



Comparison of V Technique and Femoral Arterial Palpation Techniques Accuracy in Identifying the Femoral Vein's Cannulation Site

Aida Rosita Tantri*^{ORCID}, Anas Alatas^{ORCID}, Reza Surya Dharma^{ORCID}

Department of Anesthesiology and Intensive Care, Faculty of Medicine, Universitas Indonesia, Cipto Mangunkusumo National General Hospital, Jakarta, Indonesia

Abstract

Edited by: Ana Vucurevic
Citation: Tantri AR, Alatas A, Dharma RS. Comparison of V Technique and Femoral Arterial Palpation Techniques Accuracy in Identifying the Femoral Vein's Cannulation Site. Open Access Maced J Med Sci. 2022 Mar 02; 10(B):686-690. https://doi.org/10.3889/oamjms.2022.8715
Keywords: Arterial palpation technique; Femoral access; Femoral vein; V technique; Vascular access
***Correspondence:** Aida Rosita Tantri, Department of Anesthesiology and Intensive Care, Faculty of Medicine, Universitas Indonesia, Cipto Mangunkusumo National General Hospital, Diponegoro Street No. 71, Jakarta - 10430, Indonesia. E-mail: aidatantri@gmail.com
Received: 22-Jan-2022
Revised: 08-Feb-2022
Accepted: 20-Feb-2022
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Funding: This research did not receive any financial support
Competing Interests: The authors have declared that no competing interests exist
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BACKGROUND: The femoral vein cannulation is essential for vascular access and finding it by just relying on the femoral artery pulsation can be challenging in a certain condition. V technique is a new technique to identify the femoral vein's cannulation site based on topographic anatomy without relying on femoral artery pulsation.

AIM: This study was aimed to compare V technique and arterial palpation technique accuracies in identifying the femoral vein's cannulation site.

METHODS: This study was a cross-sectional study on 115 adult patients aged 18–65 years old with body mass index 18–25 kg/m² who underwent elective surgery in Cipto Mangunkusumo National General Hospital on February-March 2020. After ethical approval and informed consent, the distance of the femoral vein's cannulation site identified by both techniques with the skin projection of the femoral vein diameter identified by ultrasonography (USG) were compared in all subjects. Accuracy was defined when the femoral vein's cannulation sites identified by both techniques were within the skin projection of femoral vein diameter identified by USG. Data were collected and analyzed using SPSS ver 20.

RESULTS: The accuracy of the V technique in determining the femoral vein's cannulation site was 93.9%, while the accuracy of the femoral artery pulsation technique was 96.5%. McNemar analysis showed no difference in both techniques' accuracy ($p = 0.549$). There was a statistically significant positive correlation between the distance of the femoral vein cannulation site predicted by both techniques with the skin projection of the femoral vein midpoint ($r = 0.548$; $p < 0.001$).

CONCLUSION: V technique's accuracy was not significantly different from the femoral artery palpation technique's accuracy in identifying the femoral vein cannulation site.

Introduction

The femoral vein is an essential intravenous access route in emergency or difficult peripheral access cases [1]. The femoral vein cannulation can provide large intravenous access, which is relatively easy to perform, with lower pneumothorax complications. It traditionally can be identified by palpating the femoral artery pulsation next to it. However, in certain patients, femoral artery pulsation is too weak to identify [1], [2]. Ultrasonography (USG) guided femoral vein cannulation is highly recommended to replace this traditional approach due to its high success rate and low complication rate but is often considered impractical because not all health care facilities have their USG-machine ready to be used [2], [3]. In addition, USG guided femoral vein cannulation also needs a competent physician to perform [3].

V technique is an anatomical topographic-based technique for identifying the femoral vein cannulation site [4]. V technique identifies femoral

vein cannulation site at the angle of V-shaped which was created by operator's firsthand web space while the operator's thumb was placed lateral to patient's pubic tubercle and index finger on the anterior superior sciatic spine [4]. This study was aimed to compare the V technique and traditional arterial palpation technique accuracies in identifying the femoral vein's cannulation site.

