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General Diabetes Treatment Options and Impact on Patients' Blood Sugar Levels

Shaohua Fei
Zhetang Central Health Center, Nanjing 211200, Jiangsu, China

Abstract: *Objective:* To explore the effect of general comprehensive treatment program on blood sugar control and insulin dosage in patients with type 2 diabetes. *Methods:* 86 patients with type 2 diabetes admitted from January 2022 to December 2023 were selected and randomly divided into a control group of 43 cases (conventional hypoglycemic regimen) and an observation group of 43 cases (general comprehensive intervention). The glycated hemoglobin (HbA1c), fasting blood glucose (FPG), 2-hour postprandial blood glucose (2hPG), insulin dosage, and occurrence of adverse reactions were compared between the two groups of patients after 3 months of treatment. *Results:* Before intervention, the HbA1c of the two groups of patients (control group was 8.42 ± 1.35%, observation group was 8.38 ± 1.41%), FPG (control group was 9.25 ± 1.72 mmol/L, observation group was 9.18 ± 1.68 mmol/L) difference was not statistically significant ($p > 0.05$); after intervention, the HbA1c of the observation group dropped to 7.02 ± 0.93%, which was significantly lower than the 7.89 ± 1.12% of the control group ($p < 0.05$). FPG (6.85 ± 1.02 mmol/L) and 2hPG (9.06 ± 1.34 mmol/L) were lower than those of the control group (7.94 ± 1.25). mmol/L, 10.87 ± 1.59 mmol/L) decreased more significantly ($p < 0.05$). The average daily insulin consumption of the observation group was 32.15 ± 6.84 U, which was less than 41.27 ± 7.53 U of the control group ($p < 0.05$). The total effective rate of the observation group was higher than that of the control group, and the adverse reactions were lower than that of the control group ($p < 0.05$). *Conclusion:* A comprehensive treatment program can effectively improve blood sugar control, reduce insulin dependence, and reduce the risk of hypoglycemia in patients with type 2 diabetes.
Keywords: General treatment plan for diabetes; Blood sugar level; Impact

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1. Introduction

In recent years, the prevalence of type 2 diabetes has been on the rise, and the complications caused by poor blood sugar control have become more and more prominent. In clinical practice, we found that relying solely on drugs to adjust blood sugar can improve related indicators to a certain extent, but problems such as long-term dependence on insulin and frequent hypoglycemia events have not been effectively solved. Most previous studies focused on the optimization of drug regimens or single intervention measures, but the results were poor [1]. Theoretically, a general intervention model that integrates drug treatment, dietary management, exercise guidance, and health education may improve the efficiency of blood sugar control through multi-target effects, but this still needs to be verified through clinical research. This study analyzed the role of general treatment by comparing the effects of comprehensive general treatment programs and

conventional hypoglycemic programs.

2. Materials and methods

2.1. General information

86 patients with type 2 diabetes admitted from January 2022 to December 2023 were selected and randomly divided into a control group and an observation group, with 43 cases in each group. The patients in the control group were 56.23 ± 8.71 years old, with a disease duration of 7.42 ± 2.15 years, and a BMI of 26.35 ± 3.18 kg/m2; the patients in the observation group were 55.89 ± 9.04 years old, with a disease duration of 7.38 ± 2.06 years, and a BMI of 26.17 ± 3.24 kg/m2. After analysis, the two groups of patients were balanced and comparable in terms of age, disease duration, BMI and other baseline information.

The inclusion criteria are as follows: first, they meet the diagnostic criteria for type 2 diabetes established by WHO; second, they are between 40 and 70 years old; third, they do not use insulin for treatment. The exclusion criteria are: first, having severe cardiorenal complications; second, having malignant tumors or immune system diseases; third, having participated in other intervention studies or undergone major surgery in the past 3 months.

