Physicians of India (2026): 10.59556/japi.74.1391

Introduction

The American Diabetes Association[1] has defined hyperglycemia in hospitalized patients as blood glucose levels >140 mg/dL (7.8 mmol/L). HbA1c ≥6.5%. can help in differentiating preexisting diabetes from stress hyperglycemia. HbA1c <6.5% with a blood glucose value >140 mg/dL qualifies as stress hyperglycemia.[2] In other words, stress hyperglycemia can be defined as a transient increase in blood glucose during an acute physiological stress in the absence of diabetes. Stress or injury alters normal glucose metabolism and peripheral insulin resistance, thus resulting in stress hyperglycemia. Hospitalization is also an acute stressor, physical and/or mental, and hence, may be considered to contribute to stress hyperglycemia. Patients with hyperglycemia and no previous diagnosis of diabetes have more adverse outcomes compared to patients with preexisting diabetes, for a given degree of hyperglycemia.[3]

Varying rates of hyperglycemia in hospitalized patients have been reported, to the extent that one-third of critically ill patients in tertiary care facilities were reported to be hyperglycemic.[4] Interestingly, one in five adult patients with stress hyperglycemia was reported to have undiagnosed diabetes.[5]

The entity of "hospital hyperglycemia" has not been widely studied, and the follow-up of these patients is hardly available. Keeping in view the importance of hyperglycemia and undiagnosed diabetes in patients getting admitted to hospitals and critical care units, the present study was planned to determine the profile and short-term outcome of patients with hospital hyperglycemia.

Materials and Methods

A descriptive 4-week follow-up study was conducted in a tertiary care hospital in India. A convenient sample of 50 adult (age ≥ 18 years) patients was taken over an 18-month period from January 2021 to June 2022. The study was approved by the Institutional Ethics Committee. Informed written consent was obtained from each patient. Patients presenting to the emergency department of the Medicine were screened for entry into the study, and patients having a random blood glucose level at admission >140 mg/dL were included. Type 1 diabetes patients and patients having severe anemia (Hb <7 gm%) were excluded.

Patient's demographic details along with health-related information, with particular emphasis on details about diabetic status, family history of diabetes, and body mass index (BMI), were recorded in a predesigned, pretested structured proforma. Patients' blood samples (2–3 mL of venous blood) were collected for HbA1c, in addition to other routine investigations, as required for standard of care. Duration of hospital stay and outcome were noted for each patient over a 4-week period. Venous blood was collected for measurement of blood glucose in fluoride vials, and laboratory assessment was done employing the glucose oxidase-peroxidase method, while blood collection was done in an EDTA vial for HbA1c estimation, and the latex agglutination inhibition method was employed in an automated analyzer (Beckman Coulter AU Analyzer).

The patients having hyperglycemia (>140 mg/dL) at admission, who were included in the study, were classified into four groups based on the presence of a history of diabetes diagnosis and HbA1c values at admission:

- Group A: Previously diagnosed type 2 diabetes patients (T2DM) who had RBS > 140 mg/dL.
- Group B: Undiagnosed T2DM. Patients who had RBS > 140 mg/dL at admission, and HbA1c value came out to be ≥6.5%.
- Group C: Prediabetes group—Patients with HbA1c between 5.7 and 6.4% were referred to as the prediabetes group.
- Group D: Nondiabetics—Patients having RBS >140 mg/dL and HbA1c value on testing was < 5.7%.

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How to cite this article: Ojha A, Aggarwal R, Prakash A, *et al.* Hospital Hyperglycemia is Associated with Adverse Short-term Metabolic and Mortality Outcomes. J Assoc Physicians India 2026;74(3):59–61.

After 4 weeks, groups C and D patients were subjected to an oral glucose tolerance test (OGTT) and repeat HbA1c levels. Fasting blood sugar after an overnight 8–12 hours duration fasting and 2-hour post-75 gm glucose (given mixed with 250–300 mL water) blood sugar values were performed in the same sitting for an OGTT. Depending on the values obtained, patients were categorized as normal glucose tolerance, prediabetes (impaired fasting glucose, impaired glucose tolerance), and type 2 diabetes mellitus, as per the ADA classification (Fig. 1).[6]

The collected data was transcribed on to Microsoft Excel spreadsheet on a personal computer. Information is presented as mean ± SD and as proportions and percentages.

Results

Average age of patients of hospital hyperglycemia (n = 50) studied was 43.42 ± 16.41 years. There was a slight female preponderance in the study with a male-to-female ratio of 0.8:1. The average body mass index (BMI) of the study group was 23.99 ± 4.5 kg/m^2 and hospital stay duration was 10.28 ± 4.3 days.

