

# Comparison of blood collecting on radial and femoral artery among nurses having different length of service

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**Abstract:** Objective The objective is to explore the effect of nurses having different length of service on the success rate of blood collecting and patients' pain intensity through radial and femoral artery. Methods Research objects are 178 cases of respiratory patients. Nurses are divided into three groups: less than 3 years group, 3 to 5 years group, more than 5 years group. The success rate of blood collecting and patients' pain intensity through radial and femoral artery are counted, to compare the difference of those. Result The success rate of femoral artery blood collection was higher than the that of radial artery blood collection. Less than 3 years group in the success rate of blood collecting on radial and femoral artery <3 years group was significantly lower than that in 3 to 5 years group and more than 5 years group. Patients' pain intensity through radial artery blood collection was higher than femoral artery blood collection. Conclusion For inexperienced junior nurses, we suggested femoral artery blood collection; for the relatively experienced senior nurses, we recommend radial artery blood collection.

**Keywords:** radial artery; femoral artery; blood collection

## Introduction

Arterial blood gas analysis is the important basis to determine the body's acid-base balance and oxygen saturation. Radial artery and femoral artery are the most common blood collection artery including respiratory medicine. Some studies have shown that the effect of blood collection through radial and femoral artery may be different. For example, Lv Lizhen observed the success rate of radial artery blood collection (about 90%) is significantly higher than that of femoral artery (about 79%) ( $p < 0.01$ ) [3]. However, Huang Wei found that there was no significant difference in the success rate of arterial blood collection between two parts of premature infants ( $p > 0.05$ ) [4]. There are significant differences between the different studies. The reasons may be that the technical level of the operator to a large extent affected the success rate of arterial blood collection, resulting in greater variability. However, so far, only very limited studies have focused on this factor's effect on arterial blood collection [3]. Therefore, this study compared the effect of radial and femoral artery blood collection based on nurses' length of service. The purpose is to determine the different levels of the best blood collection site, to provide a scientific basis for clinical blood collection site.

## 1 Objects and methods

### 1.1 Objects

Research objects are 178 patients who need blood gas analysis from December 2011 to April 2012 in respiratory medical ward. Inclusion criteria include that: ① target arteries are no visible damage; ② there is no other interventional

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operation one hour before this operation; ③ patients are consciousness and voluntary coordination. Exclusion criteria include that: ① patients are with edema; ② patients suffer from neuromuscular disease; ③ patients are unconsciousness or unable to cooperate with the study.

## **1.2 Methods**

### **1.2.1 Grouping method**

According to length of service, nurses are divided into three groups. The length of service of Group A are less than 3 years (not including 3 years), that of Group B is from 3 to 5 years and that of Group C is greater than or equal to 5 years. Nurses select blood collection site by themselves at each operation (either radial artery or femoral artery). There are 48 cases totally in Group A, which contains 21 cases of blood collection through radial artery and 27 cases through femoral artery. There are 65 cases totally in Group B, which contains 30 cases of blood collection through radial artery and 35 cases through femoral artery. There are 65 cases totally in Group C, which contains 28 cases of blood collection through radial artery and 37 cases through femoral artery

### **1.2.2 Operation methods**

Each time when collecting blood, nurses record the basic data of patients, the operator's length of service, blood collection methods, successful blood collection times and patients' pain intensity.

#### **(1) Radial artery blood collection**

In the forearm of the distal segment, radial artery is in the downlink between the brachioradialis and radial flexor carpal muscle, and is divided into two parts near the radial joint at the level of radial styloid process [3]. In the radial head, the arterial position is superficial and the diameter of the artery is larger (average 0.27cm) [5]. According to this anatomical features, the puncture site is positioned as the radial styloid process and the first metacarpal space, from the wrist stripes a horizontal index, 0.5 cm from the outside, to beat the obvious parts of the prevailing [6]. Patients are supine position, upper limbs of blood collection are slightly out of the exhibition, the wrist is placed under cotton pillow, palm back is bending and palm is up. Patients and operators are strictly disinfected according to arterial blood disinfection requirements. Operators fix blood vessels by left hand, hold arterial blood collection device by right hand (American BD company, the same below), and quickly pierce the artery. Puncture angle and the skin surface is about 15°. Blood 2 ml after seeing the blood. Blood collection is completed, using sterile cotton to partly press 10 minutes.

#### **(2) Femoral artery blood collection**

Patients are supine, legs are slightly abduction, and hip cotton is placed under the pillow if necessary. The puncture site is positioned as the midpoint of the inguinal ligament (anterior superior iliac spine and pubic nodular surface connection position) [1]. Operators fix blood vessels by left hand, hold arterial blood collection device by right hand, and quickly pierce the artery. Puncture angle and the skin surface is about 90°. Blood 2 ml after seeing the blood. Blood collection is completed, using sterile cotton to partly press 10 minutes.

### **1.2.3 Evaluation method**

Evaluation indicators include the success rate of puncture and patients' pain intensity. The success rate of the puncture is defined as the percentage of the total number of puncture attempts. The criteria for the success of the puncture are a

needle into the artery and collected 2 ml of arterial blood for blood gas analysis. The level of patients' pain intensity is graded by the Language Assessment Scale Method (VRS).

#### 1.2.4 Statistical method

SPSS software is used to analyze statistics. ANOVA procedure is used to analyze different factors' effects on the success rate and patients' pain intensity, and the LSD procedure is used to compare the mean.

## 2 Results

### 2.1 The success rate of blood collection through radial and femoral artery

The success rate of arterial blood collection was significantly influenced by both blood collection site and the operator's technique level ( $p < 0.05$ ). The success rate of blood collection in group A was 71% (Table 1), which was much lower than that in group B and group C (87% and 91%, respectively). The success rate of group A was similar to that of group B and group C. The success rate of blood collection in group C was similar to that of femoral artery. On the whole, the three groups' success rate of blood collection through radial artery was lower than that through femoral artery. On the two blood collection sites as a whole, the success rate of blood collection in group B was similar to that in group C, which was much higher than that in group A.

