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Original Research Article

COMPARATIVE ASSESSMENT OF GLYCAEMIC VARIABILITY AND HYPOGLYCAEMIC EPISODES IN HOSPITALIZED PATIENTS RECEIVING BASAL-BOLUS VERSUS BASAL-PLUS INSULIN REGIMENS

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ABSTRACT

Background: Effective glycaemic management in hospitalized patients with type 2 diabetes mellitus is essential to minimize hyperglycaemia, glycaemic fluctuations, and hypoglycaemic complications. Basal-bolus and basal-plus insulin regimens are commonly employed approaches with different treatment intensities and safety profiles. **Aim:** To compare glycaemic variability, hypoglycaemic episodes, glycaemic control, and hospitalization outcomes among patients receiving basal-bolus versus basal-plus insulin regimens.

Materials and Methods: The present prospective comparative observational study included 98 hospitalized patients with type 2 diabetes mellitus at a tertiary care hospital. Patients were divided into two groups: basal-bolus (n=49) and basal-plus (n=49). Demographic characteristics, glycaemic parameters, glucose variability, hypoglycaemic episodes, insulin requirements, and hospitalization outcomes were assessed. Statistical analysis was specified using SPSS version 28.0, with $p<0.05$ considered statistically significant.

Results: In the illustrative dataset, mean blood glucose was significantly lower in the basal-bolus group compared with the basal-plus group (154.60 ± 20.80 versus 174.80 ± 23.60 mg/dL; $p<0.001$). The percentage of glucose readings within the target range was higher (68.50% versus 59.90%; $p=0.001$). However, the coefficient of variation was significantly greater in the basal-bolus group (26.50% versus 20.00%; $p<0.001$). Hypoglycaemic episodes occurred in 28.57% and 10.20% of patients, respectively ($p=0.039$). Hyperglycaemia above 180 mg/dL was observed in 63.27% and 81.63% of patients ($p=0.042$). Daily insulin requirements were significantly higher with basal-bolus therapy ($p<0.001$). Hospital stay did not differ significantly ($p=0.264$).

Conclusion: Basal-bolus insulin provided better overall glycaemic control but was associated with greater glycaemic variability and increased hypoglycaemic episodes. Basal-plus insulin offered a simpler approach with reduced hypoglycaemic risk, emphasizing the importance of individualized inpatient insulin management.

Keywords: Type 2 diabetes mellitus; Basal-bolus insulin; Basal-plus insulin; Glycaemic variability; Hypoglycaemia.

INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycaemia resulting from impaired insulin secretion, insulin resistance, or a combination of both. It represents a major global public health concern because of its increasing prevalence, associated complications, and substantial healthcare burden. Patients with type 2 diabetes mellitus frequently require hospitalization for cardiovascular diseases, infections, surgical interventions, renal disorders, and other acute medical conditions. During hospitalization, glycaemic management becomes particularly

challenging because of physiological stress, altered nutritional intake, reduced physical activity, and changes in medications. Effective inpatient glucose control is therefore essential for preventing metabolic complications and improving clinical outcomes.[1] Hyperglycaemia in hospitalized patients may develop or worsen because of increased secretion of counter-regulatory hormones, including cortisol, catecholamines, glucagon, and growth hormone. These hormones promote hepatic glucose production and peripheral insulin resistance, resulting in increased blood glucose concentrations. Persistent hyperglycaemia may impair immune function, delay wound healing, increase susceptibility to infections, and contribute to prolonged hospitalization. Conversely, excessive glucose-lowering treatment may precipitate hypoglycaemia, particularly among elderly patients and individuals with impaired renal function or inconsistent dietary intake. Therefore, inpatient diabetes management requires a careful balance between adequate glycaemic control and prevention of treatment-related complications.[2] The management of inpatient hyperglycaemia has evolved toward individualized glycaemic targets and structured insulin protocols. For most noncritically ill hospitalized adults, maintaining blood glucose concentrations between 100 and 180 mg/dL is recommended when achievable without significant hypoglycaemia. Insulin remains the preferred treatment for patients requiring substantial glycaemic correction because of its rapid onset, flexible dosing, and predictable glucose-lowering effects. However, selecting an appropriate insulin regimen depends on several clinical factors, including baseline glycaemic control, nutritional intake, severity of illness, previous treatment, renal function, and risk of hypoglycaemia. Standardized glucose monitoring and timely insulin adjustments are essential components of effective inpatient diabetes management.[3] The basal-bolus insulin regimen is a widely recommended approach for managing hyperglycaemia in noncritically ill hospitalized patients with adequate nutritional intake. This regimen combines long-acting basal insulin, scheduled rapid-acting insulin before meals, and additional correctional doses when required. Basal insulin provides continuous coverage of endogenous glucose production, whereas prandial insulin controls meal-related glucose excursions. Although basal-bolus therapy offers comprehensive physiological insulin replacement, it requires multiple daily injections, frequent blood glucose monitoring, and careful coordination with meal consumption. These requirements may increase treatment complexity and the possibility of hypoglycaemic episodes, particularly when dietary intake is unpredictable or insulin requirements change rapidly.[4] The basal-plus insulin regimen represents a simplified alternative that combines scheduled basal insulin with rapid-acting correctional insulin administered according to measured glucose concentrations. Unlike basal-bolus therapy, it does not routinely include scheduled prandial insulin injections. This approach may be particularly suitable for patients with reduced or variable oral intake, lower insulin requirements, or increased susceptibility to hypoglycaemia. However, the absence of scheduled mealtime insulin may result in inadequate control of postprandial hyperglycaemia in patients with substantial nutritional intake or greater insulin resistance. Consequently, evaluation of the relative effectiveness and safety of these regimens remains important for individualized inpatient treatment planning.[5]

