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Review Article

The preventive effect and safety of personalized nursing in intravenous indwelling needle infections

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Abstract: Objective: To explore the effect of personalized nursing on the prevention of infections and the safety of patients with intravenous indwelling needles. Methods: From June 2016 to January 2018, 112 patients who underwent venous indwelling needle puncture in our hospital were selected as the study subjects. Among them, 60 cases who were administered intravenous indwelling needles during their treatment were selected as the control group (CG), and the remaining 52 patients who were treated with personalized nursing on the basis of routine nursing were selected as the research group (RG). The puncture success rate, indwelling time, adverse reactions, catheter removal rate and blocking rate, pain, compliance, and nursing satisfaction were compared between the two groups. Results: Compared with the CG, the RG presented a markedly higher puncture success rate ($P<0.05$), a significantly longer intravenous indwelling time ($P<0.05$), a notably lower incidence of total adverse reactions ($P<0.05$), and significantly lower rates of catheter removal and blocking ($P<0.05$). The VAS scores in the RG were significantly lower than they were in the CG ($P<0.05$). The infusion compliance in the RG was significantly higher than it was in the CG ($P<0.05$), as was the case with the nursing satisfaction ($P<0.05$). Conclusion: Personalized nursing can reduce the indwelling needle infection rate, improve the safety of infusions, and improve the quality of medical treatment.

Keywords: Personalized nursing, intravenous indwelling needle, infection, prevention, nursing safety

Introduction

Intravenous infusion is commonly used to help drugs enter the blood circulation of patients and effect the process of clinical drug treatment [1]. Repeated puncture pain has become a norm that patients have to suffer from unobstructed traditional intravenous infusions. Those who have been hospitalized for intravenous infusion for a long time may develop a certain psychological resistance and physical and mental damage. Repeated infusion punctures are also prone to cause inflammation and infection at the puncture point, which in turn affects the overall treatment effect and recovery progress and increases patients' psychological and treatment burdens [2, 3]. The peripheral venous indwelling needle, also known as a trocar, is a relatively novel infusion method and has the advantages of reducing puncture times, alleviating vascular stimulation, and preventing drug exudation and phlebitis, and is applicable to patients with intermittent or continuous intravenous infusions [4, 5]. Apart from that, intravenous catheters can avoid repeated punctures to effectively eliminate patients' psychological resistance, guarantee patients' medication duration, indirectly improve the treatment success rate of endangering patients, and reduce patients' daily work amount, thus greatly improving the efficiency of nursing staff [6, 7].

Generally, the intravenous indwelling needle can be retained for 3-5 days, but most clinical indwelling needles have a poor efficacy and can only last for 2-3 days, a duration mainly affected by the patients' activity friction, improper nursing work, clinical complications, and other factors, bringing certain risks and obstacles to the clinical use of indwelling needles [8, 9]. During the retention of the indwelling needle, coagulation can be seen in the heparin cap and

the Y-shaped pipe of the indwelling needle, hindering drugs from being injected into the body [10], which might affect the patient's life safety in serious cases. In view of the clinical problems during the indwelling needle period, it is particularly important to choose the appropriate nursing scheme and pay attention to safety during the nursing period. Now, the effect of personalized nursing on the prevention of infection in patients with intravenous indwelling needles is actively analyzed and discussed. The detailed process is as follows.

Materials and methods

General information

From June 2016 to January 2018, 112 patients treated with intravenous indwelling needle punctures in our hospital were selected as the study objects. Among them, 60 patients receiving routine nursing intervention with intravenous indwelling needles were included in the CG, and the rest of the 52 patients were supplemented with personalized nursing on the basis of routine nursing and enrolled in the RG. As to their ages, 22 cases were under 10 years old, 56 cases were between 10-60 years old, and 34 cases were over 60 years old. According to the diseases classification, 25 cases suffered from gastrointestinal tumor diseases, 61 cases suffered from liver and biliary diseases, 18 cases suffered from intestinal obstruction, and 8 cases suffered from other diseases. Inclusion and exclusion criteria: Patients who needed fluid replacement for more than 3 days and voluntarily received intravenous indwelling needle infusion were included. In contrast, patients with hypersensitivity to iodine and heparin, patients with a high risk of infection, patients with pre-punctured bacteremia, patients who did not comply with the nursing care or who strongly demanded the termination of the nursing care, as well as those with critical conditions or special medical histories were excluded.

