Journal of Clinical Anesthesia 36 (2017) 98–101

Contents lists available at ScienceDirect

Journal of Clinical Anesthesia

Original contribution

Oblique approach for ultrasound-guided radial artery catheterization vs transverse and longitudinal approaches, a randomized trial☆,☆☆,★

Usama Elsayed Mohammed Abdalla, MD *, Alaa Elmaadawey, MD, AlRefaey Kandeel, MD

Lecturer of Anesthesia and Surgical Intensive Care, Mansoura University, Egypt

ARTICLE INFO

Article history:
Received 28 October 2015
Received in revised form 15 September 2016
Accepted 27 October 2016
Available online xxxx

Keywords:
Radial
Catheterization
Ultrasound
Guidance

ABSTRACT

Study objective: To investigate the value of using a new technique for ultrasound-guided radial artery catheterization; oblique approach; vs transverse and longitudinal views are the traditionally used approaches aiming to combine benefits and avoid drawbacks of aforementioned approaches.
Design: A prospective randomized nonblinded study.
Setting: Gastroenterology Center, Mansoura University, Egypt from February 2015 to August 2015.
Patients: One hundred twenty-six surgical and intensive care unit patients indicated for arterial catheterization.
Intervention: Patients were randomly allocated into 3 groups according to the US-guided technique used; group T (n = 42) using transverse view, group L (n = 42) using longitudinal view, group O (n = 42) using oblique view.
Measurements: Primary objective was overall success rate; secondary objectives were first attempt success, time to cannulate, and operator satisfaction with the used technique.
Main results: Forty-two patients were included for each study group. Overall success rate of radial artery catheterization was significantly higher in group O than in group T and clinically higher than group L (60% for group T, 70% for group L, 90% for group O; $P < .02$). Likewise, time needed to cannulate the radial artery was significantly lower in group O than in both group T and group L (28 ± 19 s for group T, 66 ± 5 s for group L, 16 ± 7 s for group O; $P < .00$].
Conclusion: These results support the conclusion that the oblique approach for US-guided radial artery catheterization may replace the 2 classic approaches owing to its superior success rate, higher first attempt success and shorter time consumed for catheterization with more operator satisfaction after the procedure.

1. Introduction

Arterial catheterization is a commonly performed invasive procedure in the intensive care unit (ICU) and operating theater, facilitating accurate hemodynamic monitoring and frequent blood sampling. The procedure may be challenging especially in patients with hypotension, edema, and obesity, is often difficult, and may require multiple attempts. Such repeated attempts may lead to more difficult catheterization due to arterial spasm or injury, and may also increase the incidence of thrombosis and hematoma formation [1]. The radial artery is the commonest site for catheterization owing to its superficial course and its dual arterial supply to the hand [2]. Traditionally, radial artery was located through palpation of the pulse depending on the anatomical landmarks. However, anatomical variations, obesity, hypotension, edema, and atherosclerosis may render artery localization via palpation a difficult or even impossible task [3]. Recently, ultrasound-guided central vein catheterization offered the advantages of increased success rate, patient safety, and cost effectiveness [4,5]. Building on these results, US guidance has been introduced into arterial catheter insertion seeking the same advantages. Up to our knowledge, there are 2 approaches for US-guided radial artery catheterization which are the following: the long access (in-plane or longitudinal) and the short access (out-of-plane or transverse) approaches with different degrees of success for each technique [3,6,7]. The aim of the study is to confirm our hypothesis that oblique US guidance during radial artery catheterization using oblique (out-of-plane) technique may improve the success rate of radial artery catheterization from the first attempt and may shorten the duration for successful catheterization.

2. Patients and methods

After approval of institutional research board of Faculty of Medicine, Mansoura University, Egypt, this study was carried out in Mansoura University Hospitals. Consent was taken from 126 (ASA I-II surgically listed or ICU admitted) patients indicated for radial artery

☆ Trial registry: www.clinicaltrials.gov; Identifier: NCT02550223.
☆☆ Funding: no funding resources to be declared.
★ Conflict of interest: None.
* Corresponding author at: Dakahleyya Government, Geihan St, Gastroenterology Center, Second Floor, Liver Transplant ICU, Mansoura City 35516. Tel.: +20 1028842265.
E-mail addresses: usamaelsayed20@yahoo.com, usamaelsayed82@gmail.com (U.E.M. Abdalla).

http://dx.doi.org/10.1016/j.jclinane.2016.10.016
0952-8180/

catheterization. Patients were of either sex, aging from 20-50 years, and body mass index less than 35. Patients with +ve modified Allen test, coagulopathy (international normalized ratio, ≥1.5; platelet count, ≤70 × 10^3/μL), peripheral arterial disease, infection, or burn at the site of insertion were excluded from the study.

2.1. Sample size

G*power software version 3.1.9.2 (Heinrith-Heine-Universitat Dusseldorf/Germany) was used for sample size calculation. For a 90% study power and α error of 0.05, a sample size of 108 patients was required to detect a 35% difference in overall success rate (primary variable) between the studied groups. Additional 18 cases were added to compensate for dropouts, making the total sample size; 126 cases, 42 in each group (using G*power software version 3.1.9.2).