Glycaemic variability has emerged as an important parameter in evaluating the effectiveness of insulin therapy beyond conventional measures such as fasting blood glucose and mean daily glucose concentration. It reflects fluctuations in glucose levels throughout the observation period and may be assessed using standard deviation, coefficient of variation, and maximum–minimum glucose differences. Increased glycaemic variability may contribute to oxidative stress, endothelial dysfunction, and metabolic instability. Intermittent capillary glucose monitoring provides clinically useful information regarding treatment response, although it may not detect every glucose excursion occurring between scheduled measurements. A comprehensive assessment of glycaemic variability can therefore provide additional insight into the quality and safety of inpatient glucose management.[6] Hypoglycaemia represents a clinically significant complication of inpatient insulin therapy and may occur because of excessive insulin administration, missed meals, impaired renal function, or unexpected changes in metabolic requirements. Blood glucose concentrations below 70 mg/dL are generally considered hypoglycaemic, while concentrations below 54 mg/dL indicate clinically significant hypoglycaemia. Severe episodes may require assistance from another person and can be associated with neurological impairment, cardiovascular instability, and other adverse consequences. Recognition of hypoglycaemia may be particularly difficult in hospitalized patients because symptoms can be altered or masked by concurrent illness and medications. Therefore, systematic documentation of hypoglycaemic episodes is necessary when comparing insulin regimens.[7]

MATERIALS AND METHODS

The present study was designed as a prospective comparative observational study conducted at a tertiary care hospital to assess glycaemic variability and the occurrence of hypoglycaemic episodes among hospitalized patients receiving basal-bolus and basal-plus insulin regimens. The study was conducted in the Department of General Medicine, involving patients with type 2 diabetes mellitus requiring subcutaneous insulin therapy during

hospitalization. A standardized clinical assessment and blood glucose monitoring protocol was followed to evaluate glycaemic control, insulin requirements, and treatment-related complications. A total of 98 hospitalized patients diagnosed with type 2 diabetes mellitus were included in the study. Patients were divided into two groups according to the insulin regimen prescribed by the treating physician. Group A comprised 49 patients receiving the basal-bolus insulin regimen, while Group B comprised 49 patients receiving the basal-plus insulin regimen. Participants were selected through consecutive sampling based on predefined eligibility criteria. Treatment allocation was determined by clinical requirements, nutritional intake, and physician judgment rather than randomization.

Inclusion Criteria

Patients aged 18 years and above with established type 2 diabetes mellitus requiring inpatient insulin therapy were considered eligible. Patients admitted with uncontrolled hyperglycaemia, diabetes-related complications, or other medical conditions requiring glycaemic management were included. Participants receiving either basal-bolus or basal-plus insulin therapy and undergoing regular capillary blood glucose monitoring were eligible for inclusion. Patients willing to participate and providing informed consent were considered for recruitment.

Exclusion Criteria

Patients with type 1 diabetes mellitus, gestational diabetes, diabetic ketoacidosis, hyperosmolar hyperglycaemic state, or critical illness requiring intensive care were excluded. Patients receiving continuous intravenous insulin infusion, those with conditions preventing reliable glucose monitoring, and those receiving continuous enteral or parenteral nutrition were excluded. Pregnant and lactating women and patients unwilling to provide informed consent were also excluded.

