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Effect of nephrotic enteral nutrition preparation on the nutritional status and microinflammatory state in patients with maintenance hemodialysis complicated by malnutrition

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ABSTRACT

Objective: To study the effect of nephrotic enteral nutrition preparation on the nutritional status and microinflammatory state in patients with maintenance hemodialysis complicated by malnutrition. **Methods:** A total of 68 patients who received maintenance hemodialysis and had malnutrition in our hospital between January 2013 and July 2016 were collected and divided into control group (n=34) and observation group (n=34) according to random number table. Control group received regular dietary intervention, and observation group received nephrotic enteral nutrition preparation based on routine intervention. Nutritional status and microinflammatory state before and after intervention were compared between two groups of patients. **Results:** Before intervention, the differences in peripheral blood levels of protein indexes and trace elements as well as serum levels of inflammatory factors were not statistically significant between two groups of patients. After intervention, peripheral blood nutrition-related proteins TP, ALB, PA, Hb and TRF levels of observation group were higher than those of control group; peripheral blood trace elements Zn and Fe levels were higher than those of control group while Ca level was lower than that of control group; serum inflammatory factors IL-6, hs-CRP and TNF-α levels were lower than those of control group. **Conclusion:** Nephrotic enteral nutrition preparation can effectively optimize the nutritional status and reduce the microinflammation degree in patients with maintenance hemodialysis complicated by malnutrition.

1. Introduction

Maintenance hemodialysis (MHD) is the only non-transplant way for patients with end-stage renal disease to extend the survival time, which not only effectively removes side products and metabolized moisture, but can also affect the normal homeostasis of patients[1,2]. The present studies have shown that with the extension of MHD time, the probability of malnutrition and systemic inflammatory response increase in patients, which even leads to the body's immune disorders and infectious disease in important organs later, and is not conducive to the ease of disease and optimization of patients′ overall state[3,4]. How to promote the nutritional status in patients with end-stage renal disease during MHD has been the key point of the clinical research, nephrotic enteral nutrition preparations are the new nutrition preparations containing enough heat, essential amino acids and small amount of fat and electrolyte, they are applicable to patients with renal insufficiency, and they can ensure the supply of nutrients while reduce residual kidney load in metabolites[5]. In this study, nephrotic enteral nutrition preparation was added in the intervention of patients with MHD, and the application value was discussed from nutritional status, inflammatory response and other aspects, hereby reported as follows.

2. Information and methods

2.1 Case information

A total of 68 patients who received maintenance hemodialysis and had malnutrition in our hospital between January 2013 and July 2016 were collected as the research subjects, and the family

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members of patients signed the informed consent. Enrolled patients were divided into control group (n=34) and observation group (n=34) according to random number table. Control group included 18 men and 16 women, they were 47-81 years old, and the course of maintenance hemodialysis was 0.5-4 years; observation group included 17 men and 17 women, they were 45-79 years old, and the course of maintenance hemodialysis was 0.5-5 years. The differences in gender, age and course of maintenance hemodialysis were not statistically significant between the two groups of patients (P>0.05), and the study was approved by the hospital ethics committee.

2.2 Inclusion and exclusion criteria

Inclusion criteria: (1) diagnosed with uremia and without malnutrition before dialysis; (2) receiving regular dialysis for 6 months, and with clear malnutrition at present; (3) finishing the whole research and with complete clinical data. Exclusion criteria: (1) with severe infection, gastrointestinal bleeding and other complications in dialysis; (2) combined with basic and serious heart and liver dysfunction; (3) combined with the basic gastrointestinal dysfunction and malabsorption of nutrients; (4) combined with malignant tumor disease.

2.3 Intervention

Observation group of patients received nephrotic enteral nutrition intervention at the same time of maintenance hemodialysis, specifically as follows: 400-600 kcal/d nephritic enteral nutrition preparations, the active ingredients in unit dose (100 g) of nutrition preparations included 72.2 g sugar, 11.1 g protein, 12.3 g fat, 3 g dietary fiber, 2 g glutamine as well as moderate amount of vitamins and trace elements, and the intervention lasted for 1 month. The control group received only normal dietary guidance.

