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Ultrasound Guided Peripheral IV Insertion

Evidence Based Medicine Guideline

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SUMMARY
The use of ultrasound guided peripheral intravenous access (IV) has several advantages. Ultrasound guidance increases successful cannulation to 85-97%. Use of ultrasound guided peripheral access also decreases the use of central lines and peripherally inserted central catheter (PICC) lines. Peripheral IVs of any length (midline or standard) have fewer infectious complications that other forms of IV access. Training to gain proficiency in ultrasound guided IV insertion is highly effective requiring as little as 30 minutes to four hours. Establishing an ultrasound guided IV placement program reduces central line days, avoids many central line placements, and decrease central-line associated bloodstream infections (CLABSI).

RECOMMENDATIONS

- **Level 1**
  - **None**
- **Level 2**
  - **Use of ultrasound increases successful cannulations in difficult IV access patients.**
  - **Peripheral IV catheters, midline or standard length, have fewer infectious complications than central lines and PICC lines.**
  - **Use of ultrasound guided peripheral IVs decreases central line days, central line usage, and CLABSIs.**
  - **Procedural competency at ultrasound guided peripheral IV insertion can be attained with only brief training sessions.**
- **Level 3**
  - **There is no cost benefit to ultrasound guided peripheral IVs**

INTRODUCTION

The use of bedside ultrasound as an adjunct to critical care evaluation, resuscitation and procedural guidance has become a standard of care in the treatment of the critically ill. Although many advances have been made in the prevention of CLABSI, it remains a serious contributor to morbidity. In the modern ICU, one goal of care should be to remove central venous access as soon as no clinical indication exists. Obtaining traditional peripheral IV access in critically ill patients can be challenging. Oft cited reasons for this include edema, obesity, and poor vasculature. The use of ultrasound to guide peripheral IV access is a safe and effective way to remove central lines sooner, avoid some central line placements, and potentially decrease CLABSIs. The aim of this guideline is not to discourage the use of central lines, but to avoid their use when no indication exists, decrease their dwell times, decrease the potential for CLABSIs, and decrease the potential for other complications associated with their placement.

LEVEL OF RECOMMENDATION DEFINITIONS

- **Level 1:** Convincingly justifiable based on available scientific information alone. Usually based on Class I data or strong Class II evidence if randomized testing is inappropriate. Conversely, low quality or contradictory Class I data may be insufficient to support a Level I recommendation.
- **Level 2:** Reasonably justifiable based on available scientific evidence and strongly supported by expert opinion. Usually supported by Class II data or a preponderance of Class III evidence.
- **Level 3:** Supported by available data, but scientific evidence is lacking. Generally supported by Class III data. Useful for educational purposes and in guiding future clinical research.

LITERATURE REVIEW

Peripheral IV catheters are typically inserted into superficial or deep veins of the upper extremities. Ultrasound guidance proves to be extremely helpful with IV insertion when a patient is obese, edematous, has a history of IV drug abuse, history of multiple IV catheter insertions, or is hypovolemic. Several studies have been conducted on the success of cannulation using ultrasound guided techniques. Keyes et al. conducted a prospective study as far back as 1999 of 101 patients that were deemed difficult IV access (1). The success rate of cannulation of the brachial and basilic veins using ultrasound guidance was 91%. Further prospective studies in 2004 and 2005 by Brannam et al. and Constantino et al., respectively, confirmed this assertion (2,3). Brannam found that emergency room nurses with 45 minutes of training had an 87% success rate in cannulation of peripheral veins with ultrasound guidance. Constantino found a 97% success rate for cannulation using ultrasound guidance. Gregg et al. conducted a retrospective single institution review of 148 ICU patients in whom ultrasound guided peripheral IV placement was attempted; 147 were successful (4). Stolz et al. performed a meta-analysis of 7 studies that showed ultrasound guidance significantly increased the rate of cannulation compared to traditional landmark techniques (5).