2.2. Study groups and randomization

As shown in Fig. 1, patients were randomly allocated into 3 equal groups using closed envelope technique in 7 blocks of 18 (6 patients for each group, 2 of which were assigned to 1 of the 3 expert operators involved in the study);

- Group L (n = 42): US-guided longitudinal group.
- Group O (n = 42): US-guided oblique group.
- Group T (n = 42): US-guided transverse view.

2.3. Technique of radial artery catheterization

After modified Allen test confirmed to be negative, the patient is placed in the supine position with nondominant arm placed up on a flat surface in moderate dorsiflexion of the wrist with a towel under its dorsal aspect. After forearm sterilization with betadine, it was draped. This position was maintained by taping the hand and fingers to the work surface.

Ensuring sterile or aseptic technique, ultrasound transducer gel was put in contact with the superficial probe (Toshiba Xario, Japan, PLT 805AT transducer), and then the probe tip was covered with sterile glove (due to nonavailable sterile covers) followed by passing the probe and its connection into a sterile cover. Initially, machine was set to a preset mode MSK (frequency, 8 MHz; depth, 3 cm); thereon, gain and depth were modified to get most accepted view by the operator. The probe was aligned according to the patient group as illustrated in Fig. 2;

- Group L: the probe will be parallel to the course of the artery.
- Group T: the probe will be perpendicular to the course of the artery.
- Group O: oblique view will be used to visualize the artery. The probe is positioned transverse perpendicular to the artery as in group T then the medial end of the probe was rotated clockwise till an angle of 30°-60° oblique according to maximum visualization. Also, a slight tilt can be used to maximize the cross-sectional area of the artery.

First, the radial artery was imaged in the transverse view to get the initial measurements (depth, area, and diameter). Then, catheter-needle system (Leadercath Arterial; Vygon, United Kingdom) was inserted; by operator's dominant hand, at an angle of 30°-45° to the skin and advanced under ultrasound guidance until it is observed entering the vessel, and pulsatile flow is detected. At this moment, an assistant held the probe, whereas the operator fixed the needle and continues the procedure. The guidewire was introduced and arterial catheter threaded over it.

2.4. Statistical analysis

Collected data were analyzed using IBM SPSS statistics, version 20. Normally distributed continuous data were presented as mean ± SD, whereas nonnormally distributed continuous data were presented as median (interquartile range). Percentages (absolute numbers) were used to present nominal and ordinal data. For detection of statistical differences between the 3 studied techniques, 1-way analysis of variance with Tukey post hoc analysis or the Kruskal-Wallis H test was used as proper. A *P* value of less than .05 was considered significant.

3. Results

Ninety patients (80 operative patients, 46 ICU patients), indicated for radial artery catheterizations, were enrolled in the study. Patients were randomly allocated into the following 3 study groups: oblique

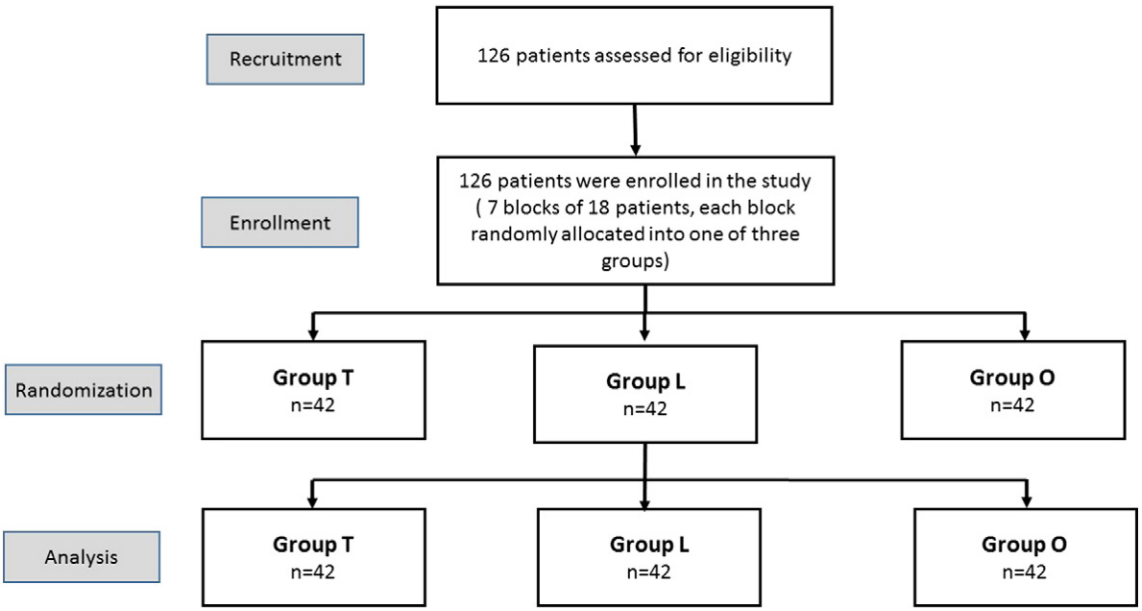

Fig. 1. Study flowchart.