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# The Effects of Simulated Teaching on Prevention of Catheter Extrusion of Patients with PICC

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**Abstract:** *Objective:* To explore the effects of simulated teaching on avoidance of catheter extrusion in patients with PICC. *Background* Catheter extrusion is one of the most common complications after PICC catheterization. The incidence is 5% to 31% in literature which have reported. Catheter prolapse not only directly affects the treatment of patients, but also increases the pain and financial burden of patients. The main causes of catheter prolapse are improper external fixation, traction of external force, excessive activity of patients and lack of self-protection catheter knowledge. Health education can promote patients who are the co-administrator of the catheter to form correct behaviors and concepts. Health education has become an important part of clinical nursing work. *Methods:* A total of 915 patients with PICC were recruited in the present study. Simulated teaching regarding prevention of catheter extrusion to get her with previous health education was carried out in the laboratory center. Participants were required to do re-demonstration after the critical skills were taught. The tests core was compared before and after the simulated teaching. Besides, the rate of catheter extrusion was also recorded and compared with those patients who did not receive the simulated teaching before. *Results:* Compared with the test score before the simulated teaching, test score after the teaching was higher. Rate of catheter extrusion among those who received simulated teaching was lower than those who did not get the teaching ( $\chi^2=23.701$ ,  $P<0.001$ ). *Conclusion:* Health education with simulated teaching can help patients with PICC know the key points that they should pay attention to. Such teaching method can significantly decrease the rate of catheter extrusion.

**Keywords:** Health Education, Peripherally Inserted Central Catheter, Catheter Extrusion, Analogue Simulation

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## 1. Background

Peripherally Inserted Central Catheter (PICC) is often inserted via an upper extremity peripheral vein, such as noble vein, cephalic vein, and median elbow vein, into central venous including superior or inferior vena cava, which has the advantages of protecting the peripheral veins, long-term indwelling, alleviating pain and improving the quality of life [1]. Studies have shown that the incidence of PICC complications in cancer patients at home is as high as 42.5%. Catheter extrusion is one of the most common complications, which can significantly increase the incidence of other complications, such as phlebitis, limb swelling, pain, fluid leakage, thrombosis and so on. Some investigation have shown that catheter extrusion after discharge is associated with the lack of awareness of self-maintenance and health education [2]. The main causes of catheter prolapse are

improper fixation, external traction, over activity and lack of knowledge about self-protection of catheters. Health education can promote patients to form correct behaviors and concept [3], which is an important part of clinical nursing work. Simulation teaching is the hotspot and direction of medical teaching reform. In developed European and American countries, it has been widely used in medical education and throughout the whole teaching course [4-5]. In this study, simulated teaching was used to health education for patients with PICC, and get better results.

## 2. Objects and Methods

### 2.1. Research Object

We selected hospitalized patients who received PICC catheter from January to December 2015 in our hospital.

Inclusion criteria: The educational level above Junior high school; Ability of normal communication; During the treatment interval, catheter maintenance is completed in our clinic; The chest X-ray shows the tip of the catheter located in the superior vena cava. Exclusion criteria: Patients who requiring long-term bedridden care can not cooperate. A total

of 915 patients were eligible, including 415 males and 500 females, aged 18-82 (62.00 + 16.11) years. There was no significant difference in age, sex and marital status between the two groups ( $P > 0.05$ ), which was comparable, as shown in Table 1.

**Table 1.** Comparison of two groups of patients' sex, age and marital status (case).

group	Total number of cases /n	sex		Marital status		age
		man	woman	married	unmarried	
2014year	850	397	453	622	228	60.16±14.53
2015year	915	415	500	705	210	62.00±16.11
$\chi^2/ t$		0.243	0.352	0.214	0.116	1.845
P		0.622	0.541	0.643	0.734	0.066

## 2.2. Method

### 2.2.1. Team Members

There are 4 members in full-time specialist nursing team, and the Matron is in changing of the team. We are all supervisor nurse, having more than 10 years practice experience, receiving PICC knowledge training and obtaining professional certificate of induction.

