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Original Article

Effect of predictive nursing on the comfort, illness perception, metabolism of calcium and phosphorus, and complications in hemodialysis patients

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Abstract: Objective: This study aimed to explore the effect of predictive nursing on the comfort, illness perception, metabolism of calcium and phosphorus, and complication of hemodialysis patients. Methods: A total of 160 patients admitted to our hospital were selected as the research participants. Among them, 80 patients who did not undergo predictive nursing before admission were divided into the control group, and 80 patients who received predictive nursing before admission were divided into the study group. The comfort of nursing intervention, illness perception, metabolism of calcium and phosphorus, and complication rate of the patients was compared between the two groups. Results: The result of the comparison showed that the general comfort questionnaire (CGQ), illness perception questionnaire (IPQ-R), level of calcium and phosphorus metabolism, and nursing satisfaction of the study group were significantly higher than those of the control group ($P<0.05$). The incidence of complications such as anaphylaxis and hemorrhage in the study group was lower than that in the control group ($P<0.05$), and the levels of nutritional indicators (serum albumin, total serum protein) in the study group after intervention were higher than those in the control group ($P<0.05$). Conclusion: Predictive nursing can not only help improve the comfort and calcium and phosphorus metabolism of hemodialysis patients during the treatment process, and improve patients' illness perception and nursing satisfaction, but also help reduce the incidence of various complications, and adjust the nutritional level of patients, which is worthy of clinical application.

Keywords: Predictive nursing, hemodialysis, comfort, illness perception, metabolism of calcium and phosphorus, complication

Introduction

Hemodialysis is a treatment process that provides blood outside the body with substance exchange through a dialyzer composed of hollow fibers with the principles of diffusion, ultrafiltration, adsorption and convection, which can eliminate metabolic waste in the body, maintain the body's electrolyte and acid-base balance, eliminate excess water in the body, and return the purified blood to the body [1, 2]. Hemodialysis is currently the main treatment for end-stage renal disease. Data show that about 500,000 to 1 million patients with renal failure in the world rely on hemodialysis to maintain their lives. The 5-year survival rate of hemodialysis patients can be more than 75%, and the longest treatment period can be up to 39 years, indicating that hemodialysis is an effective means to prolong the life of patients with end-stage renal disease [3, 4].

However, in clinical practice, the influence of factors such as patients' poor illness perception, irregular clinical nursing operations, and untimely nutritional intervention, some hemodialysis patients have a higher incidence of various complications, among which the more obvious ones include anaphylaxis, potassium ion disorders, infections, and hypotension [5, 6]. All of the above affect the hemodialysis intervention to a certain extent, and may even shorten the survival time of patients. Therefore, it is recommended to explore more appropriate nursing intervention to improve the prognosis of hemodialysis patients [7, 8].

Prediction refers to the anticipation and foresight of the development of things. Predictive nursing refers to a mode where nursing staff can predict the problems patients may have before or during the nursing process according to their individual situation, and then imple-

ment effective prevention and treatment measures as soon as possible, so as to minimize the suffering of patients, improve nursing care, and switch passive treatment into active rescue [9, 10]. Predictive nursing has been widely used in clinical practice. A study of patients with acute cerebral hemorrhage found that predictive nursing can significantly shorten the length of hospital stay and reduce the incidence of complications such as gastrointestinal hemorrhage and bedsores [11]. Another study pointed out that the use of predictive nursing in patients with acute myocardial infarction can reduce the mortality rate and improve patients' nursing comfort [12]. This research aimed to explore the feasibility of predictive nursing for hemodialysis patients, thereby providing clinical reference for improving the quality of life of hemodialysis patients.

Materials and methods

General materials

A total of 160 patients admitted to our hospital from August 2018 to August 2020 were selected as the research participants. Among them, 80 patients who did not undergo predictive nursing before admission were divided into the control group, and 80 patients who received predictive nursing before admission were divided into the study group.

Inclusion criteria: (1) All the enrolled patients underwent continuous treatment of hemodialysis; (2) Patients could communicate smoothly and cooperate with the research; (3) The medical records of the patients were complete; (4) The study was implemented with the approval of the Medical Ethics Committee of Yichun People's Hospital; (5) All the patients signed the informed consent.

