The AccuCath Intravenous Catheter System With Retractable Coiled Tip Guidewire and Conventional Peripheral Intravenous Catheters: A Prospective, Randomized, Controlled Comparison

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Abstract

Background: *Current peripheral intravenous catheter (PIV) first attempt success averages 47%, complications 47%, and dwell time 44 hours. Multiple intravenous (IV) access lines requiring replacement during each admission result in poor satisfaction and unnecessary costs. With 2011 Infusion Nursing Society standards allowing IV lines to dwell until complication, there is incentive to explore improvement opportunities.*

Purpose: *A new, proprietary coiled tip guidewire PIV was compared with conventional IV catheters in adult patients. The experimental IV catheter was projected to have a higher rate of successful placement on first attempt, fewer complications, longer dwell times, higher completion of therapy, higher user satisfaction, and lower overall costs than conventional catheters.*

Methods: *Adult patients requiring nonemergent IV catheters provided consent and were enrolled and randomized. The study, conducted over 4 months, included 248 patients (experimental IV group n = 123, conventional IV group n = 125).*

Results: *Experimental IV first attempt success was 89% compared with 47% for the conventional catheter. Fifty percent of conventional IV placements required a second attempt. Experimental IV complications occurred 8% of the time and complications occurred with the conventional catheter 52% of the time. Completion of therapy was 89% with the experimental IV versus 34% with the conventional IV (*$P < .001$*). Dwell time improved with the experimental IV (mean 4.4 days [105 hours] vs conventional IV at 1.5 days [35 hours]) (*$P < .001$*). Overall patient satisfaction using a 5-point Likert scale scored an average of 4.5 with the experimental IV compared with the conventional IV, which scored 3.*

Conclusions: *A new, proprietary coiled tip guidewire-delivered PIV demonstrated clear superiority over the conventional catheter in our study. Clinical outcome results showed statistically significant improvements in first attempt success, complications, completion of therapy, dwell time, and overall patient satisfaction.*

Keywords: *peripheral IV, guidewire, IV first attempt success, IV complications, IV dwell time, IV patient satisfaction, IV outcomes*

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Introduction

Up to 70% of patients in acute care hospitals require intravenous (IV) access via peripheral intravenous catheters (PIVs).[1] Depending on the clinical setting, obtaining access can be difficult for even highly qualified personnel.[2] Difficult access (due to patient age, obesity, vein size, tortuosity, and overall vascular status, for example)[2-4] is classically responsible for increased cannulation attempts, which in turn

delays initiation of patient management plans, increases adverse events, and reduces patient satisfaction.[2]

Current PIV placement procedures are viewed as suboptimal. Available data record first attempt success rate averages at only 40% in adult patients and between 44% and 46% in pediatric patients.[3,5-7] The overall complication rate is 47% (eg, infiltration, phlebitis, occlusion, and dislodgement) with average dwell duration of 44 hours.[8,9] Importantly, approximately 50% of PIV lines require replacement before completion of therapy, which leads to medication delays (suboptimal patient care) and high patient dissatisfaction rates.[3,4,10] In addition, complications from infusion and vascular access device failures have negative financial implications with respect to personnel and supply use rates.[11]

The Centers for Disease Control and Prevention propose PIVs may be left in place for longer periods of time than is the current practice of 96 hours.[12] Based on these data, the 2011 Infusion Nursing Society Standards of Practice eliminated the standardized change protocol based on time frame (96 hours) for short-term PIVs.[12] The recommended frequency for site rotation is now based on clinical indications (eg, pain on injection, erythema, infiltration, phlebitis, and unable to flush).[12] This protocol modification has in theory created an opportunity to improve a patient's PIV experience, reduce material waste, and reduce hospital costs.

A recent report suggested that if 15% of catheters required for more than 3 days were changed based on clinically indicated replacement criteria (as opposed to placement duration) it would prevent 6 million IV catheter insertions and save 2 million hours of staff time as well as $60 million in health costs each year in the United States.[1] A primary barrier to realizing these potential improvements is the current performance of conventional PIV catheters that average fewer than 2 days (44 hours) of functional placement time.[9] According to a US Health and Human Services Agency for Healthcare Research and Quality report,[13] the average length of hospital stay across all discharges is approximately 4 days. By extension, with these outcomes, even with clinically indicated replacement many PIVs will still require site change before hospital discharge.

Guidewires have been used successfully in central venous and arterial line placement for years; the same technology would in theory improve PIV performance. This postulate has been put forth by Vascular Pathways Inc (Naples, FL), which has designed an IV catheter system with a guidewire. Our study sought to determine if this catheter would lead to fewer insertion attempts during an average inpatient stay along with fewer interruptions in IV access. Outcome measures included placement success, number of catheters used per insertion, complication rates, dwell time, completion of therapy, patient and clinician satisfaction, and costs.

Methods

Study Design

Our randomized, prospective, Food and Drug Administration-approved clinical trial was approved by the institutional review board at University Hospitals Case Western University; the hospital is a quaternary medical center with 1,000 beds. The study enrolled adults admitted to an inpatient unit who required elective, nonemergent PIV access as determined by the attending physician. Patients were assessed for study eligibility and when inclusion criteria were met, patients were invited to participate (inclusion criteria: male or female, age $\geq$18 years or $\leq$89 years; capable and willing to give informed consent; English speaking; acceptable candidate for an elective, nonemergent PIV as determined by ordering physician; and admitted to study inpatient unit).

Inserter Characteristics, Selection, and Training

All registered nurses in our hospital are required to insert PIVs following initial training on a conventional IV device. For this trial, nurses from the surgical intensive care and surgical telemetry units were recruited solely based on their interest in participating in a research project. All but 1 were practicing nurses with less than 7 years' experience, with an average of 2-3 years' experience. None were IV team members.

The experimental catheter used in our study (AccuCath 20 and 22 gauge; Vascular Pathways Inc, Naples, FL) has the same look and feel as our conventional IV catheter (Insyte Autoguard 20 and 22 gauge; Becton Dickinson, Sandy, UT), such that training requirements were minimal. A brief inservice demonstration was provided that focused on the unique features of guidewire insertion. Each practitioner used the device 2-3 times on a vein block and then completed 1-2 patient insertions before enrolling patients. Hand position was similar; a 1-handed technique was most commonly preferred. Registered nurse competency in IV placement was quickly achieved and confirmed by study personnel.

Study Procedures

After obtaining informed consent, patient randomization assignments were made using preassigned (sealed) sequential study numbers. Random assignments were balanced in a 1:1 ratio between the treatment (experimental catheter) and control group (conventional catheter).

As patients were admitted into the study, the hospital standard of care for PIV insertion was followed. Each IV site location was labeled with date, time, and the initials of the inserter. Case report forms were completed during and immediately after IV placement. If the first attempt was unsuccessful, a second attempt by the same practitioner was performed at another vein site. If still unsuccessful, placement was repeated by a second practitioner up to 2 additional times per hospital policy unless an alternative therapy was ordered that no longer required peripheral venous access.

Catheters were stabilized using the same stabilization device (StatLock IV Ultra Stabilization Device; C.R. Bard, Inc, Murray Hill, NJ) to ensure uniformity. Daily follow-up occurred per institution policy. The 2011 Infusion Nursing Society Standards of Practice recommendations were followed for routine site assessment.[12] Site rotations occurred only if clinically indicated (eg, pain on injection, erythema, infiltration phlebitis, and unable to flush).

Data Collection

We employed an IV catheter rating scale to measure the degree of difficulty for each catheter insertion attempt.[14,15]