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The application effect of the trans-theoretical model of behavior change in diabetic kidney disease patients treated with maintenance hemodialysis

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Abstract

Objectives: The application effect of the trans-theoretical model (TTM) of behavior change in diabetic kidney disease (DKD) patients treated with maintenance hemodialysis (MHD) was discussed. **Methods:** According to the random number table method, 80 patients with DKD on MHD were divided into control group and observation group, 40 patients in each group. **Results:** After the intervention for 6 months, the self-rating depression scale (SDS) and self-rating anxiety scale (SAS) scores of patients in the observation group were all lower than those before the intervention and those in the control group ($P < 0.05$); the compliance of patients to fluid intake in the observation group was higher than that in the control group while the total incidence rate of associated acute complications of the former was lower than that of the latter ($P < 0.05$). The fasting blood glucose (FBG) and 2-h postprandial blood glucose (2hPBG) indexes of the observation group were lower than those of the control group ($P < 0.05$), and the laboratory test indexes of serum creatinine (SCr), blood urea nitrogen (BUN), glomerular filtration rate (GFR) were lower than those before the intervention and lower than those of the control group ($P < 0.05$). **Conclusions:** The nursing combined with TTM of behavior change can effectively strengthen the compliance of DKD patients subjected to MHD to fluid intake, reduce patients' negative moods (such as depression and anxiety), and lower the incidence rate of complications, and improve the life quality.

Keywords

blood glucose • compliance • complications • diabetic kidney disease • maintenance hemodialysis • renal function • trans-theoretical model of behavior change

1. Introduction

Diabetic kidney disease (DKD) is considered the most common and the most severe complication in diabetic patients; unfortunately, China has become a country with the highest proportion of diabetic patients in the world. The prevalence rate of DKD also rises in a manner positively proportional to the significant growth of the prevalence rate of diabetes, which has been the main secondary factor triggering the end-stage renal disease (ESRD) [1, 2]. Maintenance hemodialysis (MHD) is regarded as a common renal replacement therapy method to effectively prolong the survival time of DKD patients in the end-stage; however, a long-term treatment process is required and the self-nursing process is complex; multiple complications are possibly incurred during the treatment. As a result, most patients lack confidence during the treatment and are caught in negative moods such as depression and anxiety, which affects patients' overall life quality to some extent. Research has shown that favorable self-behavior management can improve patients' life quality and increase their survival rate [3]. Traditional health education is basically spoon-feeding, which ignores patients' psychological appeal. Therefore, it is hard to realize the unity of patients' cognition and practice. Trans-theoretical model (TTM) of behavior change proceeds in a step-by-step and continuously complex process, which falls into five stages, *i.e.* pre-contemplation, contemplation, preparation, action, and maintenance. According to different stages of behavior change, targeted intervention measures are taken to improve patients' self-behavior management and moods [4, 5]. Thus, the nursing combined with TTM of behavior change was employed and its application effect in DKD patients treated by MHD was explored.

2. Data and Methods

2.1. General data

Eighty DKD patients treated by MHD in the blood purification center in The First Affiliated Hospital of China Medical University from January 2018 to January 2020 were selected. According to the random number table, the patients were partitioned into a control group and an observation group, and there were 40 cases in each group. Dialysis was performed in the age group ranging from 6 months to 13 years; hemodialysis was performed

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for each patient three times per week, each lasting for 4 h. In terms of the observation group, there were 24 males and 16 females, who were all aged 41–67 years old (57.6 ± 4.2 years old) and whose body mass index (BMI) was between 21.5 kg/m^2 and 24.3 kg/m^2 (23.2 ± 1.2 kg/m^2); in the control group, 27 males and 13 females were included, aged 38–70 years (55.8 ± 5.3 years old), and their BMI was between 21.4 kg/m^2 and 24.1 kg/m^2 (23.0 ± 1.1 kg/m^2). The inclusion criteria involved: (1) satisfying the clinical diagnostic criterion of DKD [6]; (2) regular hemodialysis not shorter than 6 months; (3) having no psychosis history or cognitive impairment; (4) being capable of independently completing the associated items needed to cooperate during the treatment; and (5) voluntarily participating in the research and signing the informed consent. Exclusion criteria: (1) complicated with severe liver and kidney diseases or cardiovascular disease; (2) complicated with other severe diabetic complications; and (3) expecting to receive renal transplantation within 3 months. The difference between the two groups of patients in general data (*e.g.* gender, age, BMI, and educational background) showed no statistical significance ($P > 0.05$), with comparability.

