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Decrease in Central Venous Catheter Placement and Complications Due to Utilization of Ultrasound-Guided Peripheral Intravenous Catheters

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INTRODUCTION

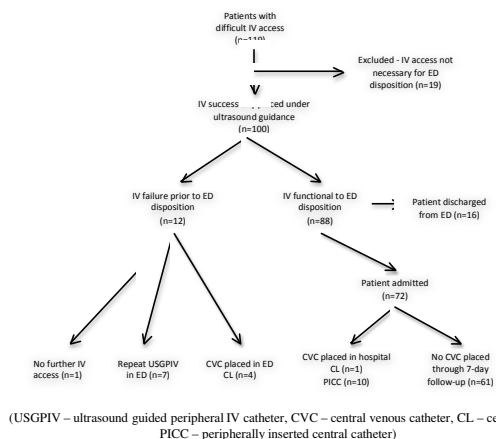
- Up to 40% of ED visits include diagnostic blood tests and 26% result in administration of IV fluids necessitating successful peripheral intravenous (IV) catheter placement.¹
- There is a subset of patients with difficult IV access (DIVA) in which traditional cannulation methods are unsuccessful resulting in central venous cannulation (CVC).
- CVCs have a 5-15 percent complication rate² and attributable costs per CVC related infection have been estimated at \$34,508-\$56,000.³
- Ultrasound-guided peripheral IV catheters (USGPiVs) provide a method of potentially decreasing the need for CVC placement, however due to poor durability of USGPiVs the actual reduction in CVCs is unclear.
- This study set out to quantify the reduction in CVCs in patients with DIVA by utilization of USGPiVs.

METHODS

- Study Design:** Prospective observational study of patients with difficult IV access.
- Setting:** Two urban Emergency Departments with annual censuses of 65,000 and 40,000. Enrollment occurred from November 2010 – June 2011.
- Population:** Convenience sample of patients with at least two failed peripheral IV attempts plus a failure to establish extrajugular access (failure, patient refusal, or inability to lay supine) determined to require CVC for IV access if ultrasound was not available were included. Patients were excluded if unable to give verbal consent, if CVC was determined to be required for patient stabilization or if the caring physician indicated that a CVC would not be necessary despite the failure to establish peripheral IV access.
- Protocol:** USGPiVs were placed by ED physicians at all levels of training. All USGPiVs were 20GA 48mm long catheters placed using a Sonosite Micromaxx or M-Turbo (Sonosite Inc., Bothell, WA) high-frequency linear array transducer. Patients were followed for 7 days or until hospital discharge to assess for subsequent central venous access and related complications.

References:
1. Niska R, Bhatiya F, Xu J. National Hospital Ambulatory Medical Care Survey: 2007 Emergency Department Summary. National Health Statistics Reports. 2010;26:1-31.
2. McGee DC, Gould MK. Preventing Complications of Central Venous Catheterization. N Engl J Med 2003; 348: 1123-33.
3. O'Grady NP et al. "Guidelines for the Prevention of Intravascular Catheter-Related Infections." The Centers for Disease Control, August 9, 2002. Vol 51(RR16):1-26.

Figure 1: USGPiV placement and outcomes



RESULTS

- 119 patients underwent USGPiV by 22 different physicians.
- 19 patients excluded from data analysis because the ED provider felt they would not have required CVC placement even if USGPiV placement had failed, yielding 100 patients for analysis.
- USGPiVs failed in 12 (12.0%, 95 CI: 7.0-19.8%) patients prior to ED disposition, resulting in 4 central venous catheters, 7 repeated USGPiVs and one patient requiring no further intervention.
- Overall a total of 15 (15.0%, 95 CI: 9.3-23.3%) patients underwent central venous access (5 central lines and 10 PICCs).
- Four (4.0%, 95 CI: 1.6-9.8%) patients had documented complications due to USGPiV (3 extravasation of fluids, 1 extravasation of IV contrast).
- One patient in the CVC group developed a catheter related infection resulting in a 6.7% (95 CI: 1.2-29.8%) complication rate.

Table 1: Characteristics of patients requiring USGPiV

N = 100	
Sex	
Male	44
Female	56
Race	
African American	62
Caucasian	32
History	
IV Drug Abuse	9
Hypertension	46
Diabetes	35
Dialysis	11
Prior Difficult IV Access	83
Obese	39
Chemotherapy	7

LIMITATIONS

- No randomization or blinding.
- Underpowered to assess the true complication rates of CVCs.
- Potential bias in determining necessity of central venous access.

CONCLUSIONS

- Ultrasound prevents the need for central venous access in approximately 85% of patients with difficult IV access.
- Assuming a standard CVC complication rate of 5-15% in the DIVA cohort, by avoiding CVC placement in 85% of this cohort, USGPiVs potentially reduce significant complications of CVCs in this cohort down to 0.75-2.3%.
- For every eight patients with DIVA that get an USGPiV instead of a CVC, at least one CVC complication is avoided