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Original Article

Improvement and applied research of hemodialysis vascular access nursing technology

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Abstract: Objective: The aim of this study was to explore the application of vascular access technology in nephropathy patients treated with hemodialysis. Methods: A total of 537 patients with nephropathy were selected as study subjects for this retrospective analysis. Subjects were divided into an experimental group of 294 patients (patients using bundled nursing model) and a control group of 243 patients (patients using conventional nursing model). Vascular blocking rates, hospital stays, awareness of risks, nursing satisfaction, and adverse reactions were compared. Patients were also assessed for quality of life using Short Form Health Survey (SF-36). Results: Length of hospital stay in the experimental group was significantly less than the control group, $P < 0.01$. Rate of risk awareness in the experimental group was 82.73% ± 6.54, significantly higher than that of the control group 64.23% ± 8.08, $P < 0.01$. Vascular access blocking rate in the experimental group was 7.48%, significantly lower than the control group 17.28%, $P < 0.01$. Incidence of adverse reactions in the experimental group was significantly lower than the control group ($P < 0.01$). Total average SF-36 score of the observation group was 84.50 ± 9.74 points, significantly better than that of the control group, $P < 0.01$. Conclusion: For patients with nephropathy treated with hemodialysis, the use of bundled nursing can effectively increase establishment of vascular access while reducing adverse reactions and vascular access blockages. Bundled nursing is worthy of promotion in clinical use.

Keywords: Hemodialysis, vascular access, nephropathy, hemodialysis nursing

Introduction

At present, there are no conclusions regarding the pathogenesis of nephropathy within the scientific community. The morbidity of nephropathy, however, continues to increase each year [1]. Statistical results by Bakris et al. [2] showed 1.2 million patients newly-diagnosed with nephropathy in 2015. Gradually, it has become quite common among the younger population. Studies [3] have shown that nephropathy may become the only chronic disease apart from diabetes. Because nephropathy is a chronic disease, it is difficult to cure. Currently, there are no effective treatments in clinical practice [4]. Many patients cannot effectively follow guidelines during prolonged treatment and monitoring, resulting in ineffective treatment of the disease and even progression [5]. Statistics reported by Ruggenenti et al. [6] revealed that approximately 68.5% of all patients with nephropathy, worldwide, have disease progression accompanied by acute nephritis, glomerulus lesions, and even kidney cancer. Therefore, for treatment of kidney disease, it is clinically advocated that a rapid and effective treatment can achieve the best therapeutic effects.

Due to renal insufficiency, many patients with renal disease develop an abnormal metabolism [7]. Therefore, hemodialysis therapy is used to purify arterial blood and effectively improve the patient internal environment to achieve expected effects [8]. However, due to limited experimental techniques, hemodialysis therapy was not widely used in clinical practice before the 1920s [9]. With the rapid development of medical technology, hemodialysis therapy quickly improved. Currently, about 35.8% of patients with kidney disease choose hemodialysis therapy as their treatment method [10]. Statistical data reported by Okano et al. [11] indicated that the therapeutic efficiency of hemodialysis therapy has reached up to 76.8%. During the

course of hemodialysis treatment, stenosis and occlusion of endoleaks often occur, negatively impacting the prognosis of patients [11]. Therefore, ensuring smooth flow of blood is the basis and focus of treatment. However, no studies have been reported regarding how to effectively improve techniques for vascular access in patients undergoing hemodialysis therapy. Carthon et al. [12] showed that bundled nursing for patients undergoing cardiac artery bypass surgery can effectively reduce difficulty in surgery and improve the degree of cardiac arterial activity. Theoretically, the use of bundled nursing can achieve better therapeutic effects in patients with nephropathy during hemodialysis treatment and reduce vascular access-associated complications by improving the techniques. This present analysis aimed to find the best method to improve the value of hemodialysis therapy and provide reference guidelines for future clinical treatment of patients with nephropathy.

