

Efficacy of Veinlite PEDI in Pediatric Peripheral Intravenous Access A Randomized Controlled Trial

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Objectives: A previous study by Katsogridakis et al (*Pediatr Emerg Care*. 2008;24:83–88) evaluated the use of the white light Veinlite transillumination device to improve vein access in children. Since then, advanced light emitting diode color lighting has been developed to improve the visualization of veins. To evaluate the efficacy of the new technology, we carried out a study in our pediatric emergency departments using the light emitting diode-based Veinlite PEDI (TransLite, Sugar Land, Tex).

Methods: A total of 112 pediatric patients were enrolled in the study. Children who presented to the emergency department aged 1 to 10 years old were randomly assigned to the Veinlite PEDI (Veinlite) group or standard of care (SoC) group. The primary outcome measure was first attempt success. Secondary outcome measures were number of intravenous (IV) attempts and time to peripheral intravenous catheter (PIC) placement.

Results: A total of 110 patients completed the study: 58 boys and 52 girls. The first attempt success rate was significantly higher in the Veinlite group compared with the SoC group (92.9% vs 72.2%, $P < 0.004$). In addition, the Veinlite group had a fewer number of attempts compared with the SoC group (1.07 ± 0.54 vs 1.31 ± 0.25 , $P = 0.04$). The Veinlite group resulted in a shorter total time of attempts per patient compared with the SoC group (49.98 ± 18.4 vs 59.68 ± 22.5 , $P = 0.01$).

Conclusions: The use of new technology in the Veinlite PEDI (TransLite, Sugar Land, Tex), to assist with peripheral IV access in children, improves the first time success rate for IV access. Improved visualization of veins also reduced the number of attempts and the time required for PIC placement. These results suggest that the new technology of the Veinlite results in better PIC access than Veinlite transilluminaton device with white light.

Key Words: peripheral intravenous cannulation, transillumination, Veinlite PEDI, Veinlite

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Although peripheral intravenous catheter (PIC) intervention is frequently used in pediatric emergency departments, it is still regarded as a difficult task by health professionals.¹ Pediatric patients are the most challenging patients for performing PIC interventions.^{2–4} They have smaller blood vessels that are often surrounded by subcutaneous tissue and difficult to see superficially. In addition, communicating with children during the PIC procedure is difficult owing to their young age.⁴

Previous randomized studies done with PIC in children have reported first time success rates ranging from 44% to 53%^{5,6} and require second or third attempts for successful PIC insertion. Delays in PIC interventions often lead to delayed care, increased

pain and anxiety for the child, and changes in parents' views about care, as well as lead to increased workload.^{7,8}

Several devices, ranging from transilluminators to near infrared imaging and ultrasound, have been used to assist with PIC in children and adults. Studies have shown that the use of ultrasound in peripheral catheter insertions improves the success rate of IV interventions.^{3,9–11} Near infrared devices use infrared light to penetrate the skin, and the device projects an image of the vein on the skin. Cuper et al^{2,12,13} have presented the results of a cluster studies and showed no significant improvement in the success rate for access except in neonates.

Transilluminators were first used in a study of Kuhns et al⁹ who conducted with infants and obese children.¹⁴ These devices shine light through the hand to make the hand translucent. Veins in the hand show up as darker lines. Transilluminators were used only for newborns for several years but have been used in all age groups in recent years.^{15,16}

The use of side-transillumination was first introduced in 1999 by TransLite as the Veinlite product. Katsogridakis et al¹⁰ conducted a randomized clinical trial in 2008 using the white light fiber optic Veinlite in their pediatric emergency department. Their results showed that the use of Veinlite improved IV access in children from 74% for standard of care (SoC) to 85% for Veinlite in 2 attempts.

Our study was conducted to investigate the use of Veinlite PEDI (TransLite, Sugar Land, Tex) to assist with PIC placement. The Veinlite PEDI uses new LED technology to enhance the visualization of veins by using orange and red color that are absorbed in venous blood. We carried out a study similar to the previous study by Katsogridakis et al¹⁰ to measure the first stick success rate for peripheral venous access in children. Our hypothesis for this study was that new LED technology would result in a better success rate than the SoC.

