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# Advantage of B-ultrasound Guidance in Indwelling Needle Puncture of External Jugular Vein for Patients in General ICU

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**Abstract:** The paper aims to investigate the advantage of B-ultrasound guidance in indwelling needle puncture of external jugular vein in the emergency treatment for critical patients with microcirculation failure. We included 70 microcirculation failure patients induced by different factors and with unclear external jugular veins that were admitted to the general ICU from September 2018 to June 2019 and performed indwelling needle puncture on them. We used random number table to divide the patients into control group and observation group with 35 patients in each group. The control group received traditional indwelling needle puncture and the observation group was given B-ultrasound guided indwelling needle puncture. The success rate, time and cost of indwelling needle puncture of two groups were compared. In the control group, 31 out of 35 cases of indwelling needle puncture were successful. The success rate was 88.6% and the average time consumed in each case was (9.09±2.35) min; in the observation group, 35 out of 35 cases of indwelling needle puncture were successful. The success rate was 100% and the average time consumed in each case was (2.13±0.52) minutes. Statistically, the results of observation group were significantly better than those of the control group ($P<0.01$). In the emergency treatment for critical patients with microcirculation failure, compared with the doctor-guided central venous catheterization, B-ultrasound guided indwelling needle puncture of the external jugular vein has the advantages of high success rate and time efficiency so as to open the vein access for critical patients quickly and help them take the medicine timely, which reduces the pressure of nurses and is well worth clinical application.

**Keywords:** B-ultrasound Guidance, Iindwelling Needle of External Jugular Vein, Puncture, Patient in General ICU, Advantage

## 1. Introduction

External jugular veins are the largest superficial veins in the cervix and are thick and apparent. Thus, it is easy and safe to operate in external jugular veins and there are very few complications. Also, with a short distance to the heart, external jugular veins have high velocity of blood flow, which is conducive to the thinning of drug, reducing irritation to the blood vessels. Cases of using indwelling needle puncture through external jugular veins to establish fast intravenous channel in pre-hospital emergency treatment, patients with microcirculation failure induced by various factors and ICU patients have been reported [1-4].

The intensive care unit crowded with critical patients often receive patients on whose peripheral veins performing puncture is difficult and among whom those with hypovolemic shock are the most common. Besides, long-term bed rest leads to thinness and low elasticity of the vascular walls in patients' four limbs, which is also unfavorable to puncture. The traditional puncture technique still depends on vision and touch to locate certain blood vessel and the success rate of puncture depends on vein filling degree and operator's skill of puncture, etc. However, repetitive locating of blood vessels and puncture delay emergent medication of the patients and increase their pain.

A substantial body of literature supports the use of the

ultrasound-guided method as a second option in patients with a poor peripheral venous network in order to obtain a stable and safe peripheral venous access. Only one randomised study conducted in selected trained emergency nurses has demonstrated that, in anticipated difficult intravenous access patients, an ultrasound-guided method was associated with a higher success rate compared with the LM. Vascular access in ICU is, on the other hand, a specific condition which cannot be compared with the emergency department setting [5-7]. B-ultrasound guided indwelling needle puncture of external jugular vein achieved satisfactory results in establishing fast venous access for critical patients with microcirculation failure before setting up CVC access from September 2018 to June 2019. The report is as follows.

# 2. Data and Methods

### *2.1. Clinical Data*

We included 70 critical patients admitted to the general ICU of the First Affiliated Hospital of Jinan University from September 2018 to June 2019. The inclusion criteria were: patients with unclear external jugular veins causing difficulty in establishing venous access, and with microcirculation failure requiring establishing venous access for fast dilation and transfusion. Random number table was used to divide the included patients into observation group and control group with 35 patients in each group. The 37 males and 33 females age from 28-91 with an average age of 65.2±15.1. Their diseases include 12 cases of hemorrhage of digestive tract, 29 cases of shock (infectious, septic and hemorrhagic), 10 post-CPR operation cases, 8 cases of cerebrovascular accident and 11 cases of other diseases. There were no significant difference in sex, age and disease between two groups ($P>0.05$).

### *2.2. Methods*

#### *2.2.1. Methods of Operational*

Patients in the two groups were given indwelling needle puncture of external jugular vein. BD fourth-generation disposable closed 20-22 G venous indwelling needles were adopted.

