



Original Contribution

Ultrasound-guided central venous access: which probe is preferred for viewing the subclavian vein using a supraclavicular approach? ☆☆☆



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ABSTRACT

Background: Point-of-care ultrasound guidance using a linear probe is well established as a tool to increase safety when performing a supradiaphragmatic cannulation of the internal jugular central vein. However, little data exist on which probe is best for performing a supradiaphragmatic cannulation of the subclavian vein.

Methods: This was a prospective, observational study at a single-site emergency department, where 5 different physician sonologists evaluate individual practice preference for visualization of the subclavian vein using a supraclavicular approach with 2 different linear probes and 1 endocavitary probe.

Results: Of 155 patients enrolled, there was no clear preference any of the probes ($P = .03$). After pooling linear probe preference, there was a preference for either linear probe over the alternative endocavitary probe (76.8% vs 23.1%, $P < .05$).

Conclusion: We observed a preference for a linear probe over an endocavitary probe. Further investigation is necessary to determine which probe is optimal for this application.

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1. Introduction

Central venous catheters are commonly placed in the internal jugular, femoral, or subclavian veins for critically ill patients who require hemodynamic monitoring or administration of centrally acting intravenous medications. In 2006, the American College of Emergency Physicians recognized and endorsed the use of point-of-care ultrasound for safe placement of these catheters to the internal jugular when a supradiaphragmatic cannulation is necessary [1]. More recently, a growing number of adult and pediatric studies have documented the potential use and advantages of point-of-care ultrasound guidance in the cannulation of the subclavian vein (SCV) as well [2–6]. Furthermore, the supraclavicular approach to point-of-care ultrasound-guided SCV cannulation has demonstrated significant advantages with success and safety when compared with the more traditional “blind” infraclavicular approach [7–13].

It is well known that various ultrasound probes can be used to aid with ultrasound-guided SCV cannulation; however, there is no agreed upon consensus as to which probe is best. On the basis of studies for the internal jugular, visualization within the supraclavicular fossa has typically been performed using a high-frequency linear probe in a longitudinal plane of the SCV, which is done to prevent transfixion of the vein and avoid the dreaded complication of an iatrogenic pneumothorax. Although suggested by Mallin et al [14] that the endocavitary probe may be better suited for use for supraclavicular line placement due to the cul-de-sac shape of the supraclavicular space, there remains no studies that have compared the use of different ultrasound probes to visualize the SCV from a supraclavicular approach.

In this pilot study, we sought to identify which probe is preferred by clinicians for the visualization of the SCV using a supraclavicular approach. No attempt was made to determine accuracy or easiness of performing the procedure under ultrasound guidance.

2. Methods

2.1. Study design

This was a single-center, prospective, observational study that compared provider preference of 3 different probes in identifying the SCV using a supraclavicular approach. The study was approved by the site institutional review board.

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☆☆ Ethical approval: This study was conducted in compliance with the rules and regulations of the Health Insurance Portability and Accountability Act as well as in adherence to the Declaration of Helsinki and all other relevant federal and state laws. This study was approved by the University of California, Irvine, institutional review board.

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2.2. Study setting and population

The study was performed at an urban, level 1 trauma center that supports an Emergency Medicine Residency Program. The emergency department (ED) has an annual census of 57 000 patients. Adult patients presenting to the ED between February 2014 and October 2014 were eligible for participation. Inclusion criteria were age 18 years or more and ability to provide written consent in either English or Spanish. Any patient physically present in the ED was eligible for participation except for those with chest trauma or a history of chest surgery. On the basis of institutional guidelines, prisoners, pregnant patients, and those presenting with psychiatric complaints were also excluded from the study.

2.3. Study protocol

Five physicians of various training levels were asked to visualize the SVC using a supraclavicular approach with 3 different ultrasound probes and then indicate their preferred probe. All 5 physicians were trained in image acquisition by a fellowship trained, expert sonologist. Training sessions consisted of a 30-minute lecture and hands-on training. Undergraduate research student volunteers assisted in patient enrollment and data collection.

After obtaining consent, patients underwent bedside ultrasonography of the SCV by one of the trained physicians. A patient could be scanned by multiple sonologists, as long as the sonologists were blinded to the findings and preferences of the prior scanner. A Sonosite Edge ultrasound machine (FUJIFILM SonoSite Inc, Bothell, Washington) with a long footprint linear probe (38 mm, 10–5 MHz), a short footprint linear probe (25 mm, 13–6 MHz), and a microconvex tightly curved footprint endocavitary probe (8–5 MHz) were used for image acquisition. Access to the supraclavicular fossa was obtained by placing patients in the supine position with their heads rotated contralaterally. The SCV was identified by 1 of 2 methods: (1) following the internal jugular vein caudally into the supraclavicular fossa where it meets the SCV or (2) placing the probe into the fossa and angling anteriorly to capture the long-axis view of the SCV (Fig. 1). Either the right or left SCV was scanned at the discretion of the physician performing the scan.

2.4. Outcome measures

The primary end point of this study was sonologist preference by probe type for visualizing the SCV.