Baseline Clinical and Laboratory Assessment

Detailed demographic and clinical information was recorded using a structured study proforma. Parameters included age, gender, body mass index (BMI), duration of diabetes, reason for hospitalization, previous antidiabetic treatment, insulin usage history, dietary intake, and associated comorbidities such as hypertension, chronic kidney disease, cardiovascular disease, and dyslipidaemia. Laboratory investigations included fasting blood glucose, postprandial blood glucose, admission random blood glucose, glycated haemoglobin (HbA1c), serum creatinine, estimated glomerular filtration rate (eGFR), and serum electrolytes. Concomitant medications, particularly corticosteroids, were documented.

Insulin Treatment Protocol

Patients in Group A received a basal-bolus regimen consisting of long-acting basal insulin once daily and scheduled rapid-acting insulin before meals, supplemented by correctional insulin when required. The initial total daily insulin dose was individualized, with approximately 40–50% administered as basal insulin and the remaining dose distributed as prandial insulin.

Patients in Group B received a basal-plus regimen consisting of once-daily basal insulin combined with rapid-acting correctional insulin according to blood glucose levels, without scheduled prandial insulin. Insulin doses in both groups were individualized according to body weight, admission glucose levels, nutritional intake, renal function, and previous insulin requirements. Dose adjustments were performed according to the institutional glycaemic management protocol.

Blood Glucose Monitoring

Capillary blood glucose levels were measured using calibrated bedside glucometers before breakfast, lunch, dinner, and bedtime. For patients not consuming meals, monitoring was performed at approximately six-hour intervals. Additional measurements were obtained whenever symptoms of hypoglycaemia or marked hyperglycaemia occurred. All glucose readings were recorded systematically. The inpatient glycaemic target was maintained between 100 and 180 mg/dL whenever clinically appropriate, with individualized adjustments to minimize hypoglycaemia.

Assessment of Glycaemic Variability

Glycaemic variability was the primary outcome parameter and was assessed using mean blood glucose, standard deviation (SD), coefficient of variation (CV%), and the difference between maximum and minimum glucose values. The coefficient of variation was calculated as SD divided by mean glucose, multiplied by 100. Scheduled glucose measurements were used for calculating variability to maintain consistency between groups. Higher SD and CV values indicated greater glycaemic fluctuations. The proportion of scheduled glucose readings within the target range of 100–180 mg/dL was also determined.

Assessment of Hypoglycaemic Episodes

Hypoglycaemia was defined as a blood glucose concentration below 70 mg/dL. Level 1 hypoglycaemia was defined as 54–69 mg/dL, while level 2 hypoglycaemia was defined as below 54 mg/dL. Level 3 hypoglycaemia represented severe episodes requiring assistance from another person, irrespective of the measured glucose concentration. The frequency, severity, timing, and recurrence of hypoglycaemic episodes were documented. Consecutive low readings were considered part of the same episode until glucose recovery was documented.

Additional Outcome Parameters

Secondary outcomes included mean daily blood glucose concentration, fasting and premeal glucose levels, incidence of hyperglycaemia above 180 mg/dL, marked hyperglycaemia above 250 mg/dL, total daily insulin requirement, frequency of insulin injections, treatment modification, and length of hospital stay. The proportion of patients experiencing at least one hypoglycaemic episode and the number

of episodes per patient were compared between groups.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS), version 28.0. Continuous variables were expressed as mean ± standard deviation or median with interquartile range, while categorical variables were presented as frequencies and percentages. Normality was assessed using the Shapiro–Wilk test. The independent samples t-test or Mann–Whitney U test was applied for continuous variables, while the Chi-square test or Fisher's exact test was used for categorical variables. Multivariable regression analysis was considered to adjust for baseline clinical differences and potential confounding factors, subject to adequate sample size and event counts. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Table 1: Comparison of Demographic and Clinical Characteristics Between the Two Study Groups

Table 1 showed the demographic and clinical characteristics of 98 patients, with 49 patients in each group. The mean age was 54.40 ± 9.20 years in the basal-bolus group and 56.10 ± 10.70 years in the basal-plus group (p=0.401). Male patients constituted 57.14% and 55.10% of the respective groups (p=0.839). The mean BMI was 27.60 ± 3.50 kg/m² in the basal-bolus group and 27.90 ± 3.70 kg/m² in the basal-plus group (p=0.681). The mean duration of diabetes was 8.50 ± 4.70 and 8.90 ± 5.10 years, respectively (p=0.687). Hypertension was present in 55.10% and 61.22% of patients, while chronic kidney disease was observed in 16.33% and 20.41%, respectively. No statistically significant differences were observed between the groups regarding demographic characteristics, previous insulin therapy, or corticosteroid use (p>0.05).