2.4 Nutrition-related proteins and trace elements

Before and after intervention, 3.0 mL fasting cubital venous blood was extracted from two groups of patients, and RIA was used to detect the levels of nutrition-related proteins, including total protein (TP), albumin (ALB), prealbumin (PA), hemoglobin (Hb) and transferrin (TRF). Automatic biochemistry analyzer (Wuhan Xiandai Youbang Technology Co., Ltd., the article number ynh2016001) was used to detect the contents of trace elements, including zinc (zinc), iron (Fe) and calcium (Ca).

2.5 Micro-inflammatory state

Before and after intervention, 2.0 mL fasting peripheral blood was extracted from two groups of patients in the same way, anti-coagulated and centrifuged at low speed to get upper serum, and enzyme-linked immunosorbent assay was used to determine the contents of inflammatory factors, including interleukin-6 (IL-6), hypersensitive C-reactive protein (hs-CRP) and tumor necrosis factor α (TNF-α).

2.6 Statistical methods

Data in the study were calculated by SPSS 21.0 and the statisticians were with professional qualification. Nutrition-related proteins, trace elements, inflammatory factors and other measurement data were in terms of mean ± standard deviation, and comparison was by t test. Statistics P<0.05 was the standard of statistical significance in differences.

3. Results

3.1 Nutrition-related proteins

Before intervention and 1 month after intervention, comparison of peripheral blood nutrition-related proteins TP (g/L), ALB (g/L), PA (mg/L), Hb (g/L) and TRF (g/L) levels between two groups of patients was as follows: peripheral blood TP, ALB, PA, Hb and TRF levels were not significantly different between two groups of patients before intervention (P>0.05); compared with same group before intervention, peripheral blood TP, ALB, PA, Hb and TRF levels of observation group increased significantly after intervention (P<0.05) while peripheral blood TP, ALB, PA, Hb and TRF levels of control group didn't change significantly after intervention (P>0.05); compared with those of control group, peripheral blood TP, ALB, PA, Hb and TRF levels of observation group increased significantly after intervention (P<0.05), shown in Table 1.

Table 1.

Comparison of peripheral blood nutrition-related protein levels between two groups of patients before and after treatment.

Groups	n	Time	TP	ALB	PA	Hb	TRF
Control group	34	Before intervention	58.23±6.15	23.81±3.29	139.37±15.88	87.23±9.16	1.63±0.20
		After intervention	58.64±6.09	23.56±3.08	138.69±16.02	88.15±9.07	1.71±0.19
Observation group	34	Before intervention	58.16±6.34	23.76±3.42	139.25±15.49	87.14±8.93	1.61±0.25
		After intervention	66.79±8.23$^{*\#}$	34.18±5.29$^{*\#}$	179.53±21.47$^{*\#}$	98.25±10.12$^{*\#}$	2.89±0.31$^{*\#}$

Note: compared with same group before intervention, $^{*}P<0.05$; compared with control group after intervention, $^{\#}P<0.05$.

Table 2.

Comparison of peripheral blood trace element levels between two groups of patients before and after treatment.

Groups	*n*	Time	Zn	Fe	Ca
Control group	34	Before intervention	78.23±8.92	7.12±0.83	6.37±0.72
		After intervention	78.66±8.79	7.17±0.88	6.28±0.69
Observation group	34	Before intervention	78.41±8.65	7.10±0.81	6.32±0.68
		After intervention	89.75±9.28*#	9.05±0.94*#	4.19±0.56*#

Note: compared with same group before intervention, *$P<0.05$; compared with control group after intervention, #$P<0.05$.

Table 3.

Comparison of serum inflammatory factor levels between two groups of patients before and after treatment.

Groups	*n*	Time	IL-6	hs-CRP	TNF-α
Control group	34	Before intervention	84.29±9.15	7.29±0.86	57.29±7.18
		After intervention	84.56±9.24	7.42±0.82	56.83±6.95
Observation group	34	Before intervention	84.17±8.93	7.21±0.85	57.48±7.42
		After intervention	51.62±5.88*#	4.18±0.53*#	29.66±3.41*#

Note: compared with same group before intervention, *$P<0.05$; compared with control group after intervention, #$P<0.05$.

