Clinical Comparative Study of Lower Limb PICC and Deep Venous Catheterization

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Research

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Abstract

Objective: To compare the clinical application effects of peripherally inserted central catheter (PICC) and deep venous catheters placed through the lower limbs in adults, and to explore the advantages of ultrasound-guided PICC through the lower limbs in adults.

Methods: A retrospective study was conducted on 27 bedridden patients with advanced malignant tumor between February 2017 and February 2019. The success rate of one-time catheterization, the length of catheterization puncture time, the number of catheterizations, and the occurrence of catheter-related complications of the two methods were compared.

Results: Results of the study showed that ultrasound-guided PICC through the lower limbs has a higher success rate than deep venous catheterization. The average length of puncture time in adults with PICC through the lower limbs under ultrasound guidance was shorter than that in the femoral vein group. There was no significant difference in the incidence of catheter-related complications between the two groups.

Conclusion: The indications for PICC through the lower limbs in adults include patients with advanced malignant tumor after bilateral breast cancer lymphadenectomy or superior vena cava obstruction syndrome, and mainly bedridden patients. This technique has certain advantages over deep venous catheterization and is an effective choice for venous access.

Introduction

Peripheral venous catheterization, such as cephalic vein and median cubital vein, or catheter tip in the inferior vena cava or superior vena cava, is called peripherally inserted central catheter (PICC)^[1]. PICC has the characteristics of convenience, safety, comfort, and long indwelling time. It has been used increasingly during the treatment of patients with malignant tumor, especially for patients receiving chemotherapy and patients with end-stage malignant tumor.

The 2016 edition of "Practical Standards for Infusion Therapy" states that PICC puncture veins, including the axillary vein, temporal vein, posterior auricular vein of the head, and great saphenous vein of the lower extremity, can be selected for newborns and children^[2-4]. However, adults also need PICC through lower limbs, such as patients with advanced malignancies after bilateral breast cancer lymphadenectomy and superior vena cava obstruction syndrome.

If there is abnormal appearance of the superior vena cava in the body, which causes it to block the vein, the superior vena cava blood cannot flow smoothly. This leads to other clinical manifestations of the body, such as varicose veins, which is superior vena cava obstruction syndrome^[5]. Lymphedema after breast cancer surgery is due to surgery or radiotherapy that hinders the transport capacity of the lymphatic system, causing the accumulation of lymph fluid in the tissues^[6-7]. For patients with superior vena cava obstruction syndrome and bilateral breast cancer after radical mastectomy, to avoid increasing the pressure of the superior vena cava and aggravating the lymphedema of the head, face and upper

limbs, only lower limb infusion can be used. In the chemotherapy and nutrition support, the central vein pathway is needed because of the high incidence of phlebitis and fluid infiltration due to repeated puncture of peripheral veins of lower limbs. Therefore, PICC through lower limbs in adults is one of the effective ways to provide intravenous infusion access for such patients.

This article takes patients with advanced malignant tumors as an example to study the difference between deep venous catheters and PICC in the lower limbs, analyze their clinical application effects, and explore the advantages of ultrasound-guided PICC through the lower limbs in adults.

1. Research Methods And Content

1.1 General information

Selected cases were adult patients in the PICC under ultrasound guidance group and deep venous catheterization group.

Inclusion criteria: Patients with advanced malignant tumor after bilateral breast cancer lymphadenectomy or superior vena cava obstruction syndrome, bedridden patients, patients without mental disorders, patients can cooperate with this study, understand the content of this study, agree to participate in this experiment, and sign the relevant documents.

Exclusion criteria: Patients with high-risk thrombosis, patients with venous thrombosis of lower limbs, patients who can walk on the ground, and patients with mental disorders.

Observation time: The period from intubation to planned extubation.

1.1 .1 Picc Group

A 4Fr catheter obtained from Bard Access Systems Inc. 605 North 5600 West, Salt Lake City, Utah, 84116, USA was used in the PICC group. Operator: The ultrasound-guided PICC through lower limbs was operated by experienced nurses with a catheterization qualification. Selection of puncture point: The puncture point of PICC through the lower limbs of adults under ultrasound guidance was the middle of the thigh. Catheter tip position: Under normal circumstances, after the catheter is inserted, the lower 1/3 of the inferior vena cava is the most suitable position for the tip, and the level of the first lumbar spine or the level of the 3–4 lumbar spine is the best^[8–9]. Catheter insertion length: The estimated catheter insertion length is the sum of the distance from the puncture point to the midpoint of the inguinal ligament, the distance from the midpoint of the inguinal ligament to the umbilicus, and the distance from the umbilicus to the lower edge of the xiphoid process.

