

# Ultrasound-Guided Peripheral Intravenous Access in the Emergency Department: Patient-Centered Survey

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**Introduction:** To assess characteristics, satisfaction, and disposition of emergency department (ED) patients who successfully received ultrasound (US)-guided peripheral intravenous (IV) access.

**Methods:** This is a prospective observational study among ED patients who successfully received US-guided peripheral IV access by ED technicians. Nineteen ED technicians were taught to use US guidance to obtain IV access. Training sessions consisted of didactic instruction and hands-on practice. The US guidance for IV access was limited to patients with difficult access. After successfully receiving an US-guided peripheral IV, patients were approached by research assistants who administered a 10-question survey. Disposition information was collected after the conclusion of the ED visit by accessing patients' electronic medical record.

**Results:** In total, 146 surveys were completed in patients successfully receiving US-guided IVs. Patients reported an average satisfaction with the procedure of 9.2 of 10. Forty-two percent of patients had a body mass index (BMI) of greater than 30, and 17.8% had a BMI of more than 35. Sixty-two percent reported a history of central venous catheter placement. This patient population averaged 3 ED visits per year in the past year. Fifty-three percent of the patients were admitted.

**Conclusion:** Patients requiring US-guided IVs in our ED are discharged home at the conclusion of their ED visit about half of the time. These patients reported high rates of both difficult IV access and central venous catheter placement in the past. Patient satisfaction with US-guided IVs was very high. These data support the continued use of US-guided peripheral IVs in this patient population. [West J Emerg Med. 2011;12(4):475–477.]

## INTRODUCTION

The use of ultrasound (US) guidance to place peripheral intravenous (IV) catheters in patients who have undergone unsuccessful attempts at traditional IV access has been adopted as an alternative method in some emergency departments (ED). The type of vascular access selected for an ED patient can be affected by numerous factors, including patient-centered characteristics such as previous history of intravenous drug abuse and obesity. At the same time, consideration of predicted ultimate disposition may affect this decision process: for example, critically ill patients may require central venous catheters (CVC), whereas CVCs are usually avoided in patients

expected to be discharged home. To our knowledge, only 1 study has examined the ultimate disposition of these patients, and few have commented on patient characteristics and satisfaction.<sup>1,2</sup>

Rates of obesity are increasing in the United States, and as a result, the subset of ED patients requiring alternative methods of IV access is likely growing; further characterizing these patients may provide useful information regarding their management. Without access to US-guided peripheral IV placement, when a peripheral IV cannot be placed, a patient frequently receives either a CVC or an external jugular catheter. It is well established that CVCs have significant complication

rates and should be placed only when medically necessary, rather than simply for routine access.<sup>3</sup> Placing CVCs in patients without indications for central-line placement unnecessarily puts these patients at risk for complications such as bacteremia, pneumothorax, thrombosis, and arterial puncture. Ultrasound-guided peripheral IV access can provide a less-invasive vascular-access option for these patients.

We sought to characterize further the patient population at our institution who successfully received ultrasound-guided peripheral IV access. Specifically, we hypothesized that despite high rates of previous difficulty with IV access and high rates of previous CVC placement, these patients would frequently be discharged home from the ED. We hypothesized that this population would have high rates of obesity and a history of multiple ED visits.

## METHODS

### Study Setting

This study was a prospective observational study conducted in the ED of an urban teaching hospital with approximately 68,000 ED patient visits per year and a residency training program in emergency medicine. The Department of Emergency Medicine, with the support of the George Washington University Hospital nursing administration, adopted the protocol of US-guided IV access as performed by ED technicians. The ED technicians had a 2-hour training session, including a didactic presentation discussing the principles of ultrasonography, the care and disinfection of the US machine, how to use the US properly to identify and cannulate veins, and the upper extremity venous anatomy. The training session also included identifying veins in live models' arms by using ultrasound, and practice IV insertion on gel phantoms (Blue Phantom, Kirkland, Washington). The ED technicians were credentialed by the hospital to perform this procedure. In this study, we surveyed a convenience sample of patients who successfully received US-guided peripheral IV access during the period from January 2008 until March 2009. Our local institutional review board approved this study.

### Enrollment of Study Subjects

Patients became eligible for the study if they were at least 18 years old, required an IV line, and had undergone 2 failed peripheral IV attempts or were known to have difficult vascular access from previous visits. Patients were excluded from the trial if they were unstable or otherwise required CVC or another form of emergency IV access. After receiving ultrasound-guided peripheral IV access, patients were approached by research assistants. Research assistants were notified by the ED technician who performed the procedure. Research assistants were present in the ED up to 16 hours per day for 12 of the 15 months of the study. Attempts were made to identify all patients successfully receiving ultrasound-guided IV access; however, as research assistants were not always present, a convenience sample was obtained.

### Data Collection

After obtaining informed consent, research assistants administered a 10-item questionnaire. The research assistants verbally administered the surveys. Interpreters were available to complete the surveys for some but not all non-English-speaking patients. The questionnaire included patient satisfaction, rated on a 10-point Likert scale, history of previous difficult IV access and CVC placement, patient weight and height, and the number of reported previous ED visits in the past year.

Disposition data were determined after the conclusion of the ED visit by using medical record numbers, date of service, and the patients' electronic medical record. Disposition was recorded as either admitted to the hospital or discharged from the ED.

