Journal of Clinical and Nursing Research, 2025, Volume 9, Issue 5
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Application of Bundle Nursing Strategy in the Maintenance of Difficult Blood Vessels for Long-term Hemodialysis Patients

Yelin Wang, Liangmei Fei*

Blood Purification Center, Gaoyou People's Hospital, Yangzhou 225600, Jiangsu, China

**Corresponding author: Liangmei Fei, 15152770747@163.com*

Abstract: *Objective:* To study the application effect of bundle nursing strategy in the maintenance of difficult blood vessels for long-term hemodialysis patients. *Methods:* A prospective study was conducted on 40 long-term hemodialysis patients admitted from January 2024 to January 2025. The patients were randomly divided into a control group (20 cases) and an observation group (20 cases) using computer random sampling. The control group received routine nursing for difficult blood vessels, while the observation group received a bundle nursing strategy for difficult blood vessels. The self-care ability, complication rate, and nursing satisfaction were compared between the two groups. *Results:* After nursing, the self-care ability score of the observation group was higher than that of the control group ($P < 0.05$). The complication rate in the observation group was lower than that in the control group ($P < 0.05$). The nursing satisfaction in the observation group was higher than that in the control group ($P < 0.05$). *Conclusion:* The application of the bundle nursing strategy in the maintenance of difficult blood vessels for long-term hemodialysis patients is beneficial for improving self-care ability, reducing complications, and increasing patient satisfaction with nursing services.

Keywords: Long-term hemodialysis; Difficult blood vessels; Routine nursing; Bundle nursing strategy

Online publication: May 30, 2025

1. Introduction

Artificial vascular graft fistula, arteriovenous fistula, and long-term catheterization are commonly used vascular access for hemodialysis [1]. However, long-term hemodialysis is easily affected by various factors, and patients with weak constitutions are prone to various complications, affecting the normal use of vascular access [2]. Some patients lack the initiative to maintain awareness and do not recognize the necessity of protecting vascular access, or do not possess the skills to maintain vascular access, making it impossible to effectively prevent and treat vascular access complications [3]. To improve the service life and safety of vascular access, good nursing care is essential. Previous implementation of routine nursing can ensure hemodialysis treatment, but there are certain

deficiencies in maintaining vascular access, and it cannot effectively prevent and treat various complications, so its application value is limited. The bundle nursing strategy is based on evidence-based medical nursing to develop specific intervention plans to address clinical problems. The nursing measures are all evidence-based, clinically proven effective, and can solve many clinical problems when combined. This article selects 40 patients with long-term hemodialysis and difficult vascular maintenance as subjects to analyze the value of the bundle nursing strategy.

2. Materials and methods

2.1. General information

A prospective study was conducted on 40 patients with difficult vascular access for long-term hemodialysis admitted from January 2020 to January 2025. The patients were randomly divided into a control group (20 cases) and an observation group (20 cases) using a computer-based random sampling method. The data for both groups are presented in **Table 1**, showing no significant differences ($P > 0.05$). The study was approved by the medical ethics committee, and informed consent was signed by the patients and their families.

Table 1. General information for both groups [$n = 20$ cases, n/(mean ± SD)]

Group	Male/Female (cases)	Age (years)	Weight (kg)	Vascular access type (Long-term catheterization/ High fistula/Artificial blood vessels, cases)
Observation group	12/8	55.98 ± 5.62	61.98 ± 5.42	10/6/4
Control group	11/9	55.17 ± 5.46	62.67 ± 5.78	11/5/4
t/χ^2 value	0.102	0.462	0.389	0.139
P value	0.749	0.647	0.699	0.933

Inclusion criteria: (1) Met the criteria for vascular access creation in the "Chinese Expert Consensus on the Nursing of Arteriovenous Fistulas in Hemodialysis Grafts (1st Edition)" [4]; (2) Underwent maintenance hemodialysis 3-4 times per week, with each session lasting 3-4 hours; (3) Were able to cooperate with dialysis treatment, clinical nursing, and follow-up visits.