Table 2: Comparison of Baseline Glycaemic and Laboratory Parameters Between the Study Groups

Table 2 presented the comparison of baseline glycaemic and laboratory parameters between the two groups. The mean admission random blood glucose level was 246.20 ± 51.40 mg/dL in the basal-bolus group and 241.60 ± 49.80 mg/dL in the basal-plus group (p=0.654). The mean HbA1c level was 8.80 ± 1.40% and 8.70 ± 1.30%, respectively (p=0.715). Serum creatinine levels were 1.11 ± 0.31 mg/dL in the basal-bolus group and 1.17 ± 0.37 mg/dL in the basal-plus group (p=0.386). The mean eGFR was 78.40 ± 19.30 mL/min/1.73 m² in the basal-bolus group compared with 75.90 ± 21.20 mL/min/1.73 m² in the basal-plus group (p=0.543). Although minor variations were observed in these parameters, none of the differences reached statistical significance. Both groups demonstrated comparable baseline glycaemic and renal function parameters (p>0.05).

Table 3: Comparison of Glycaemic Variability and Glycaemic Control Between Basal-Bolus and Basal-Plus Groups

Table 3 demonstrated significant differences in glycaemic control and variability between the two insulin regimens. The mean blood glucose level was significantly lower in the basal-bolus group (154.60 ± 20.80 mg/dL) compared with the basal-plus group (174.80 ± 23.60 mg/dL; p<0.001). The within-patient glucose SD was significantly higher in the basal-bolus group (41.20 ± 11.50 versus 35.10 ± 10.20 mg/dL; p=0.007). Similarly, the coefficient of variation was 26.50 ± 7.00% in the basal-bolus group compared with 20.00 ± 6.00% in the basal-plus group (p<0.001). The maximum–minimum glucose difference was higher in the basal-bolus group, although the difference was statistically insignificant (p=0.103). The percentage of glucose readings within the target range was significantly higher in the basal-bolus group (68.50 ± 12.30% versus 59.90 ± 13.00%; p=0.001). Mean fasting glucose was also significantly lower in the basal-bolus group (139.00 ± 22.00 versus 164.00 ± 26.00 mg/dL; p<0.001).

Table 4: Comparison of Hypoglycaemic Episodes Between Basal-Bolus and Basal-Plus Insulin Regimens

Table 4 illustrated the frequency and severity of hypoglycaemic episodes among patients receiving the two insulin regimens. At least one hypoglycaemic episode was documented in 28.57% of patients receiving basal-bolus insulin compared with 10.20% receiving basal-plus insulin, showing a statistically significant difference (p=0.039). Level 1 hypoglycaemia was observed in 24.49% and 10.20% of patients, respectively (p=0.108). Level 2 hypoglycaemia occurred in 8.16% of the basal-bolus group and 2.04% of the basal-plus group (p=0.362). Severe hypoglycaemia requiring assistance was reported in one patient (2.04%) receiving basal-bolus insulin, whereas no such episode occurred in the basal-plus group (p=1.000). Recurrent hypoglycaemia was observed in 14.29% and 2.04% of patients, respectively (p=0.059). The total number of documented hypoglycaemic episodes was 24 in the basal-bolus group compared with seven in the basal-plus group, indicating a higher observed frequency of hypoglycaemia with the basal-bolus regimen.

Table 5: Comparison of Hyperglycaemia, Insulin Requirements, and Hospitalization Outcomes

Table 5 compared the occurrence of hyperglycaemia, daily insulin requirements, and hospitalization outcomes between the two groups. Hyperglycaemic readings above 180 mg/dL were observed in 63.27% of patients receiving basal-bolus insulin compared with 81.63% receiving basal-plus insulin (p=0.042). Marked hyperglycaemia above 250 mg/dL occurred in 16.33% and 34.69% of patients, respectively, showing a statistically significant difference (p=0.037). The mean total daily insulin requirement was significantly higher in the basal-bolus group

(47.50 ± 12.40 units/day) compared with the basal-plus group (35.70 ± 10.50 units/day; p<0.001). The mean number of daily insulin injections was also significantly higher in the basal-bolus group (4.20 ± 0.80 versus 2.30 ± 0.70; p<0.001). Insulin dose modifications were required in 59.18% and 65.31% of patients, respectively (p=0.532). The mean hospital stay was 5.90 ± 2.10 days in the basal-bolus group and 6.40 ± 2.30 days in the basal-plus group, with no statistically significant difference (p=0.264).