2.2. Method

The control group used conventional hypoglycemic regimen. The initial dose of metformin is 0.5 g/time, twice a day. Based on the patient's gastrointestinal tolerance and blood sugar control effect, the dose may be increased by 0.5 g per week, with the maximum dose not exceeding 2 g/d. The initial dose of glimepiride is 1 mg/d, taken before breakfast, and the dose is adjusted according to blood glucose monitoring results every 1 to 2 weeks, with the maximum dose not exceeding 6 mg/d. For patients whose oral medication is not well controlled, combined with subcutaneous injection of insulin, the starting dose of insulin glargine is calculated as 0.2 U/kg/d and injected subcutaneously before going to bed; mealtime insulin (insulin aspart) is distributed as 1 U for every 15 g of carbohydrates eaten and injected subcutaneously 15 minutes before meals. The dose adjustment is based on the patient's fasting and postprandial blood sugar levels, and is adjusted by 1–2 U every 3–5 days until the blood sugar level reaches the target.

The observation group implemented general comprehensive intervention. On the basis of conventional anti-diabetic treatment, other interventions are carried out

(1) In terms of personalized diet planning, the patient's diet is first assessed, the patient's diet is recorded for three days, and the proportion of total calories, carbohydrates, protein and fat consumed daily is analyzed through professional nutrition software. Develop a personalized diet plan based on the patient's age, gender, weight, labor intensity and blood sugar level. The calculation of total daily calories is based on the standard of 20–25 kcal/kg for adult bedridden patients, 30 kcal/kg for light manual workers, 35 kcal/kg for moderate manual workers, and 40 kcal/kg for heavy manual workers. Carbohydrates account for 50–65% of total calories, giving priority to foods with low glycemic index, such as oats, brown rice, etc. Protein accounts for 15–20%, mainly high-quality protein, such as lean meat, fish, and beans; fat accounts for 20–30%, limiting the intake of saturated fatty acids and trans fatty acids. At the same time, patients are provided with guidance on food exchange methods to facilitate patients to arrange their diet flexibly.

(2) In regular exercise guidance, an exercise plan is formulated based on the patient's physical condition and exercise preferences. For patients without serious complications, it is recommended to perform at least 150 minutes of moderate-intensity aerobic exercise per week, such as brisk walking, jogging, swimming, etc. Each exercise lasts for more than 30 minutes and can be completed in multiple times; perform resistance exercise 2–3 times per week, such as dumbbell training and elastic band exercises, with 2–3 groups of each action, and each group is repeated 8–12 times. The appropriate exercise intensity is when the heart rate reaches (220 - age) × (60–70%) during exercise. Warm up for 5–10 minutes before exercise, and relax for 5–10 minutes after exercise. During

exercise, instruct patients to monitor blood sugar, measure blood sugar once before and after exercise, and avoid exercising on an empty stomach or during peak hours of hypoglycemic drugs to prevent hypoglycemia.

(3) Carry out blood glucose monitoring and medication guidance once a week. Use a portable blood glucose meter to monitor the patient's fasting, 2 hours after meals and before bedtime blood glucose. Record the blood glucose value and draw a blood glucose curve. According to blood sugar fluctuations, adjust the dose of hypoglycemic drugs or insulin in a timely manner. If fasting blood glucose is > 7.0 mmol/L for two consecutive times, increase the basal insulin dose by 1–2 U; if blood glucose 2 hours after a meal is > 10.0 mmol/L, increase the mealtime insulin dose by 1–2 U. Follow-up evaluation with a general practitioner is conducted once a month to comprehensively monitor patient indicators and evaluate the occurrence of complications. Combined with the patient's blood sugar control goals, lifestyle changes, and adverse drug reactions, the treatment plan is optimized, and if necessary, other types of hypoglycemic drugs are combined or the insulin dosage form is adjusted.

2.3. Observation indicators

The average daily insulin dosage, blood sugar indicators, total effective rate, and adverse reactions of patients before and after treatment were compared between the two groups.

2.4. Efficacy standards

After treatment, HbA1c is < 7.0%, FPG is < 7.0 mmol/L, and 2hPG is < 10.0 mmol/L. It is considered effective. HbA1c decreases by ≥ 1.0%, and FPG and 2hPG decrease by ≥ 20% compared with before treatment. It is considered effective. Failure to meet the above standards is considered ineffective.

