Journal of Clinical and Nursing Research, 2024, Volume 8, Issue 9
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Study on the Clinical Application of Nutritional Management Combined with Clinical Monitoring of Glycated Albumin in Diabetic Nephropathy Dialysis Patients

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Abstract: *Objective:* To explore the clinical application of nutritional management combined with clinical monitoring of glycated albumin (GA) in diabetic nephropathy (DN) dialysis patients. *Methods:* A total of 20 diabetic nephropathy dialysis patients admitted to the People's Hospital of Guandu District from January 2022 to February 2023 were included in the study. They were randomly divided into a conventional group (n = 10) and an observation group (n = 10). The study evaluated the blood glucose control, nutritional status, dialysis efficacy, and quality of life scores of both groups. *Results:* Before the intervention, there were no significant differences in fasting plasma glucose (FPG), GA, serum albumin, body mass index (BMI), dialysis efficiency values, urea clearance rate, or quality-of-life scores between the two groups ($P > 0.05$). After the intervention, the observation group showed significantly lower FPG and GA levels, higher serum albumin, dialysis efficiency values, urea clearance rate, and improved quality-of-life scores compared to the conventional group ($P < 0.05$), with no difference in BMI ($P > 0.05$). *Conclusion:* Nutritional management combined with clinical monitoring of glycated albumin has a significant effect on the clinical application of diabetic nephropathy dialysis patients. It can effectively improve patients' blood glucose control and nutritional status, reduce the risk of complications, and enhance the quality of life, demonstrating clinical value for broader application.

Keywords: Nutritional management; Glycated albumin; Diabetic nephropathy; Dialysis

Online publication: September 26, 2024

1. Introduction

Diabetic nephropathy (DN) is one of the most common chronic complications of diabetes, with a complex pathogenesis involving glucose metabolism disorders, oxidative stress, and inflammatory responses. As the disease progresses, patients experience gradual kidney function failure, eventually requiring dialysis treatment to sustain life [1,2]. However, dialysis alone cannot fully reverse kidney damage and may lead to various complications. Therefore, effective management of the nutritional status of DN dialysis patients, along with accurate monitoring of their blood glucose levels, has become a clinical priority. Glycated albumin (GA) is a product of the non-enzymatic glycation reaction between glucose and albumin in the blood. Its concentration is positively correlated with blood glucose levels and reflects the average blood glucose level over the past 2–3 weeks [3,4]. For DN dialysis patients, regular monitoring of glycated albumin helps provide timely insights into their blood glucose control, offering a basis for adjusting insulin dosage or antidiabetic drug regimens. This study aims to explore the clinical application effect of combining nutritional management with glycated albumin monitoring in diabetic nephropathy dialysis patients.

2. Materials and methods

2.1. General information

Twenty diabetic nephropathy dialysis patients admitted to the People's Hospital of Guandu District between January 2022 and February 2023 were included as the research subjects and randomly divided into a conventional group and an observation group, with 10 patients in each group. In the conventional group, there were 6 males and 4 females, aged 43–77 years, with an average age of 54.55 ± 3.72 years; dialysis duration was 3–38 months, with an average of 15.68 ± 1.28 months. In the observation group, there were 5 males and 5 females, aged 42–78 years, with an average age of 55.40 ± 3.73 years; dialysis duration ranged from 4 to 37 months, with an average of 16.39 ± 1.78 months. There was no significant difference in baseline characteristics between the two groups ($P > 0.05$), making them comparable.

Inclusion criteria: (1) Met the diagnostic criteria of the "Multidisciplinary Diagnosis and Management Expert Consensus on Diabetic Nephropathy" [5]; (2) Used arteriovenous fistula as the vascular access for hemodialysis; (3) Dialysis duration ≥ 3 months, with regular dialysis 2–3 times a week; (4) No mental illness; (5) Family members signed informed consent; (6) Approved by the hospital ethics committee.

Exclusion criteria: (1) Contraindications to arteriovenous fistula; (2) Estimated life expectancy less than six months; (3) Severe complications such as cardiovascular diseases or malignant tumors; (4) Poor treatment compliance.

2.2. Methods

2.2.1. Conventional group: Regular dialysis

According to the specific conditions of the patients, a suitable dialysis method was chosen, such as hemodialysis or peritoneal dialysis. The frequency and duration of dialysis were determined based on factors such as kidney function, urine output, and electrolyte balance [6]. Hemodialysis was performed 2–3 times a week, each session lasting 4–5 hours. During dialysis, vital signs such as blood pressure, heart rate, and respiration, along with biochemical parameters like electrolyte and acid-base balance, were monitored to adjust dialysis parameters, including dialysis fluid flow rate and ultrafiltration volume, ensuring safety and effectiveness.

