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Ultrasound-Guided Brachial and Basilic Vein Cannulation in Emergency Department Patients With Difficult Intravenous Access

Annals of Emergency Medicine - Volume 34, Issue 6 (December 1999) - Copyright © 1999 American College of Emergency Physicians

LABORATORY INVESTIGATION

Ultrasound-Guided Brachial and Basilic Vein Cannulation in Emergency Department Patients With Difficult Intravenous Access

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Received for publication July 28, 1999.
Accepted for publication September 9, 1999.

Presented in abstract form at the Society for Academic Emergency Medicine annual meeting,Chicago, IL, May 1998.

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0196-0644/99/$8.00 + 0

47/1/102684

Study objective: Emergency department patients who require intravenous access but lack peripheral intravenous sites frequently require central line placement. Blind percutaneous brachial vein cannulation has been proposed as an alternative in these patients but is associated with high failure and complication rates. We evaluated an ultrasound-guided approach to percutaneous deep brachial vein or basilic vein cannulation in ED patients with difficult intravenous access.
Methods: We prospectively enrolled ED patients who required intravenous access in whom there had been 2 unsuccessful attempts at establishing a peripheral intravenous line. Using a 7.5-MHz ultrasound probe, the deep brachial vein or basilic vein was identified and then cannulated with a 2-in, 18- to 20-gauge intravenous catheter. Time from probe placement to cannulation, number of attempts, and complications were recorded.
Results: One hundred one patients were enrolled, of whom 50 were injection drug users and 21 were obese. Cannulation was

successful in 91 patients (91%) and accomplished on the first attempt in 73 (73%). The mean (±SD) time required for cannulation was 77 seconds (±129, range 4 to 600 seconds). The line infiltrated or fell out within 1 hour of cannulation in 8 (8%) patients. One patient reported severe pain. There were 2 (2%) cases of brachial artery puncture.
Conclusion: Ultrasound-guided brachial and basilic vein cannulation is safe, rapid, and has a high success rate in ED patients with difficult peripheral intravenous access. [Keyes LE, Frazee BW, Snoey ER, Simon BC, Christy D: Ultrasound-guided brachial and basilic vein cannulation in emergency department patients with difficult intravenous access. *Ann Emerg Med* December 1999;34:711-714.]

INTRODUCTION

Obtaining intravenous access in emergency department patients is sometimes difficult. In patients who lack peripheral intravenous access sites because of body habitus, injection drug use, or underlying medical problems, central line placement may be required. Unfortunately, in many cases, the patient requires only a single dose of intravenous antibiotics, an intravenous load of phenytoin, or a brief procedure under intravenous conscious sedation. In these instances, the risk, discomfort, expense, and time associated with a central line seem unwarranted. Blind percutaneous cannulation of the deep brachial vein has been proposed as an alternative to central line placement. [1] [2] However, this procedure is associated with high failure and complication rates, particularly arterial puncture and paresthesias. [1]

ED ultrasound provides a potential new tool to facilitate peripheral intravenous cannulation. Ultrasound can reliably localize veins and arteries, [3] thereby offering the possibility of cannulating veins that cannot be seen or easily palpated while avoiding accidental arterial puncture or nerve stimulation. Ultrasound guidance has been shown to aid in central line placement, [4] but its use in peripheral intravenous cannulation has not been studied. We evaluated an ultrasound-guided approach to percutaneous deep brachial vein or basilic vein cannulation in ED patients with difficult intravenous access.

MATERIALS AND METHODS

We prospectively enrolled a convenience sample of patients presenting to our urban county hospital, Level II trauma center ED who required intravenous access. Patients were eligible if they were older than 17 years, required intravenous access, and had undergone 2 or more unsuccessful attempts at establishing a peripheral intravenous line. Informed consent was obtained from all subjects, except those presenting as medical or trauma resuscitations. The protocol was approved by the Alameda County Medical Center institutional review board.

Ultrasound imaging was performed using an Aloka 650CL ultrasound machine (Aloka Co, Ltd, Wallingford, CT) with a 7.5-MHz probe. Studies were conducted by 1 of 5 attending or senior resident emergency physicians who had ultrasound experience and underwent a brief training session in the identification of the deep brachial vein and basilic vein by ultrasound (Figure 1).

