Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 2
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Analysis of the Efficacy of Short-Term Intensive Continuous Subcutaneous Insulin Infusion (CSII) Combined with Ganagliflozin Proline Tablets in Elderly Patients with Type 2 Diabetes Mellitus

Hui Dai

Dantu District People's Hospital of Zhenjiang City, Zhenjiang 212000, Jiangsu, China

Abstract: *Objective*: To investigate the effects of switching to either Prandilin 25R monotherapy or Prandilin 25R combined with ganagliflozin proline tablets after short-term intensive continuous subcutaneous insulin infusion during hospitalization in elderly patients with type 2 diabetes mellitus on glycemic control, glycometabolic indicators, and cardiovascular risk factors, and to evaluate the safety of the two regimens. *Methods*: A total of 78 elderly patients with type 2 diabetes mellitus admitted to our hospital from January 2025 to September 2025 were selected and randomly divided into a control group and an observation group, with 39 cases in each group. The control group received monotherapy with insulin lispro protamine recombinant injection (Prandilin 25R) after intensive continuous subcutaneous insulin infusion, while the observation group received Prandilin 25R combined with ganagliflozin proline tablets. Continuous glucose monitoring (CGM) was performed for 14 days during the intensive continuous subcutaneous insulin infusion therapy phase in the hospital, followed by routine fingertip blood glucose monitoring after 14 days. Glycemic control indicators, glycometabolic indicators, and the incidence of adverse reactions were compared between the two groups. *Results*: After treatment, the mean amplitude of glycemic excursions and the 24-hour blood glucose standard deviation were significantly lower in the observation group than in the control group, while the time spent within the target blood glucose range was significantly higher ($p < 0.05$). The levels of glycated hemoglobin, fasting blood glucose, and 2-hour postprandial blood glucose were better in the observation group than in the control group; moreover, the body mass index, systolic blood pressure, and blood lipid levels improved more significantly in the observation group than in the control group ($p < 0.05$). There was no statistically significant difference in the incidence of hypoglycemia between the two groups. *Conclusion*: Combination therapy with ganagliflozin proline tablets after short-term intensive continuous subcutaneous insulin infusion therapy can effectively improve glycemic variability in elderly patients with type 2 diabetes mellitus, with good safety. This suggests that ganagliflozin proline tablets have a hypoglycemic advantage in the combination regimen and possess high clinical promotional value.

Keywords: Type 2 diabetes mellitus; Continuous subcutaneous insulin infusion; Ganagliflozin proline tablets; Glycemic variability

Online publication: Mar 13, 2026

1. Introduction

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disease characterized by insulin resistance and impaired pancreatic β-cell function, with a continuously rising global incidence [1]. As China's population ages, the prevalence of T2DM among the elderly has increased, often accompanied by comorbidities such as hypertension, dyslipidemia, obesity, and cardiovascular diseases, which complicate clinical management. There are differences in disease mechanisms and manifestations between elderly and younger patients. Aging leads to a decline in pancreatic β-cell reserve and reduced insulin secretion; deteriorating liver and kidney function, along with autonomic nervous system dysfunction, make blood glucose levels more prone to fluctuations. Additionally, the ability to recognize hypoglycemia diminishes with age, and once hypoglycemia occurs, it may trigger arrhythmias or cerebrovascular events. Relying solely on glycated hemoglobin (hemoglobin A1c, HbA1c) as an indicator has limitations, as it reflects the average blood glucose level over 2 to 3 months and fails to reveal intraday fluctuations [2]. Glycemic variability can promote the development of microvascular and macrovascular complications through oxidative stress, inflammation, and vascular endothelial damage, potentially posing a greater threat to the cardiovascular system than persistent hyperglycemia [3]. Continuous subcutaneous insulin infusion (CSII) can simulate basal and prandial insulin secretion and allows for flexible dosage adjustments, making it effective for patients with significant glycemic variability or poor response to oral medications. However, its sole use may still lead to weight gain, increased insulin dosage, and suboptimal control of blood glucose peaks. Ganagliflozin proline tablets, a newly introduced SGLT2 inhibitor at our hospital in 2025, incorporates proline to reduce the risk of urinary tract infections. By inhibiting glucose reabsorption in the renal tubules, this medication increases urinary glucose excretion, acts independently of insulin, carries a low risk of hypoglycemia, and improves cardiovascular outcomes, offering potential cardiovascular protection for elderly patients with T2DM [4].