### Statistical Analysis

Surveys were entered into a Microsoft Excel (Microsoft, Redmond, Washington) database by research investigators. The primary outcomes were patient satisfaction rated on a 10-point Likert scale and patients' disposition. Categorical data were evaluated by using summary statistics.

## RESULTS

In total, 146 patients were approached regarding enrollment in the study, and no patient declined enrollment. This patient population reported a mean of 3 ED visits per year. Mean patient satisfaction with the procedure on a 10-point Likert scale was 9.2, with 76% of subjects rating the procedure a "10." On a 5-point scale asking how the US-guided IV compared with previous IVs, the mean score was 4.4, and the mode and median were both 5, with 69% of respondents reporting a 5 (4, "mildly better than previous IVs"; 5, "much better than previous IVs"). In 77 (52.7%) of 146 encounters, the patient was admitted to the hospital. Ninety-one (62.3%) patients reported previous placement of a CVC, and 127 (87%) reported difficulties with IV access in the past. Sixty-one (41.8%) patients were obese (body mass index [BMI] greater than 30), and 26 of those (17.8% of total) were morbidly obese (BMI greater than 35).

## DISCUSSION

This study demonstrates that ED technician-performed peripheral vascular access is acceptable to patients undergoing the procedure. First, our study found that patients who had successful US-guided IV placement were satisfied with this approach. When our patients compared this experience with US-guided access with previous IV-access attempts, the large majority rated it favorably. Other studies examining patient satisfaction have had varied results, some reporting that satisfaction was significantly higher than with blind attempts.<sup>2,4</sup> Stein et al<sup>5</sup> reported that patient satisfaction was no higher with US-guided IVs than with alternative methods. We did not compare satisfaction between groups; therefore, we can report only that in our sample, satisfaction was high.

Second, these patients report having undergone CVC placement in the past when this technique was not available. Our data suggest that peripheral IV access can be a valuable option for patients who may have required CVCs in the past. Bauman et al<sup>2</sup> also found that CVCs would have been necessary in a significant proportion of a similar patient population. Fifty-three percent of the patients in this study were admitted to the hospital. If ultrasound-guided peripheral IV access had not been an option, it is reasonable to believe that at least some of these nonadmitted patients might have required CVC placement despite ultimately being discharged home. Considering that prior studies have reported a risk of complications for CVCs as high as 15%, the use of ultrasound-guided peripheral IV access avoids these potential complications.<sup>3</sup>

Ultrasound-guided IVs are generally considered less durable as CVCs, stemming from an early initial study demonstrating that 8% infiltrated within an hour of placement.<sup>6</sup> In this study, we did not examine the duration of IV-access persistence after admission. In the group of patients who are discharged home, ultrasound-guided peripheral access was sufficient to provide the care necessary to the ED workup and treatment of these patients. Therefore, despite the risk of infiltration, US-guided IVs may be a better option than CVCs for patients who do not clearly warrant admission at initial evaluation.

Finally, our discharge rate was 47%, although a prior study evaluating the utility of ultrasound-guided intravenous access found only 15% of their study population were discharged home at the conclusion of their ED visit.<sup>1</sup> This may indicate true differences in ED populations, or may represent the fact that ED technician-performed ultrasound-guided intravenous access has resulted in a wider application of the procedure to a broader range of patients.

## LIMITATIONS

First, the characteristics of our population are not generalizable outside of our study population. The prevalence of obesity as a major risk factor for difficult intravenous access is likely to vary from center to center and would affect the results in other settings. The prevalence of obesity in our study was 41.8%, whereas prevalence in similar patient populations has been reported as 21% to 29.4%.<sup>1,2</sup>

Second, our sample was a convenience sample because of lack of availability of research assistants. We may have enrolled a disproportionate number of nonadmitted patients, as their ED length of stay tends to be shorter than that for admitted patients. As a result, the percentage of nonadmitted patients may be underestimated.

Third, we surveyed only patients who successfully received US-guided peripheral IVs. It is likely that patients undergoing unsuccessful attempts had lower satisfaction rates. Also, we may have enrolled patients with characteristics that make US-guided IVs easier, such as patients who are less obese. It is not possible to comment on the disposition of patients who

underwent unsuccessful attempts, but it is known that the success rate of our ED technicians is greater than 75% and that physician success rates vary from 91% to 97%.<sup>4,6,7</sup> Finally, although 62.3% of these patients required CVCs in the past, this study did not assess whether access to this procedure actually decreased the rate of CVCs placed in this patient population.

## CONCLUSION

Mounting evidence suggests that US-guided peripheral IV access is an acceptable alternative to CVCs in patients with difficult IV access who do not need central venous access specifically for other reasons (that is, vasopressor infusion, central venous pressure monitoring). In our study, patients who successfully received US-guided peripheral IV access were highly satisfied with this alternative, and although many were admitted, nearly half of patients requiring this procedure in this study were eventually discharged home, making US-guided peripheral IV access a desirable alternative to more-invasive central venous access.

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*Conflicts of Interest:* By the WestJEM article submission agreement, all authors are required to disclose all affiliations, funding sources, and financial or management relationships that could be perceived as potential sources of bias. The authors disclosed none.

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