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Original Article

Cluster nursing in the prevention of PICC-related venous thrombosis and its influence on tumor patients' coagulation functions

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Abstract: Objective: To explore the role of cluster nursing in preventing peripherally inserted central catheter (PICC)-related venous thrombosis in tumor patients. Methods: A total of 148 PICC catheterization patients were divided into two groups: the control group (n=74, which underwent routine nursing), and the observation group (n=74, which underwent cluster nursing) in this prospective study. Before and after the intervention, the changes in the patients' PICC and blood coagulation function-related indexes, their moods, quality of life, and self-care abilities were compared in the two groups. Results: There was no significant difference in the planned extubation times between the two groups (P>0.05). The incidences of unplanned extubation and venous thrombosis in the observation group were significantly lower than they were in the control group (P<0.05). In the control group, there were no significant changes in the prothrombin times, the activated partial thromboplastin times, or the D-dimer and fibrinogen levels after the intervention (P>0.05). In the observation group, both the prothrombin times and activated partial thromboplastin times were significantly prolonged, and the D-dimer and fibrinogen levels were significantly reduced after the intervention (P<0.05). The two groups' Hamilton Anxiety Scale (HAMA) and Hamilton Depression Scale (HAMD) scores were significantly reduced after the intervention, and the Short-Form Health Survey (SF-36) and Exercise of Self-care Agency (ESCA) scores were significantly increased at 6 months after discharge (all P<0.05). Conclusion: The use of cluster nursing for tumor patients with PICC catheterization can restore their normal coagulation function, thereby inhibiting the occurrence of venous thrombosis. It can also relieve the patients' emotions, improving their quality of life after their hospitalization.

Keywords: Peripherally inserted central catheter, cluster nursing, venous thrombosis, coagulation function

Introduction

A peripherally inserted central catheter (PICC) is a clinical technique for establishing long-term venous support for critically ill patients. Its puncture is in the peripheral vein. The success rate of this clinical implementation is relatively high, and it has been widely used in many aspects such as nutrition and tumor chemotherapy [1, 2]. Although this technology has a wide range of applications, catheter-related complications may still occur during PICC treatment, such as PICC-related deep vein thrombosis of the upper extremity [3, 4]. Studies have shown that the incidence of venous thrombosis in tumor patients with PICC can reach 35%-40% [5]. It has become a major and serious complication of PICC. As a novel nursing model, the concept of cluster nursing was first proposed by the Institute of Health Promotion in the United States. It is a collection of evidence-based nursing interventions to treat refractory diseases. Patients are provided with targeted and highly efficient services, which have been proven to be clinically effective and to significantly improve their clinical outcomes [6]. Nowadays, the cluster nursing model has been widely used and has achieved satisfactory results, such as the prevention of ventilator-related pneumonia and pressure sores [7, 8]. The main purpose of this study is to explore the effect of cluster nursing in preventing PICC-related venous thrombosis in tumor patients and its influence on coagulation function.

Materials and methods

General information

A prospective study was conducted that included 148 tumor patients with PICC intubation who were treated at the Tangshan Gongren Hospital from September 2017 to October 2019. They were divided into two groups: the control group (n=74, which underwent routine nursing), and the observation group (n=74, which underwent cluster nursing). This study was approved by the Ethics Committee of Tangshan Gongren Hospital. All the patients signed a written informed consent.

Inclusion criteria: Patients between 30-80 years old, patients diagnosed with malignant tumors through pathological biopsies and with expected survival times of no more than 3 months, patients who voluntarily accepted and cooperated with the PICC nursing, patients who signed the informed consent, patients were able to communicate effectively using words.

Exclusion criteria: Patients with abnormal blood coagulation function, patients who had PICC catheterization times shorter than 24 hours, patients who were declared dead, patients who had a mental illness or cognitive impairment.

Methods

The patients in the control group mainly received routine nursing as follows: (1) The patient's vital signs were closely monitored and any abnormalities were promptly reported to the senior nurse. (2) The PICC was checked and determined to be sealed and leakage-free, and it was then fixed with tape.