Table 1: Comparison of Demographic and Clinical Characteristics Between the Two Study Groups (N=98)

Parameters	Basal-Bolus (n=49)	Basal-Plus (n=49)	p-value
Age (years), Mean ± SD	54.40 ± 9.20	56.10 ± 10.70	0.401
Male, n (%)	28 (57.14%)	27 (55.10%)	0.839
Female, n (%)	21 (42.86%)	22 (44.90%)	—
BMI (kg/m²), Mean ± SD	27.60 ± 3.50	27.90 ± 3.70	0.681
Duration of diabetes (years), Mean ± SD	8.50 ± 4.70	8.90 ± 5.10	0.687
Hypertension, n (%)	27 (55.10%)	30 (61.22%)	0.539
Chronic kidney disease, n (%)	8 (16.33%)	10 (20.41%)	0.602
Previous insulin therapy, n (%)	23 (46.94%)	20 (40.82%)	0.541
Corticosteroid use, n (%)	9 (18.37%)	11 (22.45%)	0.616

Table 2: Comparison of Baseline Glycaemic and Laboratory Parameters Between the Study Groups

Parameters	Basal-Bolus (n=49) Mean ± SD	Basal-Plus (n=49) Mean ± SD	p-value
Admission random blood glucose (mg/dL)	246.20 ± 51.40	241.60 ± 49.80	0.654
HbA1c (%)	8.80 ± 1.40	8.70 ± 1.30	0.715
Serum creatinine (mg/dL)	1.11 ± 0.31	1.17 ± 0.37	0.386
eGFR (mL/min/1.73 m²)	78.40 ± 19.30	75.90 ± 21.20	0.543

Table 3: Comparison of Glycaemic Variability and Glycaemic Control Between Basal-Bolus and Basal-Plus Groups

Glycaemic parameters	Basal-Bolus (n=49) Mean ± SD	Basal-Plus (n=49) Mean ± SD	p-value
Mean blood glucose (mg/dL)	154.60 ± 20.80	174.80 ± 23.60	<0.001
Within-patient glucose SD (mg/dL)	41.20 ± 11.50	35.10 ± 10.20	0.007
Coefficient of variation (%)	26.50 ± 7.00	20.00 ± 6.00	<0.001
Maximum–minimum glucose difference (mg/dL)	155.80 ± 42.00	142.50 ± 37.80	0.103
Scheduled glucose readings within target range (100–180 mg/dL), mean patient-level percentage	68.50 ± 12.30	59.90 ± 13.00	0.001
Mean fasting glucose (mg/dL)	139.00 ± 22.00	164.00 ± 26.00	<0.001

For illustration, UACR was assumed to be available for all 104 patients. In the actual analysis, the denominator must reflect the number tested.

Table 4: Comparison of Hypoglycaemic Episodes Between Basal-Bolus and Basal-Plus Insulin Regimens

Hypoglycaemic parameters	Basal-Bolus (n=49)	Basal-Plus (n=49)	p-value
Patients with ≥1 hypoglycaemic episode (<70 mg/dL), n (%)	14 (28.57%)	5 (10.20%)	0.039
Level 1 hypoglycaemia (54–69 mg/dL), n (%)	12 (24.49%)	5 (10.20%)	0.108
Level 2 hypoglycaemia (<54 mg/dL), n (%)	4 (8.16%)	1 (2.04%)	0.362
Level 3 severe hypoglycaemia requiring assistance, n (%)	1 (2.04%)	0 (0.00%)	1.000
Recurrent hypoglycaemia (≥2 episodes), n (%)	7 (14.29%)	1 (2.04%)	0.059
Total documented hypoglycaemic episodes, n	24	7	—

Table 5: Comparison of Hyperglycaemia, Insulin Requirements, and Hospitalization Outcomes

Outcome parameters	Basal-Bolus (n=49)	Basal-Plus (n=49)	p-value
Patients with ≥1 hyperglycaemic reading (>180 mg/dL), n (%)	31 (63.27%)	40 (81.63%)	0.042
Patients with marked hyperglycaemia (>250 mg/dL), n (%)	8 (16.33%)	17 (34.69%)	0.037
Total daily insulin requirement (units/day), Mean ± SD	47.50 ± 12.40	35.70 ± 10.50	<0.001
Mean insulin injections/day, Mean ± SD	4.20 ± 0.80	2.30 ± 0.70	<0.001
Patients requiring insulin dose modification, n (%)	29 (59.18%)	32 (65.31%)	0.532
Length of hospital stay (days), Mean ± SD	5.90 ± 2.10	6.40 ± 2.30	0.264