Exclusion criteria: (1) Patients who had mental illness; (2) Patients who had poor compliance with the survey; (3) Patients who had coronary syndrome, liver failure, *etc*.; (4) Patients who had malignant tumors; (5) Pregnancy or lactating female patients.

Rejection criteria: (1) Patients who were lost to follow-up during the survey; (2) Patients who voluntarily requested suspension or withdrawal during the survey; (3) Death during the research.

Intervention methods

The patients in the control group only received routine hemodialysis nursing. The nursing staff provided patients with dietary guidance, medication supervision, and vascular access protection guidance without regular and systematic intervention guidance.

The patients in the study group received predictive nursing interventions, and the specifics are as follows: (1) A predictive nursing intervention team was established, which included head nurses, nurses-in-charge, nurses, senior nurses, and other nursing staff at different levels. The team was responsible for the implementation of predictive nursing intervention, preliminary research, data collection, patients' follow-up and other work. Additionally, team members formulated management measures and held regular meetings as appropriate to discuss and correct predictive nursing intervention measures. (2) Preparation stage: Team members searched literature, studied past cases, consulted senior nurses, *etc*., and studied the important and difficult problems of hemodialysis nursing as much as possible, including the common types, causes of the complications, *etc*. The team leader summarized and held a meeting to brainstorm and work out predictive nursing measures with the team members. (3) Intervention implementation stage: Through the collection of preliminary data, it was concluded that common complications of hemodialysis patients included anaphylaxis, low level of calcium, hemorrhage, potassium ion disorders, infections, and hypotension. Therefore, the following matters were paid attention to: ① Monitor and maintenance of the ward environment was focused on. The number of bacterial colonies on the nursing staff and in the dialysis environment was regularly monitored to prevent cross-infection and bacterial operations, and ultraviolet disinfection and surface disinfection in the dialysis room were carried out daily. ② Infection prevention of the catheter. Through health education and video demonstrations, patients were informed of the importance of infection prevention at the puncture site, so that they could develop the habit of consciously protecting the puncture site, and try not to move the catheter during the treatment to avoid hemorrhage. The nursing staff disinfected the puncture point and

changed the dressing in time. ③ Health education. Some hemodialysis patients were not fully aware of the preventive measures for complications due to their limited educational background, so nursing staff carried out health education for them through WeChat, books, videos and other means to increase their understanding of hemodialysis and improve their self-care awareness. ④ Psychological intervention. Dialysis patients often had significant negative emotions due to illness. Nursing staff assisted them in building treatment confidence and used successful treatment cases to encourage patients and improve their treatment compliance if necessary. ⑤ Improvement of immunity. Patients were instructed to have a diet high in protein and vitamins, and to limit their intake of phosphorus, sodium, and water to reasonably control weight.

Observation indicators and evaluation standards

Changes' of comfort level, illness perception, metabolism of calcium and phosphorus before and after intervention: Four periods of time were investigated: before intervention, at 1, 3, and 6 months after intervention were selected as observation points. The comfort, illness perception, level of calcium and phosphorus metabolism of the patients in the two groups was tested, and the inter-group differences and intra-group differences before and after the intervention were compared. The assessment of comfort was carried out by the general comfort questionnaire (GCQ) developed by the American comfort nursing expert Kolcaba. The questionnaire includes a total of 28 items in four dimensions, including physiology, psychology, social culture, and environment, all of which use a 4-grade Likert score of 1-4 points. A higher total score indicates a higher comfort level of the participants [13]. Illness perception was assessed with the revised IPQ-R, which includes a total of 70 items in three dimensions, including illness discrimination, illness perception and etiology. A higher score indicates better perception of the illness [14]. The levels of calcium and phosphorus metabolism were carried out by laboratory testing. Fasting venous blood samples were collected from the patients in the early morning each time, and after centrifugation, the levels of blood calcium and blood phosphorus were detected by chemiluminescence analysis.

The incidence of various complications during the intervention: The incidence of various complications such as anaphylaxis, low level of calcium, hemorrhage, potassium ion disorders, infection and hypotension during hemodialysis in the two groups were statistically analyzed, and the inter-group differences were compared between the two groups.

