THE EFFECT OF ULTRASOUND GUIDANCE ON THE PERCEIVED DIFFICULTY OF EMERGENCY NURSE-OBTAINED PERIPHERAL IV ACCESS

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Abstract—Emergency nurses (ENs) typically place peripheral intravenous (IV) lines, but if repeated attempts fail, patients usually receive central line access. To measure the effect of ultrasound (US) guidance on the perceived difficulty of EN peripheral IV access in Emergency Department patients, a prospective observational study was conducted of ENs in a level I trauma center with a census of 75,000, performing US-guided IV line placement in difficult stick patients (difficult or hard stick patients defined as repeated blind IV placement failure or established history of blind IV placement failure). ENs trained on an inanimate model after a 45-min lecture. Surveys were filled out after each US-guided IV attempt on a patient. ENs could decline to fill out surveys, which recorded reason for US use, type of patient, success, technique used, and difficulty. Successful cannulation was confirmed by drawing blood and infusion of 100 mL of IV fluids. Student’s t-test was used to compare data. A total of 321 surveys were collected in a 5-month period; no ENs declined to participate. There were 258 (80%) of the patients rated as very hard sticks before US, 59 as hard, 3 as easy, and none as very easy. Of the 258 very hard sticks without US, 29 were still rated as very hard even with US use; 43 changed to hard, 112 changed to easy and 137 to very easy. After a brief tutorial, ultrasound guidance for IV access in emergency patients significantly decreased the perceived difficulty in difficult access patients. © 2006 Elsevier Inc.

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INTRODUCTION

Acquiring intravenous (IV) access, particularly in the Emergency Department (ED) setting, is a common and occasionally difficult procedure. Frequently part of a life-saving procedure, this task often falls to the nurse as the expert in gaining access. This can be a challenge for even the most experienced emergency nurse (EN). The success rate, time to completion, number of attempts, and the rate of complications are all important aspects of this procedure.

Emergency patients may be vascular access challenges due to a multitude of etiologies such as obesity, chronic illness, hypovolemia, intravenous drug abuse, vasculopathy and others. Many of these patients lack easily located peripheral venous sites, which may render peripheral access difficult or even impossible to obtain by the usual landmark and palpation method. Several studies have evaluated the use of US guidance for central venous access by physicians in the ED, and recently, this technique has been applied to peripheral venous access as well (1–6). The purpose of this study was to measure the effect of ultrasound (US) on the perceived difficulty of EN peripheral IV access in ED patients.
METHODS

This was a prospective, observational study of ENs in our ED performing US-guided intravenous line placement. The study was conducted at a level I trauma center with an Emergency Medicine (EM) residency program and was IRB approved. The department is staffed by certified ENs and acts as a training site for nursing students from several accredited nursing schools. Nurses were introduced to US guidance for peripheral venous access during one of three classes before the initiation of this study. The classes consisted of a 45-min lecture that included still images, video segments, US physics and technique explanation, followed by hands-on practice on an inanimate model simulating a deep peripheral arm vein (Figure 1). Nurses performed US-guided line placement using standard aseptic technique per hospital policy. None of the nurses had used ultrasound guidance for vascular access previously nor had any of them used any other ultrasound application. The emergency nurses ranged in experience from 1 to 22 years of postgraduate nursing experience in the Emergency Department setting. Experience levels were not statistically controlled.

Nurses were asked to fill out a one-page survey after attempting an US-guided line placement on a patient. These forms were available on the US machine (ILook 25, Sonosite, Bothell, WA) dedicated for this purpose in the ED. On each form nurses were asked the reason US-guided access was required. The survey form also asked for the number of blind (traditional, or non-US guided) placement attempts that were made before US use. Nurses were asked to rate the difficulty of attempting IV placement both before US use on a patient and then again with US guidance. Rating choices given were “very hard” (difficult to establish IV under the best of circumstances, many other nurses would probably fail after multiple attempts), “hard” (difficult to establish IV, may require catheter manipulation and more than one attempt), “easy” (catheter manipulation typically not required as this is a straight shot, only a novice would fail), and “very easy” (vein easily seen and would not be a challenge for a trainee) for both blind and US-guided techniques. Further, the type of technique, i.e., short axis vs. long axis vein visualization, was also recorded. Blind IV attempts were not required before US use if the patient had a significant history of poor venous access or no potential vein cannulation sites were located on the physical examination by the nurse.