DISCUSSION

The present study included 98 hospitalized patients with type 2 diabetes mellitus, equally distributed between the basal-bolus and basal-plus insulin groups. The mean age was 54.40 ± 9.20 years in the basal-bolus group and 56.10 ± 10.70 years in the basal-plus group (p=0.401). The proportion of male patients was 57.14% and 55.10%, respectively, while the mean BMI was 27.60 ± 3.50 and 27.90 ± 3.70 kg/m² (p=0.681). The mean duration of diabetes was 8.50 ± 4.70 and 8.90 ± 5.10 years, respectively. These demographic characteristics were comparable with the findings reported by Umpierrez et al. (2011), who conducted the RABBIT 2 Surgery trial involving 211 patients with type 2 diabetes mellitus. Their study reported mean ages of 58 ± 12 years in the basal-bolus group and 57 ± 10 years in the sliding-scale insulin group. The corresponding BMI values were 30.3 ± 7.4 and 32.2 ± 8.5 kg/m², while the mean duration of diabetes was 6.3 ± 6.2 and 6.8 ± 6.3 years, respectively. Baseline demographic differences were

statistically insignificant in their study, similar to the present observations. However, their comparison involved basal-bolus and sliding-scale insulin regimens rather than basal-plus insulin.[8] Regarding baseline glycaemic parameters, the present study showed mean admission random blood glucose levels of 246.20 ± 51.40 mg/dL in the basal-bolus group and 241.60 ± 49.80 mg/dL in the basal-plus group (p=0.654). The corresponding HbA1c values were 8.80 ± 1.40% and 8.70 ± 1.30% (p=0.715), indicating comparable baseline glycaemic profiles. Serum creatinine levels were 1.11 ± 0.31 and 1.17 ± 0.37 mg/dL, while eGFR values were 78.40 ± 19.30 and 75.90 ± 21.20 mL/min/1.73 m², respectively, without statistically significant differences. These findings were comparable with those reported by Umpierrez et al. (2007) in the RABBIT 2 trial, which included 130 hospitalized insulin-naive patients with type 2 diabetes mellitus. Their study reported a mean admission blood glucose concentration of 229 mg/dL and an HbA1c level of 8.8 ± 2.0%. Furthermore, the investigators observed that 66% of patients receiving basal-bolus insulin achieved blood glucose levels below 140 mg/dL compared with 38% receiving sliding-scale insulin. The baseline glycaemic findings were broadly similar, although the treatment groups and glycaemic targets differed between the studies.[9] The assessment of glycaemic variability demonstrated significant differences between the two insulin regimens. The mean blood glucose concentration was significantly lower in the basal-bolus group than in the basal-plus group (154.60 ± 20.80 versus 174.80 ± 23.60 mg/dL; p<0.001). However, within-patient glucose SD was significantly higher in the basal-bolus group (41.20 ± 11.50 versus 35.10 ± 10.20 mg/dL; p=0.007). Similarly, the coefficient of variation was 26.50 ± 7.00% and 20.00 ± 6.00%, respectively (p<0.001). These findings were compared with Haw et al. (2015), who evaluated glycaemic variability in 279 noncritically ill hospitalized patients receiving basal-bolus or basal-plus insulin regimens. Their study reported glucose SD values of 38.5 ± 18 and 37.1 ± 16 mg/dL, respectively, while the mean amplitude of glycaemic excursions was 67.5 ± 34 and 66.1 ± 39 mg/dL. No statistically significant differences were observed in overall glycaemic variability between the treatment groups (p>0.05). In contrast, the present study showed significantly greater variability with basal-bolus insulin despite better mean glycaemic control. Haw et al. also reported higher variability with basal-bolus insulin in surgical patients, whereas no significant difference was demonstrated among general medicine patients.[10]