Evaluation of nursing satisfaction after intervention: After intervention, patients in both groups were evaluated for nursing satisfaction with a self-made nursing satisfaction questionnaire in the hospital. The questionnaire includes five aspects of emergency management, health education, life guidance, *etc*., with a total score of 100. A score of 90 or above represents very satisfied, a score of 70-89 represents satisfied, and a score of 69 or less represents unsatisfactory. Satisfaction degree = (very satisfied + satisfied)/total number of cases × 100%.

Comparison of nutritional status of the patients in the two groups before and after intervention: The blood samples of the patients in both groups were collected before intervention and at 6 months after intervention. The serum was collected after centrifugation for unified detection for the indicators of content of albumin and total protein, and the inter-group differences and intra-group differences were compared before and after intervention.

Statistical methods

Collected data were entered into EXCEL. The statistical analysis of data was processed by SPSS 22.0, and a normal distribution test was carried out on the collected data. If the data conformed to a normal distribution, the counting data were expressed in the form of [n (%)]. The *Chi*-square test was employed for inter-group comparisons. The measurement data were expressed as mean ± standard deviation. The t-test was used for inter-group comparisons and the analysis of the differences of the continuous variables. $P<0.05$ was considered statistically significant [15].

Results

Comparison of differences in general clinical data between the two groups

After collection and comparison, the patients in both groups had little difference in general clin-

Table 1. Comparison of general clinical indicators between the two groups ($\bar{x} \pm s$)/[n (%)]

General clinical data		Study group (n=80)	Control group (n=80)	t/X^2	*P*
Gender	Male	43	45	0.101	0.751
	Female	37	35		
Average age (years)		40.19±4.33	39.98±4.64	0.296	0.768
Average weight (kg)		65.44±3.22	65.67±3.21	0.452	0.652
Average course of disease (years)		1.02±0.13	1.05±0.12	1.517	0.131
Educational background	Bachelor and above	23	25	0.208	0.901
	High school	40	40		
	Junior high school and below	17	15		
Monthly income	<1000 CNY	20	20	0.352	0.839
	1000-5000 CNY	43	40		
	5000 CNY and above	17	20		
Marital status	Married	67	68	0.047	0.828
	Unmarried	13	12		
Hypertension	Yes	21	20	0.033	0.856
	No	59	60		
Diabetes	Yes	12	18	1.477	0.224
	No	68	62		

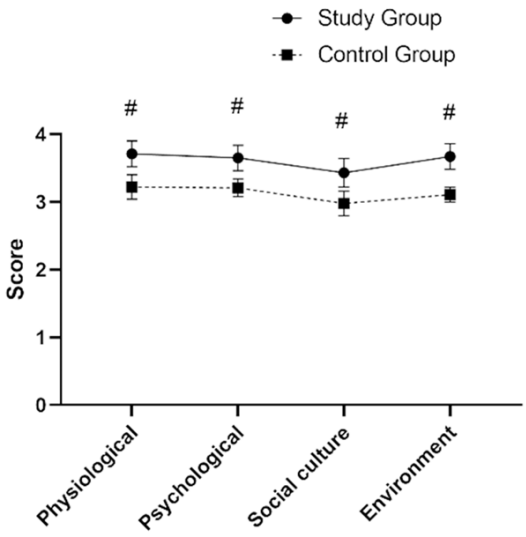

Figure 1. Analysis of comfort changes in the two groups during the intervention. The analysis showed that with the extension of the intervention time, the scores of each dimension of the GCQ of the study group and the control group showed an upward trend. Taking 6 months after intervention as the comparison point, the inter-group comparison showed that the scores of all dimensions of GCQ in the study group were higher than those in the control group (*P*<0.05). # represents that the inter-group difference is statistically significant at the same indicator and at the same time.

ical data such as gender, age, course of disease, marital status, education level, family income, and history of underlying diseases (*P*>0.05), which were comparable (**Table 1**).