Materials and methods

General information

A total of 537 patients with nephropathy, admitted to the Second Hospital of Shandong University, were selected as study subjects for this retrospective analysis. There were 429 males and 108 females, aged 40-60 years. Inclusion criteria were as follows: (1) Patients diagnosed with nephropathy, based on Renal Disease Diagnostic Guidelines of 2013, performed by the Department of Pathology [13]; (2) Patients receiving hemodialysis treatment in our hospital after diagnosis; (3) Patients 40 to 60 years of age willing to cooperate with medical staff to arrange appointments; and (4) Patients willing to complete the study. Patients with other cardiovascular and cerebrovascular diseases, serious organ diseases, upper respiratory tract infections, lower alimentary tract infections, cancer, physical disabilities, and pregnancies as well as long-term bedridden patients were excluded from the study. All above patients signed informed consent documentation.

Method

The 243 patients receiving care under the conventional nursing model comprised the control group. The conventional nursing method was strictly as follows. Patient care included regular measurement of blood pressure, pulse, respiration, critically ill patients at any time measurement, timely detection of patient discomfort, and timely treatment closely observing whether puncture sites were bleeding. The staff paid attention to whether the blood pipeline was smooth, if there was distortion or pressure, if the pipeline was full, if the dialyzer leaked blood, and coagulation. They double-checked the treatment parameters of the dialysis machine, enduring they were correct and recorded. They encouraged patients to eat, helping to prevent hypoglycemia. Patient health education was carried out, instructing guide patients how to eat and live well. After returning to the ward or home, patients were instructed to rest in the bed while closely observe changes in vital signs. It was important to measure body temperature, pulse, respiration, and blood pressure on time while recording intake and output, paying attention to the balance of water and electrolytes, and observing closely if there was blood leakage at the puncture site. If there was bleeding, it was immediately stopped. If there was a large amount of bleeding, the doctor was notified immediately to get symptomatic treatment. Correct dietary guidance has become the treatment basis for maintenance of dialysis patients, educating them to avoid a high calorie, high protein, high vitamin, and low salt diet. They were instructed to strictly limit potassium, get rid of bad eating habits, treat indigestion and other diseases, and measure body weight daily. Staff regularly assessed nutritional status and regularly tested blood biochemistry and renal function. They helped patients establish confidence in overcoming the disease while encouraging them to listen to the instructions of doctors and nurses, dialyze on time, take medicines on time, and reasonably arrange daily living. They encouraged patients to not smoke or drink alcohol. Under the guidance of a doctor, physical exercises were performed, developing a detailed exercise program to restore and enhance endurance, laying the foundation for recovery work. Routine care during vascular access by the nursing team was enhanced to include assessment of patient blood vessels before puncture (including thickness, general trend, etc.).

The 294 patients receiving treatment under the bundled nursing model comprised the experi-

Table 1. Comparison of clinical data between the two groups of patients

	Test group (n=294)	Control group (n=243)	X^2 or t	P
Age (years)			1.06	0.29
	51.27 ± 8.32	52.09 ± 9.57		
Body weight (KG)			0.39	0.70
	69.87 ± 13.54	70.33 ± 14.06		
Disease course (day)			0.21	0.83
	18.63 ± 4.87	18.54 ± 5.09		
Gender			2.90	0.09
Male	227 (77.21)	202 (83.13)		
Female	67 (22.79)	41 (16.87)		
Kidney disease type			0.10	0.76
CN	154 (52.38)	124 (51.03)		
HN	140 (47.62)	119 (48.97)		
Smoking			0.31	0.58
Yes	204 (69.39)	174 (71.60)		
No	90 (30.61)	69 (28.40)		
Drink alcohol			0.11	0.73
Yes	164 (55.78)	132 (54.32)		
No	130 (44.22)	111 (45.68)		
Place of residence			0.34	0.56
City	245 (83.33)	207 (85.19)		
Rural	49 (16.67)	36 (14.81)		

CN: chronic nephritis. HN: hypertensive nephropathy.