2.2.2. Observation group: Personalized nutrition management in addition to regular dialysis

(1) Personalized nutrition plan: A nutrition management plan was tailored based on the patient's age, gender, weight, dialysis frequency, and complications. High-quality protein intake was emphasized, such as lean meat, fish, and legumes, to meet the high protein needs of dialysis patients, while avoiding excessive intake of low-quality proteins to reduce the production of nitrogenous metabolic waste.

Fluid and salt intake was controlled to alleviate symptoms such as edema and hypertension. Vitamins and minerals, particularly water-soluble vitamins and minerals like calcium and phosphorus, were supplemented to maintain electrolyte balance and bone health [7].

(2) Regular nutrition assessment: Patients' nutritional status was regularly evaluated, including indicators such as weight, serum albumin levels, and electrolytes, as well as food intake and variety. The nutrition management plan was adjusted accordingly to ensure adequate nutritional support while avoiding over- or undernutrition.

2.2.3. Glycated albumin testing for both groups

The specific testing procedure included:

(1) Blood samples were taken after fasting and no strenuous exercise;

(2) The puncture site was disinfected with iodine tincture or alcohol swabs in a circular motion from the center outward;

(3) A tourniquet was applied about 6 cm above the puncture site, and the patient was asked to clench their fist to fill the veins;

(4) A blood collection needle was swiftly inserted into the vein at an appropriate angle (about 30 degrees), and after confirming that the needle was inside the vein, a vacuum blood collection tube was connected to collect sufficient blood;

(5) After collection, the needle was quickly withdrawn, and the puncture site was pressed with a cotton swab for several minutes to stop the bleeding, and the patient was advised to continue pressing for a while to avoid bleeding or hematoma;

(6) The blood samples were transported to the laboratory, where they were analyzed using the liquid enzyme method or high-performance liquid chromatography. During transport, blood samples were kept at a low temperature [8].

2.3. Observation indicators

(1) Blood glucose control indicators: fasting plasma glucose (FPG) and glycated albumin (GA).

(2) Nutritional status indicators: serum albumin and body mass index (BMI).

(3) Dialysis effectiveness indicators: Dialysis efficiency value [Kt/V, where the ratio of urea clearance (K) multiplied by dialysis time (t) to the volume of water in the body (V)] and urea clearance rate.

(4) Quality of life: assessed using a health survey form [9], which includes eight dimensions. The total score is 100, with higher scores indicating better quality of life.

2.4. Statistical analysis

Data were analyzed using SPSS23.0. Continuous data were expressed as mean ± standard deviation (SD) and analyzed using the *t*-test. Categorical data were expressed as percentages and analyzed using the Chi-squared test. A *P*-value < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of blood glucose control between the two groups

Before the intervention, there was no significant difference in FPG and GA levels between the two groups (*P*

> 0.05). After the intervention, the FPG and GA levels in the observation group were significantly lower than those in the conventional group ($P < 0.05$), as shown in **Table 1**.

Table 1. Comparison of blood glucose control between the two groups (mean ± SD)

Groups	*n*	FPG (mmol/L)		GA (%)	
		Pre-intervention	Post-intervention	Pre-intervention	Post-intervention
Observation group	10	8.71 ± 1.58	7.09 ± 0.89	18.48 ± 2.18	15.18 ± 1.26
Conventional group	10	8.68 ± 1.38	8.49 ± 1.29	18.29 ± 2.08	18.09 ± 1.99
t		0.045	2.825	0.199	3.907
P		0.970	0.010	0.850	0.001

3.2. Comparison of nutritional status between the two groups

Before the intervention, there was no significant difference in serum albumin and BMI between the two groups ($P > 0.05$). After the intervention, serum albumin in the observation group was significantly higher than in the conventional group ($P < 0.05$), while there was no significant difference in BMI between the two groups ($P > 0.05$), as shown in **Table 2**.

Table 2. Comparison of nutritional status between the two groups (mean ± SD)

Groups	*n*	Serum albumin (g/L)		BMI (kg/m^2)	
		Pre-intervention	Post-intervention	Pre-intervention	Post-intervention
Observation group	10	34.48 ± 3.78	39.02 ± 2.52	23.18 ± 2.68	23.88 ± 2.29
Conventional group	10	34.28 ± 3.48	34.60 ± 3.20	23.01 ± 2.55	23.12 ± 2.40
t		0.123	3.432	0.068	0.724
P		0.904	0.003	0.950	0.480

3.3. Comparison of dialysis effectiveness between the two groups

Before the intervention, there was no significant difference in Kt/V values and urea clearance rates between the two groups ($P > 0.05$). After the intervention, the Kt/V values and urea clearance rates in the observation group were significantly higher than those in the conventional group ($P < 0.05$), as shown in **Table 3**.