Analysis of changes in comfort scores of the two groups during the intervention

GCQ was used to analyze the changes in the comfort levels between the two groups during the intervention. The results showed that the GCQ scores of the two groups showed an overall upward trend during the intervention, and the inter-group comparison at 6 months after intervention showed that the scores of all dimensions of the GCQ in the study group were higher than those in the control group (*P*<0.05) (**Figure 1**).

Analysis of changes in the score of illness perception of the two groups during the intervention

The IPQ-R was used to evaluate the illness perception between the two groups during the intervention. The inter-group comparison showed that the IPQ-R scores of the study group at 1, 3 and 6 months after intervention were higher than those of the control group (*P*<0.05) (**Figure 2**). The intra-group comparison before and after intervention showed that the illness perception of both groups at 6 months after intervention was better than that before intervention (*P*<0.05).

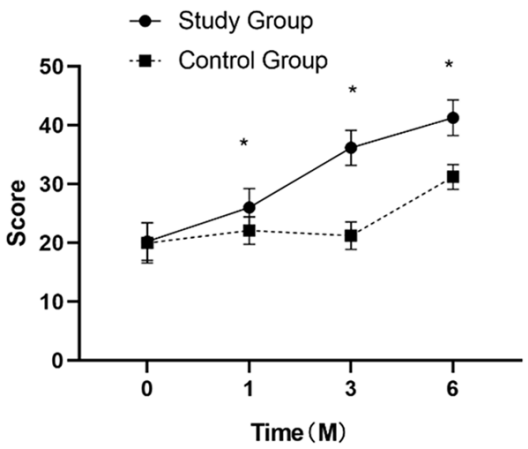

Figure 2. Analysis of changes in illness perception scores of the two groups during the intervention. The inter-group comparison showed that there was little difference of the two groups in IPQ-R scores before intervention (P>0.05), and the IPQ-R scores of the study group were significantly higher than those of the control group (P<0.05) at 1, 3 and 6 months after intervention. * represents that the inter-group difference is statistically significant at the same indicator and at the same time.

Comparison of the difference of calcium and phosphorus metabolism between the two groups before and after intervention

Blood samples were collected from both groups of patients and the blood phosphorus and blood calcium levels were tested before intervention and at 6 months after intervention. The results showed that levels of the blood phosphorus and blood calcium were not significantly different between the two groups before intervention (P>0.05). The inter-group comparison was carried out again at 6 months after intervention, and the blood calcium level of the study group was significantly higher than that of the control group, while the phosphorus level of the study group was significantly lower than that of the control group. The inter-group difference was significant (P<0.05) (**Table 2**).

Comparison of the incidence of complications during the intervention between the two groups

Through clinical follow-up and subsequent consultation, the incidence of various complications such as anaphylaxis, low calcium levels, hemorrhage, potassium disorders, infections, and hypotension of the patients within 6 months of the intervention was recorded in both groups, and the inter-group differences were compared. The results showed that the incidence of low calcium levels, infection, and hypotension in the study group was significantly lower than that in the control group (P<0.05) (**Table 3**).

Comparison of satisfaction of nursing intervention between the two groups

The satisfaction of nursing intervention between the two groups was evaluated by a self-made questionnaire in the hospital. The results showed that the study group included 60 patients who were very satisfied and 18 that were satisfied. The total number of satisfied cases was 78 with a satisfaction rate of 97.50%. In the control group, there were 49 patients that were very satisfied and 21 were satisfied. The total number of satisfied cases was 70 with a satisfaction rate of 87.50%. The satisfaction rate of the study group was significantly higher than that of the control group (P<0.05) (**Table 4**).

Comparison of differences in nutritional indicators between the two groups before and after intervention

The serum albumin and serum total protein levels were tested between the two groups before intervention and at 6 months after intervention. The inter-group comparison and intra-group comparison showed that the levels of the above indicators at 6 months after intervention were significantly higher than those before intervention (P<0.05). The inter-group comparison showed that the above indicators in the study group were higher than those in the control group (P<0.05) (**Figure 3**).