2.5. Statistical methods

The data were processed with SPSS22.0 software, and χ^2 statistics and t test were performed. $p < 0.05$ indicated that the difference was significant.

3. Results

3.1. Comparison of average daily insulin dosage between the two groups

The average daily insulin consumption of the observation group was lower than that of the control group, $p < 0.05$, see **Table 1**.

Table 1. Comparison of average daily insulin consumption between the two groups ($\bar{x} \pm s$)

Group	Average daily insulin dosage (U)
Control group (43)	41.27 ± 7.53
Observation group (43)	32.15 ± 6.84
t	5.879
p	0.000

3.2. Comparison of blood glucose indicators before and after treatment

The indicators of the observation group were significantly lower than those of the control group, $p < 0.05$. As shown in **Table 2**.

Table 2. Comparison of blood glucose indicators before and after treatment ($\bar{x} \pm s$)

Group	HbA1c (%)		FPG (mmol/L)		2hPG (mmol/L)	
	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Control group (43)	8.42 ± 1.35	7.89 ± 1.12	9.25 ± 1.72	7.94 ± 1.25	10.63 ± 1.51	10.87 ± 1.59
Observation group (43)	8.38 ± 1.41	7.02 ± 0.93	9.18 ± 1.68	6.85 ± 1.02	10.57 ± 1.46	9.06 ± 1.34
t	0.134	3.919	0.191	4.430	0.187	5.498
p	0.893	0.000	0.849	0.000	0.852	0.000

3.3. Comparison of total effective efficiency

The observation group was higher, $p < 0.05$. As shown in **Table 3**.

Table 3. Comparison of total effective rates between two groups [n (%)]

Group	Effective	Efficient	Invalid	Always efficient
Control group (43)	20 (46.51)	17 (39.53)	6 (13.95)	37 (86.05)
Observation group (43)	28 (65.12)	15 (34.88)	0 (0.00)	43 (100.00)
χ^2				4.479
p				0.034

3.4. Comparison of adverse reactions between the two groups

The observation group was lower than the control group, $p < 0.05$, see **Table 4**.

Table 4. Comparison of adverse reactions between the two groups [n (%)]

Group	Hypoglycemia	Urinary tract infection	Other adverse reactions	Overall incidence
Control group (43)	12 (27.91)	3 (6.98)	2 (4.65)	17 (39.53)
Observation group (43)	4 (9.30)	0 (0.00)	1 (2.33)	5 (11.63)
χ^2				8.795
p				0.003

4. Discussion

Type 2 diabetes is a common chronic metabolic disease, and the number of patients worldwide is increasing. Its pathological mechanism is mainly insulin resistance and pancreatic β-cell function defects, which in turn leads to an imbalance in blood sugar regulation. At present, the diagnosis of type 2 diabetes is mainly based on indicators such as fasting blood glucose, 2-hour postprandial blood glucose, and glycated hemoglobin. In terms of treatment, there are many clinical plans, but the core goals are to control blood sugar levels and prevent complications. Conventional treatment and comprehensive intervention both play an important role in diabetes management. Conventional hypoglycemic regimens mainly focus on drug treatment. Oral hypoglycemic drugs such as metformin and sulfonylureas as well as insulin injections are widely used in the treatment of type 2 diabetes. Metformin can lower blood sugar by inhibiting hepatic glucose output and improving peripheral tissue sensitivity to insulin; sulfonylureas exert a hypoglycemic effect by stimulating

pancreatic beta cells to secrete insulin; insulin subcutaneous injection can directly supplement the lack of insulin in the body and quickly lower blood sugar [2]. This routine program can control blood sugar to a certain extent. At the same time, distributing health education brochures and organizing group health lectures can also help patients learn about diabetes. However, conventional antidiabetic regimens also have their limitations. In terms of drug treatment, some patients have poor tolerance to drugs and may experience adverse reactions such as gastrointestinal discomfort, and long-term use of certain drugs may cause further decline in pancreatic beta cell function. Simply distributing manuals and conducting collective health lectures is difficult to fully meet the individual needs of patients. Patients lack effective supervision and guidance in the process of diet control and exercise, which results in differences in blood sugar control effects.