Other evidence exists that suggests placement of ultrasound guided midline catheters or standard-length peripheral IVs can avoid central line placement all together. Shokoohi et al. conducted a time series analysis of central venous catheter use in the emergency department (ED) of a single institution from 2006 to 2011 (6). During this time period, ED residents and ED technicians received training to attain competency in placing ultrasound guided peripheral IVs. This study included greater than 400,000 patients. Reduction in the rate of central venous catheters was observed on the order of 80%. Gregg et al. found that their placement of 147 ultrasound guided IVs allowed removal of 40 central lines and avoided placement in 34 (4).

The data comparing infectious complications between central lines and peripheral lines placed under ultrasound guidance is not robust. However, there is some evidence to suggest that implementing an in-hospital program for ultrasound peripheral IV placement can reduce CLASI rates. Pathak et al. described a retrospective community hospital study from 2012-2017 (7). They tracked central line days and CLABSIs during this time period. They found that after instituting an ultrasound guided midline placement program, the CLABSI rate and the number of central line days fell dramatically. Another retrospective review done in 2018 compared catheter related infections between central lines and midline catheters (8). In this 411-patient sample, it was found that midline catheters had an infection rate of 0.2% vs. the central line rate of 3.5%. Finally, a retrospective study in 2016 compared infectious complications between standard length peripheral IVs, midlines, central lines and PICC devices (9). This study showed that midline catheters and standard-length peripheral IVs have the same infectious complication rates. These rates were markedly less than both central lines and PICC lines.

The skills to perform these ultrasound guided techniques can be learned in a brief period of time. Studies have cited 30 minutes to 4 hours of training as needed to gain proficiency. These can range from didactic sessions alone to didactics with pre-training and post-training tests, and simulations using medical mannequins. A study from University of Florida in Jacksonville describes a 26-minute online video, post training test and skills lab requiring 5 successful cannulations (10). In a retrospective review including 830 patients, ED technicians who participated in this program had a 97% cannulation rate. 86% were on the first attempt which is comparable to other studies of physicians and nurses (87-97%).

Ultrasound guided peripheral IV insertion clearly has a benefit in success of cannulation in difficult IV access patients, reducing the number of central line days, and even avoiding use of central venous catheters. Infectious complications of midline catheters and standard-length peripheral IVs are very low compared to central IV access. Instituting a program to place ultrasound guided peripheral IVs reduces central line days and their overall use. A cost-benefit analysis to establishing such a program remains lacking however.

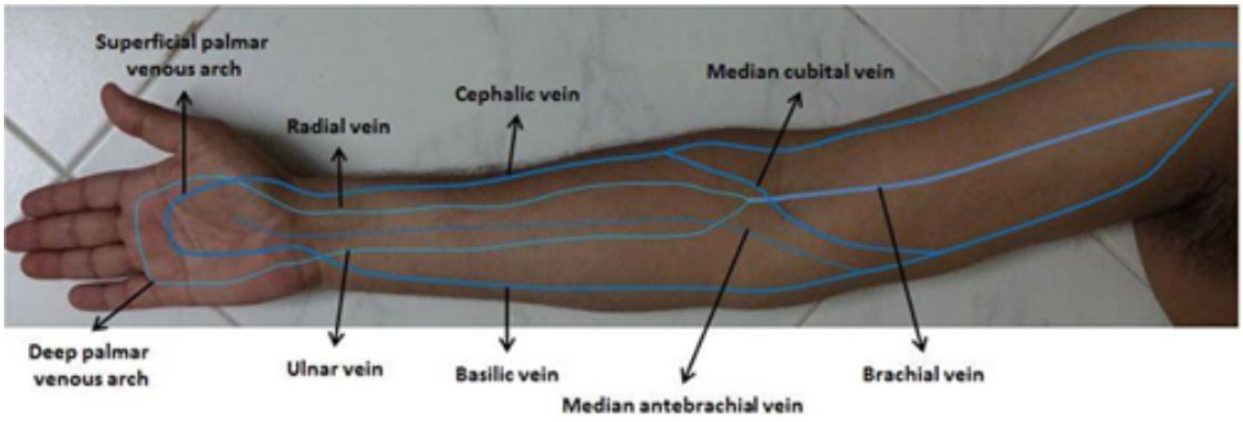

Figure 1: The venous vasculature of the upper extremity. Standard length peripheral IVs are generally placed below the cubital fossa. Midline peripheral IVs are best suited for veins above the cubital fossa. The preferred placement of midline catheters is with the tip close to the axillary vein.