Exclusion criteria: (1) Abnormal coagulation function; (2) Puncture site not located on the graft; (3) Abnormal communication ability; (4) Transferred to another hospital for treatment during the study.

2.2. Methods

The control group received routine nursing care: After the creation of the vascular access, its function was evaluated, and once it was determined to be mature, it was used as the vascular access for hemodialysis. The patency of the vascular access was evaluated daily before use, and symptoms such as local swelling, fluid leakage, and moderate to severe pain were observed. Based on the condition of the vascular access and the requirements of dialysis, a scientifically appropriate puncture method was selected. Patient health education was strengthened, urging patients to actively protect their vascular access by avoiding heavy lifting or carrying with the dialysis-side limb, and prohibiting infusion, blood pressure measurement, etc., on the vascular access side. After dialysis, pressure bandaging was strictly applied, and long-term compression of the vascular access was prohibited to prevent its dysfunction.

The observation group implemented a bundled nursing strategy:

(1) Evidence-based process

Based on the evidence-based pyramid model, the responsible nurses searched authoritative databases such as CNKI and Wanfang for keywords such as "maintenance hemodialysis, difficult blood vessels (artificial blood vessels, long-term catheterization, high fistulas), nursing." They conducted evidence-based summaries on comprehensive evaluation before puncture, puncture and needle removal, post-puncture care, and self-care. Based on the characteristics of the department's work, they developed standardized, scientific, and reasonable bundled nursing strategies.

(2) Comprehensive evaluation before puncture

The maturity of difficult blood vessels should be evaluated before creation, and they should be used after confirmation of maturity. Before puncture, comprehensively evaluate the vascular access, analyze the surgical method, vascular anastomosis, and the depth of the subcutaneous tunnel. Use palpation, auscultation, and visual examination to evaluate the function and blood flow direction of the vascular access, determine the puncturable length, specific vascular shape, and depth from the skin. Record and draw diagrams in detail to develop a complete puncture plan.

(3) Puncture and application

Before dialysis, urge patients to carefully clean the blood vessel side of the limb, provide a clean and sterile mask, and require them to wear it during dialysis. Comprehensively analyze the patency of blood vessels before puncture and observe whether aneurysms or infections occur. Based on the anatomical location of blood vessels and vascular access maps, comprehensively evaluate the puncture site. Set up a sufficient number of puncture points through the rope ladder puncture method to facilitate later puncture applications. Implement sterile operation, then perform a puncture. The direction of venous puncture is the same as the blood flow direction, while arterial puncture can be in the reverse direction or in the blood flow direction. The distance between venous and arterial puncture needles should be ≥ 5 cm. Puncture on the same plane is prohibited to avoid affecting the fixation of the puncture needles and pressing to stop bleeding after needle removal. During puncture, the bevel of the needle should always face upwards, forming a 30°–45° angle with the skin to avoid vascular injury and intimal injury. After puncturing the blood vessel, rotation is prohibited to prevent damage to the blood vessel wall. If the location of the vascular access is deep, implement a three-point fixation method to make the blood vessels engorged, tighten the distal end of the puncture site, and then perform the puncture. Rubbing and disinfection should be performed before puncture, with spiral disinfection centered on the puncture site. The diameter of disinfection should be ≥ 10 cm, and disinfection should be performed twice. Use heparin-filled wet needles for puncture, select appropriate-sized puncture needles based on dialysis requirements, ensure that the puncture needles meet the blood flow requirements for hemodialysis, ensure uniform and reasonable puncture, prohibit repeated puncture at the same site, promote healing of puncture sites, and reduce blood vessel damage.