Average age, BMI, and duration of hospital stay in the different groups are outlined in Table 1. Average age as well as the BMI varied, with least being for the subjects of normoglycemia group but increasing in prediabetes to undiagnosed diabetes mellitus, and known cases of diabetes mellitus.

Half of the hospital hyperglycemia patients were diabetics (n = 25), of which 48% (n = 12) were previously diagnosed with diabetes, and 52% (n = 13) had preexisting diabetes (HbA1c ≥ 6.5%), but were unaware of their diabetes status. Only one out of 12 previously known diabetic patients had HbA1c under control, and the rest of the diabetic patients had HbA1c > 6.5%, but none had HbA1c > 8.5%. Patients who were unaware that they had diabetes and were diagnosed at admission had HbA1c values ranging from 6.6 to 12.6%.

At admission, 26% (n = 13) of the study population was prediabetic (group C), while 24% (n = 12) were normoglycemic (group D). On following up groups C and D, to assess for hospital admission-related outcomes, two (8%) patients of group C (prediabetes) expired during in-hospital stay. The cause of death was lung abscess with acute respiratory distress syndrome in one of the patients and tuberculous meningitis in the other. There were no expiries in the other groups.

Duration of hospital stay did not vary significantly, though it was on the higher side (10.42 ± 3.4 days) in patients with higher mean HbA1c as seen in previously known cases of diabetes (7.35 ± 0.6%), compared to 9.25 ± 4.79 days hospital stay in nondiabetic patients with HbA1c < 5.7%.

Table 2 illustrates the outcomes of group C and group D on OGTT at 4-week follow-up (n = 23, excluding two patients who had expired). Two patients (8.7%) were diagnosed to have T2DM, four patients (17.4%) had impaired fasting glucose (IFG), and three patients (12%) had impaired glucose tolerance (IGT). One patient who was having prediabetes (belonging to group C) became normoglycemic, while 12 patients belonging to Group D remained normoglycemic.

Discussion

Acute illnesses can lead to the development of hospital hyperglycemia, but this stress response is presumed to be transient. Stress hyperglycemia typically resolves when the acute illness or the surgical stress is cured.[7] However, the natural course of patients who develop stress hyperglycemia is as yet uncharacterized. Although diabetes patients who present with hyperglycemia at admission have greater adverse outcomes, the same cannot be said categorically for nondiabetic patients. Nondiabetics can have hospital hyperglycemia due to impaired glycemic control as in prediabetes or due to an increase in counter-regulatory hormones such as cortisol, glucagon and growth hormone. Whether stress induced hyperglycemia directly causes harm or is a marker of severity of counter-regulatory hormone release, inflammatory response, and degree of illness is not known.[8] Other risk factors, such as age, family history of diabetes mellitus, and BMI, may also have a contribution.

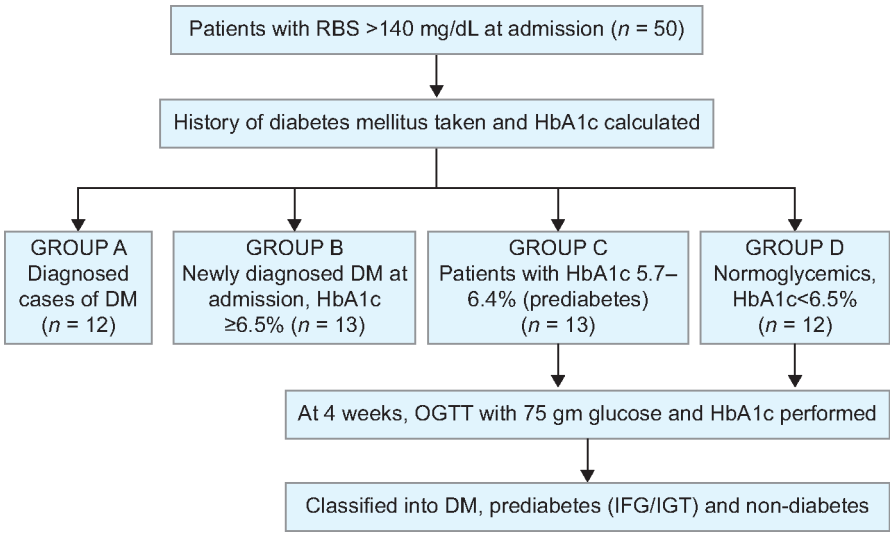

Fig. 1: Flow of patients and distribution in various groups

Table 2: Classification of hospital hyperglycemia patients (admission HbA1c < 6.5%) at 4 weeks follow-up, based on OGTT results