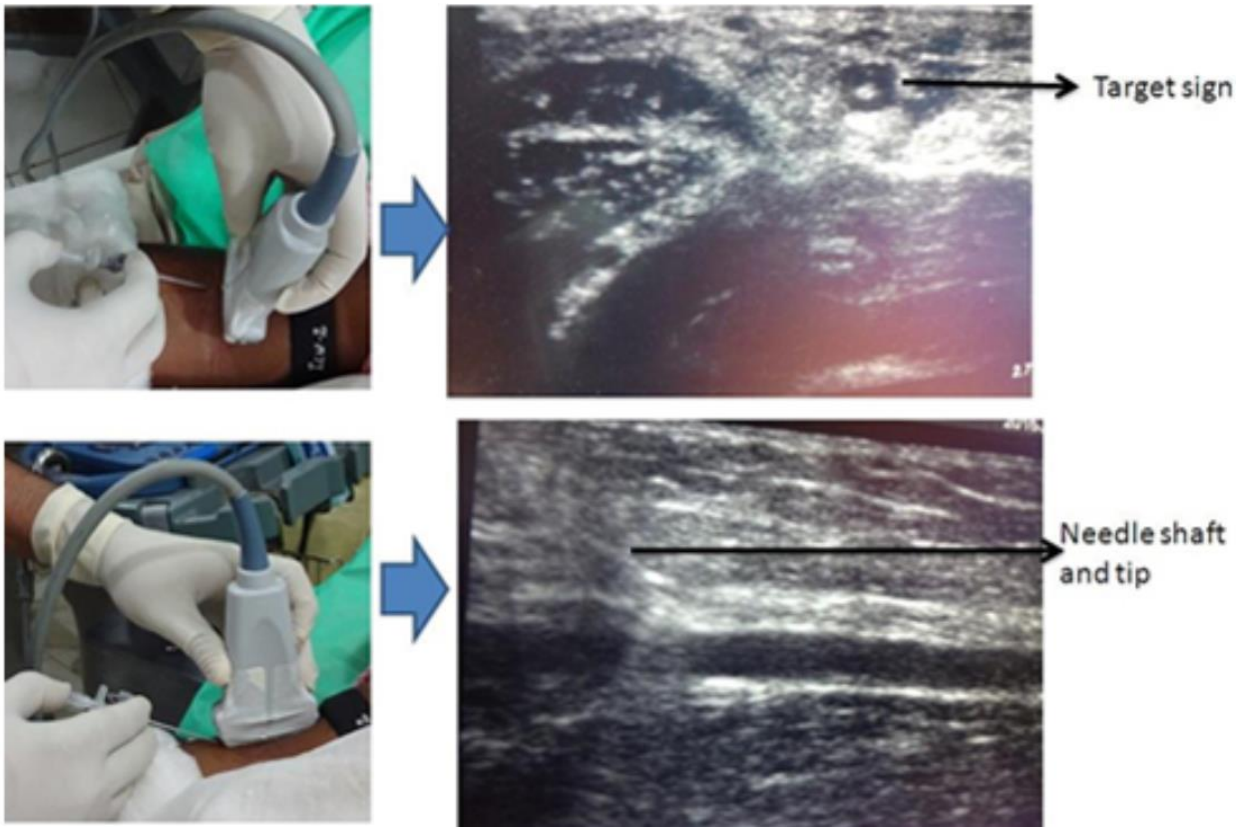

Figure 2: The top is a depiction of an ultrasound guided peripheral IV placement in the axial plane. The “target sign” refers to visualization of the needle tip within the target vein in the axial plane. The bottom figure shows the same ultrasound guided technique using the linear plane along the course of the target vein. The advantage of this method is the ability to see the needle tip and shaft, as well as a longer segment of the target vein.

An excellent YouTube video on the use of ultrasound for peripheral IV placement can be found here:

https://youtu.be/6jMo4c_WShs

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