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Development of a nurse-led ultrasound-guided peripheral intravenous program

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Establishing reliable peripheral intravenous access is one of the most common procedures performed daily by nurses across clinical settings in the hospital. The insertion of peripheral intravenous access devices is usually guided by palpation, direct visualization, landmark technique, or by trial and error. The invasive nature of the procedure accompanied by the associated risks requires successful cannulation on the initial attempt. In an effort to decrease the number of peripheral venous access attempts in patients with difficult venous access, a course was developed to educate a cohort of registered nurses on the basic principles and use of ultrasound. After successful completion of the course, each registered nurse was required to perform a minimum of 10 proctored successful ultrasound venous peripheral intravenous catheter insertions. The first attempt success rate for the proctored ultrasound venous peripheral intravenous catheter attempts was 83%, which was higher than that reported in the literature (20%–50%). Overall, the program effectively demonstrated a decrease in the number of attempts required to insert a peripheral venous catheter in patients with difficult venous access.
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Establishing reliable peripheral intravenous access (PIVA) is one of the most common procedures performed daily by nurses across clinical settings in the hospital. PIVA is essential for obtaining blood samples and for providing an intravenous (IV) route to administer fluids or medications. The insertion of PIVA devices is usually guided by palpation, direct visualization, landmark technique, or by trial and error. The invasive nature of the procedure accompanied by the associated risks requires successful cannulation on the initial attempt. Traditionally, patients with difficult venous access (DVA) are subjected to multiple failed PIVA attempts or central venous cannulation.[1–4]

DVA is most often defined as at least 2 failed attempts to gain PIVA using traditional methods or alternative interventions may be required to establish and maintain PIVA.[1,3–8] Predictive factors for DVA include obesity, edema, hypovolemia, and a history of IV drug abuse.[9] Other factors associated with DVA are chronic illness, end-stage renal disease, and vasculopathy. Even though patients with DVA require timely peripheral venous access, their condition may not necessitate invasive methods of venous cannulation (central venous catheters [CVCs]), increasing their susceptibility to infection and various other complications. Recent studies support the use of ultrasound (US) at the bedside to assist with peripheral IV placement in patients with DVA with whom traditional techniques have failed.[2,3,10] US-guided peripheral venous access (USGPVA) has been shown to be superior in achieving successful peripheral IV cannulation versus traditional (landmark technique and palpation) approaches.[1,10]

USGPVA is a skill not usually taught to nurses, thus an educational course that included follow-up training was identified as a need. A review of literature was conducted to identify guidelines and standards for US-guided peripheral vascular education courses.

LITERATURE REVIEW

PubMed and CINAHL databases were searched from the year 1999 to 2019 using the search terms “difficult venous access patients”, “US-guided peripheral IV insertion”, “peripheral IV insertion”, “peripheral IV access”, “difficult venous access”, “US-guided peripheral vascular courses”, and “difficult vascular access patient”. The search was limited to the English language. Pediatric patients were omitted from the search. A total of 29 articles were retrieved, and this number was reduced to twenty after reviewing the abstracts.

The concept of USGPVA was clearly defined and well understood in each of the studies identified. A theme of interchangeable US terms emerged: ultrasonography, US, ultrasound-guided peripheral intravenous (USGPIV) catheter placement, ultrasound-guided venous access (USGPVA), US scanning techniques, first attempt success rates, and IV catheter types and lengths. The terms describing the population were consistent: difficult venous access, difficult to access, obesity, multiple failed peripheral intravenous (PIV) attempts, hypovolemia, end stage renal disease, edema, vessel damage, IV drug abuse, and vasculopathy. Primarily the experts of the studies were physician

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residents, physicians, or registered nurses (RNs) who were trained during their residencies or attended USGPVA courses developed by their institution.[1–3,6,9–14] In addition, emergency department technicians were described in the studies as having the aptitude to perform this skill under the supervision of a physician until the required proctored attempts for proficiency are completed.[4,15]

Although no exact guidelines were identified to develop an US-guided peripheral access program, the literature does suggest that a USGPVA program minimizes the need for CVCs and complications associated with such devices. RNs and emergency department technicians can be proficiently trained to use USGPVA in patients with DVA without any prior US experience. The training courses identified in the literature typically consisted of 120 minutes of class instruction and hands-on time with US machines using inanimate models. To be proficient in US-guided PIV catheter insertions, a practitioner must perform at least 5 to 10 proctored attempts.[1,4,12,13,15–17] After reviewing this information, an educational intervention was developed with the overarching goal of decreasing the number of cannulation attempts required to obtain venous access in patients with DVA through the use of US.