mental group. Bundled nursing was conducted in strict accordance with the 2013 Nursing Instructions [14]. Experimental method was as follows. The nurses tried to make a successful puncture with only one attempt. Selection of the central vein was a priority and directional puncture was adopted. During hemodialysis, patients were given assistance in completing necessary physiological activities to keep the body stable and to prevent the blood vessel intima from damage and destruction. After the needle was pulled, patients were instructed to raise their arm to prevent backflow of blood. Prior to treatment, psychological counseling was conducted, including an introduction to risk awareness regarding their treatment and how successful treatment should be carried out. After dialysis was completed, moderate pressure was applied to the injection site to stop the bleeding. If it was not possible to successfully puncture at the internal fistula site in arteriovenous, the physician was assisted in using synthetic materials for internal fistula surgery. If the patient had renal failure, the nurse immediately switched to the internal jugular vein catheter to establish vascular access. Patient vital signs were strictly monitored, postoperatively, and blood vessels were periodically checked for murmurs with a stethoscope. During the operation, aseptic techniques were strictly followed to avoid secondary infection.

Observation indicators

Clinical data, vascular blocking rates, hospital stays, awareness rate of risks, satisfaction of nursing care provided, and adverse reactions in the two groups were evaluated using the hundred-mark system and anonymous evaluation forms. Satisfaction scores of 90 points or more were rated as quite satisfactory. Scores of 60 to 80 points were rated as satisfactory and scores of 60 points or less were rated as unsatisfactory. Salazar et al. [15] noted that patient quality of life scores, SF-36, include evaluations for physical function, emotional function, social activity function, pain, and palindromia. Higher scores indicate better quality of life. After clarifying the requirements for each evaluation in the survey, the patients and their family members completed the comprehensive SF-36 survey.

Statistical methods

SPSS 22.0 statistical software (IBM China Company Ltd., Beijing, China) was used to process and analyze data. Chi-square test was used for comparison between the groups concerning the counting data, including vascular blocking rates, awareness rate of risk awareness, and patient satisfaction with nursing methods.

Measurement data, such as length of hospital stays and SF-36 scores, are expressed as mean ± the standard deviation. Comparisons were analyzed with t-tests. $P < 0.05$ indicated a statistically significant difference.

Table 2. Comparison of hospitalization time and awareness between the two groups of patients

	Test group (n=294)	Control group (n=243)	t	P
Hospital stay (days)	13.54 ± 3.66	18.42 ± 4.05	14.65	< 0.01
Risk awareness rate (%)	82.73 ± 6.54	64.23 ± 8.08	29.32	< 0.01

Table 3. Obstruction in the two groups of patients

Group	Nonobstructive patients	Obstructive patients	X^2	*P* value
Experimental group	272 (92.52)	22 (7.48)	11.258	0.001
Control group	201 (82.72)	42 (17.28)		

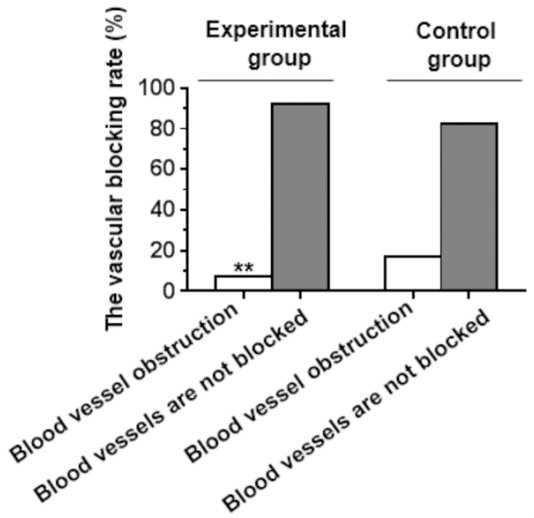

Figure 1. Vascular blocking rates in the experimental and control groups. In the experimental group, vascular blocking occurred in 22 cases and the vascular blocking rate was 7.48%. In the control group, vascular blocking occurred in 42 patients and the vascular blocking rate was 17.28%. **, P < 0.01, Experimental group compared with control group.