Based on the clinical practice model at our hospital, this study aims to compare the effects of Prandilin 25R monotherapy versus Prandilin 25R combined with ganagliflozin proline tablets on glycemic control and cardiovascular risk indicators after short-term intensive continuous subcutaneous insulin infusion therapy, providing evidence for treatment strategies in elderly patients with T2DM.

2. Materials and methods

2.1. General information

This study selected elderly patients with type 2 diabetes mellitus admitted to the Endocrinology Department of our hospital from January 2025 to September 2025 as the research subjects, totaling 78 cases. All patients were randomly divided into two groups using a random number table method: the observation group and the control group, with 39 cases in each group. The observation group consisted of 26 males and 13 females, aged between 60 and 78 years, with an average age of (68.48 ± 4.99) years, and a diabetes duration of 6 to 18 years. The control group consisted of 22 males and 17 females, aged between 61 and 80 years, with an average age of (69.11 ± 5.23) years, and a diabetes duration of 5 to 17 years.

There was no statistically significant difference in general information between the two groups ($p > 0.05$), indicating comparability.

2.1.1. Inclusion criteria

(1) Meet the diagnostic criteria of the "China Guideline for Type 2 Diabetes Prevention and Treatment" [5];
(2) Age ≥ 60 years;
(3) Poor glycemic control, with glycated hemoglobin ≥ 9% and fasting plasma glucose ≥ 10 mmol/L, requiring insulin therapy;
(4) Informed consent and ability to cooperate with follow-up.

2.1.2. Exclusion criteria

(1) Type 1 diabetes or special types of diabetes;
(2) Severe liver or renal dysfunction;
(3) Complicated with acute infection or malignancy;
(4) Use of SGLT-2 inhibitors within the previous 3 months;
(5) History of ketoacidosis.

2.2. Methods

2.2.1. Control group

Intensive CSII therapy was administered from day 1 to day 6 of admission, followed by monotherapy with Prandial 25R from day 7 onwards, with unchanged dietary and exercise guidance.

2.2.2. Observation group

Intensive CSII therapy was administered from day 1 to day 6 of admission, followed by a switch to Prandial 25R combined with oral administration of ganagliflozin proline tablets from day 7 after pump discontinuation, with subsequent continuous medication and unchanged dietary and exercise guidance.

2.3. Observation indicators

(1) Continuous glucose monitoring system (CGM) was used to monitor blood glucose fluctuations for 14 days, including mean amplitude of glycemic excursions (MAGE), 24-hour blood glucose standard deviation (SD), and time in range (TIR); monitoring time points included daily recordings from day 1 to day 8 of admission and days 1–6 after discharge.
(2) Fasting plasma glucose (FPG), 2-hour postprandial plasma glucose (2hPG), and glycated hemoglobin (HbA1c); monitoring times: day 1 and day 8 of admission, and weeks 2, 4, and 8 after discharge.
(3) Body mass index (BMI), systolic blood pressure (SBP), and low-density lipoprotein cholesterol (LDL-C); monitoring times: day 1 and day 8 of admission, and weeks 2, 4, and 8 after discharge.
(4) Adverse reactions (hypoglycemia, urinary tract infections) were recorded throughout the study.

2.4. Statistical methods

Statistical analysis was performed using SPSS 26.0 software in our hospital. Measurement data were expressed as mean ± standard deviation ($\overline{x} \pm s$), with independent sample *t*-tests used for inter-group comparisons and paired t-tests for intra-group comparisons; count data were expressed as number of cases (%), with χ^2 tests used for inter-group comparisons; $p < 0.05$ was considered statistically significant.

3. Results

3.1. Comparison of blood glucose fluctuation indicators between the two groups before and after treatment

After treatment (on the 8th day of admission), blood glucose fluctuation indicators improved in both groups, with the observation group showing a significantly greater improvement than the control group ($p < 0.05$), as shown in **Table 1**.