METHODS

Study Design, Setting, and Population

We conducted a prospective randomized controlled clinical study of children treated in a pediatric ED who required PIC. The goal of the research project was to evaluate whether the new Veinlite with selected red and orange LED colors would improve PIC placement in children and compare the results with the conventional method.

The research protocol for the study was approved by the hospital institutional review board. Children aged 1 to 10 years were eligible for the study. Informed consent was obtained from their parent or guardian. The study was carried out at the pediatric emergency department between November 2015 and February 2016. Criteria for inclusion in research were that the child's situation is not critical or that cardiopulmonary resuscitation is not needed, that the parents can speak Turkish, and they volunteer to participate in the research.

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FIGURE 1. Veinlite PEDI Transilluminator Vein Finder (<http://www.veinlite.com>).

Sample Selection and Study Protocol

Patients were randomized to receive either PIC placement using the standard technique (SoC) or to receive PIC with the aid of the Veinlite PEDI (Veinlite) (Fig. 1). Subjects in both the Veinlite and SoC groups were to be stratified into 3 age groups: 1 to 3, 4 to 6, and 7 to 10. The sample size was calculated using the G*Power (v3.0.10) software for power analysis. The number of patients needed in each group was based on the ability to detect a 30% difference in the time to success with an α error of 0.05 and 90% power. This number was calculated as 51. Accounting for breaks in protocol, we decided on a sample size of 56. Each subject was only entered once into the study. The research data were collected by a researcher and a volunteer nurse who worked for at least 1 year in the emergency care unit where the study was conducted. The nurse who was involved in the collection of data was trained by a trained vein imaging device consultant.

Before starting PIC, the Veinlite device was inserted in a new plastic disposable cover designed to protect the device and reduce interpatient contamination (Fig. 2). Patients assigned to SoC were prepped, and PIC was inserted. The Veinlite was turned on and pressed gently on the skin for the Veinlite patients. Superficial veins were visualized as darker colored lines. The nurse then applied PIC into the vein. A tourniquet was placed on the arm of the patient. The research assistant recorded time to successful PIC placement.

Data Collection

Before starting the PIC, the patient was prepped according to the PIC guidelines set by the hospital. The patient is checked for baseline vital signs, diagnosis, and allergies to medications, cleansing fluids, and dressings. The patient and her/his family are provided a clear explanation of the procedure including potential

adverse and side effects. The patient's dominant/nondominant side is evaluated, and the veins are checked for status and suitability. The equipment is prepared. The patient is positioned, and PIC is performed.

The recorded time for cannulation was after the tourniquet placement and was stopped when successful PIC was achieved and blood was drawn or saline was flushed. First attempt success was recorded. When multiple attempts were required, total cannulation time was recorded as the sum of individual PIC attempts. The research assistant collected data on patient demographics, and the number of attempts were recorded. Complications (hemorrhage-hematoma) that may develop during the procedure were observed and recorded in both groups.

Data Analysis

The data of the present study were analyzed in the SPSS 22.0 (SPSS, Inc, Chicago, Ill). In the analysis of the data, sociodemographic information about children was given in numbers and percentages. To evaluate the success rate of the first PIC intervention by the methods used in children, the χ^2 was used. The Student *t* test was used for the assessment of the mean number of the interventions and the mean length of the procedure. For the statistical significance, *P* value of <0.05 was considered as significant.