Discussion

Chronic renal disease has now become an obvious public health problem [16]. Data shows that chronic renal failure ranked 18th among the global deaths in 2010. In recent years, with the increase in the incidence of hypertension and diabetes, the incidence of chronic renal disease has further increased [17]. Clinical practice has pointed out that patients with end-stage renal disease have basically lost their ability to excrete metabolic waste due to severely impaired renal filtration function, so it is necessary to conduct renal replacement

Table 2. Comparison of differences in levels of calcium and phosphorus metabolism between the two groups before and after intervention ($\bar{x} \pm s$)

Groups	n	Serum phosphorus (mmol/L)		Serum calcium (mmol/L)	
		Before intervention	At 6 months after intervention	Before intervention	At 6 months after intervention
Study group	80	2.15±0.32	1.51±0.12#	2.01±0.23	2.34±0.19#
Control group	80	2.14±0.29	1.78±0.21#	1.98±0.23	2.23±0.21#
t	-	0.207	9.985	0.825	3.474
P	-	0.836	<0.001	0.411	0.001

Note: #*P*<0.05 when compared with that before intervention.

Table 3. Comparison of the incidence of complications during the intervention between the two groups [n (%)]

Groups	n	Anaphylaxis	Low calcium level	Hemorrhage	Potassium ion disorders	Infection	Hypotension
Study group	80	2 (2.50)	1 (1.25)	4 (5.00)	2 (2.50)	0 (0.00)	1 (1.25)
Control group	80	4 (5.00)	7 (8.75)	5 (6.25)	2 (2.50)	4 (5.00)	11 (13.75)
X^2	-	0.693	4.737	0.118	0.0	4.103	9.009
P	-	0.405	0.03	0.732	1.0	0.043	0.003

Table 4. Comparison of satisfaction of the nursing intervention between the two groups [n (%)]

Groups	Cases	Very satisfied	Satisfied	Unsatisfactory	Grade of satisfaction
Study group	80	60 (75.00)	18 (22.50)	2 (2.50)	78 (97.50)
Control group	80	49 (61.25)	21 (26.25)	10 (12.50)	70 (87.50)
X^2	-	-	-	-	5.766
P	-	-	-	-	0.016

therapy to maintain their lives. Hemodialysis is an important means of renal replacement therapy. Epidemiological survey shows that the number of hemodialysis patients has reached 340,000 in China by the end of 2014 [18].

Dialysis has now become an effective treatment to prolong the survival of patients with end-stage renal disease. According to the survey, dialysis treatment can prolong the survival time of patients with end-stage renal disease by an average of 3 years, and reduce the 5-year mortality rate of patients from 43% to 22% [19]. However, another study pointed out that the reason for the poor quality of life of hemodialysis patients is related to their condition, and improper nursing intervention is also an important factor [20]. A questionnaire survey conducted on 80 hemodialysis patients showed that 48% of the patients complained that they wanted nursing staff to listen to their inner thoughts, 70% of patients said that they hoped to get follow-up care outside the hospital, and 50% of patients believed that good nursing interventions contributed to the outcome of their illness [21].

In this study, different groups were set up to analyze the impact of predictive nursing on the comfort, illness perception, metabolism of calcium and phosphorus and complications of hemodialysis patients. The results showed that compared with patients in the control group receiving routine nursing, the patients in the study group undergoing predictive nursing had better comfort and higher scores for illness perception during the intervention, indicating that predictive nursing could effectively improve the patient's nursing experience and illness perception. A multi-center and retrospective study indicated that the self-efficacy of hemodialysis patients was significantly improved after receiving predictive nursing intervention, and the incidence of infection was decreased from 27% to 11%, showing a noteworthy effect [22]. The authors of this study analyzed and believed that good health education is of positive significance in promoting the outcome of the disease. The process of health education actually promotes patients to understand their own situation and actively cooperate with clini-