2.5. Statistical analysis

Sample size calculations determined that 151 images were required to detect a statistical significance of less than .05 with a power of 80%. We collected data on 174 images to allow for 10% exclusion. Study data were collected and analyzed using Research Electronic Data Capture tools. The data were analyzed using Stata (Version 12.1, StataCorp, College Station, Texas). Categorical variables were analyzed using Pearson χ^2 test.

3. Results

One hundred seventy-four patients were enrolled in the study. Nineteen (10.9%) were excluded due to incomplete data. One hundred fifty-five (90.1%) were included in the final analysis (Fig. 2). The average body mass index (BMI) was 25.9, with 49% being male. Most of the patients (72.9% vs 27.1%, $P < .05$) were obese (BMI, > 30.0) (Table 1). Break-down of assessments done by each sonologist were as follows: 10 by fellowship-trained sonologist (6.5%), 30 by fellow A (19.4%), 23 by fellow B (14.8%), 11 by fellow C (7.1%), and 81 by a Post graduate year-2 resident (52.3%).

There was no individual preference between each of the individual probes (38.7% [$n = 60$] 25 mm linear, 38.1% [$n = 59$] 38 mm linear, 23.2% [$n = 36$] endocavitary; $P = .03$). After pooling linear probes,

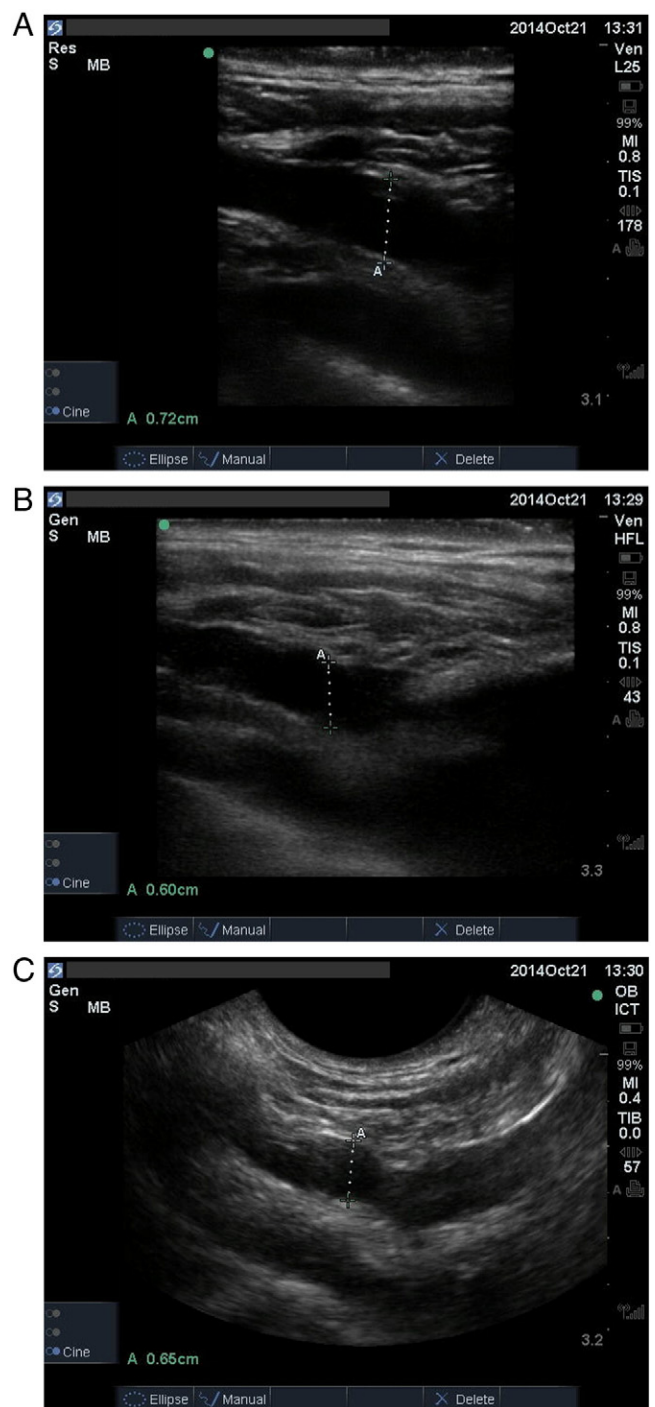


Fig. 1. The SCV from the supraclavicular view, using the L-25 (A), L-38 (B), and endocavitary probes (C).

there was a preference for linear over endocavitary (76.8% [$n = 119$] either linear vs 23.2% [$n = 36$] endocavitary; $P < .05$) (Table 2). When comparing all probes, there was no difference in sonologist probe preference based on sex ($P = .81$) or patient BMI ($P = .30$).

4. Discussion

In recent years, a growing number of studies have documented the high rates of success and low rates of complications using ultrasound via the supraclavicular approach to assist in subclavian line placement in both pediatric and adult populations [7,8,10–12]. The largest, a retrospective series by Bertini et al [9], reported 100% success rate in the

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