The observation group received clustered care as follows: (1) Risk assessment before the intubation: Before the intubation, the tumor stage, metastasis, chronic disease, co-infection, and blood coagulation were evaluated, and the high risk was treated symptomatically, and then the PICC was placed afterwards. (2) Catheterization process: The puncture site was carefully placed at a point 3-4 cm above the patient's elbow, and a brachial vein with an internal diameter more than 3.0 mm was selected as the puncture entrance. A 4Fr silicone three-way valve catheter was chosen. After the catheter was inserted, a chest x-ray was performed to determine whether the catheter position was appropriate. The PICC catheter was then fixed with tape. (3) Post-intubation risk assessment: After placing the catheter in a suitable position, a scientific, reasonable, and effective assessment of the internal diameter of the punctured vessel and the position of the catheter tip was carried out. (4) Daily maintenance of PICC: The PICC catheter was maintained 1 to 2 times a week, and any abnormalities were handled promptly. (5) Functional exercise: 4-6 hours after the tube was placed, the ball grip exercise was conducted by holding an elastic ball. The elastic ball was squeezed by 1/2, and the arm was straightened and raised to the top of the head for more than 10 s. After resting for 10 to 15 s, the exercise was repeated. 24 hours after the tube was placed, the patients were told to draw circles with their arms. The patients were told to exercise 3 to 4 times per day, 10 to 15 minutes each time until the tube was extubated. (6) Health education: Education manuals were distributed, and online media, such as videos and telephone follow-ups, were used to teach patients. The patients were told to familiarize themselves with the matters needing attention during their PICC intubation and after the extubation. The patients were also asked to return to the hospital for treatment if any abnormalities were found after their discharge.

Outcome measures

Main outcome measures: The two groups' PICC-related indexes were recorded, such as planned extubation times, unplanned extubation incidences, and venous thrombosis incidences [9]. Unplanned extubation incidence (%) = (patients with unplanned extubation) number/total patient number * 100%. The venous thrombosis incidence (%) = (patients with venous thrombosis) number/total patient number * 100%. Venous thrombosis was diagnosed using Doppler ultrasound or angiography [10].

About 4 mL of venous blood was collected both before the PICC tube insertion and when each patient was discharged from the hospital. The blood was placed in anticoagulation tubes. The plasma was separated using centrifugation. An automatic coagulation analyzer (Coatron 3000, Megtron Inc., Germany) was used for the coagulation tests, including determining the plasma prothrombin times (PT), the activated partial thromboplastin times (APTT), and the D-dimer (D-D) and fibrinogen (FIB) levels. The PT and APTT were tested using coagulation assays (00796, 00798, Shanghai Sun Biotechnology Co., Ltd., China), and the D-dimer was tested

Table 1. Comparison of the basic data of the two groups of patients (n, $\bar{x}$ ± sd)

	Observation group (n=74)	Control group (n=74)	χ^2/t	P
Gender (n)			0.247	0.619
Male	34	31		
Female	40	43		
Age (Y)	54.4±4.3	53.9±5.7	0.602	0.548
Tumor type (n)			1.897	0.104
Lung cancer	20	17		
Gastric cancer	16	20		
Liver cancer	13	15		
Breast cancer	10	8		
Cervical cancer	6	7		
Others	9	7		
Average PICC intubation time (d)	89.80±8.39	91.95±10.04	1.414	0.160

Note: PICC: peripherally inserted central catheter.

Table 2. Comparison of the PICC-related indicators between the two groups (n, $\bar{x}$ ± sd)

Group	Planned extubation time (d)	Incidence of unplanned extubation (%)	Incidence of venous thrombosis (%)
Observation group (n=74)	94.49±7.70	1 (1.35)	1 (1.35)
Control group (n=74)	96.05±9.43	8 (10.81)	8 (10.81)
χ^2/t	1.102	4.259	4.259
P	0.272	0.039	0.039

Note: PICC: peripherally inserted central catheter.

using immunoturbidimetric assays (NY09575, Diagnostica Stago Co., France). The FIB was tested using enzyme-linked immunosorbent assays (ml060701, Shanghai Enzyme-Linked Biotechnology Co., Ltd., China).