The general comprehensive intervention implemented by the observation group is based on conventional anti-diabetic treatment, adding personalized diet planning, regular exercise guidance, frequent blood sugar monitoring and medication guidance, and regular follow-up evaluation by general practitioners. Personalized diet planning will accurately calculate the total daily calories and the proportion of various nutrients required based on the patient's individual characteristics, guide the patient to choose appropriate food types and control intake, and reduce blood sugar fluctuations from the source. Regular exercise guidance will develop an exercise plan based on the patient's physical condition. Aerobic exercise can enhance cardiopulmonary function and improve insulin sensitivity, while resistance exercise can increase muscle mass and help improve glucose metabolism [3,4]. Weekly blood sugar monitoring and medication guidance can detect changes in blood sugar in a timely manner and accurately adjust drug dosages based on blood sugar values, making the treatment plan more in line with the patient's actual situation. The monthly general practitioner follow-up evaluation will comprehensively examine the patient's various indicators, comprehensively consider the patient's overall health status to optimize the treatment plan, and achieve multi-dimensional and comprehensive diabetes management.

After the intervention, the blood sugar drop in the observation group was significantly better than that in the control group because the personalized diet plan strictly controlled the daily total calories and carbohydrate intake, and gave priority to foods with a low glycemic index, which reduced the sharp rise in blood sugar after meals; in regular exercise, aerobic exercise and resistance exercise were combined to enhance cardiopulmonary function, increase muscle mass, and improve insulin sensitivity, allowing the body to absorb and utilize glucose more effectively. Weekly blood sugar monitoring and medication guidance can detect blood sugar fluctuations in a timely manner, and accurately adjust drug doses according to blood sugar values, avoiding the persistence of poor blood sugar control. The combined effect of multiple intervention measures has significantly improved the blood sugar control effect of the observation group [5,6].

The average daily insulin consumption in the observation group was significantly reduced because patients with type 2 diabetes are in a state of long-term hyperglycemia, which will increase the burden on pancreatic beta cells and lead to their gradual decline in function. Excessive use of exogenous insulin may also further inhibit the ability of the own pancreatic beta cells to secrete insulin. Personalized diet planning in comprehensive general intervention reduces the burden of excessive glucose processing on pancreatic islet β cells. Regular exercise helps reduce weight, reduce fat accumulation, and improve insulin resistance. All of these create favorable conditions for the recovery of pancreatic β cell function. At the same time, frequent blood glucose monitoring and timely medication adjustments ensure that the dosage of insulin is more in line with the actual needs of patients and avoid overuse of insulin, thus reducing the dosage of exogenous insulin [5,6].

In terms of safety, the reason why the observation group is small is that patients with type 2 diabetes are at risk of hypoglycemia during treatment with anti-diabetic drugs and insulin, and unreasonable diet and exercise may also induce hypoglycemia. The exercise guidance in the general comprehensive intervention clearly requires patients to avoid exercising on an empty stomach or during peak hours of hypoglycemic drugs, and to measure blood sugar before and after exercise, which effectively reduces the chance of hypoglycemia. Personalized diet planning ensures balanced nutrition, maintains the patient's good physical condition, and enhances the body's resistance. Monthly general practitioner follow-up evaluations can detect and deal with potential health problems in time, prevent complications and adverse reactions in advance, and thus ensure the safety of patients during treatment [7,8].

To sum up, this study shows that the general comprehensive treatment plan can effectively improve the blood sugar control level of patients with type 2 diabetes, reduce insulin dependence, and reduce the risk of hypoglycemia through multi-faceted collaborative intervention, providing a better plan for the management of type 2 diabetes.

About the author

Fei Shaohua (1987–), male, Han nationality, native of Haicheng City, Liaoning Province, bachelor's degree, current title of attending physician, works at Zhetang Central Health Center, research direction is related to general treatment of diabetes

Disclosure statement

The author declares no conflict of interest.

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