Diabetic status at follow-up	*Frequency*
Normoglycemia	14
Prediabetes (IFG, IGT)	7 (IFG = 4, IGT = 3)
Newly diagnosed T2DM	2
Mortality	2
Total	25

Table 1: Comparison of parameters in the four study groups

Parameters	*Group A Known DM (n = 12)*	*Group B Undiagnosed DM (n = 13)*	*Group C Prediabetes (n = 13)*	*Group D Normoglycemia (n = 12)*
Family history of DM	7 (58.33%)	2 (15.38%)	2 (15.38%)	2 (16.67%)
Age (years)†	56.67 ± 9.63	45.77 ± 15.7	37.62 ± 16.76	33.92 ± 13.96
BMI (kg/m^2)††	26.43 ± 5.05	25.14 ± 5.83	22.98 ± 2.24	21.38 ± 2.37
Duration of hospital stay (days)	10.42 ± 3.4	10.69 ± 4.19	10.69 ± 5.01	9.25 ± 4.79

†p = 0.002; ††p = 0.023 (ANOVA)

In the present study, out of 50 patients with hospital hyperglycemia, 56% (n = 28) were female and 44% (n = 22) were male. In a study conducted by Russo et al.,[2] there were 55% males among hospital hyperglycemia patients. The difference in the result could be due to nonuniform data distribution and a small sample size. In this study on hospital hyperglycemia, mean BMI was higher in diabetic subgroups (25.63 ± 5.25 kg/m^2) compared to nondiabetic subgroups (22.49 ± 2.58 kg/m^2).

The present study revealed that 26% of patients who had hospital hyperglycemia were not aware that they had diabetes, and an equal number had prediabetes. Greci et al.[5] reported that one in five adult patients with stress hyperglycemia as having unrecognized diabetes. O'Sullivan et al.[9] studied 126 patients with hyperglycemia and found that only 11 patients were newly diagnosed diabetics at admission. The lesser number of newly diagnosed patients as compared to our study could be because of the different methodology adopted by them for diagnosing diabetes mellitus. They included patients with RBS >180 mg/dL on two occasions and labelled as newly detected diabetic patients, while the present study used an HbA1c value ≥ 6.5% along with hospital hyperglycemia, i.e., random blood sugar at presentation > 140 mg/dL. Therefore, it is likely that the numbers in O'sullivan's study may be underreported. Further, the higher number of undiagnosed diabetes population among the hospital hyperglycemia patients in the present study could be a reflection of the high prevalence of diabetes among the Indian population. The overall prevalence of type 2 diabetes varies from 8 to 12%, while an equal number of people are in the prediabetes range, as has been evidenced by the ICMR-INDIAB study.[10] Our study highlighted the fact that diabetes mellitus still remains one of the silent comorbidities in patients, irrespective of their illness.

Half of the hospital-hyperglycemia patients in our study were nondiabetic at admission. These patients had RBS > 140 mg/dL at admission but HbA1c < 6.5%. Out of 269 patients of hospital hyperglycemia studied by Tamez-Pérez et al.,[11] 164 (61%) did not have diabetes at presentation, which was slightly higher than the present study, and may be attributed to the high prevalence of diabetes and prediabetes in our population.

In our study, we found that 26% (n = 13) of the studied population were prediabetic at the time of admission. These patients had HbA1c between 5.7 and 6.4%. In a study conducted to find the prevalence of prediabetes among hypertensive patients, the prevalence of prediabetes was 18%.[12] In another study by Mustafa et al.,[13] the prevalence of prediabetes in Malaysian adults was found to be 22.1%.

The variation witnessed in our results when compared to other works, can be attributed to regional and ethnic variations in prevalence of diabetes and atherosclerotic risk factors in south Asia, as also the fact that criteria for hospital hyperglycemia (>140 mg/dL) as enunciated by ADA, which is used in this study is the more stringent one, compared to earlier ones, when the cut-off was higher. Since definitions of hospital hyperglycemia, as well as tools for defining it, as used by various authors, are variable, the results reported in the literature are difficult to compare with our results. Application of a uniform criterion would give a better projection of undiagnosed diabetes in hospital hyperglycemia patients.

In our study, we found that two patients (8.7%) were prediabetics and developed T2DM at follow-up. In a study to determine the incidence of type 2 diabetes among IFG patients, 53 out of 633 patients (8%) developed type 2 diabetes as observed by Forouhi et al.[14] There is a paucity of published literature on the incidence of diabetes mellitus in hospital hyperglycemia patients.