3.2 Trace elements

Before intervention and 1 month after intervention, comparison of peripheral blood trace elements Zn (μmol/L), Fe (mmol/L) and Ca (mmol/L) levels between two groups of patients was as follows: peripheral blood Zn, Fe and Ca levels were not significantly different between two groups of patients before intervention ($P>0.05$); compared with same group before intervention, peripheral blood Zn and Fe levels of observation group increased significantly while Ca level decreased significantly after intervention ($P<0.05$), and peripheral blood Zn, Fe and Ca levels of control group didn't change significantly after intervention ($P>0.05$); compared with those of control group, peripheral blood Zn and Fe levels of observation group increased significantly while Ca level decreased significantly after intervention ($P<0.05$), shown in Table 2.

3.3 Inflammatory factors

Before intervention and 1 month after intervention, comparison of serum levels of inflammatory factors IL-6 (pg/mL), hs-CRP (mg/L) and TNF-α (ng/mL) between two groups of patients was as follows: serum IL-6, hs-CRP and TNF-α levels were not significantly different between two groups of patients before intervention ($P>0.05$); compared with same group before intervention, serum IL-6, hs-CRP and TNF-α levels of observation group decreased significantly after intervention ($P<0.05$), and serum IL-6, hs-CRP and TNF- levels of control group didn't change significantly after intervention ($P>0.05$); compared with those of control group, serum IL-6, hs-CRP and TNF-α levels of observation group decreased significantly after intervention ($P<0.05$), shown in Table 3.

4. Discussion

MHD is the main method of replacement therapy for patients with end-stage renal disease, but the dialysis is not complete, the extension of application time can lead to toxin accumulation and malnutrition, and the specific reasons include the following: (1) negative emotions in patients with end-stage renal disease reduce the oral food intake; (2) the toxin stimulates the gastrointestinal tract; (3) there is metabolic acidosis in the body, which affects the absorption of nutrients; (4) there are the loss of nutrients and the increase of protein decomposition in the process of dialysis; (5) infection and complications[6-8]. The research shows that the proportion of malnutrition in patients with MHD is about 58.33%, the efficiency of dialysis of patients with malnutrition further falls, and severe cases may even lead to the deaths of patients in the short term. Optimizing the nutritional status of patients with MHD is the key to improving clinical efficacy, and the selection of reasonable nutritional preparations is the hot and difficult point of clinical research.

Nephrotic enteral nutrition intervention is the new preparation in accordance with the nutritional requirements for patients with chronic kidney disease, it contains amino acids necessary to human body, and the nitrogen is completely from animal protein, and accords with human body amino acid pattern[9]. The necessary amino acids and medium chain triglyceride in nephrotic enteral nutrition intervention can be directly absorbed without digestion, there are also moderate amount of glutamine and dietary fiber, and they help enhance gastrointestinal mucosal barrier function, promote protein absorption and also reduce the residual kidney damage caused by the urea nitrogen that is produced by nonessential amino acid[10,11]. In this study, nephrotic enteral nutrition intervention was added in patients with MHD, and its effect on the nutritional status and microinflammatory state of the patients was explored.

Inadequate protein intake and increased decomposition are the

most direct causes of malnutrition in MHD patients. They are also the most reliable indicators to measure the patient's malnutrition[12]. TP, ALB, PA, Hb and TRF are the proteins that play an important role in the realization of human body functions, their synthesis and decomposition are in dynamic equilibrium under physiological state, and in the case of gastrointestinal dysfunction or excessive metabolic toxin generation, the above protein indicators can be massively decomposed and consumed and show low levels[13,14]. In the study, the protein index contents in the peripheral blood were compared between two groups of patients before and after the intervention, and it was found that compared with those before intervention, peripheral blood TP, ALB, PA, Hb and TRF levels of control group didn′t change significantly while peripheral blood TP, ALB, PA, Hb and TRF levels of observation group increased significantly; further compared with those of control group, peripheral blood TP, ALB, PA, Hb and TRF levels of observation group were higher after intervention, confirming that nephrotic enteral nutrition intervention can effectively increase the functional protein contents in patients with MHD, and help to improve the overall nutritional status in patients.