Traditional method was used in the control group: Two nursing staff were required for this method. One was to assist the patient in assuming horizontal recumbent position, with head towards the opposite side of the puncture, a soft pillow under the shoulder blade to make the head lower, shoulder higher and the neck straight horizontally, exposing the external jugular vein completely. At the same time, the nursing staff pressed the superior margin of the midpoint of the patient's collarbone with the index finger and middle finger and another hand pressed patient's shoulder to avoid unwanted movement. After routine disinfection, the other nursing staff tightened the skin with left thumb and held the indwelling needle with right hand. The indwelling needle was inserted at an angle of 15-30 degree. When there appeared reverse flow of blood or emptiness, the puncture angle was gradually lowered and the outer thimble in the right hand was pushed forward along the direction of the vein until the indwelling needle was totally planted into the vein. When there appeared reverse flow of blood during pumpback, the nursing staff pulled out the stylet and fixed the indwelling needle with 3M transparent film. The date and time of insertion and the names of the nursing staff were noted.

B-ultrasound guided puncture was adopted in the observation group: A nursing staff assisted the patient in assuming horizontal recumbent position, with head towards the opposite side of the puncture. The B-ultrasound probe detected the orientation of the blood vessel and determined the puncture point between the junction of the upper and middle third of sternocleidomastoid. After routine disinfection of the skin, 75% alcohol was applied to the probe sleeve and sterile gloves. The nursing staff used the probe with left hand to burrow into the vein vertically, with hypothenar clinging to where beside the puncture side and inserted the indwelling needle with right hand into the vein at the angle of 15-20 degree. When the puncture needle was about to enter into the vein, it could be seen in the screen of the B-ultrasound machine that the top of the blood vessel transection was deformed due to compression from outside. When the needle entered into the vessel, it could be seen in the screen that a lightspot entered into the vessel, during which, if pumping back the needle, there would be reverse flow of blood. The nursing staff pulled out the stylet and fixed the indwelling needle with 3M transparent film. The date and time of insertion and the name of the nursing staff were noted.

#### *2.2.2. Observation Indicators*

1) Success rate of indwelling needle puncture: One-time success rate and total success rate were noted. When the puncture needle entered the vein for the first time and there was no reverse flow of blood and the needle stayed in the vein, it was referred to as one-time success rate. When the needle was inserted into the vein at the second time and there appeared reverse flow of blood, it was counted as second-time success. Multiple-time success rate referred to when the puncture needle failed to stay in the vein but catheterization was finished after 2 times of puncture of the same blood vessel. If the puncture was performed on different blood vessels, it was counted as a failure.

2) Time consumption of puncture (from assuming body position, blood vessel examination, disinfection to completion of puncture).

3) Cost of indwelling needles (Once the dwelling needle exited from the vein, it was counted as a consumption, and the price of a BD fourth-generation closed venous dwelling needle was CNY18.4).

### *2.3. Statistical Methods*

We employed SPSS24.0 to enter the data for analysis. Enumeration data were shown as percentage and mean±standard deviation. Chi-square was adopted to test measurement data and two independent sample t-test was adopted for enumeration data. $P<0.05$ meant there was significant difference.

# 3. Results

### *3.1. Details of Puncture*

The research included 70 patients and they were averagely randomized into observation group and control group. The success rate of the observation group was 100% (35 cases) and that of the control group was 88.6% (31 cases). There was a significant difference in the number of times of catheterization (P<0.05). Details are shown in the following Table 1.

***Table 1.*** *Comparison of success rate of catheterization between observation group and control group.*

| Group | Case | One-time success (%) | Second-time success (%) | Multiple-time success (%) | Failure (%) | Total success (%) |
|---|---|---|---|---|---|---|
| Control | 35 | 22.90% | 34.30% | 31.40% | 11.42% | 88.6% |
| Observation | 35 | 88.60% | 11.40% | 0.00% | 0.00% | 100% |
| *P* | | | | | | 0.000 |
| $\chi^2$ | | | | | | 32.56 |

### *3.2. Time Consumption of Puncture and Cost of Indwelling Needles*

There were significant difference in the number of times of consumption of puncture and cost of indwelling needles (P<0.05). Details are shown in the following table 2.