The present study demonstrated significantly better glycaemic control with the basal-bolus regimen, with mean fasting glucose concentrations of 139.00 ± 22.00 mg/dL compared with 164.00 ± 26.00 mg/dL in the basal-plus group (p<0.001). The percentage of scheduled glucose readings within the target range of 100–180 mg/dL was also significantly higher with basal-bolus insulin (68.50 ± 12.30% versus 59.90 ± 13.00%; p=0.001). Furthermore, hyperglycaemic readings above 180 mg/dL occurred in 63.27% and 81.63% of patients, respectively (p=0.042). Umpierrez et al. (2013), in the multicentre Basal Plus Trial, randomized 375 hospitalized patients to basal-bolus, basal-plus, or sliding-scale insulin therapy. Their study demonstrated similar improvement in mean daily blood glucose between basal-bolus and basal-plus regimens (p=0.16). Glucose readings within the target range of 70–140 mg/dL accounted for 37% in the basal-bolus group and 42% in the basal-plus group, whereas readings above 180 mg/dL represented 27% and 32%, respectively. Treatment failure occurred in 0% of basal-bolus patients compared with 2% receiving basal-plus and 19% receiving sliding-scale insulin. Unlike the present comparison, their study did not demonstrate a significant difference in overall glycaemic control between the two basal insulin strategies. The different glucose targets and outcome definitions limit direct numerical comparison.[11] The frequency of hypoglycaemic episodes represented another important outcome in the present study. At least one hypoglycaemic episode below 70 mg/dL occurred in 28.57% of patients receiving basal-bolus insulin compared with 10.20% receiving basal-plus insulin (p=0.039). Level 1 hypoglycaemia was observed in 24.49% and 10.20%, while level 2 hypoglycaemia occurred in 8.16% and 2.04%, respectively. Recurrent hypoglycaemia was more frequent in the basal-bolus group (14.29% versus 2.04%; p=0.059), and the total numbers of documented hypoglycaemic episodes were 24 and seven, respectively. Bellido et al. (2015) conducted a prospective randomized study involving 72 hospitalized patients with type 2 diabetes mellitus, comparing basal-bolus insulin with premixed human insulin. Their study reported hypoglycaemic episodes in 24.2% of patients receiving basal-bolus insulin compared with 64.1% receiving premixed insulin (p=0.001). Mean daily blood glucose values were comparable between the groups (175 ± 32 versus 179 ± 43 mg/dL; p=0.64). The hypoglycaemia frequency in their basal-bolus group was relatively similar to the 28.57% observed in the present basal-bolus group. However, the premixed insulin comparator was different from the basal-plus regimen, preventing direct comparison of treatment effects.[12] The present study also demonstrated significant differences in insulin requirements and treatment complexity between the two groups. The mean total daily insulin requirement was 47.50 ± 12.40 units in the basal-bolus group compared with 35.70 ± 10.50 units in the basal-plus group (p<0.001). Similarly, the mean number of insulin injections per day was significantly higher in patients receiving basal-bolus therapy (4.20 ± 0.80 versus 2.30 ± 0.70; p<0.001). Batule et al. (2022) conducted a prospective randomized study among 102 hospitalized older adults with type 2 diabetes mellitus, comparing basal-bolus insulin with basal insulin combined with vildagliptin. Their study reported mean total daily insulin requirements of 29.1

± 11.8 units in the basal-bolus group compared with 15.3 ± 5.1 units in the basal-vildagliptin group (p=0.001). The glycaemic coefficient of variation was also significantly higher with basal-bolus insulin (28% versus 22%; p<0.001). These findings were consistent with the present pattern of higher insulin requirements and greater glycaemic variability in the basal-bolus group. Nevertheless, the alternative treatment in their study included vildagliptin rather than correctional insulin alone, and their participants were substantially older, which limits direct comparability.[13] The present study demonstrated marked hyperglycaemia above 250 mg/dL in 16.33% of patients receiving basal-bolus insulin compared with 34.69% receiving basal-plus insulin (p=0.037). Insulin dose modifications were required in 59.18% and 65.31% of patients, respectively (p=0.532). The mean length of hospital stay was 5.90 ± 2.10 days in the basal-bolus group and 6.40 ± 2.30 days in the basal-plus group, without a statistically significant difference (p=0.264). Pasquel et al. (2017), in the multicentre Sita-Hospital randomized trial involving 277 patients included in the analysis, compared sitagliptin plus basal insulin with a basal-bolus regimen. Their study reported mean daily blood glucose concentrations of 9.5 ± 2.7 mmol/L and 9.4 ± 2.7 mmol/L, respectively, demonstrating noninferior glycaemic control with sitagliptin plus basal insulin. Treatment failure occurred in 16% and 19% of patients (p=0.54), while hypoglycaemia was recorded in 9% and 12%, respectively (p=0.45). The median length of hospital stay was four days in both groups (p=0.54). Consistent with their findings, the present comparison did not demonstrate a significant difference in hospital stay despite differences in glycaemic outcomes. However, treatment failure and marked hyperglycaemia were defined differently, and the alternative regimens were not identical.[14]

CONCLUSION

The present study suggested that the basal-bolus insulin regimen provided better overall glycaemic control, with lower mean blood glucose levels and fewer hyperglycaemic episodes compared with the basal-plus regimen. However, basal-bolus therapy was associated with greater glycaemic variability, higher insulin requirements, and an increased frequency of hypoglycaemic episodes. The basal-plus regimen demonstrated lower glycaemic variability and reduced hypoglycaemic risk, with fewer daily insulin injections. No statistically significant difference was observed in the length of hospital stay between the two groups. These illustrative findings highlight the importance of individualized insulin therapy to achieve optimal glycaemic control while minimizing hypoglycaemic complications in hospitalized patients.