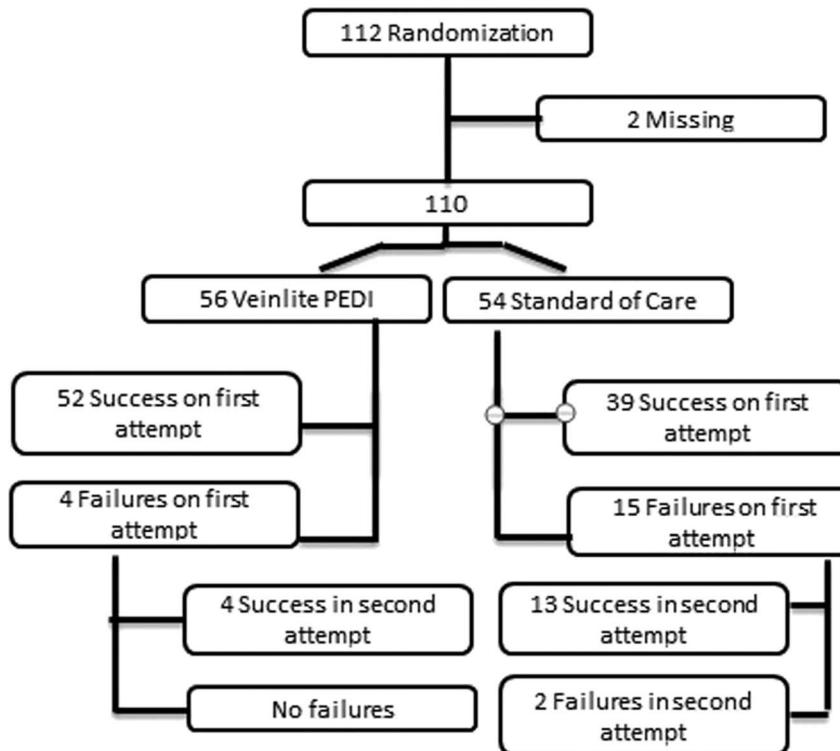
RESULTS

One hundred twelve patients were entered into the study and randomly assigned to the SoC group or the Veinlite group. Two patients in the control group were excluded from the study because of missing data. There were 56 patients in Veinlite group and 54 patients in the SoC group (Fig. 3).

The demographic data for the 110 patients are summarized in Table 1. There were no differences between the 2 groups in terms



FIGURE 2. Disposable bag fitted over the device.

**FIGURE 3.** Flowchart.

of basic demographic data including age, chronic medical condition, and the location of the initial attempt.

The primary outcome measure was the first attempt success rate, and the rate was significantly higher in the Veinlite group compared with the SoC group (92.9% vs 72.2%, $P < 0.004$). There were also significantly fewer number of attempts in the Veinlite group compared with the SoC group (1.07 ± 0.54 vs 1.31 ± 0.25 vs $P < 0.04$) and a significantly shorter successful PIC insertion time per patient in the Veinlite group compared with the SoC group (49.98 ± 18.4 seconds vs 59.68 ± 22.5 seconds $P < 0.01$) (Table 2). In the Veinlite group, 4 patients required second attempts whereas 13 patients required second attempts in the SoC group. Two complications (hematomas) were recorded in the SoC group, whereas no complications occurred in the Veinlite group.

DISCUSSION

This study was performed with the Veinlite PEDI vein imaging device to measure the success rate of peripheral intravenous catheterization in children. Success was determined based on the number of PIC attempts, the duration of the insertion time, and the first attempt success rate. Comparing the Veinlite and SoC groups for efficacy of the procedure, it was observed that fewer attempts were needed in the Veinlite group compared with the SoC group and that the procedural time was similarly shorter in the Veinlite group. The Veinlite group had a significantly higher first attempt success rate (Table 2). The results of the study show that the use of Veinlite during the PIC procedure significantly improves success rates in children.

TABLE 1. Demographic Characteristics of the Patients With and Without Use of Veinlite Pedi

	Veinlite	Standart of Care	P
Mean (SD)			
Age, y	4.60 ± 2.74	4.35 ± 2.53	0.614
Frequency (%)			
Age group, y			
Ages 1–3	20 (35.7)	22 (40.7)	0.467
Ages 4–6	22 (39.3)	21 (38.9)	0.387
Ages 7–10	14 (25)	11 (20.4)	0.356
Chronic medical condition	7 (12.5)	10 (18)	0.383
Dorsum of hand	34 (60)	29 (53)	0.635
24 Gauge	45 (86)	48 (88)	0.216

Means were compared using t test, and frequencies were compared using χ^2 test.