Methods

Research design

This study was a comparative observational study with a cross-sectional design conducted in Dr. Cipto Manungkusumo General Hospital on February-March 2020. The estimated number of samples in this study was calculated using the formula for comparing two proportions to achieve a power of 80% and a

significance level of 5% (two sided). After given drop-out of 10%, we included 115 subjects. Subjects were recruited after obtaining approval from the Ethics Committee of the Faculty of Medicine, University of Indonesia (KET69/UN2.F1/ETIK/PPM.00.02/2020).

Inclusion and exclusion criteria

Patients aged 18–65 years with a body mass index (BMI) of 18–25 kg/m² who would undergo elective surgery in Dr. Cipto Mangunkusumo General Hospital were included in this study. Patients who could not lie flat, had congenital or acquired abnormalities in the pelvic and inguinal region, had a history of previous femoral vein puncture, and allergy to USG gel was excluded.

Research protocol

After informed consent, all subject's age, heights, and weight were measured and recorded. In the operating theater, subjects were positioned supine with the lower extremity in 15° abduction and 60° exorotation. An anesthesiologist will perform the V technique on the patient's inguinal area to predict the femoral vein cannulation site. The anesthesiologist would first mark the area 2 cm inferior to the inguinal ligament. Using the hand that was contralateral to the injection site, the anesthesiologist placed his thumb lateral to the patient's pubic tubercle and his index finger on the anterior superior sciatic spine. The predicted location of the femoral vein cannulation site was at the angle of V-shaped which was created by anesthesiologist's firsthand webspace, 2 cm inferior to the inguinal ligament (Figure 1a). The anesthesiologist would adjust the V shape formed so that the cannulation site remains 2 cm below the ligamentum, with the anesthesiologist's thumb still being placed lateral to the patient's pubic tubercle and the index finger on the anterior superior sciatic spine (Figure 1b). The V technique's predicted femoral vein cannulation site was marked with a ultraviolet (UV) marker.

After the V technique was performed, the same anesthesiologist would predict the femoral vein cannulation site traditionally by palpating the femoral artery pulse with his index and middle fingers along the inguinal ligament. The femoral arterial pulsation technique's predicted vein cannulation site was 1 cm medial to the femoral artery pulsation and 2 cm inferior to the inguinal ligament. This location was marked with a UV marker.

The accurate femoral vein projection on the skin was determined by performing USG (Hitachi Arietta 850) examination with a linear probe (2–12 MHz). The USG probe was first placed parallel to the inguinal ligament perpendicular to the skin and moved inferiorly until the probe was at 2 cm from the inguinal ligament. USG of the femoral vein in this area was obtained using the hanging technique, which used a lot of USG gel and less probe pressure to prevent changes in the vein

diameter. The midpoint and projection of the vein on the skin were obtained from the vein USG and marked with an UV marker (Figure 2).

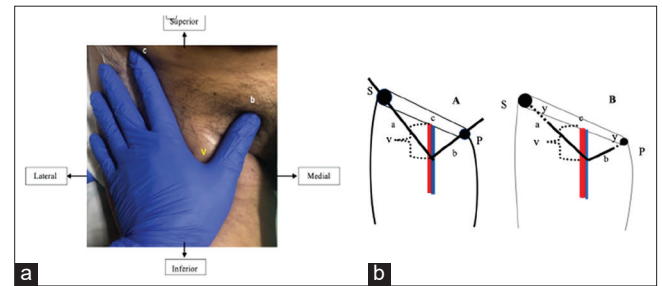


Figure 1: (a) The hand position in the V technique. The angle of V-shaped, which was created by anesthesiologist's firsthand webspace, predicts the femoral vein cannulation site 2 cm inferior to the inguinal ligament. (b) The anesthesiologist would adjust the V shape formed by the first webspace so that the cannulation site remains 2 cm below the ligamentum. The anesthesiologist's thumb was still placed lateral to the patient's pubic tubercle and the index finger on the anterior superior sciatic spine. Several possibilities of the hand position when conducting V techniques. (a) An anesthesiologist performs the V technique with a relatively large hand. (b) Anesthesiologist with a relatively small hand performs the V technique. The V dot line showed the area 2 cm below inguinal ligament. The Y line was an imaginary line that connected SIAS and pubic tubercle. The S dot was SIAS; the P dot was the pubic tubercle. a = direction of the index finger on the pubic tubercle, b = the direction of the thumb, c = inguinal ligament