RESULTS

A total of 321 survey forms were collected in a 5-month period. Twenty-three ENs in all participated in the study and submitted surveys. Before US use, 258 (80%) of all patients were rated as “very hard sticks.” There were 59 (18%) patients rated as “hard sticks,” 3 (1%) as “easy” and none as “very easy.” Once US guidance was utilized, only 29 (11%) patients were rated by nurses as “very hard sticks.” A further 43 (13%) patients were rated as “hard sticks.” One hundred twelve (34%) patients were rated as “easy” and the majority, 137 patients (42%), were rated as “very easy sticks.” The change from blind to US-guided difficulty perception was statistically significant for each category (Table 1). Of the 258 most difficult patients (rated as “very hard sticks”) for blind
These US recent attempts, 29 (12%) remained “very hard” after US guidance was added. Another 36 (14%) of these patients improved to “hard,” with a further 86 (33%) improving to “easy.” The majority of these patients, 107 (41%), changed to “very easy.”

ENs made 202 attempts in the short axis; 89% (179) of these attempts were successful. There were 119 long axis attempts; of these, 85% (101) were successful. The difference between the two success rates was not statistically significant, with $p = 0.21$.

**DISCUSSION**

Nurses are the primary providers of IV access in many EDs. Often an IV is required on an emergent or urgent basis in patients who may have poor peripheral access due to prior medical conditions or due to their presenting medical problem. Ultrasound-guided central IV access has been studied since the early 1990s (1–9). However, recent attention has focused on peripheral access under US guidance (6,9). A study by Keyes et al. evaluated US-guided peripheral line placement in 101 ED patients, the majority of whom were intravenous drug users or significantly obese (6). The lines were placed by emergency physicians with a reported success rate of 91%. These patients are the ones most likely to receive a central line when presenting to the ED with a requirement for venous access and would also be the most likely to suffer the potential complications associated with central line placement. Another study, by Costantino and Fojtik, evaluated the success rate of emergency physicians in placing peripheral lines in 51 patients using US guidance when ENs had not been successful; they reported a success rate of 92% (9). Both of these studies involved emergency physicians using US to place peripheral lines even though the initial attempts were made by the nursing staff.

When obtaining US-guided IV access, the basilic vein is the most commonly utilized vein. The basilic vein is rarely utilized by blind IV cannulation procedures and, therefore, there is rarely any scarring of this vein. We have previously reported ENs’ success rate of 86% (10). Such a success rate was comparable to those given in studies evaluating US-guided peripheral line placement by emergency physicians.

Of significant importance is that our study shows ENs reported a decrease in the perceived difficulty in obtaining IV access by using ultrasound. This is despite the use of ultrasound as a new technology. Upon discussion with ENs, familiarization with the equipment and the technique used for both visualization and cannulation occurred quickly and easily. The most difficult aspect of utilizing US, as reported by the nursing staff, was the increased dependence on eye/hand coordination. This required visualizing the vein on the US machine and maintaining proper probe placement with one hand and cannulation with the other.

An unintended result of initiating US use by our nurses was the apparent dependence some patients with chronic access problems began to feel on US-guided line placement. In several cases patients presenting to the ED who previously had lines placed under US and previous history of multiple sticks, refused blind intravenous line attempts. In fact, several nurses also received infrequent, but regular consultations from the medical intensive care unit and several floors for placement of US-guided peripheral lines in critically ill and problem-access patients.

This study has several limitations including a non-randomized design and the fact that sequential patient enrollment was not possible because nurses were asked to use ultrasound only on patients who presented vascular access challenges. The measures used in the study have not been previously validated. Open-ended questions would have had some advantage in discerning the nurse’s perception more accurately. However, they can also pose some practical limitations. Ultimately, a much larger study looking at groups of patients with a variety of reasons for their difficult access would more clearly define the role of ultrasound in the emergency nurse’s hands.

In summary, after a brief tutorial, ultrasound guidance for IV access in emergency patients decreased the perceived difficulty in difficult access patients. Many patients who were initially rated as “very difficult sticks” were changed to “easy” or “very easy” with the use of US guidance.

**REFERENCES**