Results

Patient clinical data

There were no significant differences among age, weight, course, sex, smoking, drinking, place of residence, and disease types, including chronic nephritis (CN), diabetes, and hypertensive nephropathy (HN), in the clinical data between the two groups (P>0.05) (**Table 1**).

Comparison of hospital stays, vascular blocking rates, and awareness rate of risk awareness

Length of hospital stay in the experimental group was 13.54 ± 3.66 days, significantly lower than the control group, 18.42 ± 4.05 days, P < 0.01. Awareness rate of risks in the experimental group was (82.73% ± 6.54%), significantly higher than that of the control group (64.23% ± 8.08%), P < 0.01. In the experimental group, vascular access blocking occurred in 22 cases with a vascular access blocking rate of 7.48%. In the control group, there were 42 patients with vascular blocking with a vascular access blocking rate of 17.28%. Differences in vascular access blocking rates between the two groups were statistically significant (P < 0.01) (**Tables 2** and **3**; **Figure 1**).

Comparison of adverse reactions

There were a total of 21 patients in the experimental group that experienced one or a combination of adverse reactions. In the control group, 45 patients experienced one or a combination of adverse reactions. The incidence rate of adverse reactions was 7.14% in the experimental group and 18.52% in the control group, with the experimental group significantly lower than the control group (P < 0.01). Observing types of adverse reactions in the two groups of patients revealed that unbalanced syndrome, intradialytic hypertension, arrhythmia, and muscle spasms were common adverse reactions in hemodialysis treatment. The experimental group was superior to the control group in each of these adverse reactions (**Table 4**).

Satisfaction surveys

Patient satisfaction, regarding the nursing care provided, in the observation group was 98.64%, significantly higher than that of the control group, 92.18% (P < 0.01). In the observation group, 243 patients (82.65%) were quite satisfied (90 points or more), while the control group consisted of only 84 patients (34.57%). In the observation group, only 4 patients (1.36%)

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

	Test group (n=294)	Control group (n=243)	X^2	P
Allergy	2 (0.68)	4 (1.65)		
Unbalanced syndrome	5 (1.70)	12 (4.94)		
Hypotension in dialysis	4 (1.36)	8 (3.29)		
Dialysis of hypertension	6 (2.04)	14 (5.76)		
Arrhythmias	7 (2.38)	15 (6.17)		
Fever	6 (2.04)	5 (2.06)		
Muscle cramps	9 (3.06)	14 (5.76)		
Hemolysis	3 (1.02)	7 (2.88)		
Incidence of adverse reactions (%)	7.14	18.52	15.97	< 0.01

Table 5. Comparison of satisfaction surveys between the two groups of patients [n (%)]

	Test group (n=294)	Control group (n=243)	X^2	P
Very satisfied	243 (82.65)	84 (34.57)		
Satisfaction	47 (15.99)	140 (57.61)		
Not satisfied	4 (1.36)	19 (7.82)		
Degree of satisfaction (%)	98.64	92.18	13.54	< 0.01

were dissatisfied while 19 patients (7.82%) in the control group expressed dissatisfaction. Patients were more satisfied with bundled nursing (**Table 5**).

SF-36 scores

The total average score of the observation group SF-36 was 84.50 ± 9.74 points, significantly better than that of the control group (72.38 ± 10.15 points), $P < 0.01$. Differences in body function scores were the most significant, with the experimental group scoring 86.65 ± 9.52 points and the control group scoring 72.31 ± 10.52 points, $P < 0.01$. Scores of other functions in the observation group were also better than those in the control group (all $P < 0.01$) (**Table 6**).