TABLE 2. Comparison Between the Patients With and Without Use of Veinlite Pedi

Items	Veinlite Group	Standard Care Group	P
First attempt success	92.9 (52/56)	72.2 (39/54)	0.004*
Time to successful cannulation	49.98 ± 18.4	59.68 ± 22.5	0.01*
Number of attempt	1.07 ± 0.54	1.31 ± 0.25	0.04*

Means were compared using *t* test, and frequencies were compared using χ^2 test.

Accessing veins in children is difficult because of the smaller size of the veins, adipose tissue obstructing the viewing of the vein, and pigmentation of the skin. To assist in identifying the difficult patients, a difficult IV access (DIVA) score^{5,7} has been developed to identify the children who may pose difficulty in IV access. Pediatric emergency departments usually have to deal with high DIVA scores, which make IV access a challenge. Although we did not use the DIVA score in our study, our patient population usually has patients who pose a challenge for IV access and would be classified with high DIVA scores.

Our study is similar to the previous study done by Katsogridakis et al¹⁰ in that both studies were done in the pediatric emergency department. Both studies included children with difficult IV access. However, there are several differences in the 2 studies to warrant some discussion. First, the patient population in the Katsogridakis et al¹⁰ study was ages 1 to 18 years compared with 1 to 10 years in ours. Their patients had a history of difficult IV access compared with ours, which may account for a lower first stick success rate for the SoC group (56% vs 72%). Second, they used several different nurses with different skill levels to perform IV access, whereas we used only 1 nurse to minimize the variation in skill levels. Third, their study was published in 2008 and used an older Veinlite model with white light. Since then, the technology used in the Veinlite PEDI, with orange and red colored LEDs, is very much improved for visualization of veins. This, combined with better procedures for using the portable Veinlite PEDI during IV access, could be contributing factors to a higher first stick success rate in our study compared with theirs (93% vs 59%).

In the present study, the duration of the PIC procedure was significantly shorter in the Veinlite group compared with the SoC group (49.98 ± 18.4 vs 59.68 ± 22.5 seconds). This may be due to the fact that the side-transillumination technique used in the Veinlite device makes it easy to find and access the vein anywhere on the body. The ability to insert the needle in the vein, while viewing and anchoring the vein, makes successful needle insertion easier.

Our results also differ from other transillumination studies carried out with older through-the-body transilluminators.^{9,13,14,17} Through-the-body transillumination is limited to parts of the body that are less than 3 cm in thickness owing to the absorption of light in tissue. Areas like the hand are often transilluminated to find the veins, but other areas like the forearm cannot be used. This limits the finding of the veins in children.

Several papers have been published on new vein finding devices^{2,12,18} that use near infrared light (NIR) to detect the vein and project the image of the vein on the skin. Cluster analysis of the several randomized clinical trials performed with the NIR devices shows very little improvement in IV success rate with NIR compared with SoC. This may be attributed to the fact that it is difficult to assess the depth of the vein from the picture on the skin, which is projected on top of the skin. Phipps et al¹² showed better vein access in neonates where the skin is more translucent and the vein is usually shallow.

Ultrasound devices are often used for PIC insertion in children with difficult IV access^{8,19–21} as well. They are excellent for installing PIC lines in patients who require repeated infusions or who have difficulty with IV access. Compared with transilluminator devices, ultrasound devices require a lot more training and cost much more to acquire and use.

The only limitation of our study was working with a single nurse. If a new patient arrived while the nurse was performing the procedure, she/he was not included in the study so we missed data. To conclude, Veinlite PEDI transilluminator devices significantly improved peripheral intravenous access in children. A larger study should be carried out to further validate our findings.

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