Secondary outcome measures: Comparison of the negative emotions before and after the intervention: Anxiety and depression were assessed using the Hamilton Anxiety Scale (HAMA) and the Hamilton Depression Scale (HAMD) [11, 12]. The scores and negative emotions were positively correlated.

Comparison of the quality of life and self-care ability: The Short-Form Health Survey (SF-36) and Exercise of Self-care Agency (ESCA) were used to assess the quality of life and self-care abilities of the patients before the intervention and at 6 months after discharge [13, 14]. The scores were directly proportional to the quality of life and self-care ability.

Statistical analysis

SPSS 20.0 was used for the data analysis. The enumeration data were represented as the number of cases/percentage (n/%) and were tested with χ^2 tests. The measurement data conforming to a normal distribution were represented as the mean ± standard deviation ($\bar{x}$ ± sd) and were tested using t-tests. P<0.05 was considered statistically significant.

Results

Basic information

The basic data of the two groups of patients were comparable and showed no significant differences (P>0.05). See **Table 1**.

PICC related indicators

There were no significant differences in the planned extubation times between the two groups (P>0.05). The incidences of unplanned extubation and venous thrombosis in the observation group were significantly lower than they were in the control group (all P<0.05). See **Table 2**.

Coagulation function

The patients' PT, APTT, D-Dimer, and FIB levels in the control group did not change significantly

Table 3. Comparison of the coagulation function between the two groups (n, $\bar{x} \pm sd$)

Group	PT (s)	APTT (s)	D-D (mg/L)	FIB (g/L)
Observation group (n=74)				
Before intervention	11.98±0.90	35.76±2.13	0.38±0.10	2.51±0.60
After intervention	12.30±0.75*,##	36.63±2.07*,#	0.34±0.12*,#	2.31±0.44*,#
Control group (n=74)				
Before intervention	11.80±0.83	35.39±2.86	0.40±0.11	2.47±0.65
After intervention	11.89±0.79	35.77±2.10	0.39±0.12	2.50±0.59

Note: Compared with this group before the intervention, *P<0.05; compared with the control group after the intervention, #P<0.05, ##P<0.01. PT: prothrombin time; APTT: activated partial thromboplastin time; D-D: D-dimer; FIB: fibrinogen.

Table 4. Comparison of the HAMA and HAMD scores between the two groups ($\bar{x} \pm sd$, points)

Group	HAMA Score	HAMD Score
Observation group (n=74)		
Before intervention	12.09±1.85	6.05±0.86
After intervention	10.49±1.20***,###	4.70±0.70***,###
Control group (n=74)		
Before intervention	12.24±1.28	6.14±0.79
After intervention	11.76±1.33*	5.90±0.59*

Note: Compared with this group before the intervention, *P<0.05, ***P<0.001; compared with the control group after the intervention, ###P<0.001. HAMA: Hamilton Anxiety Scale; HAMD: Hamilton Depression Scale.

before and after the intervention (P>0.05). In the observation group, the PT, APTT, D-Dimer, and FIB levels were significantly higher after the intervention than they were before the intervention (all P<0.05), and there were significant differences compared with the control group (P<0.05 or P<0.01). See **Table 3**.

The HAMA and HAMD scores

The two groups' HAMA and HAMD scores were significantly reduced after the intervention (P<0.05 or P<0.001). The observation group's scores were significantly lower than the control group's (all P<0.001). See **Table 4** and **Figure 1**.

SF-36 scores

After 6 months of follow-up, the SF-36 scores of the two groups of patients at 6 months after discharge were significantly increased (P<0.01 or P<0.001), and the observation group's were significantly higher (all P<0.05). See **Table 5**.