Nursing methods

The patients were given intravenous infusion with femoral vein indwelling needles using sitting and supine limb abduction, and the puncture point was selected on the forearm or arm after disinfecting and spreading the towel. A 4-5 cm catheter was placed, and the infusion device was fixed and connected. The CG was given routine nursing, including clinical observation, and replacement and disinfection of the intravenous indwelling needle, while the RG was treated with personalized nursing, including the following measures [4]: (1) Nursing care before the indwelling needle puncture. There were some patients exhibiting fear and resistance to infusion therapy who did not cooperate with the treatment or nursing. By understanding the patient's psychology, transferring the patient's attention, and explaining relevant knowledge, the medical staff eliminated the patient's psychological defenses and concerns, comforted their bad state, and built mutual trust between the doctors and patients to improve their therapeutic cooperation. (2) Nursing during puncture. The disinfection area of the skin around the puncture site was larger than the dressing area. The nursing staff explained the cooperation mode of the patients with venipuncture, communicated with each other and tried to meet the reasonable requirements of the patients. (3) Nursing after puncture. A real-time observation was made on whether the skin at the indwelling needle had exudate, redness or swelling, and whether the needle slipped or shifted. In addition, the nursing staff also checked whether the drainage was smooth during infusion and eliminated the adverse effects of pressure and distortion of the infusion catheter. When an unsmooth infusion was found, heparin fluid was used to facilitate the unobssive operation to avoid the distal small vessel embolization caused by the forced infusion. After confirming that the pressure in the closed cavity exceeded the venous pressure, the needle was slowly pushed out and withdrawn, so as to avoid extravasation, swelling, and needle blockage. (4) Nursing of complications. The puncture site was strictly sterilized with a 0.02 g/mL iodine-volt cotton ball every day. In the process of infusion, the patient maintained immobility of the limbs for a long time and the blood flow of veins was not smooth, which could easily cause a swelling of limbs at the infusion end and patient anxiety. By instructing the patient to master individual massage techniques, the medical staff massaged the infusion limb and provided the patient with slight limb stretch to reduce the swelling while ensuring the safety of the indwelling needle.

Nursing safety management

(1) Establishment of a standardized operation training system: We strictly regulated the safety awareness of the nurses using indwelling needles. We regularly gathered the nurses to conduct safety operation education exercise lectures, organized discussions and exchanges after class to give experience, carried out warning education on a series of complications that may accompany the intravenous indwelling needle procedure, and advocated the responsible nurses to strengthen the understanding of the safe use of the intravenous indwelling needles, payed attention to the situations such as the disconnection of the intravenous indwelling needle and the bleeding caused by the patient's self extubation. The head nurse regularly organized nursing safety summaries and evaluations of the use of intravenous indwelling needles, and analyzed the actual problems to get solutions. (2) Notices on matters needing the attention of patients and their families to confirm the implementation of indwelling needles: The explanation went first. Before the indwelling needle puncture operation, the responsible nurse first elucidated the work to avoid disputes, and instructed the patients and their families to sign the informed consent about the side effects of indwelling needles. The specific contents included the purpose and necessity of indwelling needle operations, precautions, complications, explanation of the nursing operation, the self-protection method of the indwelling needle, keeping the puncture site clean and dry. (3) Enhancement of the venous indwelling needle puncture technique: Institutionalized management and standardized nursing behaviors to improve the skills of nurses' indwelling needle puncture, guided the nurses to consult relevant literature to deepen the nurses' understanding and knowledge of the nursing skills involving indwelling needles. We adopted the operation ability assessment method to teach nurses the correct operation method, conducted routine inspections to urge nurses to conform to the standards, and implemented a monthly reward and punishment system to improve enthusiasm. We established and improved an inspection and handover system to complete the bedside handover procedure. The inspection contents included the application of the aseptic transparent membrane, catheter removal and extubation, contamination and leakage of puncture site and bleeding, and the like. The abnormal situation was handled and recorded for future reference. (4) Making the most of the intravenous indwelling needle: Attention was paid to avoiding the shedding of indwelling needles and bleeding of the indwelling needle caused by the friction of the patient's activity. In addition to the necessary perambulate inspection by the on-duty nurses, the nurses carefully checked the sealing catheter, membrane paste, heparin cap and sealing catheter rack before the puncture operation and fixed the hemostatic clamp with a layer of small pieces of paper to prepare for the next day. Apart from that, the film was replaced according to the individual conditions and covered with sterile gauze and tape.