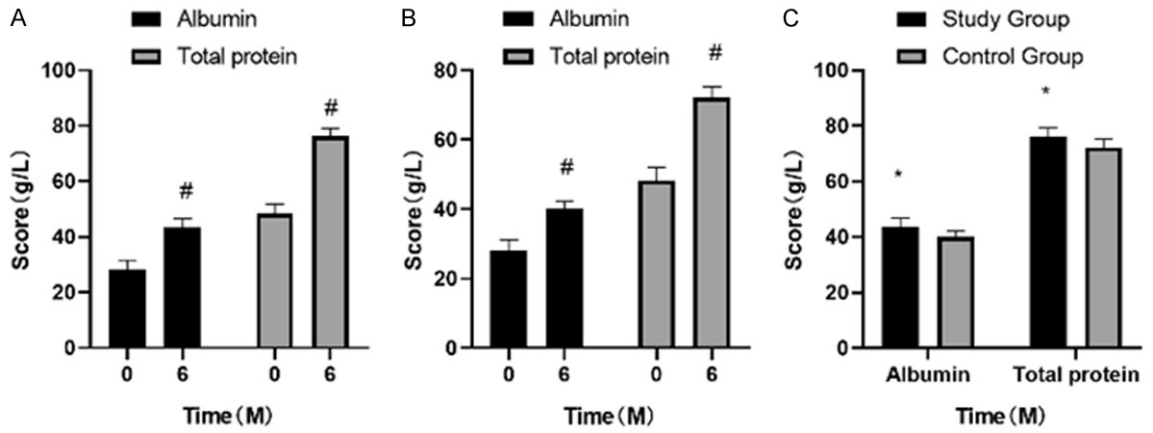

Figure 3. Comparison of differences in nutritional indicators between the two groups before and after intervention. The comparison showed that after intervention, the serum albumin and total protein level of the study group (A) and the control group (B) were significantly higher than those before treatment, and the differences between before and after intervention were significant ($P<0.05$). (# represents that the difference before and after intervention is statistically significant at the same indicator). (C) The inter-group comparison showed that the serum albumin and total protein levels of the study group were higher than those of the control group at 6 months after intervention. (* represents that the inter-group difference is statistically significant at the same indicator).

cal work to intervene for themselves, which has a better effect on improving patients' awareness of the condition [23]. Meanwhile, predictive nursing can provide detailed guidance for patients in terms of psychology, society, medication, diet, *etc*., and create a comfortable dialysis environment for patients, which can fully reflect the humanistic care of nursing, so the patient's comfort and satisfaction of nursing intervention are higher [24].

The study also analyzed patients' serum calcium and phosphorus levels after intervention, the incidence of complications during the intervention, and the nutritional indicators after intervention of the two groups. The results showed that compared with the control group, patients in the study group had higher blood calcium levels, lower complication rates, and higher levels of serum albumin and total protein after intervention. A survey conducted on hemodialysis patients showed that the high incidence of complications in dialysis was one of the main factors that reduced patients' quality of life, and the survival of patients was significantly prolonged by reducing the incidence of various complications [25]. Another study found that when metabolic wastes are re-filtered during the process of dialysis, some nutrients and trace elements are also lost, so dialysis patients tend to be in a state of low immunity, which is also a reason for the frequent occurrence of complications [26]. The authors of the study found that patients are prone to the symptom of abnormal calcium and phosphorus metabolism during dialysis, which can induce hyperthyroidism, renal bone disease, cardiovascular and cerebrovascular diseases and other diseases, and reduce patients' quality of life. Predictive nursing advocates that nurses cultivate advanced thinking, fully understand the causes of complications in patients through disease understanding and literature review before intervention, and then implement targeted interventions, which can more effectively reduce the incidence of complications, and has a positive significance for improving the' nutritional indicators of patients [27].

In summary, predictive nursing can not only help improve the comfort as well as the calcium and phosphorus levels of hemodialysis patients during the treatment process and improve patients' illness perception and nursing satisfaction, but also help reduce the incidence of various complications and regulate the nutritional level of patients, which is worthy of clinical application. The innovation of this research lies in the detailed demonstration of the feasibility and effectiveness of predictive nursing in hemodialysis patients from many aspects such as patients' perception, mastery of health knowledge, physiological metabolism

and complications, *etc*. The data are detailed and reliable, providing reliable theoretical support for subsequent research. The shortcoming of this research is that the impact of underlying diseases on the intervention has not been excluded, which may lead to some bias in the data and is planned to be corrected in the follow-up study.

Disclosure of conflict of interest

None.

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