2.2. Methods

The patients in the control group received routine nursing from the department and health education while those in the observation group received nursing combined with TTM of behavior change based on the nursing mode of the control group. On this basis of five stages of behavior generation and change, the following specific measures were taken:

2.2.1. Precontemplation and contemplation stages

A treatment group for health education was established which was led by a head nurse as the group leader, one doctor, and four professional nurses to ensure blood purification. The health education plan and its specific implementation scheme were determined to enable patients to fully recognize the operability and positive roles of behavior intervention and motivate patients to experience the significance of behavior change. Caregivers were encouraged to participate and offer the much-needed psychological support to help patients build a favorable lifestyle. By doing so, it was possible to achieve good capacity management, complete the process of dialysis treatment, relieve various complications (such as hypotension, hypertension, muscle spasm, and arrhythmia), and lower the psychological pressure and negative moods.

2.2.2. Preparation stage

A WeChat group was constructed to regularly upload the data on health education and science videos according to the schedule of the health education plan. Moreover, each patient in the observation group was educated through various forms, such as health education forums, online tours, meetings and group discussions to guide the patients to try to change by utilizing the grasped related knowledge in daily life. Aiming at the cognitive bias occurring in the experience process, one-to-one interviews and interpretation were conducted to clarify the importance of caregivers and the treatment compliance; moreover, the cognitive bias and incorrect behaviors were corrected. The implementors need to make a record after completing an item and evaluate the educational effect.

2.2.3. Action stage

The treatment group further communicated with the direct caregivers for each patient in the observation group to enable the caregivers to participate in the supervision work on patients' daily behaviors, release the card recording the patients' behaviors during the dialysis period, and guide the caregivers to correctly fill in. The recording card was fed back to the members of the treatment group during each dialysis treatment. The doctor organized the treatment group to perform a ward round each week to assess the comprehensive state of each patient. According to various indices and the content evaluation and feedback of the recording cards, the factors influencing the existing behavioral problems were co-analyzed by the patients and their caregivers, in expecting to progressively cultivate favorable behavior habits.

2.2.4. Maintenance stage

The compliment interview was employed to strengthen the patients' effective behavior ways, which was performed twice per month for a total of 12 times. In this way, the psychological support was strengthened to encourage patients to actively take part in social activities, work within their capabilities, return to the society as far as possible and attain the identification of the family and the society to prevent from failing to maintain the built favorable behavior habit due to environment or self-efficacy inadequacy. The treatment group performed cyclic strengthening, guidance, and re-education until all expected behavioral objectives were completely realized.

2.3. Observation indices

The patients' depression and anxiety states were separately evaluated by using a self-rating depression scale (SDS) and self-rating anxiety scale (SAS), in which the demarcations in SDS and SAS were 53 and 50, respectively. The higher the score was, the more severe the symptoms. The fasting blood glucose (FBG) and 2-h postprandial blood glucose (2hPBG) of the patients were measured by a blood glucose analyzer for comparison; an automatic biochemical analyzer was used to measure the serum creatinine (SCr), blood urea nitrogen (BUN), glomerular filtration rate (GFR) for comparison.

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The patients' compliance with fluid intake was evaluated by applying the questionnaires on non-compliance to the diet and fluid intake. The scales, including completely compliant, basically compliant, partly compliant, hardly compliant, and non-compliant, were filled in all under the uniform guidance of the members of the treatment group. The compliance rate = the number of patient cases who completely and basically complied/the total number of patient cases × 100%.

A comparison of the incidence rates of associated acute complications in patients in the two groups during the hemodialysis treatment was observed and recorded.

2.4. Statistical analysis

Data analysis was performed by using SPSS 20.0 statistical software. The measurement data conforming to subnormal distribution were described by applying ($\bar{x} \pm s$) and the intergroup comparison was performed by using two independent sample *t*-tests. The count data were represented by using the number of cases and percentage while the intergroup comparison was conducted by applying χ^2 test. The difference was statistically significant at $P < 0.05$.

3. Results

3.1. Comparison of SDS and SAS scores of two groups of patients

Before the intervention, the SDS and SAS scores of the patients in the observation group were in the range of 56.63 ± 7.31 and 57.62 ± 7.41 while those in the control group were within 56.57 ± 7.23 and 57.71 ± 7.24, respectively. The difference showed no statistical significance ($P > 0.05$).

After the intervention, the SDS and SAS scores of patients in the observation group were in the range of 35.26 ± 8.21 and 34.55 ± 8.36 while those in the control group were within 51.32 ± 9.02 and 42.37 ± 8.42, respectively.

The SDS and SAS scores of patients in the observation group after the intervention were all lower than those before the intervention and also those in the control group. The difference presented statistical significance ($P < 0.05$) **(Table 1)**.

