Application of Bedside Ultrasound-Guided Central Vein Puncture in the Perioperative Critically Patients with Tuberculosis

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Abstract: Objective: To observe the safety and value of bedside ultrasound-guided deep vein puncture in selecting the site of critical tuberculosis patients. Methods: From Aug 2023 to Oct 2024, 150 cases of ultrasound-guided deep vein puncture in Xi'an Chest hospital were selected, and 2 cases of cervical lymphadenopathy were excluded. Inclusion criteria: pre-anaesthesia assessment of the need for blood transfusion and surgical trauma in patients with excessive blood loss, hemorrhagic shock. Exclusion criteria: Patients with infection at the puncture site and bleeding tendency that is difficult to correct. According to the operation site, it was divided into internal jugular vein group, subclavian group and axillary vein group. According to standard practice for emergency ultrasound. The blood vessel was punctured by the short-axis positioning method, and the arteriovenous was marked by ultrasonic spectrum. During puncture, the needle insertion point was observed and the translational probe was used to find the needle tip. The ultrasound image needle tip was completely extracted into the venous vessel and inserted into the guide wire, and the guide wire was inserted into the vein. The first puncture success rate, total success rate, complications and postoperative comfort of the three groups were compared. Results: There was no significant difference in age, sex and body mass index among the three groups. Ultrasound-guided puncture of deep vein was successful in all three groups, the success rate of one puncture in the axillary vein group, the internal jugular vein group and the subclavian bone group were 95.8%, 93.8% and 84.3%, respectively. The success rate of one puncture in the axillary vein group was higher in the three groups, and the difference between the groups was statistically significant ($P < 0.05$). The first puncture was completed in the internal jugular vein group, and the difference was statistically significant ($P < 0.05$). The patient satisfaction in subclavian group was higher than that in axillary vein group, and the internal jugular vein was the lowest, and the catheter in axillary vein group was blocked. Conclusion: Bedside ultrasound-guided deep vein puncture improves the efficiency and safety, and the puncture time of internal jugular vein group is short, which is beneficial to the perioperative treatment of critical tuberculosis patients. When internal jugular vein cannot be punctured, axillary vein can be used instead.

Keywords: Bedside Ultrasound; Central Venous Catheterization; Axillary Vein

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1 Introduction

Patients with tuberculosis pulmonary surgery should cause thoracic deformation caused by pleural thickening and pulling, resulting in changes in anatomical structure, and wasting and malnutrition due to tuberculosis [1]. Therefore, the difficulty of central venous puncture and more likely to form thrombosis after surgery. The central vein has become one of the routine operations of major surgery.

Central vein catheterization is a basic technique for critical surgical rescue [2], and it is also used for intraoperative channel and hemodynamic monitoring of rapid and effective infusion. Clinical surgical patients are usually selected for the internal jugular vein, subclavian vein, axillary vein, and femoral vein. The choice of central venous location in patients undergoing tuberculous empyema surgery is conducive to their intraoperative observation, fluid rehydration status and postoperative recovery [3]. This study investigated the clinical value of central vein location selection under bedside ultrasound, dynamic monitoring of bedside ultrasound, observation, and reduced patient trauma.

2 Data and Methods

2.1 General Information

The subjects of this study were 148 cases of ultrasound-guided deep vein puncture in our hospital from August 2023 to October 2024. Inclusion criteria were: preoperative assessment requiring blood transfusion and surgical trauma, patients with hemorrhagic shock. Exclusion criteria: infection at the puncture site and difficulty to correct the bleeding tendency. Patients were divided into internal jugular vein, subclavian and axillary vein groups according to the puncture location. Age of the three groups. sex. Physical mass index, heart rate, and mean blood pressure were all significantly insignificant (P> 0.05). Suggesting that the three groups are comparable. This study met the medical standards and was approved by the medical ethics committee of our hospital, with informed consent from the patients and their family members.

2.2 Operation Method

The ultrasound operators are systematically trained and qualified to complete the bedside ultrasound independently. According to the selected location, randomly select the internal jugular vein, subclavian vein and axillary vein to determine the puncture vein. According to the emergency ultrasound standard operating specification [4]. The blood vessel was punctured by the short axis positioning method, and the arteriovein was divided through the ultrasound spectrum. During the puncture, the needle injection point and the translation probe was observed to find the needle tip, the needle tip completely entered the vein of the vein, and the guide wire was inserted, and the guide wire inserted into the vein was observed by ultrasound [5].

2.3 Evaluation Index

Statistics of first puncture to tube placement, first puncture success rate, total success rate, complications, and postoperative patient comfort.

2.4 Statistical Methods

The SPSS20.0 statistical software was used. Measurement data are expressed as (±s), t-test for comparison between groups, count data as rate (%), and chi-square test for comparison between groups. P<0.05 was considered to be statistically significant.