Table 1. Comparison of blood glucose fluctuation indicators between the two groups before and after treatment ($\overline{x} \pm s$)

Group	MAGE (mmol/L)		SD (mmol/L)		TIR (%)	
	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Control group (n = 39)	6.82 ± 1.41	5.25 ± 1.12	2.96 ± 0.73	2.34 ± 0.66	52.53 ± 8.86	64.14 ± 7.54
Observation group (n = 39)	6.99 ± 1.55	3.49 ± 0.90	3.01 ± 0.81	1.87 ± 0.53	51.98 ± 8.91	75.26 ± 6.84
t	0.341	6.123	0.278	4.539	0.294	7.415
p	0.734	< 0.001	0.781	< 0.001	0.772	< 0.001

3.2. Comparison of glycometabolism indicators between the two groups

After treatment (on the 8th day of admission and the average values during follow-up after discharge), blood glucose control in the observation group was superior to that in the control group, with statistically significant differences ($p < 0.05$), as shown in **Table 2**.

Table 2. Comparison of glycometabolism indicators between the two groups ($\overline{x} \pm s$)

Group	FPG (mmol/L)	2hPG (mmol/L)	HbA1c (%)
Control group (n = 39)	7.33 ± 1.02	10.57 ± 1.53	7.72 ± 0.65
Observation group (n = 39)	6.63 ± 0.97	9.24 ± 1.35	6.91 ± 0.52
t	3.251	4.091	6.401
p	0.002	0.001	0.001

3.3. Comparison of cardiovascular risk-related indicators between the two groups

On the 8th day of admission and during follow-up after discharge, the observation group showed more significant improvements in body mass index, blood pressure, and blood lipids ($p < 0.05$), as shown in **Table 3**.

Table 3. Comparison of cardiovascular risk indicators between the two groups ($\overline{x} \pm s$)

Group	BMI (kg/m^2)	SBP (mmHg)	LDL-C (mmol/L)
Control group (n = 39)	25.42 ± 2.34	138.63 ± 12.36	2.97 ± 0.63
Observation group (n = 39)	24.25 ± 2.18	130.79 ± 11.67	2.36 ± 0.57
t	4.123	3.987	5.153
p	0.001	0.001	0.001

3.4. Comparison of the incidence of adverse reactions between the two groups

On the 8th day of admission and during follow-up after discharge, there was no statistically significant difference in the incidence of adverse reactions between the two groups ($p > 0.05$), as shown in **Table 4**.

Table 4. Comparison of the incidence of adverse reactions between the two groups (n, %)

Group	Hypoglycemia	Urinary tract infection	Total
Control group (n = 39)	2 (5.13%)	0 (0%)	2 (5.13%)
Observation group (n = 39)	1 (2.56%)	1 (2.56%)	2 (5.13%)
χ^2	0.861	0.601	0.00
p	0.581	0.401	1

4. Discussion

Elderly patients with type 2 diabetes mellitus (T2DM) face significantly increased challenges in glycemic control due to decreased pancreatic β-cell reserve, aggravated insulin resistance, and the coexistence of multiple chronic diseases [6]. In addition to persistent hyperglycemia, glycemic variability has been recognized in recent years as a crucial factor influencing diabetes-related complications. Frequent or large-amplitude glycemic fluctuations can enhance oxidative stress, activate inflammatory pathways, and damage vascular endothelium, accelerating atherosclerosis and thereby increasing the risk of cardiovascular events. Therefore, in the treatment of elderly patients, attention should be paid not only to HbA1c levels but also to glycemic stability [7]. The results of this study indicate that the short-term intensive continuous subcutaneous insulin infusion therapy phase can rapidly reduce both average blood glucose levels and glycemic variability. When combined with ganagliflozin proline tablets, it can maintain and consolidate the glycemic control effect. Compared with the control group, the combined treatment group exhibited superior MAGE and 24-hour glycemic control, suggesting that ganagliflozin proline tablets effectively mitigate glycemic variability in the combined regimen [8]. Mechanistically, short-term intensive continuous subcutaneous insulin infusion therapy allows for flexible insulin infusion based on required doses, mimicking the body's normal insulin secretion pattern to achieve rapid glycemic control. Subsequent maintenance therapy with ganagliflozin proline tablets reduces renal glucose reabsorption, thereby further maintaining glycemic stability. Meanwhile, the proline component can also reduce the risk of urinary system side effects, enhancing treatment tolerance in elderly patients. This study further suggests that transitioning from short-term intensive continuous subcutaneous insulin infusion therapy to a combined regimen of ganagliflozin proline tablets and Prandial 25R not only improves glycemic control but also facilitates comprehensive management of cardiovascular risk factors [9]. In terms of safety, the incidence of hypoglycemia did not increase in the observation group of this study, and there was only one mild case of urinary tract infection that resolved after standardized treatment, indicating that the combined regimen is safe and feasible in elderly patients [10].