3.2. Comparison of blood glucose indexes and renal function markers between the two groups of patients

Before intervention, blood glucose indexes FBG (10.19 ± 1.13 mmol/L), 2hPBG (12.33 ± 1.66 mmol/L) in observation group; renal function markers SCr (876.56 ± 154.33 μmol/L), BUN (41.33 ± 8.45 mmol/L), GFR (66.4 ± 8.4 mL/min), blood glucose index FBG (10.22 ± 1.11 mmol/L), 2hPBG (12.49 ± 1.83 mmol/L) in control group; renal function marker SCr (897.44 ± 167.16 μmol/L), There was no significant difference in BUN (42.53 ± 7.68 mmol/L) and GFR (69.3 ± 7.8 mL/min) ($P > 0.05$).

After intervention, the blood glucose indexes of patients in the observation group were FBG (7.48 ± 0.77 mmol/L), 2hPBG (9.67 ± 1.03 mmol/L); renal function markers SCr (291.21 ± 154.33 μmol/L), BUN (6.37 ± 1.68 mmol/L), GFR (87.3 ± 7.2 mL/min), blood glucose index FBG (8.55 ± 0.67 mmol/L), 2hPBG (11.03 ± 1.28 mmol/L) in control group; renal function marker SCr (368.64 ± 169.43 μmol/L), BUN (8.01 ± 1.98 mmol/L), GFR (81.10 ± 8.30 mL/min).

The blood glucose indexes (FBG, 2hPBG) and renal function markers (SCr, BUN) of the observation group were lower than those before the intervention and lower than those of the control group, and the GFR level was increased, and the difference was statistically significant ($P < 0.05$) **(Table 2)**.

3.3. Comparison of the compliance of patients in the two groups to fluid intake

The difference in the compliances of patients in the two groups to fluid intake before the intervention showed no statistical significance ($P > 0.05$).

After the intervention, there were 21 (52.5%) and 16 (40.0%) patients in the observation group, and 13 (32.5%) and 10 (25.0%) patients in the control group who separately, completely, and basically complied with fluid intake.

The compliance of patients in the observation group to fluid intake was obviously superior to that in the control group. The difference delivered statistical significance ($P < 0.05$) **(Table 3)**.

Group	Number of cases	SDS score		SAS score	
		Before the intervention	After the intervention	Before the intervention	After the intervention
Observation group	40	56.63 ± 7.31	35.26 ± 8.21	57.62 ± 7.41	34.55 ± 8.36
Control group	40	56.57 ± 7.23	51.32 ± 9.02	57.71 ± 7.24	42.37 ± 8.42
t		0.064	10.562	0.168	9.577
P		0.927	<0.05	0.858	<0.05

SDS, self-rating depression scale; SAS, self-rating anxiety scale.

Table 1. Comparison of SDS and SAS scores of patients in the two groups ($\bar{x} \pm s$)

Group	Number of cases	FBG (mmol/L)		2hPBG (mmol/L)		SCr (μmol/L)		BUN (mmol/L)		GFR(mL/min)	
		Before the intervention	After the intervention	Before the intervention	After the intervention	Before the intervention	After the intervention	Before the intervention	After the intervention	Before the intervention	After the intervention
Observation group	40	10.19 ± 1.13	7.48 ± 0.77	12.33 ± 1.66	9.67 ± 1.03	876.56 ± 154.33	291.21 ± 154.33	41.33 ± 8.45	6.37 ± 1.68	66.4 ± 8.4	87.3 ± 7.2
Control group	40	10.22 ± 1.11	8.55 ± 0.67	12.49 ± 1.83	11.03 ± 1.28	897.44 ± 167.16	368.64 ± 169.43	42.53 ± 7.68	8.01 ± 1.98	69.3 ± 7.8	81.1 ± 8.3
t		0.231	8.146	0.197	7.895	0.156	6.362	0.608	5.672	0.811	4.673
P		0.764	<0.05	0.901	<0.05	0.831	<0.05	0.511	<0.05	0.398	<0.05

FBG, fasting blood glucose; 2hPBG, 2-h postprandial blood glucose; BUN, blood urea nitrogen; GFR, glomerular filtration rate; SCr, serum creatinine.

Table 2. Comparison of blood glucose indexes and renal function markers between the two groups ($\bar{x} \pm s$)

3.4. Comparison of incidence rates of associated acute complications in patients in the two groups treated with hemodialysis

Before the intervention, the difference in the incidence rates of various complications (such as hypotension, hypertension, muscle spasm and arrhythmia) of patients in the two groups presented no statistical significance ($P > 0.05$).

After the intervention, there were 2 (5%), 2 (5%), 1 (2.5%), and 0 patients in the observation group who were separately subjected to hypotension, hypertension, muscle spasm, and arrhythmia; in the control group, 7 (17.5%), 6 (15.0%), 6 (15.0%) and 2 (5%) patients separately suffered from hypotension, hypertension, muscle spasm, and arrhythmia.