3 Results

3.1 Comparison of Three Groups of Cases in General Conditions

A total of 150 cases were collected in this study, and 2 cases were excluded due to tuberculosis of cervical lymph nodes. There were 49 cases in the internal jugular vein group, 51 cases in the subclavian vein group, and 48 cases in the axillary vein group. There was no statistically significant difference in age, gender, body mass index, and abnormal coagulation function among the three groups (P>0.05), as shown in Table 1.

Table 1 The general situation of the three groups of ultrasound-guided deep venous puncture cases

Group	Gender composition		Age	BMI	coagulation function	
	male	female			normal	abnormal
internal jugular vein group	31	18	36.94±8.97	18.76±2.78	45	4

Group	Gender composition		Age	BMI	coagulation function	
	male	female			normal	abnormal
subclavian vein group	34	17	37.86±7.32	17.34±3.12	47	4
axillary vein group	32	16	33.38±7.11	17.78±3.64	45	3

3.2 The Success Rate of Single- Puncture in the Three Groups

The success rates for the axillary vein group, internal jugular vein group, and subclavian vein group are 95.8%, 93.8%, and 84.3% respectively. The axillary vein group has a higher rate of successful single- puncture, and there is a statistically significant difference between the groups (P<0.05). The single- puncture and catheterization of the internal jugular vein was completed the fastest, and the difference between the groups was statistically significant (P<0.05), as shown in Table 2.

Table 2 Three ultrasound-guided puncture success rates (n (%)] and time from first puncture to blood return (±s)

Group	N	The success rate of single- puncture	Total success rate	First puncture to tube placement
internal jugular vein group	49	46 (93.8)	49 (100)	357.28±145.86
subclavian vein group	51	43 (84.3)	51 (100)	472.14±153.47
axillary vein group	48	46 (95.8)	48 (100)	400.37±164.15

3.3 Complications and Comfort of Deep Venipuncture in the Three Groups

The incidence of catheter occlusion in the axillary vein group was higher than that in the other two groups, and the difference between the groups was statistically significant (P<0.05). The comfort of the patients in the subclavian group was higher, and there was a statistically significant difference between the groups (P<0.05).

Table 3 Comparison of Complications and Comfort of Ultrasonic-Guided Deep Venipuncture among the three groups (n)

Group	N	local hematoma	Catheter blockage	catheter-related infection	degree of comfort (%)
internal jugular vein group	49	0	0	0	81.6
subclavian vein group	51	1	1	0	88.2
axillary vein group	48	1	3	0	87.5

4 Discussion

Deep venous catheterization is of great value for surgical treatment, especially in thoracic surgery [6], where central venous pressure monitoring, rapid infusion access, and rapid establishment are critical for fluid resuscitation and hemodynamic monitoring, especially in critically ill patients in shock. The traditional "blind" puncture method involves positioning based on surface anatomical landmarks [7], and determining the success of catheter placement by withdrawing to observe the color of the blood and the pressure within the vessel. The success rate of the puncture often relates to the experience of the person performing the procedure. Patients with long-term tuberculosis who are malnourished and bedridden can develop hypovolemic shock, hemodynamic instability, difficulty with venous filling [8, 9], collapse of vessel walls, making it challenging to achieve successful puncture on the first attempt. With the use of ultrasound equipment, it is possible to determine the internal diameter of the central vein, its depth below the skin surface, and the anatomy of the surrounding tissues before puncturing [10].

The purpose of this study is to observe the perioperative effect of different positions of central vein catheterization in critically ill patients with tuberculosis under ultrasound guidance [11]. The results showed that the axillary vein group had a higher success rate than the other two groups, but the internal jugular vein group had the shortest time during operation [12]. During the perioperative period, especially in critically ill patients, the timing and success rate of the deep vein operation play a decisive role in maintaining the patient's internal circulation and maintaining blood volume. However, the operation time of the axillary vein group is relatively longer than that of the internal jugular vein group. Most of the deep veins in critically ill patients with tuberculosis are collapsed and poorly filled, while the internal jugular vein should be associated with tuberculous empyema and lead to cervical lymph node enlargement, which is affected by puncture in the internal jugular vein group [13, 14]. The axillary vein group is relatively safe

and has a high success rate, but the axillary vein is covered by muscles [15]. Muscle contraction leads to axillary vein catheter deformation, leading to catheter obstruction. The introduction of bed ultrasound allows operators to check the deep vein conditions of patients before puncture, and select appropriate deep veins according to the patient's conditions [16]. The internal jugular vein is the best choice for critically ill patients with tuberculosis, but lymph node enlargement is prone to occur near the internal jugular vein in patients with tuberculosis, which is not conducive to internal jugular vein puncture. At this time, the axillary vein can be chosen as the deep vein choice.

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