The disorder of trace element levels plays an important role in malnutrition in patients with MHD, zinc is the main component of biological membrane lipoprotein, and the decrease of its content can affect the functions of many enzymes and destroy the cell membrane stability[15]. Zn is an activator of various metalloenzyme in the body, it can be involved in the removal of oxygen free radicals and lipid peroxides, and those with insufficient Zn content are susceptible to virus and bacterial infection. Fe is an essential trace element of human body, it is an important functional element of hemoglobin, myoglobin and iron enzyme, and the decrease of its content can directly result in the synthesis problems of a variety of proteins[16]. Ca content increases in the circulating blood of patients with MHD, it is because that the loss of renal function cannot activate vitamin D, make parathyroid glands secrete many hormones and absorb the calcium in bone, compensatory hypercalcemia is formed and this is one of the important signs of poor prognosis of patients with chronic kidney disease. In the study, the trace element contents in the peripheral blood were compared between two groups of patients before and after the intervention, and it was found that compared with those before intervention, peripheral blood Zn and Fe levels of observation group were higher while Ca level was lower; further compared with those of control group, peripheral blood Zn and Fe levels of observation group were higher while Ca level was lower after intervention, confirming that nephrotic enteral nutrition preparations can effectively balance the body trace element content, and this also is the important aspect of nutritional status improvement.

There is widespread micro-inflammation state in MHD patients, it is essentially an immune inflammation, the nonpathogenic microorganisms stimulate the immune system, result in massive release of inflammatory mediators, cause systemic mild inflammatory reaction and further damage the residual renal function, and it also is the main side effect of incomplete MHD[17,18]. A new study suggests that the systemic inflammatory condition is severer in MHD patients with malnutrition, which may be associated with the lower protein content, and the weakened effect of related materials on removing inflammatory factors. In the study, serum levels of inflammatory cytokines were compared between the two groups of patients before and after intervention, and it was found that compared with those before intervention, serum IL-6, hs-CRP and TNF-α levels of observation group of patients were lower after intervention; further compared with control group, the observation group of patients were with lower serum IL-6, hs-CRP and TNF-α levels after the intervention, explaining that nephrotic enteral nutrition preparations can also reduce the micro-inflammation in patients with MHD, which mainly is directly related to the relieved malnutrition in patients.

It is thus clear that nephrotic enteral nutrition preparation intervention for patients with MHD complicated by malnutrition can effectively optimize the systemic nutritional status and reduce the degree of micro-inflammation, is a highly efficient and reliable way of nutritional intervention, and can be applied in the intervention of future similar diseases.

References

[1] Gulin M, Klaric D, Ilic M, Radic J, Kovacic V, Sain M. Blood pressure of maintenance hemodialysis patients in the dalmatian region of Croatia: differences between hospital and out-of-hospital dialysis centers. *Blood Purif* 2017; **44**(2): 110-121.

[2] Naalweh KS, Barakat MA, Sweileh MW, Al-Jabi SW, Sweileh WM, Zyoud SH. Treatment adherence and perception in patients on maintenance hemodialysis: a cross - sectional study from Palestine. *BMC Nephrol* 2017; **18**(1): 178.

[3] Mathew S, Abraham G, Vijayan M, Thandavan T, Mathew M, Veerappan I, et al. Body composition monitoring and nutrition in maintenance hemodialysis and CAPD patients--a multicenter longitudinal study. *Ren Fail* 2015; **37**(1): 66-72.

[4] Shi Ling-yun, He Hua-ping, Ni Song, Chen Qi-jie, Wang Qi, Chen Fu-hua, et al. Nutritional status of maintenance hemodialysis patients and the risk factors for malnutrition. *Prog Modern Biomed* 2016; **16**(6): 1135-1139.