Analysis indicators

(1) The puncture success rate, indwelling time, and adverse reactions in the two groups were recorded and observed; (2) The incidences of catheter blocking and needle shedding were observed and recorded [11]. Catheter blocking with indwelling needle referred to a decrease in the fluid flow rate or no drip during the indwelling catheter, the absence of blood reflux from the syringe, or an obstruction of the injection of normal saline. The shedding of indwelling needle refers to the exposure of 2/3 of the indwelling needle length to the outside of the blood vessel and the loosening of the transparent application. (3) Pain degree: The pain evaluation was performed using the visual analogue scale (VAS). The patients were asked to choose according to their degree of pain from 0 to 10 points, and the higher the score, the more severe the pain was [12]. (4) Compliance during infusion: Low compliance was characterized by a strong urge to terminate the infusion therapy due to pain, and high compliance meant that the patient sensed mild pain, but still continued on with the infusion. (5) Nursing satisfaction was assessed using a departmental self-made satisfaction questionnaire [6], which was divided into 3 levels of satisfaction, basic satisfaction, and dissatisfaction by >85 points, 60-85 points, and <60 points respectively. Nursing satisfaction = (number of satisfied patients + number of basically satisfied patients)/total number of patients ×100%.

Table 1. Comparison of the general information [n (%)]

Characteristic variables	The CG (n=60)	The RG (n=52)	X^2	P
Age (years)			0.817	0.665
<10	13 (21.67)	9 (17.31)		
10-60	29 (48.33)	27 (51.92)		
>60	18 (30.00)	16 (30.77)		
Gender (cases)			0.185	0.667
Male	34 (56.67)	31 (59.62)		
Female	26 (43.33)	21 (40.38)		
History of colds (cases)			0.089	0.765
Frequent colds	21 (35.00)	17 (32.69)		
Occasional colds	39 (65.00)	35 (67.31)		
Type of diseases (cases)			0.365	0.947
Gastrointestinal tumor disease	14 (23.33)	11 (21.15)		
Liver and biliary disease	32 (53.33)	29 (55.77)		
Intestinal obstruction (not caused by tumor)	10 (16.67)	8 (15.38)		
Others	4 (6.67)	4 (7.69)		
Blood leukocytes before puncture (cases)			0.866	0.352
Below normal	12 (20.00)	8 (15.38)		
Normal or slightly higher	48 (80.00)	44 (84.62)		
Antibiotic infusion (cases)			0.020	0.887
Yes	34 (56.67)	29 (55.77)		
No	26 (43.33)	23 (44.23)		
Type of indwelling needles (cases)			0.320	0.572
22 G	29 (48.33)	27 (51.92)		
24 G	31 (51.67)	25 (48.08)		
Place of indwelling needle (cases)			0.084	0.772
Forearm	23 (38.33)	21 (40.38)		
Arm	37 (61.67)	31 (59.62)		
Operating personnel working time (year)			0.099	0.753
1	16 (26.67)	15 (28.85)		
>1	44 (73.33)	37 (71.15)		

Statistical analysis

SPSS 19.0 statistical software was employed to process and analyze all the data after the classification and summary. The t-test was adopted to compare the measurement data sets, and the counting data was compared using χ^2 tests. GraphPad Prism 8 was applied to plot the required pictures. $P<0.05$ indicated that a difference was statistically significant.

Results

General information

The general information as represented by age, gender, history of colds, and disease types did not identify any significant differences between the two groups ($P>0.05$) (**Table 1**).

Comparison of the puncture success rates between the two groups

The puncture success rate in the RG was significantly higher than it was in the CG ($P<0.05$) (**Figure 1**).

Comparison of the intravenous indwelling times between the two groups

The indwelling time of the intravenous indwelling needle was significantly longer in the RG than it was in the CG ($P<0.05$) (**Figure 2**).