Discussion

There is a stable and balanced environment in the human body. Once it is destroyed, it will cause the abnormal operation of various functions in the body, inducing various diseases. Diabetes and nephropathy are the most common chronic diseases [16, 17]. Regarding occurrence of chronic diseases, there are usually no significant signs in the early stages with no significant harm. However, they will impair the body with imperceptible damage by inducing or transforming into other more serious diseases [18]. By the time this happens, it is too late to cure the disease. Symptoms can be treated, however, and disease management can delay progression [19]. Therefore, research on how to cure chronic diseases has always been a hot topic in clinical practice. At present, no breakthroughs have been achieved in China. For treatment of nephropathy, early detection and early treatment are advocated in clinical practice [20]. Improvements to hemodialysis therapy have been increasingly recognized and widely used in clinical practice. Hemodialysis is designed to improve the symptoms of the disease by draining blood from the patient's body to a decontamination device, absorbing the pathogenic factors in patient blood and then returning the purified blood to the patient [21, 22]. Over the course of treatment, once patient blood vessels become blocked, they will not only invalidate the treatment but may also form a thrombus, causing an acute blood supply insufficiency and life-threatening status [23]. Therefore, the care of vascular access in hemodialysis is the most important aspect of the entire treatment. Currently, there is controversy regarding the role of the nursing in vascular access. Therefore, this article aimed to achieve optimum effects for patients with nephropathy treated with hemodialysis by analyzing vascular access while providing effective references for clinical use.

Table 6. SF-36 scores in both groups

	Test group (n=294)	Control group (n=243)	t	P
Physical function	86.65 ± 9.52	72.31 ± 10.52	16.57	< 0.01
Emotional function	84.65 ± 7.64	73.59 ± 8.14	16.21	< 0.01
Social activities	85.11 ± 11.45	71.56 ± 10.72	14.05	< 0.01
Pain	89.26 ± 8.76	79.56 ± 11.53	11.07	< 0.01
Disease relapse	76.84 ± 11.34	64.87 ± 9.86	12.91	< 0.01
The average score	84.50 ± 9.74	72.38 ± 10.15	14.08	< 0.01

Results of this study demonstrated that length of hospital stay, vascular blocking rates, adverse reactions, and SF-36 scores from the bundled nursing model were significantly better than conventional nursing model. Over the course of vascular dialysis treatment, thrombosis is an important cause of vascular access blockage [24]. Long-term use of patient blood vessels leads to vascular stenosis and hypercoagulability, which not only increases the difficulty of treatment but may also cause a series of adverse reactions. The bundled nursing model requires nursing staff to monitor and control the blood pressure of patients, avoid the use of heart failure drugs, and cooperate with patients to perform some actions that help increase blood pressure. This greatly stimulates blood circulation and improves blood vessel permeability. In dialysis treatment, nursing staff selection of the central vein for puncture can effectively relieve patient pain more than traditional puncturing. Utilizing the central vein can also increase blood flow which is more conducive to the establishment of vascular access. Hemostasis through compression of the injection site not only reduces patient pain, but also reduces the possibility of secondary infection after operation. During hospital stays, paying close attention to patient vital signs and regularly examining blood vessels with a stethoscope can effectively prevent postoperative venous pressure. This is one of the factors influencing the prognosis of patients. Over the course of treatment, patients can easily show negative emotions, including irritability, fear, and anxiety. These will have a great negative impact on healing. Bundled nursing requires medical staffs to perform long-term and regular psychological counseling and communication with patients [25]. This allows patients to maintain an optimistic attitude and improve self-confidence, enhancing cooperation with the treatment, thereby significantly improving patient prognosis and quality of life. Communication with patients not only enhances their medical knowledge but also imperceptibly improves the relationship between doctors and patients. Patient satisfaction with nursing and awareness rate of risk awareness has been naturally increased. After patients master the knowledge of their own diseases and health, they know how to seek profit while avoid harm in life, thus, improving quality of life. Compared with the conventional nursing model, bundled nursing techniques reduce vascular blocking and adverse reactions, increase the quality of blood purification, and effectively improve patient prognosis by psychological counseling, good performance during puncture, assistance and cooperation during treatment, and strict postoperative monitoring.

However, due to experimental conditions, there were some limitations to this study. These limitations include the small number of study subjects and the single center population.

In summary, for patients with nephropathy treated with hemodialysis, the use of bundled nursing can effectively increase establishment of vascular access while reducing adverse reactions and vascular access blockages. Bundled nursing is worthy of promotion in clinical use.

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Disclosure of conflict of interest

None.

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