REFERENCES

1. Sun H, Saeedi P, Karuranga S, Pinkepank M, Ogurtsova K, Duncan BB, et al. IDF Diabetes Atlas: global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. Diabetes Res Clin Pract. 2022;183:109119. doi: 10.1016/j.diabres.2021.109119.
2. Idrees T, Castro-Revoredo I, Dhatariya KK, Hernandez L, Umpierrez GE. Advances in the management of hyperglycaemia and diabetes mellitus during hospitalization. Nat Rev Endocrinol. 2025;21(12):757-768. doi: 10.1038/s41574-025-01157-1.
3. American Diabetes Association Professional Practice Committee. 16. Diabetes care in the hospital: Standards of Care in Diabetes—2025. Diabetes Care. 2025;48(Suppl 1):S321-S334. doi: 10.2337/dc25-S016.
4. Korytkowski MT, Muniyappa R, Antinori-Lent K, Donihi AC, Drincic AT, Hirsch IB, et al. Management of hyperglycemia in hospitalized adult patients in non-critical care settings: an Endocrine Society clinical practice guideline. J Clin Endocrinol Metab. 2022;107(8):2101-2128. doi: 10.1210/clinem/dgac278.
5. Seisa MO, Saadi S, Nayfeh T, Muthusamy K, Shah SH, Firwana M, et al. A systematic review supporting the Endocrine Society clinical practice guideline for the management of hyperglycemia in adults hospitalized for noncritical illness or undergoing elective surgical procedures. J Clin Endocrinol Metab. 2022;107(8):2139-2147. doi: 10.1210/clinem/dgac277.
6. Galindo RJ, Migdal AL, Davis GM, Urrutia MA, Albury B, Zambrano C, et al. Comparison of the FreeStyle Libre Pro flash continuous glucose monitoring (CGM) system and point-of-care capillary glucose testing in hospitalized patients with type 2 diabetes treated with basal-bolus insulin regimen. Diabetes Care. 2020;43(11):2730-2735. doi: 10.2337/dc19-2073.
7. Criner KE, Kim HN, Ali H, Kumar SJ, Kanter JE, Wang L, et al. Hypoglycemia symptoms are reduced in hospitalized patients with diabetes. J Diabetes Complications. 2021;35(10):107976. doi: 10.1016/j.jdiacomp.2021.107976.
8. Umpierrez GE, Smiley D, Jacobs S, Peng L, Temponi A, Mulligan P, et al. Randomized study of basal-bolus insulin therapy in the inpatient management of patients with type 2 diabetes undergoing general surgery (RABBIT 2 surgery). Diabetes Care. 2011;34(2):256-261. doi: 10.2337/dc10-1407.
9. Umpierrez GE, Smiley D, Zisman A, Prieto LM, Palacio A, Ceron M, et al. Randomized study of basal-bolus insulin therapy in the inpatient management of patients with type 2 diabetes (RABBIT 2 trial). Diabetes Care. 2007;30(9):2181-2186. doi: 10.2337/dc07-0295.
10. Haw JS, Farrokhi F, Smiley D, Peng L, Reyes D, Newton C, et al. Comparison of basal insulin regimens on glycemic variability in noncritically ill patients with type 2 diabetes. Endocr Pract. 2015;21(12):1333-1343. doi: 10.4158/EP14540.OR.
11. Umpierrez GE, Smiley D, Hermayer K, Khan A, Olson DE, Newton C, et al. Randomized study comparing a basal-bolus with a basal plus correction insulin regimen for the hospital management of medical and surgical patients with type 2 diabetes: basal plus trial. Diabetes Care. 2013;36(8):2169-2174. doi: 10.2337/dc12-1988.
12. Bellido V, Suarez L, Galiana Rodriguez M, Sanchez C, Dieguez M, Riestra M, et al. Comparison of basal-bolus and premixed insulin regimens in hospitalized patients with type 2 diabetes. Diabetes Care. 2015;38(12):2211-2216. doi: 10.2337/dc15-0160.
13. Batule S, Ramos A, Pérez-Montes de Oca A, Fuentes N, Martínez S, Raga J, et al. Comparison of glycemic variability and hypoglycemic events in hospitalized older adults treated with basal insulin plus vildagliptin and basal-bolus insulin regimen: a prospective randomized study. J Clin Med. 2022;11(10):2813. doi: 10.3390/jcm11102813.
14. Pasquel FJ, Gianchandani R, Rubin DJ, Dungan KM, Anzola I, Gomez PC, et al. Efficacy of sitagliptin for the hospital management of general medicine and surgery patients with type 2 diabetes (Sita-Hospital): a multicentre, prospective, open-label, non-inferiority randomised trial. Lancet Diabetes Endocrinol. 2017;5(2):125-133. doi: 10.1016/S2213-8587(16)30402-8.