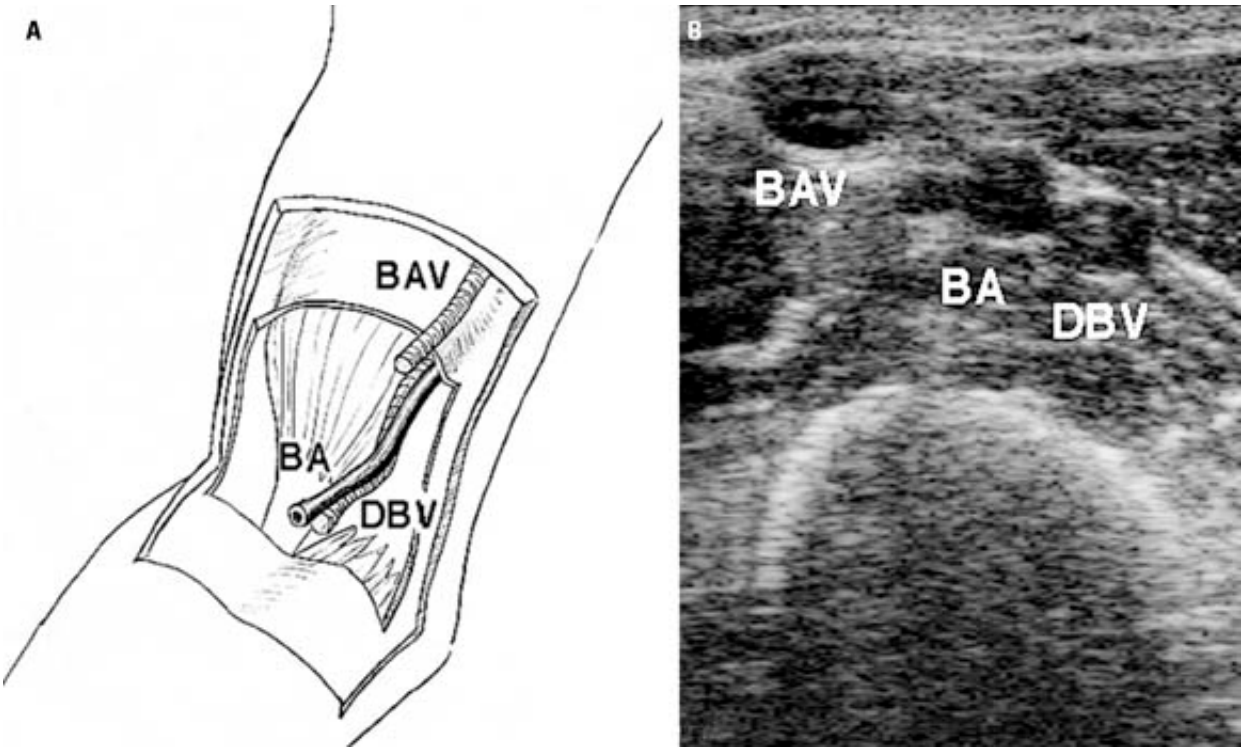

Fig. 1. A, Anatomy of the vessels of the arm. **B,** Corresponding ultrasound image obtained with an Aloka 7.5-MHz ultrasound probe on the right arm. **BAV**, basilic vein; **BA**, brachial artery; **DBV**, deep brachial vein.

The deep brachial vein was identified as the compressible vascular structure adjacent to the pulsatile and noncompressible deep brachial artery. The basilic vein was identified as a more superficial compressible vascular structure lateral (radial) to the deep brachial vessels. While the ultrasound probe was centered over the target vein, a second person, either nurse or physician, using the center of the probe as a guide, inserted a 1.8- to 2-in, 18- to 20-gauge intravenous catheter (Figure 2).

Fig. 2. Performing ultrasound-guided deep brachial vein cannulation.

A maximum of 2 attempts were made before the procedure was deemed unsuccessful. Patient characteristics, time from probe placement to cannulation, number of attempts, and complications were recorded on a standard data form.