We compared the accuracy of the femoral vein cannulation site predicted by the V technique and the femoral artery pulsation palpation technique. Accuracy was defined when the femoral vein's cannulation sites identified by both techniques were within the skin projection of femoral vein diameter identified by USG. We also measured and recorded the distance of the predicted cannulation site of each technique to the femoral vein midpoint projection on the skin.

Statistical analysis

The data obtained were analyzed using the Statistical Package for Social Sciences version 20.0. The accuracy proportion's difference between the V technique and the femoral artery palpation technique was carried out using the McNemar test. A Pearson correlation test will also be performed to compare the distance of each technique's prediction site to the midpoint of the femoral vein as shown by USG if the distribution was normal or Spearman's if the data distribution was not normal.

Results

Of the 121 patients who were recruited, four patients were excluded due to BMI >25 kg/m² (2 patients),



Figure 2: The by ultrasonography (USG's) probe position and the femoral vein diameter measurement. The Femoral Vein's midpoint was marked using USG. V1 – V2 is the diameter of the femoral vein. The red X letter is the femoral vein midpoint

BMI <18 kg/m² (one patient), and bilateral inguinal lymph node enlargement (one patient). Characteristics of the 115 final subjects can be shown in Table 1.

Table 1: Demographic characteristics

Variable	n = 115
Sex	
Male	40 (34.8) ^a
Female	75 (65.2) ^a
Age (years)	42.89 ± 12.66 ^b
Height (cm)	160.16 ± 7.08 ^b
Bodyweight (kg)	57.91 ± 7.76 ^b
BMI (kg/m ²)	22.8 (18.20–25.0) ^c

^aResults in percentage (%), ^bResults in ± SD, ^cResults in median (min-max).

There was no significant difference between the V technique and femoral artery palpation technique accuracy in predicting femoral vein cannulation site.

There was a significant correlation with medium strength ($r = 0.548$, correlation coefficient 0.41–0.60, $p < 0.001$) between the distance of femoral vein cannulation site predicted by V technique and femoral artery palpation technique to the femoral vein's midpoint (Figure 3).

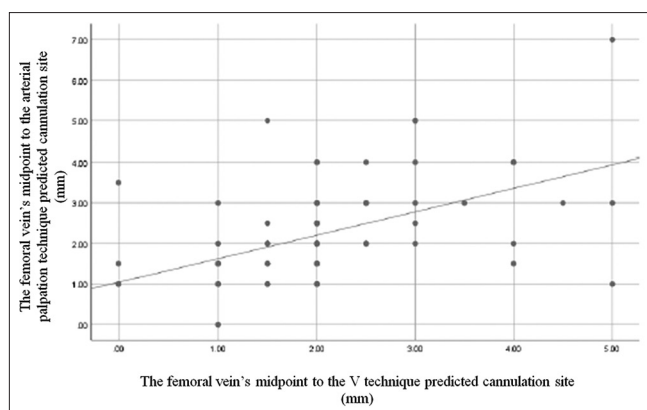


Figure 3: The relationship between V technique prediction site to the femoral vein's midpoint distance and femoral artery palpation technique prediction site to the femoral vein's midpoint distance

Discussion

The femoral vein traditionally was found by identifying the femoral artery pulsation next to it. However, in a certain patient, femoral artery pulsation

is too weak to identify. The previous study showed that accuracy in predicting femoral vein cannulation site of emergency physician vein in subjects with BMI <25 kg/m², regardless of the method, was only 74% [5].

The use of USG is undoubtedly highly recommended in femoral vein cannulation [4], [6]. However, limited availability, lack of experience, and competence often limit USG used. Anatomical topography for predicting femoral vein cannulation site had been widely studied as an alternative for femoral for artery palpation technique [7], [8], [9]. V technique, an anatomical topography-based technique, is an alternative technique to identify the femoral vein's cannulation site. This technique is also easy and fast to perform.