5. Conclusion

In summary, treatment with ganagliflozin proline tablets following short-term intensive continuous subcutaneous insulin infusion therapy effectively improves glycemic variability in elderly patients with T2DM

while ensuring safety and without significantly increasing the rate of adverse reactions. It also demonstrates a trend toward improving certain cardiovascular risk factors in the short term, providing a viable strategy for comprehensive management of diabetes in the elderly. It should be noted that the cardiovascular risk assessment in this study was based on changes in traditional risk factor indicators, without incorporating long-term continuous glucose monitoring or cardiovascular endpoint events. Therefore, further research is needed to validate the relevant conclusions.

Disclosure statement

The author declares no conflict of interest.

References

[1] Sang Y, Yuan J, Zhao Q, et al., 2024, Cardiovascular Protective Effects of SGLT-2 Inhibitors in Patients with Type 2 Diabetic Nephropathy. Chinese Journal of Cardiovascular Rehabilitation Medicine, 33(4): 449–455.

[2] Su P, Liu Y, Liang X, et al., 2022, Reducing the Risk of Adverse Events in Type 2 Diabetes Patients with Suboptimal Response to Metformin Combined with Acarbose: Adding Dipeptidyl Peptidase-4 Inhibitors Is Superior to Insulin. Chinese Journal of General Practice, 25(9): 1054–1061.

[3] Liu Z, Chen X, Zhao H, et al., 2024, Cardiovascular Safety of Metformin Combined with Sitagliptin in Type 2 Diabetes Patients in the Real World. Journal of Peking University (Health Sciences), 56(3): 424–430.

[4] Luo Q, Xu W, Li Q, et al., 2021, Comparative Efficacy of GLP-1RA and DPP-4 Inhibitors in Treating Obese Patients with Type 2 Diabetes and Their Impact on the Risk of Cardiovascular Disease. Chinese Journal of Cardiovascular Rehabilitation Medicine, 30(2): 159–164.

[5] Xie M, Liang B, Jin G, et al., 2025, Analysis of Influencing Factors in Elderly Patients with Type 2 Diabetes Complicated by Malnutrition and High Risk of Sarcopenia. Chinese Journal of General Practice, 23(1): 65–68 + 121.

[6] Dong X, Wang L, Shen H, et al., 2018, Application of Insulin Dose Adjustment in Blood Glucose Control in Type 2 Diabetes Patients Receiving Insulin Pump Therapy. Journal of Jilin University (Medicine Edition), 44(6): 1280–1285.

[7] Song J, Lu Y, Wang W, et al., 2024, Correlation Between Time in Target Range Assessed by Continuous Glucose Monitoring and Proteinuria in Elderly Patients with Type 2 Diabetes. Geriatrics & Health Care, 30(4): 1078–1083.

[8] Luo J, Wang K, Jiang M, 2021, Meta-Analysis of the Efficacy and Safety of Sodium-Glucose Cotransporter 2 Inhibitors Combined with Insulin in the Treatment of Type 1 Diabetes. China Pharmacy, 32(1): 91–97.

[9] Chen Y, Liang G, 2023, Research Progress on the Treatment of Overweight/Obese Patients with Type 2 Diabetes Using Sodium-Glucose Cotransporter-2 Inhibitors Combined With Glucagon-Like Peptide-1 Receptor Agonists. China Modern Medicine, 30(16): 32–38.

[10] Niu Y, Chai S, Ma J, et al., 2023, Treatment Strategy Selection for Type 2 Diabetes Patients with Suboptimal Response to Basal Insulin Combined with Oral Antidiabetic Drugs: An Umbrella Review. Chinese Journal of Pharmacoepidemiology, 32(11): 1275–1284.