After completing this operation, the tip position needs to be checked, and the detection method used is X-ray examination^[8–9]. Maintenance: The leg circumference was measured, and the skin around the

puncture site was disinfected three times with a 75% alcohol cotton ball and three times with an iodine cotton ball. The disinfection area was 10 cm in diameter. Finally, 0.9% normal saline pulse was used to flush the tube and fix it. When maintaining the tube, it is necessary to flush the tube before and after the infusion using normal saline with a volume of 10 ml to wash away fibrin. Attention should be paid to avoid backflow of blood^[10]. Indwelling time: the same as the upper limb PICC indwelling time (< 1 year).As shown as Table 1.

Table 1
Comparison of general data between the two groups

Group	Age	Sex		Case
		Female	Male	
Deep vein catheterization group	73.4 ± 10.11	5	9	14
PICC Catheter group	71.8 ± 14.67	6	7	13
P		0.704		0.743

1.2 Deep Venous Catheterization Group

An 8Fr catheter obtained from SCW MEDICATH LTD (Baolong industrial Town, Longgang District, Shenzhen, P.R.China) was used in the lower limb deep vein catheterization group. Operator selection: The surgeon is responsible for the operation of deep vein catheterization. Selection of puncture point: Deep vein catheterization is the main puncture site for deep vein catheterization, the selected area is the medial side of the artery, and the optimal distance is 0.3 cm–1 cm^[11]. Tip position: In general, the superior segment of the inferior vena cava is the best position. Insertion length: 15 cm is the insertion length after the catheter is inserted. After this operation, the tip position needs to be checked, and the detection method is X-ray examination.

Maintenance: The leg circumference was measured, and the skin around the puncture site was disinfected three times with a 75% alcohol cotton ball and three times with an iodine cotton ball. The disinfection area was 10 cm in diameter. Finally, 0.9% normal saline pulse was used to flush the tube and fix it. When maintaining the tube, it is necessary to flush the tube before and after the infusion, using normal saline with a volume of 10 ml to wash away fibrin. Attention should be paid to avoid backflow of blood^[10]. Indwelling time: If the indwelling time exceeds 28 days, the puncture operation needs to be repeated^[10].As shown as Table 2.

Table 2
Comparison of observation indexes between the two groups

Group	Case	Success rate of disposable catheterization	Catheter replacement rate	Average puncture time (minutes) mean $\pm$ standard deviation
PICC Catheter group	13	84.6%	0%	24.69 $\pm$ 4.35
Deep vein catheterization group	14	42.9%	35.7%	29.14 $\pm$ 6.02
P		0.015	0.041	0.038

1.3 Research Content And Statistical Analysis

The success rate of one-time catheterization, the length of the catheterization puncture, the number of catheterizations, and the occurrence of catheter-related complications of the two methods were studied. IBM SPSS STATISTICS 25.0(IBM Inc) was used for the statistical analysis. The independent sample t test was used for the puncture time of catheterization. The success rate of one-time catheterization, the number of catheterizations, and the occurrence of complications related to catheterization were tested with a Chi-square four-grid table.

2. Results

There was no significant difference in the incidence of catheter-related infection, catheter-related deep vein thrombosis, catheter blockage, and unplanned extubation complications between the two groups.

Results of clinical research show that the success rate of one-time PICC placement through lower limbs under ultrasound guidance in adults is higher than that of deep vein catheterization. The average length of puncture time in adults with PICC through lower limbs under ultrasound guidance was shorter than that in the femoral vein group.