The incidence rate of associated acute complications of the patients in the observation group during hemodialysis treatment was significantly lower than that in the control group. The difference exhibited statistical significance ($P < 0.05$) **(Table 4)**.

4. Discussion

As one of the most severe diabetic complications, DKD is characterized by an insidious onset, great harm, low awareness rate, and control rate. For the DKD patients in the ERSD, renal replacement therapy is an effective means to prolong the survival time, for which MHD is considered the primary renal replacement therapy method. Clinical research suggested that favorable hemodialysis requires patients to precisely control their fluid intake and diet, which greatly changes the patients' previous living habits [7–18]. Most patients refuse to receive the long-term hemodialysis treatment psychologically and therefore they tend to generate some negative moods (including depression and anxiety) [19]. As a result, they respond negatively to the treatment and behave with poor compliance, thus influencing the blood glucose control, overall treatment outcome, and prognosis [20–24]. Thus, it is important to change patients' incorrect behaviors by applying effective nursing intervention.

In the study, the DKD patients treated by MHD in the hospital received nursing combined with TTM of behavior change. The result showed that after the intervention, the differences between the two groups of patients in blood glucose levels, renal function, SDS score, SAS score, compliance to fluid intake, and dialysis-associated acute complications all presented statistical significance ($P < 0.05$). It implied that the nursing method combined with TTM of behavior change can relieve patients' bad psychological state, increase the compliance to fluid intake and also effectively reduce the incidence rate of dialysis-associated acute complications. Starting from the point that research objects show some behaviors unfavorable for the treatment, TTM of behavior change aims to guide the research objects to change their bad behaviors, take intervention

Group	Number of cases	Completely compliant	Basically compliant	Partly compliant	Hardly compliant	Non-compliant	Compliance rate
Observation group	40	21 (52.5)	16 (40.0)	3 (7.5)	0	0	37 (92.5)
Control group	40	13 (32.5)	10 (25.0)	10 (25.0)	5 (12.5)	2 (5.0)	23 (57.5)
χ^2							11.451
P							0.022

Table 3. Comparison of compliances of patients in the two groups to fluid intake (n/[%]).

Group	Number of cases	Hypotension	Hypertension	Muscle spasm	Arrhythmia	Total incidence rate
Observation group	40	2 (5)	2 (5)	1 (2.5)	0	5 (12.5)
Control group	40	7 (17.5)	6 (15.0)	6 (15.0)	2 (5)	21 (52.5)
χ^2						8.329
P						0.012

Table 4. Comparison of the incidence rates of associated complications of patients in the two groups during the treatment (n/[%]).

measures by stage, and strengthen new beneficial behaviors until the objective of health behaviors is realized [24–31]. Prochaska [32] thought that a person's behavior change or establishment of health behaviors proceeds in a continuous and dynamic stage process. The nursing intervention process for a DKD patient treated by MHD is partitioned into five stages *i.e.* pre-contemplation, contemplation, preparation, action, and maintenance. Furthermore, different motive and intervention measures should be taken according to psychological needs and behavior demands in different stages. Because of the long-term treatment process, most patients will experience character change, become sensitive and doubtful, and even get caught in negative moods such as depression and anxiety [33]. Therefore, implementation of psychological guidance in the pre-contemplation and contemplation stages aims to help the patients realize the importance of hemodialysis and the advantages and harms of fluid control, improve their crisis consciousness, and help the patients initiate behavior change; in the preparation stage, the treatment group discusses with the patients to formulate the specific implementation schemes and encourages the patients to bravely attempt; in the action stage, the caregivers need to acknowledge and encourage patients' correct behaviors, analyze the reasons of the existing behavioral problems and suggest solutions; in the maintenance stage, the caregivers should assist the patients to return to the society, consistently acknowledge and strengthen health behaviors and prevent relapse. The research results reveal that the application of TTM of behavior change in DKD patients treated with MHD can help patients build correct behavior habits, better blood glucose control, improve renal function and further assist patients to reduce dialysis-associated acute complications by performing nursing intervention in different stages of behavior change.

Overall, the application of the nursing combined with TTM of behavior change in DKD patients treated by MHD can increase patients' compliance to fluid intake, reduce dialysis-associated acute complications, and relieve patients' negative moods (such as depression and anxiety) and improve patients' life quality.

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Ethics Approval and Consent to Participate

The study has been approved by the Scientific Research Ethics Committee of the First Hospital of China Medical University (KLS [2020] No.119). In view of the retrospective study design and depersonalization of data, the Ethics Committee agreed to waive the requirement for patient written informed consent but required that the patients be informed of the study details during a telephone follow-up.

Conflict of Interest

Nil.

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