The previous study showed a wide range of anatomical topographic technique success rates in predicting the femoral vein cannulation site, which might relate to the operators' experience and patients' BMI difference [8], [9]. In this study, although the accuracy of the V technique, which was based on the patient's topographic anatomy, was 93.9%, lower than the femoral artery palpation technique (96.5%, Table 2), there was no significant difference between both techniques.

Table 2: V technique and femoral artery palpation technique accuracy difference

Variables	The Femoral artery's palpation technique accuracy		p
	Yes	No	
V technique accuracy			
Yes	104 (96.3)	4 (3.7)	0.549 ^d
No	7 (100.0)	0 (0.0)	

^dMcnemar test

We measured the distance of the predicted femoral vein cannulation site of both techniques with the projection of the femoral vein midpoint on the skin to obtain the accuracy of both methods quantitatively. Quantitatively, the median distance of predicted femoral vein cannulation site of V technique and arterial palpation technique both were 2 mm, with a range of 0–7 mm and 0–5 mm respectively (Table 3), which were significantly correlated with the median of arterial palpation technique with moderate strength ($r = 0.548$, $p < 0.001$). Both results of this study showed

that the V technique could be used as an alternative to arterial palpation technique in identifying femoral vein cannulation site.

Table 3: Distance of femoral vein cannulation site predicted by V technique and femoral artery pulsation technique to the femoral Vein's midpoint

Distance to the Femoral Vein's Midpoint (mm)	n = 115
The femoral vein cannulation site based on the V technique	2 (0-7) ^c
The femoral vein cannulation site based on femoral artery palpation technique)	2 (0-5) ^c

^cMedian (min-max)

In our study, based on the scatter graph (Figure 3), there was still relatively high variability found. This indicates that the V technique had susceptibility to internal variations. Despite the distance of the anterior superior ischial spine to the pubic tubercle, the predicted location of the femoral vein cannulation site based on the V technique was also determined by the examiner's hand and finger length. The examiner must adjust the hand position according to his hand and finger length so that the V shape of the first webspace lies 2 cm below the inguinal ligament (Figure 1b). This step contributed to the high internal variations of the V technique and made the V technique in certain examiners and patients challenging to perform. In addition, the size of the pelvis, which affected the distance of the anterior superior ischial spine to the pubic tubercle, also might contribute to V technique reliability. Based on this result, although both techniques showed a significant moderate positive correlation, the reliability of this technique still must be tested. Examiner variability in hand and finger length and variability in hip shapes and measurement must be considered.

On the other hand, the V technique might be used as an additional tool to overcome the limitation of the arterial palpation technique and increase its success rate. A common obstacle encountered when using the femoral artery palpation technique is identifying a weak or unpalpable femoral artery pulsation. At this condition, experienced operators can still cannulate the femoral vein by performing cannulation slightly medial to the inguinal ligament's midpoint [9]. Successful cannulations in this condition will be further enhanced when using a combination of V technique, modifying the position of the lower leg, or using ultrasound guidance [4], [6], [10], [11].

Research limitations

This research was performed on patients with BMI 18–25 kg/m². The accuracy of the femoral vein cannulation site predicted by the femoral artery palpation technique and V technique is related to the subject's BMI. Further research is needed on patients with BMI <18 kg/m² or above 25 kg/m² to get the V technique accuracy in predicting the femoral vein cannulation site. This study also was only performed to compare the accuracy of predicted femoral vein cannulation site of both techniques and did not compare the success rate of femoral vein cannulation. The success of femoral vein

cannulation was related to patient anatomy, physician experience and competence, and the cannulation technique.

Conclusion

V technique's accuracy was not significantly different from the femoral artery palpation technique's accuracy in identifying the femoral vein cannulation site. There was a statistically significant positive correlation between the distance of the femoral vein cannulation site predicted by both techniques with the skin projection of the femoral vein midpoint. However, this study was limited to normal BMI.

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