### 2.2.2. Simulation Teaching

According to the related factors of catheter extrusion, we set up teaching content. And we would teach the patients about the relevant theory and operation of how to prevent catheter extrusion by teaching tool. Patients inserted the catheter within 48 hours were organized to learn related knowledge at skill training center twice a week. The number of participants is 8 to 12 each time, and the teaching duration is about 45 minutes. The teaching process is as follows. First, explanation of theoretical knowledge: we would play a video about how to prevent catheter prolapse (The time is 6min). The video content includes the following aspects: how to prevent water into the catheter dressing (How to use the plastic wrap to protect the side arm when taking a bath); the correct posture when picking up something (After squatting, picking things up slowly); The correct way of putting on and taking off clothes (Wear loose clothes, tube-side first when dressing, and non-tube-side first when undressing); methods of enhancing catheter fixation (Elastic bandage or PICC special sleeve reinforcement); matters needing attention in daily activities (Daily activities is not limited, but tube-side upper limb cannot lift up, or thrown back and forth). Second, specialist nurses use teaching tools (plastic film, grip ball, catheter, pen, elastic bandage and other teaching materials) to demonstrate the content of video broadcast. Then, the 5 contents which taught by nurse is re-demonstrated by the patient himself. Lastly, we conduct on-site assessments of patients, re-educate patients without mastering the project,

and correct irregular operations until they are fully mastered. For example: When demonstrating how to prevent the catheter from getting wet, the nurse wraps the plastic wrap around the tube area for 2 to 3 turns. The area's upper and lower edges are glued tightly. After removal, checking whether the dressing is wet. Then the patient repeats the action. The nurse will evaluate its accuracy, correct the wrong action, and answer the patient's questions until the patient is fully mastered.

### 2.2.3. Assessment

The patients are assessed and scored for the knowledge of how to prevent catheter extrusion.

## 2.3. Evaluation

To calculate the incidence of catheter extrusion among those who received simulated teaching in 2015 and those who did not get this teaching in 2014. In 2014, a total of 850 patients met the requirements. There were 397 males and 453 females; aged 17-79 (60.16±14.53) years old, who received health education by routine methods (The nurse will carry out the oral education by the means of PowerPoint and video). Standard for catheter extrusion: Partial or total prolapse of the catheter occurs during PICC indwelling. X-ray shows that the tip is not in the superior vena cava and the catheter cannot be used continuously [6].

## 3. Result

### 3.1. Patient Assessment Results

After the simulation teaching, the examination results including the scores of each sub-item were significantly improved. The results are shown in Table 2.

**Table 2.** The comparison of the examination results before and after demonstration ( $n=915, x + s$ ).

Item	Pre training	After training	t	P
Maintenance time $\leq 7$ day	6.30±4.85	9.00±3.02	4.73	<0.001
Come to the hospital in time if special condition. shower but not bathe.	4.20±4.96	6.30±4.85	3.03	0.003
Bathing with special protective cover or plastic wrap.	3.25±2.40	4.00±2.01	2.40	0.017
the correct posture when picking up something	2.30±2.50	3.25±2.40	2.74	0.007
Wear loose clothes	3.00±4.61	9.50±2.19	12.75	<0.001
	6.60±4.76	8.10±3.94	2.43	0.016

Item	Pre training	After training	t	P
tube-side first when dressing, and non-tube-side first when undressing	5.00±5.03	7.50±4.35	3.76	<0.001
Daily life is not restricted	5.50±5.00	7.00±4.61	2.21	0.028
Do not raise for a long time.	3.00±2.46	3.95±2.05	2.97	0.003
Do not force back and forth	3.70±2.20	4.65±1.28	3.73	<0.001
Elastic bandage reinforcement	6.50±4.79	8.50±3.59	3.34	0.001
Special sleeve reinforcement	6.00±4.92	8.20±3.86	3.52	<0.001
Total score	55.35±11.20	79.95±10.74	15.85	<0.001

