



Using a Near Infrared Device to Improve Successful Venous Access in Children with Special Health Care Needs

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Abstract

Background: Children with special health care needs (CSHCN) are predicted to be at particular risk for difficult peripheral venous access (PVA). Near infrared (NIR) technology is a noninvasive method that reveals vessels that are otherwise not visible to the eye. Our primary objective was to determine whether PVA success improved with NIR when compared with traditional visualization/palpation, specifically in CSHCN.

Methods: A retrospective analysis of all patients requiring PVA insertions by the vascular access team at a 350-bed tertiary children's hospital from July 2013 until June 2014 were included. Independent variables included age, gender, ethnicity, CSHCN status and modality used (NIR, ultrasound guidance, transillumination, or none). The primary outcome was subjective difficulty, PVA success, and number of attempts required. The effect of NIR and CSHCN was analyzed using χ^2 test.

Results: Data were gathered on 7896 PVA placements in children. Out of these, 6071 children were deemed to have special health care needs. CSHCN had subjectively difficult access 88% of the time compared with non-CSHCN at 74.7% ($P < 0.0001$). CSHCN status lowered intravenous access success rates from 91.4% to 87.5% ($P < 0.0001$). The use of NIR significantly increased intravenous access success rates when compared with visualization or palpation (26% vs 19.6%; $P < 0.0001$). Modality had a statistically significant effect on the number of attempts ($P < 0.0001$), but only a slight clinical significance (NIR, up to 1-4 attempts and ultrasound or transillumination combined, 1-6 attempts).

Conclusions: NIR decreases the number of attempts and improve overall success rates in acquiring PVA in CSHCN. Further studies on maximizing PVA success in this patient population are warranted.

Keywords: children with special health care needs, near infrared device, vascular access, vascular access devices

Introduction

Peripheral venous cannulation is the most common and widespread medical procedure performed on children in hospital settings. Difficult venous access is common

in children, and can result in multiple attempts and/or anticipation of special interventions required to establish and maintain peripheral venous access (PVA).¹ Delayed or failed PVA insertions can increase the risk of complications from delayed intravenous therapies. Repetitive PVA insertion attempts have been shown to inflict psychological trauma on the child and decrease family satisfaction.¹

Children with special health care needs (CSHCN) are predicted to be at particular risk for difficult PVA.² Their frequent evaluations require multiple PVAs across their lifetimes, with potential PVA failure. Specialized or enhanced medical and nursing services, (eg, physician subspecialists, hospitals specializing in the care of children, and enhanced preventive and primary services) are required in the care of CSHCN.³

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Table 1. Vascular access team (VAT) member profiles and modality preferences. Float nurses were pooled as the 10th VAT member. The 9 years of experience was the mean experience within the float pool. Twenty-four peripheral vascular access attempts had missing nurse data (N = 7896)

VAT member	Pediatric experience (y)	Adjuncts used			Total
		None recorded	AccuVein ^a near infrared	Transillumination	
1	25	867	124	0	1130
2	32	934	441	1	1425
3	10	535	90	0	707
4	8	591	6	0	621
5	25	584	413	19	1024
6	6	573	240	0	904
7	8	297	253	5	597
8	8	372	51	7	579
9	20	30	24	5	59
Pooled float	9	405	348	72	826
	Total	5188	1990	109	7872

^aAvant Medical, Cold Spring Harbor, NY.

According to the National Survey of CSHCN, approximately 14.6 million children in the United States have special health care needs.⁴ About 65% of CSHCN experience more complex service needs that go beyond a primary need for prescription medications to manage their health care needs.

Modalities to improve PVA success by vein visualization include transillumination, ultrasound, and near infrared (NIR) technology. The Infusion Nurses Society released the position paper “Recommendations on Improving Safety Practices with Short Peripheral Catheters,” which includes recommendations to “incorporate vein visualization as a routine strategy for patients with difficult or poor venous access.”⁵ Although NIR technology has not improved PVA success rates in preoperative children,^{6,7} its use specifically in medically ill CSHCN has not been studied.

Our primary objective was to determine whether PVA success improves with NIR technology use when compared with traditional visualization or palpation technique in CSHCN. Our secondary objective was to determine success rates in specific age groups, ethnicities, and particular groups of CSHCN.

Methods

Population and Setting

This retrospective study was conducted from July 2013 until June 2014 at an urban 350-bed tertiary, freestanding pediatric hospital with a specialized 9-member vascular access team (VAT). VAT members are registered nurses who received intensive training on PVA and other access insertion

techniques and were on call throughout the hospital for patient access for both emergent and nonemergent needs.

Inclusion criteria included all patients at the children’s hospital consulted by the VAT for PVA. Additional inclusion criteria included age 0-23 years. Exclusion criteria included central line insertions and non-PVA access performed by the VAT. Patients whose PVA insertion was performed by non-VAT personnel were also excluded. This excludes some, but not all, patients in infusion and hematology clinics (ie, invasive outpatient clinics), the emergency department, and the critical care units (pediatric, cardiothoracic, and neonatal) in which non-VAT nurses routinely provide PVA.

The research protocol for the study was approved by the institutional review board at our facility.

NIR

NIR is a vein visualization modality available to our VAT since October 2013 (AccuVein400; Avant Medical, Cold Spring Harbor, NY). The NIR device operates by using infrared light to detect veins beneath the skin, then projecting the position of the veins onto the skin surface directly above the vein. Veins are depicted as black lines on the skin because hemoglobin preferentially absorbs infrared light. Thus, the vasculature that is displayed represents the content of the vein and not its walls. Unlike other NIR devices, the AccuVein400 projects the vein image directly onto the skin instead of to a remote screen (VascuLuminator, de Konigh Medical System, Arnhem, the Netherlands).⁷

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