Ultrasonographically Guided Peripheral Intravenous Access: The Answer for Pediatric Patients With Difficult Access

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Intravenous catheter placement can be a lifesaving procedure. Frequent failed attempts at access result in delays in care, as well as repeated painful stimuli, which can be particularly traumatic for children. Point-of-care ultrasonography has become a standard tool in the armamentarium of emergency providers, particularly in the realm of guidance during invasive procedures. For example, the benefits of ultrasonography in central venous catheter placement have been well studied.[1,2] More recently, ultrasonographic guidance for peripheral intravenous line placement has gained traction.[3] In fact, successful peripheral venous placement using ultrasonographic guidance in patients with "difficult" intravenous access has led to a reduction in the need for central venous catheter placement.[4,5] This is of course beneficial for patients, as well as for clinicians, who must take the time during a busy emergency department (ED) shift to perform the procedure. Intraosseous line placement is painful, nonsustainable, and typically reserved for minimally conscious or the sickest patients. Consequently, peripheral intravenous access is the mainstay of vascular access. With the majority of the literature in regard to ultrasonographic guidance for peripheral intravenous lines dedicated to adults, there has been a clear need for a well-designed study in children.

The study by Vinograd et al[6] has helped to close this evidence gap. Despite having to stop the study early because ultrasonographic guidance for peripheral intravenous line placement became the standard of care at the study institution, first-attempt success using ultrasonographic guidance was nearly twice as likely compared with traditional "blind" placement (relative risk 1.8). The lower bound of the 95% confidence interval (1.4) is still a clinically meaningful effect size, supporting the likelihood that the benefit of ultrasonography for first-attempt success is real. In addition, there were fewer attempts overall and the process for ultrasonographic guidance for peripheral intravenous line placement was more efficient insofar as half as much time was needed for such placement compared with traditional intravenous placement (14 versus 28 minutes). A particularly interesting finding was the effect on intravenous line longevity. Others have reported that ultrasonographically-guided peripheral intravenous lines may have a relatively short life span and therefore be suitable only for short-term access.[7,8] Using a Kaplan-Meier survival curve, the authors nicely show the reverse to be true. In fact, intravenous lines placed under ultrasonographic guidance had a longer "survival time" compared with those placed with traditional methods. Other important outcomes of this study include improved patient satisfaction with ultrasonographic guidance for peripheral intravenous line placement and no increase in complications compared with traditional intravenous line placement.

This study was conducted in a tertiary care pediatric ED, where nurses, who were part of the study team, are generally likely to be more successful with vascular access in small children compared with those nurses who primarily care for adults. Therefore, the results of this study are likely to be even more robust, with an even greater benefit of ultrasonographic guidance for peripheral intravenous line placement in pediatric patients treated in general EDs.

Perhaps what is not evident from this study is the practice and skill that are required to become proficient with ultrasonographic guidance for peripheral intravenous line placement. Study operators all performed a minimum of 10 successful supervised ultrasonographically guided peripheral intravenous line placements before enrollment. Although the number of operators in each training-level group was small, the authors found that the 3 attending

physicians demonstrated a 100% first-attempt success rate, and the 10 fellows and 3 nurses demonstrated 74% and 91% first-attempt rates, respectively. A previous study by the same study team demonstrated a much lower first-attempt success rate of only 68%, which is more consistent with studies of adult patients.[9] It is likely that during the 2.5-year study period, operators became more proficient with ultrasonographic guidance for peripheral intravenous line placement; however, these data are not presented. The rate at which one masters this procedure is likely related to previous experience not only with ultrasonography but also with traditional intravenous placement (and given the required hand-eye coordination…perhaps early exposure to video games!).

Children with difficult access are a particularly vulnerable population, with many having to undergo frequent intravenous line placements. It is critical that institutions implement a pathway for developing ultrasonographic competence for individuals who place intravenous lines. The study's inclusion of nurses as part of the study team lends credence to having nonphysicians use ultrasonography for peripheral intravenous line placement. Such has been shown also for medical technicians, who are often responsible for intravenous line placement.[10,11] With the introduction of point-of-care ultrasonography into medical school curricula, physicians will be (and are) learning to place intravenous lines even earlier in their training. Such a skill may be a competency skill/milestone successfully achieved by all graduating medical students in the near future.

It is clear that ultrasonographic guidance for peripheral intravenous line placement improves both patient-centered outcomes and ED process measures. An objective scoring system for difficult intravenous access[12] or other assessment tool can be used for early identification of children who would benefit from ultrasonographically guided intravenous line placement. It should no longer be acceptable for pediatric patients, particularly those with known difficult access, to receive repeated unsuccessful "blind" intravenous line insertion attempts, and ultrasonographic guidance for peripheral intravenous line placement should be considered the standard of care for this population.

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