RESULTS

One hundred one patients were enrolled; 51 (50%) were female. Fifty-two (50%) patients were injection drug users and 21 (20%) were obese. Cannulation was successful in 91 (91%) patients. The majority (73%) were accomplished with 1 attempt. The mean (±SD) time required for cannulation was 77 seconds (±129, range 4 to 600 seconds). The deep brachial vein was cannulated in 56 patients, the basilic vein in 18, and the vein used was not recorded in 26. The brachial artery was punctured in 2 cases (incidence 2%). One patient (incidence 1%) reported severe pain, which was attributed to contact with the brachial nerve, and the procedure was aborted. The catheter fell out or intravenous fluid infiltrated within 1 hour of cannulation in 8 patients (incidence 8%). In one very obese patient, the catheter was too short to cannulate the deep brachial vein.

DISCUSSION

Scant literature exists on alternative techniques for obtaining peripheral intravenous access. When right heart catheterization was developed in the 1960s, the basilic vein emerged as the preferred conduit for central venous access.[5] [6] A review by Simon et al[7] in 1987 of the technique of basilic vein cutdown emphasized the "marked variability" in anatomic location of the basilic vein. In 1983, 2 separate reports described for the first time the technique of blind, percutaneous deep brachial vein cannulation as an alternative to surgical cutdown.[1] [2] The deep brachial vein lends itself to blind cannulation because it is adjacent to the palpable brachial artery. In the study by Kramer et al[1] of 127 intravenous access attempts, brachial artery puncture occurred in 8%, paresthesias or hyperesthesias in 18%, and hematomas in 2%. Overall success rate was not reported, although the catheter could not be advanced after venous return in 18%. Although numerous studies have demonstrated that ultrasound guidance improves success rate and reduces complications of central venous catheterization,[3] [4] [8] to our knowledge, ultrasound guidance of peripheral vein cannulation has not been previously described.

The ultrasound-guided approach used in our study represents a significant advance in techniques for obtaining peripheral intravenous access. Cannulation using ultrasound visualization eliminates the problem of variable anatomic location of the deep brachial vein and basilic vein. In comparison with the blind technique used by Kramer et al,[1] ultrasound-guided deep brachial vein cannulation appears to greatly reduce the incidence of brachial artery puncture (2% versus 8%) and brachial nerve symptoms (1% vesus 18%). Perhaps most important, by facilitating successful percutaneous intravenous cannulation, the need for invasive procedures such as central line placement or surgical cutdown is reduced.

A possible limitation of our study is that the ultrasound-guided approach was not compared directly with blind cannulation. The success and complications of the blind percutaneous technique have previously been described.[1] We believed that the potentially high incidence of brachial artery injury, hematoma, and nerve injury in the blind cannulation group mitigated against the benefit of a comparison group. Although our study suggests that ultrasound-guided basilic vein and deep brachial vein is associated with very few complications, we did not monitor patients for complications occurring beyond the ED stay. Complications such as loss of catheter, intravenous fluid infiltration, or hematoma may have been underreported in our study for this reason.

A few practical caveats should be considered by emergency physicians planning to perform this procedure. In approximately 8% of patients in whom cannulation was initially successful, the catheter fell out or intravenous fluid infiltrated within 1 hour. We postulate that this problem is caused by the proximity of the intravenous sites to the biceps muscle and tendon and the occasional practice of securing the intravenous tubing across the antecubital fossa causing the catheter to dislodge from the vein with arm movement, or because in very large patients the catheter was too short. These occasional difficulties suggest that ultrasound-guided deep brachial vein and basilic vein cannulation may be best suited to patients who require intravenous access for a limited time. In patients requiring multiple blood samples or long-term intravenous access, a central line may be more appropriate. It should be noted that we used 1.8- to 2.0-in intravenous catheters in this study. Longer than normal intravenous catheters are recommended for this procedure because the deep brachial vein and basilic vein are deeper than the superficial veins normally used for peripheral intravenous lines.

Our study demonstrates that ultrasound-guided deep brachial vein and basilic vein cannulation is safe, rapid, and has a high success rate in ED patients with difficult peripheral intravenous access. This procedure adds to the armamentarium available to the emergency physician when faced with the common problem of difficult intravenous access. It offers the possibility of reducing the number of central lines placed. Finally, ultrasound-guided deep brachial vein and basilic vein cannulation illustrates the expanding role of ultrasound in the ED.

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