Comparison of the adverse reactions between the two groups

The incidence of the total adverse reactions in the RG was significantly lower than it was in the CG ($P<0.05$) (**Table 2**).

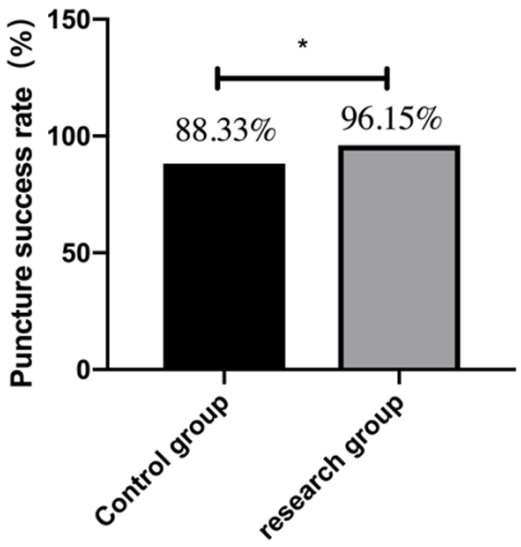

Figure 1. Comparison of the puncture success rates in the two groups. The puncture success rate in the RG (96.15%) was significantly higher than it was in the CG (88.33%). Note: * indicates P<0.05.

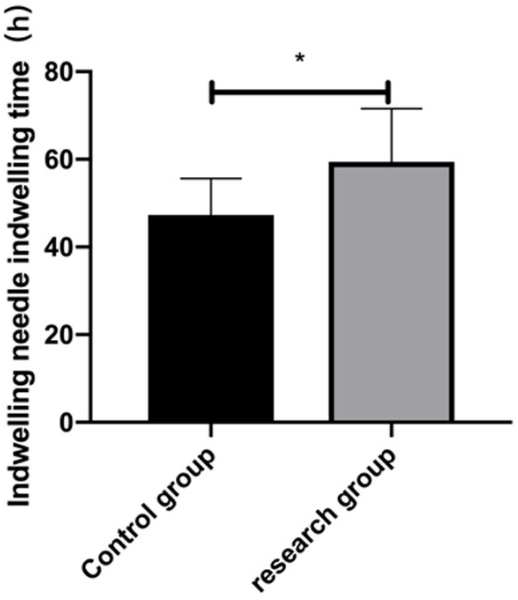

Figure 2. Comparison of the indwelling time of the intravenous indwelling needle between the two groups. The indwelling time of the intravenous indwelling needle in the RG was significantly longer than it was in the CG (P<0.05). Note: * indicates P<0.05.

Comparison of the catheter blocking rate and the removal rate between the two groups

The catheter blocking and removal rates of the RG were significantly lower than those of the CG (P<0.05) (**Figure 3**).

Comparison of VAS score between the two groups

The VAS score of the RG (2.64±0.56) points was significantly lower than that of the CG (4.29±1.02) points, with a statistically significant difference (P<0.05) (**Figure 4**).

Comparison of patients' compliance between the two groups

In the CG, there were 51 cases with high compliance (85.00%), 9 cases with low compliance (15.00%), 49 cases with high compliance (96.43%) and 3 cases with low compliance (5.77%). The infusion compliance in the RG was significantly higher than that in the CG (P<0.05) (**Table 3**).

Comparison of the nursing satisfaction between the two groups

The nursing satisfaction of the RG was significantly higher than it was in the CG (P<0.05) (**Table 4**).

Discussion

Intravenous indwelling needle infusion is one of the most rapid and effective methods of clinical drug delivery. However, patients' pain and anxiety about their own diseases and their lack of understanding of indwelling needle puncture give rise to fear and resistance before the puncture, which results in their poor cooperation with the treatment, leading to the failure of the intravenous puncture [13]. For patients who have been treated with intravenous indwelling needle infusion for a long time, the incidence of phlebitis increases after a large infusion of drugs such as mannitol, amino acids, and fat emulsion, which are highly irritating, hypertonic, or insufficiently diluted. Pathological changes in the permeability of the blood vessel walls causes the extravasation of the drug solution, local tissue edema, and tissue fluid accumulation around the body, and inappropriate treatment may lead to tissue necrosis [14, 15]. Personalized nursing refers to the systematic setting of nursing plans by nursing staff based on the actual situations of the individual patients and applying the acquired professional knowledge, adhering to the targeted nursing model with patients as the main focus, and conforming to the modern nursing concept and