[5] Fu Yan-na, Guang Cui-lan, Song Yan-hong, Zhang Yan. Evaluation on effects of nephropathy type enteral nutrition agent in patients with maintenance hemodialysis and malnutrition. *Parenteral Enteral Nutrition*

2016; **23**(5): 283-286.

[6] Kara E, Sahutoglu T, Ahbap E, Sakaci T, Koc Y, Basturk T, et al. The predictive value of malnutrition-inflammation score on 1-year mortality in Turkishmaintenance hemodialysis patients. *Clin Nephrol* 2016; **86**(2): 94-99.

[7] Imamaki H, Ishii A, Yokoi H, Kasahara M, Kuwabara T, Mori KP, et al. Low serum neutrophil gelatinase-associated lipocalin level as a marker of malnutrition inmaintenance hemodialysis patients. *PLoS One* 2015; **10**(7): e0132539.

[8] Castro JR, Silva Junior GB, Carvalho AF, Hyphantis TN, Farias Lde A, Liborio AB, et al. Cancer patients under maintenance hemodialysis: relationship between quality of life, depression, sleep quality and malnutrition-inflammation score. *Blood Purif* 2014; **38**(1): 46-54.

[9] Hirakawa Y, Hanafusa N, Nangaku M. Correction of metabolic alkalosis and elevated calcium levels by sodium chloride in ahemodialysis patient with inadequate chloride intake. *Ther Apher Dial* 2016; **20**(1): 86-87.

[10]Sezer S, Bal Z, Tutal E, Uyar ME, Acar NO. Long-term oral nutrition supplementation improves outcomes in malnourished patients with chronic kidney disease on hemodialysis. *J Parenter Enteral Nutr* 2014; **38**(8): 960-965.

[11]Chen Wei, Cui Tian-lei, Xie Lin-shen, Li Xin-yi, Wu Jing. The effect of different blood purification methods on the microinflammatory state and nutritional status of patients with maintenance hemodialysis. *Chin J Gerontol* 2015; **35**(2): 379-382.

[12]Zhang Lin-fang, Yan Hong-li, Chen Xin. Influence of calcitriol treatment on nutritional status, inflammation and oxidative stress of patients undergoing maintenance hemodialysis. *J Hainan Med Univ* 2015; **21**(8): 1062-1065.

[13]Wirawan R, Tedja AT, Henrika F, Lydia A. Concordance between reticulocyte hemoglobin equivalent and reticulocyte hemoglobin content in ckd patients undergoing hemodialysis. *Acta Med Indones* 2017; **49**(1): 34-40.

[14]Gomez de Ona C, Martinez-Morillo E, Gago Gonzalez E, Vidau Arguelles P, Fernandez Merayo C, Alvarez Menendez FV. Variation of trace element concentrations in patients undergoing hemodialysis in the north of Spain. *Scand J Clin Lab Invest* 2016; **76**(6): 492-499.

[15]Zhang Fa-cheng, Li Jian-ying, Shi Hong-mei, Zhou Ling, Li Yi, Qu Yu-zhi. The study on microelement status of patients with maintenance hemodialysis. *Health Vocational Edu* 2014; **32**(24): 119-122.

[16]Qiao De-li, Lo Min, Zhou Rong, Wu Hong-Yao, Feng Jing, Shan Lan. Evaluation of the nutritional status of patients with maintenance hemodialysis and analysis of the malnutrition-related factors. *J Tongji Univ* 2015; **36**(4): 68-72.

[17]Dekker MJ, Marcelli D, Canaud BJ, Carioni P, Wang Y, Grassmann A, et al. Impact of fluid status and inflammation and their interaction on survival: a study in an internationalhemodialysis patient cohort. *Kidney Int* 2017; **91**(5): 1214-1223.

[18]Jaqueto M, Delfino VD, Bortolasci CC, Barbosa DS, Morimoto HK, Frange RF, et al. Are PTH levels related to oxidative stress and inflammation in chronic kidney disease patients onhemodialysis. *J Bras Nefrol* 2016; **38**(3): 288-295.