Table1 The success rate of blood collection through radial and femoral artery (unit :%)

| Blood collection sites | Groups   |          |          | Mean     |
|------------------------|----------|----------|----------|----------|
|                        | Group A  | Group B  | Group C  |          |
| Radial artery          | 71 ± 11  | 87 ± 7.2 | 91 ± 1.8 | 83 ± 4.9 |
| Femoral artery         | 91 ± 1.0 | 94 ± 3.6 | 94 ± 5.6 | 93 ± 2.0 |
| Mean                   | 81 ± 6.6 | 90 ± 3.9 | 93 ± 2.7 |          |

Note: The data in the table are expressed as mean ± standard error. Nurses' length of service of Group A, B and C was less than 3 years, 3 to 5 years and 5 years and above respectively.

### 2.2 Patients' pain degree of blood collection through radial and femoral artery

Similar to the success rate of arterial blood collection (Table 1), the proportion of severe pain in blood collected patients was also significantly affected by blood collection site and the operator's technique level ( $p < 0.05$ ). In Group A, B and C, the proportion of patients with severe pain through radial artery blood collection was much higher than that through femoral artery (Table 2). The proportion of patients with severe pain through radial artery blood collection in group A was significantly higher than that in group B and group C (27% and 25%, respectively). The trend of severe pain in patients with femoral artery blood collection was similar to that of femoral artery blood collection. On the two blood collection sites as a whole, the proportion of patients with severe pain in group B was similar to that in group C, which was much lower than that in group A.

Table 2 The proportion of patients with severe pain through radial and femoral artery blood collection (unit :%)

| Blood collection sites | Groups   |          |          | Mean     |
|------------------------|----------|----------|----------|----------|
|                        | Group A  | Group B  | Group C  |          |
| Radial artery          | 52 ± 2.4 | 27 ± 1.0 | 25 ± 2.6 | 35 ± 4.6 |
| Femoral artery         | 33 ± 2.3 | 14 ± 1.9 | 14 ± 2.3 | 20 ± 3.3 |
| Mean                   | 43 ± 4.6 | 21 ± 3.0 | 19 ± 2.9 |          |

Note: The data in the table are expressed as mean ± standard error. Nurses' length of service of Group A, B and C was less than 3 years, 3 to 5 years and 5 years and above respectively.

### 3 Discussion

#### 3.1 The success rate of blood collection through radial and femoral artery

When nurses' length of service is less than 5 years, the success rate of blood collection through radial artery is lower than that of femoral artery (Table 1). The differences are particularly significant when nurses' length of service is less than 3 years ( $p < 0.05$ ). The low success rate of radial artery blood collection may be largely related to unskilled or inexperienced skills of the operator. On the one hand, the needle piercing the radial artery may cause vasoconstriction when puncturing, which usually takes some time to the blood [6]. In the case of no blood after puncture, if the operator is anxious to advance and retreat the needle, then it may lead to arterial blood failure. On the other hand, the radial veins are associated with the radial artery, and unskilled or inexperienced operators may mistakenly take venous blood, thereby reducing the success rate of radial artery blood [7]. When nurses' length of service is more than 5 years, the success rate of blood collection through radial artery is similar with that of femoral artery (Table 1). The results suggest that the operator's technique level is an important factor in the success rate of radial artery blood collection, which is similar to the results of Lv Lian's research [3]. Comparing the success rate of blood collection with nurses' length of service less than 5 years and greater than or equal to 5 years, She found that the success rate of arterial blood collection of nurses with long clinical time was significantly higher than that of nurses with short clinical time ( $p < 0.05$ ) [3]. The success rate of blood collection in each group was similar. Thus, on the three groups as a whole, the success rate of femoral artery blood collection is higher than radial artery blood collection. This suggests that the success rate of arterial blood collection depends largely on blood collection site.

#### 3.2 Pain intensity of patients with blood collection

So far, the mechanism of pain has not yet fully understood. It is generally believed that a certain degree of physical or chemical nociceptive action is applied to the pain receptors (nerve endings in the skin or other tissues). Injured parts of the organization release pain-causing substances, convert into nociceptive information, and cause pain through the conduction system to the brain. Pain degree is affected by factors such as nociceptive and pain receptors. Compared with femoral artery blood sampling, the proportion of severe pain in patients with radial artery blood vessels was significantly higher (Table 2). There are two reasons. First, compared with femoral artery, radial artery longitudinal surface projects free nerve endings, which is sensitive to pain response. Second, the smaller puncture angle of the radial artery increases the area of the site of action and the degree and intensity of the tissue injury, and promotes the release of the painful substance, thus increasing the nociceptive information of the incoming center [8]. In addition to blood

collection site, the technical level of the operator also affects the degree of pain in patients. Nurses above 3 years during arterial blood, the proportion of patients with severe pain was much lower than that of nurses whose length of service is less than 3 years. The results show that, in the case of unskilled or inexperienced operators, blood collection through femoral artery can improve the success rate of arterial blood collection and help reduce the pain of patients. For rich clinical experience and skilled operators, the success rate of radial artery blood collection is similar to femoral artery blood collection. At the same time the patient's privacy will expose as the acquisition of femoral artery and operation time is longer than the radial artery, operators can use the radial artery for blood collection. However, the proportion of severe pain in patients with radial artery blood collection is higher. Therefore, how to improve the radial artery blood collection technology to improve the success rate and reduce the degree of pain in patients will be the focus of future research.

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