Table 2. Comparison of the adverse reactions in the two groups [n (%)]

Group	The CG (n=60)	The RG (n=52)	X^2	P
Bile duct obstruction	3 (5.00)	1 (1.92)	-	-
Local swelling infection	4 (6.67)	2 (3.85)	-	-
Phlebitis	3 (5.00)	1 (1.92)	-	-
Liquid exudation	2 (3.33)	0	-	-
Venous thrombosis	2 (3.33)	1 (1.92)	-	-
Total adverse reaction rate	14 (23.33)	5 (9.62)	6.133	0.013

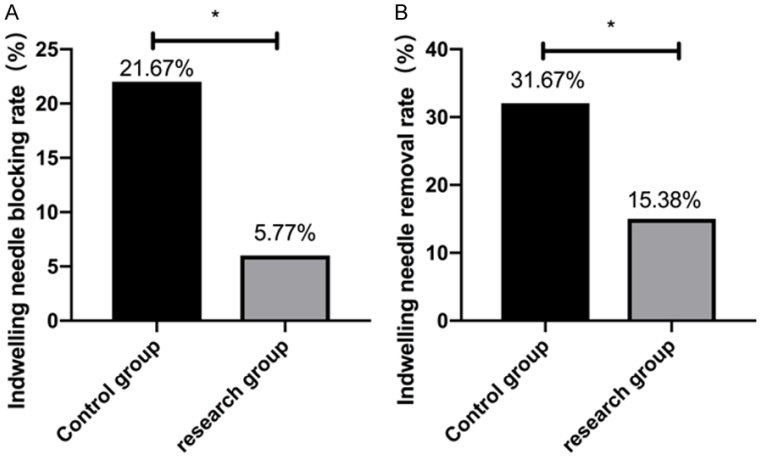

Figure 3. Comparison of the catheter blocking and removal rates in the two groups. A. The catheter blocking rate in the RG (5.77%) was significantly lower than it was in the CG (21.67%). B. The catheter removal rate in the RG (15.38%) was significantly lower than it was in the CG (31.67%). Note: * indicates P<0.05.

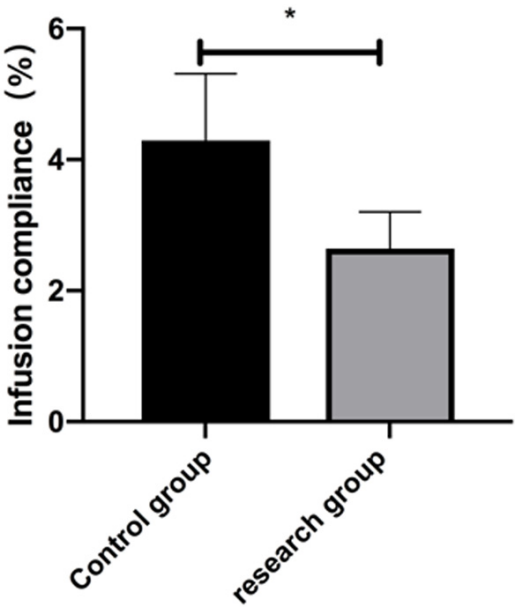

Figure 4. Comparison of the nursing satisfaction between the two groups. The nursing satisfaction in the RG was significantly higher than it was in the CG. Note: * indicates P<0.05.

the trend and standard of innovative development. In the process of treating a patient's condition, the patient's physical and mental health adjustment are given equal attention, and the nursing operation is implemented according to the patient's individual differences on the basis of embodying the concept of humanized care [16, 17]. Therefore, the humanized nursing model was designed and studied for patients with intravenous indwelling needle intervention, in order to explore its preventative and intervention effects and provide appropriate nursing programs for patients who need long-term needle-assisted infusion.