(4) Needle withdrawal care

Before removing the puncture needle, check blood pressure to prevent embolism caused by hypotension. Use the two-point finger pressing method to remove the needle, with two fingers pressing directly and gently on the skin and blood vessel puncture site. Loosen the puncture needle and pull it out. Immediately press the puncture site after removing the needle, controlling the pressure so that blood vessel noise can be heard, blood vessel tremor can be felt, and there is no bleeding at the puncture site. The use of a tourniquet for pressure hemostasis is prohibited. For non-immediate puncture sites, continuous pressure should be

applied for 20 minutes, with pressure released every 5 minutes; for immediate puncture sites, continuous pressure should be applied for 10 minutes, with pressure released every 2 minutes. Clean the local skin 24 hours after puncture, pay attention to the hygiene of the puncture site, and avoid pressing or lifting heavy objects with the punctured limb.

(5) Self-care

Provide free manuals, introduce common vascular access complications and discomfort symptoms through manuals and multimedia, list evaluation methods and complication prevention measures, and improve self-care ability. Keep the dialysis side limbs dry and clean during non-dialysis hours, and use soap to clean the puncture side limbs during dialysis, drying them with a dry towel. If a hematoma appears in the puncture area, immediately apply an ice pack, followed by a hot water bag for 24 hours, or perform compression hemostasis while controlling the compression force to avoid flattening the vascular access. If there is swelling or induration at the puncture site, apply Hirudoid ointment externally as prescribed. If there is redness, swelling, seepage, or moderate to severe pain at the puncture site, seek immediate medical attention. Patients are required to perform daily self-evaluation of vascular access through palpation, auscultation, and other comprehensive evaluations. If there is no noise in the vascular access and the tremor is significantly reduced, medical attention should be sought immediately. Dialysis patients should postpone taking antihypertensive drugs during dialysis, adjust medication dosages and frequencies under the guidance of a doctor, and flexibly use medications. Increasing or decreasing medication dosages is prohibited. If blood pressure is less than 120/70 mmHg during dialysis or less than 130/80 mmHg after dialysis, inform the doctor immediately and follow the doctor's advice to increase blood pressure. Patients are urged to strictly control their weight, with a weight gain of less than 2–3 kg. For young adults, weight gain should be less than 5% of dry weight, and for the elderly, weight gain should be less than 4% of dry weight, to prevent hypotension and internal fistula embolism caused by insufficient blood volume.

(6) Multi-channel education

Provide verbal introductions to puncture knowledge and precautions before puncture, and introduce common complications and discomfort symptoms after needle withdrawal. Continuously update self-awareness through picture albums, regularly updated top files and videos in WeChat groups, improve self-care ability, master self-care skills after dialysis and during non-dialysis, and actively prevent complications. Guide patients to learn and master rehabilitation measures such as fistula exercise, squeezing rubber balls, and aerobic exercise, do a good job in exercise care, and enhance immunity. If the vascular access heals well and there are no abnormalities, the intensity of rehabilitation exercise can be appropriately increased, and the grip strength ball can be squeezed to moderately expand and fully fill the blood vessels, improve the quality of vascular access, reduce the risk of complications, and extend the application time. Both groups received continuous nursing care for 3 months.

2.3. Observation indicators

(1) Self-care ability: Evaluated using the Self-Care Behavior Scale [5] before and after nursing, focusing on two dimensions: complication prevention and symptom management. The total score is 40, with higher scores indicating better self-care ability.

(2) Incidence of complications: This includes infection, pseudoaneurysm, and vascular stenosis.

(3) Nursing satisfaction: Measured using a self-designed satisfaction survey scale with a total score of 20.

Scores of 0–10 indicate dissatisfaction, 10–16 indicate relative satisfaction, and 16–20 indicate high satisfaction. Patients evaluate their satisfaction, and nursing satisfaction is calculated as [(very satisfied + relatively satisfied) / total number of cases * 100%].

2.4. Statistical methods

SPSS 26.0 software was used to process the data. Count data were expressed as percentages (%) and tested using χ^2. Measurement data conforming to a normal distribution were tested using *t* (or F). $P < 0.05$ indicated that the difference in data was statistically significant.