***Table 2.*** *Comparison of time consumption of puncture and cost of indwelling needles between observation group and control group.*

| Group | n | Time consumption (min) | Cost of indwelling needles (RMB) | *t* | *P* |
|---|---|---|---|---|---|
| Control | 35 | 9.09±2.35 | 28.91±13.60 | 17.087 | 0.0056 |
| Observation | 35 | 2.13±0.52 | 19.45±4.33 | 3.922 | |

# 4. Discussion

In traditional venous puncture, nursing staff uses tourniquet to bind up the point 5 cm above the puncture point to make the vein full and clear. For the same reason, in the puncture of external jugular veins, patients need to assume a supine position with head lowering backward and the external jugular vein on the upper margin of collarbone need to be pressed by fingers. It has been reported that when receiving indwelling needle puncture of external jugular vein, trendelenburg position can increase the success rate of puncture in patients with microcirculation failure [8-10]. In the present research, 35 patients in the control group assume horizontal recumbent position with a soft pillow under the shoulder blade to make the head lower, shoulder higher and the neck straight horizontally, exposing the external jugular vein completely. However this position is not favorable to the emergency treatment for the patient and the patient is likely to move because the nursing staff presses the external jugular vein when performing puncture. Thus, another nursing staff is asked to assist assuming body position and restrain them, which increases the time consumption and labor. In the observation group, 35 patients receive indwelling needle puncture of external jugular vein under the guidance of B-ultrasound to detect the orientation of the blood vessel. They assume horizontal recumbent position with head towards the opposite side of the puncture, so a nursing staff can complete the operation, saving time and labor.

General ICU admits patients with critical diseases who have severe peripheral vein collapse-induced microcirculation deficiency that causes systemic circulatory failure, which increases the difficulty of venipuncture. It is important to build venous access quickly for timely medication in emergency treatment However, both doctor-guided CVC puncture and nurse-guided indwelling needle puncture of external jugular vein depend on vision and touch to locate blood vessel thus cannot achieve 100% success rate currently. According to some reports [11, 12], success rate of traditional centripetal indwelling needle puncture of external jugular vein is 68.57%-89.13%. In the current research, the success rate of control group is 88.6% while in the observation group it is 100%, higher than that of the control group and of the reports. Increase in success rate of puncture can not only relieve pain but also buy more time for first aid so as to increase success rate of emergency treatment for critical patients.

Due to complexity of the condition of patients in ICU, doctor-guided CVC is a main choice for building venous access. According to some researchers [13], the average time consumption of CVC is 27.67±3.96 min, so nurses are required to open temporary venous access as quickly as possible before CVC. In the observation group, with the angiogram shown by the probe of ultrasound B, the nurse can detect the exact orientation of the blood vessels, reducing the time spent in locating the blood vessel through vision and touch [14-17]. Besides, under the vision created by B-ultrasound, the needle can avoid venous valve and plaque on the vascular wall and can enter the vein at a time. Of 35 cases in the observation group, the minimal time consumption is 1 minute and 26 seconds and the maximum is 3 minutes and 18 seconds. Among the 35 cases in the control group, only 8 cases receive one-time successful puncture, and the minimum time consumption is 6 minutes and 10 seconds. In 23 cases, the needle have been adjusted repeatedly to enter the blood vessel and the maximum time consumption is 13 minutes and 47 seconds. The observation group is more advantageous than control group and CVC in saving time.

# 5. Conclusions

In conclusion, in the present research, the indwelling needle puncture of external jugular vein under B-ultrasound guidance in the observation group is more advantageous than control group in body position, success rate of puncture, time consumption of puncture, additional consumption of indwelling needles, etc. For critical patients with microcirculation failure it is safer because it can build venous success more quickly to rapidly expand vessels and use vasoactive drugs. In this way, the indwelling needle puncture of external jugular vein under B-ultrasound guidance improves the success rate of emergency treatment for critical patients, and reduces the pressure of venipuncture for medical staff. Although B-ultrasound guidance requires specific ultrasound equipment and increases the hospital's cost, it is still worth well clinical application for its safety and convenience.

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