### 3.2. Analysis of Catheter Extrusion

In 2015, a total of 915 patients were enrolled in the health education through simulation, 21 patients had catheter prolapse, the rate of catheter extrusion was 2.30%; in 2014, 850 patients received the normal health education, 61 patients had catheter extrusion, the rate was 7.18%. After the simulated teaching, the catheter extrusion rate was reduced.

Table 3. Comparison of catheter prolapse in 2014 and 2015.

group	Total number of cases /n	Number of catheter prolapse /n	Incidence of catheter prolapse /%
2014year	850	61	7.18
2015year	915	21	2.30
$\chi^2$			23.701
P			0.006

## 4. Discussion

### 4.1. Simulation Teaching Can Reduce the Extrusion of PICC Catheter Effectively

At present, the common methods of health education are explanation, illustration and playing multimedia video [7]. The common method is the process of one-way knowledge transmission, so the patient are more dependent on nurses. At the same time, the task of oral education is heavier and more random, and it is difficult for patient to grasp the key points [8] or understand the relevant knowledge. Through simulation teaching, it is easier for patients to master the relevant knowledge of PICC and prevent catheter prolapse. 2 weeks after catheterization is the peak period of catheter withdrawal [9]. Through lecturing, simulated teaching, learning and re-demonstrating, patients can effectively apply the accepted knowledge to practice through actual operation, better grasp the details and improve their ability to deal with complex situations. The content of simulation in this study is closely related to the factors of catheter extrusion. At the same time, such training can also make patients' attention highly concentrated and improve the efficiency of health education. Health education with simulated teaching can help patients with PICC know the key points that they should pay attention to. This teaching method can significantly decrease the rate of catheter extrusion.

### 4.2. Problems and Solutions

There are also some problems in the implementation process. First, for patient with poor comprehension, it is necessary to improve the ability of self-care by continuous health education such as professional education video, peer education, telephone follow-up [10] and so on. Second, some patients are unable to attend the on-site teaching due to the treatment. Therefore, family members or caregivers will replace the patient to participate in the teaching course, then

they will guide the patient at home. So it is hard to accurately evaluating how well patient master knowledge. Among 21 cases of catheter prolapse, 8 cases were occurred because of the dressing integrity damage when patients were sweating at night; 3 cases were accidentally pulled out by wearing or taking off the clothes, 4 cases were due to improper maintenance, 3 cases were occurred by the reason of local exudation and the 3 cases were happened by unknown reasons. Therefore, it is necessary to improve patients' self-observation ability and increase external fixation. At the same time, we should improve the ability of nurses' catheter maintenance to reduce catheter prolapse.

In addition, due to the limited number of full-time specialist nurses, the frequency of simulation teaching is 2 times per week. But the hospital bed turnover is fast. Some patients have been discharged before the teaching time, so the proportion of health education is only about 90%. In the future, we will increase the frequency of health education with simulated teaching by increasing the number of full-time specialists, or jointing with nursing skills training center.

At present, the time and energy that the team can devote to is limited, so it is necessary to increase professional staff to ensure the sustainable development of the simulated teaching activities, improve the mastery of the catheter matters for patients with PICC, and reduce the occurrence of complications.

## 5. Conclusion

To sum up, using simulation teaching to carry out health education for PICC patients can improve the effect of health education, enhance the self-management ability of PICC patients, reduce the occurrence of catheter-related complications and ensure the safety. Simulated teaching is a scientific, practical and effective new method, which is worth promoting in clinical practice. This study only focuses on health education of PICC patients during hospitalization,

which has not been involved in continuing nursing after discharge. In the future, we will further expand the scope of research with the network platform.

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