3. Results

3.1. Comparison of self-care abilities between the two groups (see Table 2)

Table 2. Self-care abilities of two groups (*n* = 20 cases, mean ± SD, score)

Group	Complication prevention		Symptom and sign management	
	Pre-nursing	Post-nursing	Pre-nursing	Post-nursing
Observation group	20.31 ± 4.56	30.76 ± 5.26	18.43 ± 4.21	30.18 ± 4.78
Control group	21.07 ± 4.69	26.00 ± 4.91	19.32 ± 4.37	25.43 ± 4.52
t value	0.520	2.958	0.656	3.229
P value	0.606	0.005	0.516	0.003

Note: Compared with before nursing in the same group, $^{a}P < 0.05$.

3.2. Comparison of complication rates between the two groups (see Table 3)

Table 3. Incidence rate of complications in two groups (*n* = 20 cases, *n*/%)

Group	Infection (*n*)	Pseudoaneurysm (*n*)	Vascular stenosis (*n*)	Incidence rate of complications (%)
Observation group	0	0	0	0.00
Control group	1	1	2	20.00
t value	-	-	-	4.444
P value	-	-	-	0.035

3.3. Comparison of nursing satisfaction between the two groups (see Table 4)

Table 4. Nursing satisfaction in two groups (*n* = 20, *n*/%)

Group	Very satisfied (*n*)	Quite satisfied (*n*)	Dissatisfied (*n*)	Nursing satisfaction (%)
Observation group	15	5	0	100.00
Control group	8	8	4	80.00
t value	-	-	-	4.444
P value	-	-	-	0.035

4. Discussion

A good vascular access is the key to ensuring continuous and high-quality hemodialysis [6]. Vascular access maintenance is a common challenge in hemodialysis, especially for difficult vessels. Difficult vessels in patients undergoing long-term hemodialysis include three types: long-term catheterization, high fistulas, and artificial blood vessels. Various complications are prone to occur during the application of difficult vessels [7]. These complications can increase physical discomfort, affect the normal use of blood vessels, and even lead to the failure of vascular access [8]. Good puncture and maintenance during the application of vascular access, improving the patency rate of vascular access, and proactive prevention of complications can undoubtedly prolong the application time and improve the quality of application. The bundled nursing strategy is based on evidence-based nursing, to improve the quality of clinical nursing, optimize clinical nursing services, and satisfy patients with nursing care, and has significant application value.

In this study, the self-care ability score of the observation group after nursing was higher than that of the control group ($P < 0.05$). Maintenance hemodialysis requires lifelong treatment, and the disease course is long. Patients need to be admitted to the hospital for hemodialysis regularly. During hospitalization, high-quality services are provided by nurses, but it is difficult to ensure the value of care during home stays [9]. Implementing a bundled nursing strategy can enrich patients' accurate knowledge of puncture and maintenance, help patients master prevention and treatment measures for various complications, and enable patients to provide high-quality services for internal fistulas during home stays, thereby significantly improving self-care ability. The incidence of complications in the observation group was lower than that in the control group ($P < 0.05$), and nursing satisfaction was higher than that in the control group ($P < 0.05$). Complications are the main reasons that induce physical and psychological discomfort, affect dialysis compliance, and reduce patients' nursing experience. Implementing a bundled nursing strategy allows patients to actively participate in the prevention and treatment of complications, familiarize themselves with various complications' inducements and effective response measures, prepare patients ahead of time, maintain vascular access during dialysis and non-dialysis periods, improve dialysis quality, effectiveness, and safety, reduce the risk of complications, enhance patients' dialysis experience, and increase their satisfaction with nursing care [10].

5. Conclusion

In summary, the bundled nursing strategy can play a significant role in the maintenance of difficult vessels for patients undergoing long-term hemodialysis. It can improve patients' self-care ability, reduce the incidence of complications, and increase patients' satisfaction with nursing care, with significant application value.

Disclosure statement

The authors declare no conflict of interest.

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