There are many factors affecting the puncture success rate, like the selection of the diameter of the intravenous indwelling needle, the placement site and individual differences. The comparison and selection of the case data of this study between the two groups were basically similar, and the puncture success rate was studied based on the idea that the basic conditions of the study subjects did not affect the nursing results, so as to ensure the relative accuracy of the study as much as possible. The comparison of the puncture success rates in this study showed that the success rate of intravenous catheterization was higher in the RG. After the quantitative assessment of the professional system, the nursing skills and professional skills of the individualized nursing executive nurses were significantly improved [18, 19], indicating that the nurses who carried out the individualized nursing mode acquired the skill of accurately determining the needle delivery angle after repeated practice, ensuring the success of the puncture and affecting the indwelling time of the indwelling needle, and the indwelling times of the patients' indwelling needles in the RG were observed to be longer. The retention of an indwelling catheter can be effectively improved by the disinfection operation of iodide volts and the sealing of the catheter with heparin sodi-

Table 3. Comparison of the compliance in the two groups [n (%)]

Group	The CG (n=60)	The RG (n=52)	X^2	P
High compliance	51 (85.00)	49 (94.23)	4.310	0.038
Low compliance	9 (15.00)	3 (5.77)		

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

Group	The CG (n=60)	The RG (n=52)	X^2	P
Satisfied	31 (51.67)	42 (80.77)	-	-
Basically satisfied	20 (33.33)	9 (17.31)	-	-
Dissatisfied	9 (15.00)	1 (1.92)	-	-
Nursing satisfaction	51 (85.00)	51 (98.08)	10.861	0.001

um, the prevention measures of liquid leakage and swelling at the puncture, and controlling of the patients' inflammatory responses and fevers [20, 21], suggesting that the effective rate of indwelling needles in the personalized nursing mode was improved compared with routine nursing. During the nursing process of indwelling needle puncture, the incidence of unsafe incidents or complications in patients is relatively high. For example, the rate of catheter blocking, catheter removal and adverse reactions in patients after routine nursing found in this experiment are higher than those of personalized nursing. Traditional venipuncture is usually carried out too many times for patients, and the patients' vascular elasticity reduces the flow obstruction, which is likely to cause the blockage of the endovascular cavity and surrounding tissues, and the autoimmune mechanism forms the stress fibrosis response, which increases the risk of phlebitis [22]. Patients receiving indwelling needle puncture may bring about indwelling needle blockage and disengagement due to increased venous pressure, excessive activity, and position change due to emotional agitation [23, 24]. It has been proved that the individualized nursing mode also includes the safe nursing management of patients, which can effectively reduce the patients' complications, the rate of catheter blockage and the removal of indwelling needles, and the occurrence of medical accidents. Nursing measures were mainly applied to relieve the patients' pathological pain, as was verified by the results in present study showing that the pain recovery was better in the RG. Professional needle entry angles can lessen stimulation and damage to the surrounding tissues when the needle travels through the skin, while the adjustment of puncture speed can decrease the time of subcutaneous travel and skin contact area, and the fixation treatment after the puncture can reduce the involvement and pain of the patients' epidermis [25], all demonstrating that the personalized nursing mode requires the nurse to master the skillful operation techniques to reduce the possibility of secondary pain, improve the trust between doctors and patients and maintain a good doctor-patient relationship. Through this study, it was confirmed that the patients who implemented personalized nursing had a higher nursing compliance and satisfaction with the nursing services than with conventional nursing intervention. After regular quantitative assessment, the quality of personalized nursing, the sense of responsibility, and the working attitude of the nursing staff were all improved, and the indwelling needles were replaced regularly to ensure that the nursing was implemented under safe conditions, and psychological counseling was given to reduce the patients' mental pressure and improve the degree of cooperation and trust in the patients' families [26]. Combined with reading the medical literature, personalized nursing is more appropriate in doctor-patient relationship processing.

In conclusion, personalized nursing can reduce the indwelling needle infection rate, significantly improve patients' infusion safety, and enhance the quality of medical treatment. However, there are still unsolved problems in this study. Regarding the nursing effects of the adverse reactions caused by indwelling needle punctures, no detailed exploration on the exact nursing steps to prevent the occurrence of adverse reactions has been conducted. A specific understanding of the effect of the nursing implementation methods on adverse reactions is conducive to the regulation of unsafe events and provides a theoretical and practical basis for the subsequent design of detailed nursing operations for patients.

Disclosure of conflict of interest

None.

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