3. Discussion

Indications for the application of PICC to the lower limbs: The 2016 edition of the “Practical Standards for Infusion Therapy” recommends neither the insertion of PICC through the lower limbs in adults nor the indication, vascular selection, puncture point location and catheter tip position in PICC through lower limbs for adults. Some domestic scholars^[9,11,12] have conducted research on adult lower limb PICC, and the indications and catheter tip position are relatively uniform. However, there are big differences in the selection of puncture veins and the selection of puncture points. For example, in the research conducted by Chen et al.^[13] and Zhao Ling et al.^[14], the puncture location is the same as that of the femoral vein puncture. In the research conducted by Zhang et al.^[9], the puncture position selected was in the middle or

upper middle of the thigh. In the research conducted by Wu et al.^[11], the great saphenous vein was selected for the puncture, whereas Kang et al.^[8] chose the femoral vein for the puncture. In the research conducted by Zhang et al.^[12], the catheter tip was placed in the inferior vena cava.

Some studies^[11–12] state that the complications associated with PICC through lower limbs include catheter-related infection, catheter-related thrombosis, catheter blockage, and unplanned extubation. Li's^[15] study reported that the incidence of deep vein catheter thrombosis was as high as 22.22%, which was significantly higher than that of internal carotid artery and subclavian artery catheterization. Deep vein thromboembolism might cause pulmonary embolism.

The selected cases in this study are patients with contraindications for upper limb catheterization, especially the long-term bedridden patients. Since the position of these patients is consistent with the daily body position of infants mentioned in the guidelines (mostly the lying position), they will not cause significant changes in the hemodynamics of lower limbs due to standing or walking frequently, and it is not easy to cause a twisted, folded and ectopic catheter. Therefore, it is suggested that the indications of PICC through lower limbs in adults are limited to those who cannot receive upper limb infusion, especially those who are mainly in a lying position. The femoral vein was chosen as the puncture vein in this study, since owing to its deep position, fast flow rate, and thick diameter, it is not easy for vascular complications to develop, and it is easy to operate. However, the great saphenous vein is small in diameter, has many variations, and has many venous valves, and it is difficult to puncture. The puncture point selected was the middle of the thigh, far away from the perineal area to reduce the incidence of infection complications, and far away from the gathering area of nerves and lymphatic vessels to reduce the incidence of nerve injury and lymphatic leakage.

Results of this study indicate that compared with deep vein catheterization of lower limbs, ultrasound-guided PICC through the lower limb in adults has a higher success rate and can be completed in a shorter time. There was no difference in the complications of the two procedures. The characteristics of lower limb PICC are as follows: long indwelling time; the PICC has a smaller diameter and the material is soft, which makes patients feel more comfortable; the improved Seldinger technique is used during puncture, which causes less trauma; and the use of ultrasound guidance provides a higher success rate.

Therefore, in certain patients, the relevant indications must be fully understood to apply the intravenous treatment method of lower limb PICC safely and effectively. Patients with advanced malignant tumors who are bedridden have a limited survival period. It is necessary to give them rescue measures in time and ensure their nutrition. Under this condition, if only a short peripheral venous catheter of the lower limbs is used, the patient's treatment needs cannot be met. Therefore, this study is limited to patients with advanced malignant tumors after bilateral breast cancer lymphadenectomy and superior vena cava obstruction syndrome. Lower limb PICC has become one of the effective intravenous treatment pathways for patients of this type.

4. Conclusion

The indications for PICC through lower limbs in adults are limited to patients with contraindications for upper limb infusion, such as patients with advanced malignant tumors after bilateral breast cancer lymphadenectomy or superior vena cava obstruction syndrome, and mainly bedridden patients. Compared with short peripheral venous catheterization of lower limbs, this method has certain advantages and is one of the venous access options for such patients.

5. Limitations

This research chose a small sample size and did not conduct an in-depth study on the indications, so there are limitations. At present, there is no clear operating specification for PICC in adults through the lower limbs, and there is no special puncture kit for PICC in the lower limbs. Consequently, further standardization of the operation is required.

Abbreviations

PICC

peripherally inserted central catheter

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with the declaration of Helsinki. This study was conducted with approval from the Ethics Committee of Beijing Shijingshan Hospital. Written informed consent was obtained from all participants.

Competing Interest

The authors declare that they have no competing interests.

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Authors' Contributions

Li F X have made substantial contributions to conception and design, Su P acquisition of data, analysis and interpretation of data; Li Y P and Hao Y F have been involved in drafting the manuscript and revising it critically for important intellectual content; Tian M J and Zhang H Y have given final approval of the version to be published.

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Consent for publication

Not applicable.

Availability of data and materials

All data generated or analyzed during this study are included in this published article

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