ESCA scores

After 6 months of follow-up, the ESCA scores of the two groups were significantly increased at 6 months after discharge (P<0.05 or P<0.001), and the observation group's scores were significantly higher (P<0.05 or P<0.01). See **Table 6**.

Discussion

Studies have found that PICC catheterization will inevitably damage the venous wall [15]. The catheter is placed in the vascular cavity, thus narrowing the cavity and slowing the blood flow. After the PICC is inserted, patient are often unable to exercise and worry about affecting the function of the catheter. In addition, tumor patients are often in a hypercoagulable state. The above factors can all increase the risk of venous thrombosis after PICC.

Every element of care in cluster nursing has evidence-based medicine support to improve patients' prognoses and outcomes [16]. The results of this study suggest that the incidence of venous thrombosis in the observation group was lower than it was in the control group. At the same time, the PT and APTT of the observation group were significantly prolonged after the intervention, and the levels of D-Dimer and FIB levels were significantly reduced. After a valid statistical comparison, the results showed differences. The results indicated that cluster nursing in tumor patients with PICC catheterization is beneficial, both avoiding the phenomenon of high blood viscosity and high blood coagulability. It ultimately minimizes the incidence of venous thrombosis. The main reason is that cluster nursing conducts detailed and comprehensive care of patients undergoing PICC intubation from different aspects such as pre-intubation risk assessment, the intubation process, post-intubation risk assessment, PICC daily maintenance, and functional exercise.

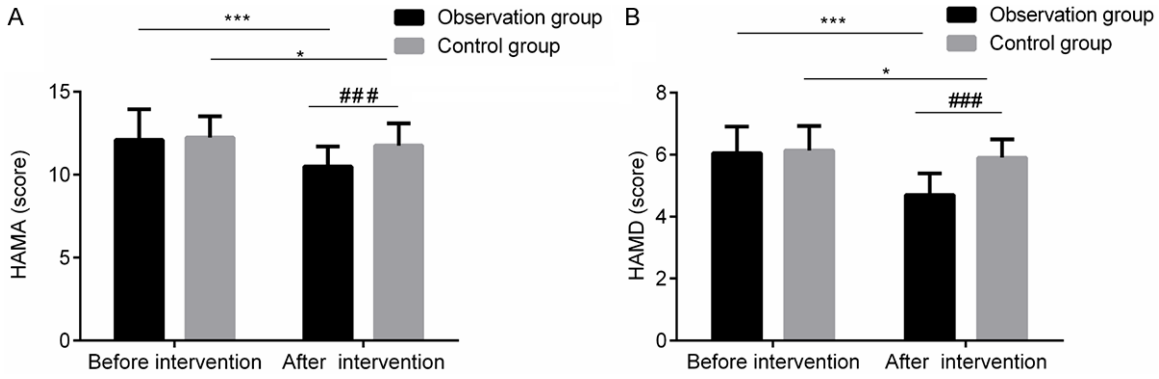

Figure 1. Comparison of the HAMA and HAMD scores between the two groups. A. Comparison of the HAMA scores between the two groups of patients before and after the intervention; B. Comparison of the HAMD scores between the two groups before and after the intervention. Compared with the same group before the intervention, *P<0.05, ***P<0.001; compared with the control group after the intervention, $^{###}$P<0.001. HAMA: Hamilton Anxiety Scale; HAMD: Hamilton Depression Scale.

Table 5. Comparison of the SF-36 scores between the two groups ($\bar{x}$ ± sd, points)