EDUCATION PROGRAM

Participation in the educational program was voluntary. Approval was obtained from the appropriate institutional review boards before the initiation of the study. Subjects were informed of the nature of the education study, their role in terms of time and effort, procedures in place to protect anonymity (with an understanding that anonymity cannot be guaranteed), and any risks or benefits as the option to terminate participation at any time. A signed informed consent was obtained from all subjects after reasonable time to decide had elapsed.

Nurses attended a two-hour USGPVA course provided by a nurse anesthetist who was trained and had over 15 years of experience working with US-guided peripheral access insertions. Didactic instruction included a 60-minute lecture, which covered anatomy, physiology, and US insertion techniques. During the course of instruction, each participant completed a pretest and a posttest to evaluate effectiveness of knowledge acquired about USGPVA. After completion of the didactic portion, each participant engaged in 1 hour of hands-on training using the Blue Phantom 4 vessel US training block model (www.bluephantom.com) rather than live human subjects. Each nurse was then required to complete a total of 10 proctored attempts to ensure competence.

The proctored IV insertions occurred in the ambulatory care surgical unit. Before each attempt, the RN and the instructor rated venous access difficulty using the scale proposed by Sebbane et al.[18] The scale uses the descriptors of easy (Many veins are visible), moderate (Few veins are visible or palpable), and difficult (Veins were neither visible nor palpable); favorable or unfavorable clinical assessments combined with obesity and underweight are independent risk factors for difficult PIV access[18] (see Table 1 Difficult IV Assessment Form).

RESULTS

Five nurses completed the didactic and hands-on portion of the training class. Each of the 5 RN participants took the training

TABLE 1

DIFFICULT VENOUS ACCESS PREDICTION FORM

RN Name _____

Evaluation	***Registered Nurse (Participant)***			***Instructor***		
Scale	Easy	Moderate	Difficult	Easy	Moderate	Difficult
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Easy = Many veins are visible; Moderate = Few veins are visible or palpable; Difficult = Veins were neither visible nor palpable. **(Adapted from Sebbane et al.[18]).**

and obtained a passing posttest score of ≥80%. However, only 2 nurses completed the proctored portion of the training (60% attrition rate). One nurse withdrew for personal reasons; another nurse chose to withdraw after speaking with her supervisor and decided the additional commitment to complete the proctored insertions required too much time; and the third nurse completed 3 proctored attempts but never returned to finish the requirements. The first attempt success rate of the proctored attempts was 83%. The ages of the sample ranged from 18 to 76, with varying comorbidities (diabetes mellitus, hypertension, IV drug abuse, and prior history of DVA) increasing their possibility of difficult venous access. The USGPVA program demonstrated successful first-attempt PIV cannulation without documented complications.

The secondary outcome measured was interrater reliability (IRR) of identifying patients with DVA. IRR establishes the degree of consistencies among raters. The project identified ≥80% as acceptable agreement among raters. The IRR for evaluating the difficulty of inserting a PIV was sufficient at 86% agreement among participants.

Traditionally, the DVA population would require CVCs when PIV attempts have failed. Central line–associated blood stream infections (CLABSIs) are one of the most common health-care–associated infections and the most lethal ones.[19] Compared with the per patient cost of just a single CLABSI ($25,849) implementation, USGPVA program is a cost-effective approach to reduce CVCs and reducing health-care–associated infections.[15,19,20]

LIMITATIONS

The population does not directly mimic the populations described in the literature. Although the Native American population does have a higher incidence of hypertension, diabetes, obesity, and drug abuse, not every patient who presented for surgery had those comorbidities. As a result, the generalizability of the results of this educational project cannot necessarily correlate to other populations. However, this project provides further evidence that nurses can effectively use US for PIVs with minimal training, thereby decreasing the number of attempted PIV insertions.

CONCLUSION

Point-of-care US to insert PIVs in patients with DVA is becoming commonplace in the health-care arena. For minimal cost, compared with one single CLABSI, a nurse-led USGPVA can be established. RNs can be effectively educated in a short period of time to perform USGPVA.[12,13,21] Although, first-attempt success rates vary, and through the literature, a common theme emerges: first-attempt PIV success rates are enhanced by using US and increase as the nurse gains experience, thus reducing hospitalized acquired infections by avoiding the need for CVCs.[12,13,15]

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