Table 3. Comparison of dialysis effectiveness between two groups (mean ± SD)

Groups	*n*	Kt/V value		Urea clearance (%)	
		Pre-intervention	Post-intervention	Pre-intervention	Post-intervention
Observation group	10	1.25 ± 0.25	1.55 ± 0.15	63.01 ± 6.02	72.03 ± 4.51
Conventional group	10	1.28 ± 0.20	1.30 ± 0.18	64.03 ± 5.49	65.02 ± 5.01
t		0.296	3.374	0.396	3.289
P		0.771	0.004	0.697	0.004

3.4. Comparison of quality-of-life scores between the two groups

Before the intervention, there was no significant difference in quality-of-life scores between the two groups ($P > 0.05$). After the intervention, the quality-of-life scores in the observation group were significantly higher than those in the conventional group ($P < 0.05$), as shown in **Table 4**.

Table 4. Comparison of quality-of-life scores between the two groups (mean ± SD, points)

Groups	*n*	Pre-intervention	Post-intervention
Observation group	10	58.01 ± 11.02	74.02 ± 7.50
Conventional group	10	59.03 ± 10.49	61.01 ± 10.03
t		0.212	3.285
P		0.840	0.004

4. Discussion

Diabetic nephropathy is a common microvascular complication in diabetic patients, with high morbidity and mortality rates that seriously threaten patients' health. Currently, dialysis is the primary clinical treatment for DN. Although it is effective to some extent, it is influenced by various factors, making it difficult to achieve optimal results [10]. Nutritional management aims to address malnutrition by adjusting diet and supplementing nutrients, improving the patient's nutritional status. DN patients on dialysis often suffer from varying degrees of malnutrition due to the dual impact of the disease and dialysis treatment, which directly affects their quality of life and prognosis. Glycated albumin, a sensitive marker of short-term blood glucose levels, plays an important role in monitoring blood glucose in DN patients undergoing dialysis. Studies have indicated that DN dialysis patients commonly face malnutrition, electrolyte imbalances, and other issues, which not only affect dialysis outcomes but also increase the risk of complications [11]. Therefore, proper nutritional management is crucial for improving nutritional status and enhancing dialysis effectiveness. In this study, the implementation of personalized nutritional management significantly improved the patient's nutritional status, providing strong support for successful dialysis treatment.

The study results show that before the intervention, there was no significant difference in FPG and GA levels between the two groups ($P > 0.05$). After the intervention, FPG and GA levels in the observation group were significantly lower than in the conventional group ($P < 0.05$), indicating that nutritional management combined with clinical monitoring of GA helps improve blood glucose control in DN patients on dialysis. Before the intervention, there was no significant difference in serum albumin and BMI between the two groups ($P > 0.05$). After the intervention, serum albumin in the observation group was higher than in the conventional group ($P < 0.05$), with no difference in BMI between the groups ($P > 0.05$), suggesting that nutritional management can significantly improve the nutritional status of DN patients on dialysis. Before the intervention, there was no difference in Kt/V values and urea clearance rates between the two groups ($P > 0.05$). After the intervention, the Kt/V values and urea clearance rates in the observation group were significantly higher than those in the conventional group ($P < 0.05$), indicating that nutritional management combined with GA monitoring can enhance dialysis effectiveness in DN patients. Additionally, before the intervention, there was no difference in quality-of-life scores between the two groups ($P > 0.05$). After the intervention, quality-of-life scores in the observation group were significantly higher than those in the conventional group ($P < 0.05$), suggesting that nutritional management combined with GA monitoring can improve the quality of life of DN patients on dialysis.

In conclusion, the combination of nutritional management and clinical monitoring of glycated albumin demonstrates significant clinical effects in DN patients on dialysis. Through appropriate nutritional management and GA monitoring, it is possible to effectively improve blood glucose control and nutritional status, reduce the risk of complications, and enhance the quality of life, making it highly valuable for clinical promotion and application.

Funding

Project of People's Hospital of Guandu District, Kunming, Yunnan Province "Study on the Correlation Between Glycated Albumin and the Nutritional Status of Diabetic Dialysis Patients" (Project No. 2022-03-05-012)

Disclosure statement

The authors declare no conflict of interest.

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