Dimension	Time	Observation group (n=74)	Control group (n=74)
Physiological function	Before intervention	67.60±5.40	68.04±6.44
	6 months after discharge	75.50±6.30$^{***,##}$	72.20±5.98***
Social function	Before intervention	63.30±4.33	64.02±5.40
	6 months after discharge	70.07±5.49$^{***,##}$	66.98±6.57**
Vitality	Before intervention	67.70±5.40	67.05±5.97
	6 months after discharge	75.58±6.57$^{***,###}$	70.07±5.44**
Physiological function	Before intervention	70.07±5.77	69.67±4.86
	6 months after discharge	76.79±5.93$^{***,###}$	73.30±5.55***
Emotional function	Before intervention	69.20±4.86	70.05±5.80
	6 months after discharge	75.59±5.49$^{***,##}$	72.85±4.88**
Mental health	Before intervention	65.40±5.96	65.02±6.40
	6 months after discharge	70.08±6.33$^{***,#}$	67.98±5.70**
Body pain	Before intervention	57.70±5.50	57.28±5.40
	6 months after discharge	65.50±6.40$^{***,###}$	60.08±4.49***
General health	Before intervention	60.06±6.49	60.32±5.47
	6 months after discharge	65.78±7.40$^{***,#}$	63.30±4.60***

Note: Compared with this group before the intervention, **P<0.01, ***P<0.001; compared with the control group after intervention, $^{#}$P<0.05, $^{##}$P<0.01, $^{###}$P<0.001.

Careful nursing effectively reduces the risk of vascular injury and successfully prevents the formation of thrombosis. The results are consistent with the results of Hu et al. [17].

The mortality of patients with malignant tumors is high. Once they are diagnosed, they will inevitably have a strong psychological reaction. A survey on the psychological state of malignant tumors patients shows that, after learning that they have cancer, more than 90% of patients exhibit unhealthy psychologies, such as fear and anxiety [18]. In patients with advanced cancer, their mental states of depression and despair are more significant, and some patients may even engage in self-harm or suicidal attempts [19, 20]. A study by Martinez et al. indicated that mental state plays an important role during cancer treatment [21]. The occurrence of a variety of bad moods will greatly affect the treatment of end-stage cancer, and the prognosis of those patients will be significantly worsened. Bad moods may even induce a higher mortality rate. The results of

Table 6. Comparison of the ESCA scores between the two groups ($\bar{x}$ ± sd)

Group	Self-concept	Self-responsibility	Self-care skills	Health knowledge
Observation group (n=74)				
Before intervention	32.20±4.39	25.50±3.33	42.20±4.33	28.03±3.40
6 months after discharge	36.84±5.88***,#	28.07±3.20***,#	46.80±5.50***,##	32.07±3.96***,##
Control group (n=74)				
Before intervention	32.75±5.20	24.98±4.39	42.70±5.39	28.64±3.68
6 months after discharge	34.54±4.99*	26.57±3.85*	44.57±4.86*	30.10±3.22*

Note: Compared with this group before the intervention, *P<0.05, ***P<0.001; compared with the control group after the intervention, #P<0.05, ##P<0.01.

this study show that the use of cluster nursing in tumor patients with PICC catheterization can effectively deal with the occurrence of a variety of negative emotions, so they can better cooperate with subsequent treatments and eventually improve their quality of life in the late period. The content of cluster nursing not only covers the risk assessment before and after intubation, it also guarantees the safety of the patient. Medical workers can carry out a targeted and in-depth analysis of the patients' adverse mental states. It aims to eliminate the anxiety and irritability to the greatest extent and enables the patients to cooperate with the treatment. At the same time, combined with early functional exercises, the quality of life is further improved. In addition, this study also found that cluster nursing can improve the self-care ability of patients with PICC catheterization. This is inseparable from the cluster nursing model that emphasizes the health education of patients after PICC catheterization. Through health education, patients are more aware of the matters that need to be paid attention to during PICC intubation and after extubation, which has a profound impact on enhancing patients' compliance with self-care and treatment.

However, the sample size of this study was limited, and it was also a single-center study. The preventive value of cluster nursing in long-term venous thrombosis has not yet been clarified, so this is the direction that needs to be studied further.

In summary, the implementation of cluster nursing for tumor patients with PICC catheters can effectively improve the hypercoagulable and hyperviscosity states of the blood. It is key to preventing the occurrence of venous thrombosis, thus helping to relieve their psychological nervousness and maximizing patients' quality of life and self-care abilities. It is worthy of extensive clinical promotion.

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Disclosure of conflict of interest

None.

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