In our study, 2 of 50 patients (4%) diagnosed with hospital hyperglycemia at admission died during the hospital stay. Both these patients belonged to group C (prediabetes group). In another study by Russo et al.[15], the mortality rate at 1 year was 13.24% in stress hyperglycemia patients. However, death in prediabetic subjects in our study was a little intriguing, as there was no mortality witnessed among previously diagnosed (group A) or undiagnosed diabetes patients (group B) in the present study. Chronic hyperglycemia also plays a role by inducing protective cellular conditioning and downregulation of glucose transporters, which would protect cells from unchecked glucose ingress. These protective mechanisms are found to be absent in patients with hospital-related or stress hyperglycemia,[16] and therefore, expiry among the prediabetes patients may be explained on the basis of the lack of these protective mechanisms.

Conclusion

Stress hyperglycemia remains one of the predictable biochemical markers of developing diabetes mellitus in the future. Hence, any patient presenting with hospital hyperglycemia should be thoroughly investigated and followed for a minimum period of 4 weeks for screening for diabetes. Nondiabetic patients with hospital hyperglycemia carry a risk of developing diabetes in the future. Family history of diabetes and BMI shows positive correlation among diabetes patients. Recent onset hyperglycemia carries a greater risk of short-term mortality. Adequate glycemic control, as measured by HbA1c < 5.7%, is associated with lesser morbidity (shorter duration of hospital stay).

Also, diabetes mellitus is still one of the silent comorbidities in asymptomatic patients, as observed in our study.

References

1. American Diabetes Association. Diabetes care in the hospital: standards of medical care in diabetes-2021. Diabetes Care 2021;44(Suppl 1):S211–S220.
2. Russo MP, Elizondo CM. Prevalence of hyperglycemia and incidence of stress hyperglycemia in hospitalized patients: a retrospective cohort. Eur J Intern Med 2017;43:e15–e17.
3. Dungan KM, Braithwaite SS, Preiser JC. Stress hyperglycaemia. Lancet 2009;373(9677):1798–1807.
4. DiNardo MM, Korytkowski MT, Siminerio LS. The importance of normoglycemia in critically ill patients. Crit Care Nurs Q 2004;27:126–134.
5. Greci LS, Kailasam M, Malkani S, et al. Utility of HbA1c levels for diabetes case finding in hospitalized patients with hyperglycemia. Diabetes Care 2003;26:1064–1068.
6. American Diabetes Association Professional Practice Committee. Classification and diagnosis of diabetes: standards of medical care in diabetes-2022. Diabetes Care 2022;45(Suppl 1):S17–S38.
7. Garber AJ, Moghissi ES, Bransome ED Jr, et al. American College of Endocrinology position statement on inpatient diabetes and metabolic control. Endocr Pract 2004;10(1):77–82.
8. Fahy BG, Sheehy AM, Coursin DB. Glucose control in the intensive care unit. Crit Care Med 2009;37:1769–1776.
9. O'Sullivan EP, Duignan J, O'Shea P, et al. Evaluating hyperglycaemia in the hospitalised patient: towards an improved system for classification and treatment. Ir J Med Sci 2014;183(1):65–69.
10. Anjana RM, Pradeepa R, Deepa M, et al. Prevalence of diabetes and prediabetes (impaired fasting glucose and/or impaired glucose tolerance) in urban and rural India: phase I results of the Indian Council of Medical Research-INdia DIABetes (ICMR-INDIAB) study. Diabetologia 2011;54(12):3022–3027.
11. Tamez-Pérez HE, Quintanilla-Flores DL, Proskauer-Peña SL, et al. Inpatient hyperglycemia: clinical management needs in teaching hospital. J Clin Transl Endocrinol 2014;1(4):176–178.
12. Meme N, Amwayi S, Nganga Z, et al. Prevalence of undiagnosed diabetes and pre-diabetes among hypertensive patients attending Kiambu district Hospital, Kenya: a cross-sectional study. Pan Afr Med J 2015;22:286.
13. Mustafa N, Kamarudin NA, Ismail AA, et al. Prevalence of abnormal glucose tolerance and risk factors in urban and rural Malaysia. Diabetes Care 2011;34(6):1362–1364.
14. Forouhi NG, Luan J, Hennings S, et al. Incidence of type 2 diabetes in England and its association with baseline impaired fasting glucose: the Ely study 1990–2000. Diabet Med 2007;24(2):200–207.
15. Russo MP, Ratti MFG, Giunta DH, et al. Hospitalized patients with stress hyperglycemia: incidence of diabetes and mortality on follow-up. Endocrinol Diabetes Nutr 2018;65(10):571–576.
16. Pakhetra R, Garg MK, Suryanarayana KM. Management of hyperglycemia in critical illness: review of targets and strategies. Med J Armed Forces India 2011;67(1):53–57.