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Use of and patient-reported complications related to midline catheters and peripherally inserted central catheters

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Abstract

We conducted a prospective observational study of indications for use and patient experiences with midline catheters (n = 50) compared to peripherally inserted central catheters (PICCs) (n = 63). The primary indication for patients with midlines was difficult venous access. Midline patients reported fewer complications than patients with PICCs.

INTRODUCTION

Peripherally inserted central catheters (PICCs) are often used for patients requiring short term (e.g., ≤ 5 days) venous access, including intravenous antibiotics.[1] However, PICCs are associated with risk of deep vein thrombosis (DVT)[2] and bloodstream infection.[3] Midline catheters, which appear to have a lower complication rate,[4,5] may be an option for some patients. Since the evolution of midlines with newer materials and design,[6] however, data about indications for use, patient experiences, and adverse events remains limited.[4,7] To bridge this gap, we compared indications for use as well as patient-reported and chart-documented complications for a cohort of patients that received midlines and PICCs.

Our primary objectives were to assess: 1) indications for device placement; 2) percentage of patients reporting a potential device-related complication; and 3) complications documented in the electronic medical record (EMR) during the same timeframe.

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METHODS

As part of a study examining patient-reported experiences with PICCs,[8] we performed a prospective observational study comparing indications for use and complications among patients receiving a midline catheter or a PICC from August 2015 - May 2017 at an urban safety net hospital (i.e., a hospital providing a significant level of care to patients regardless of their ability to pay). A convenience sample of hospitalized patients was used. Patients were eligible to participate if they: 1) had a new midline or PICC placed within three days of enrollment; 2) were 18 years or older; and 3) able to speak English or Spanish. Patients were excluded if they were unable or refused to provide consent or had participated previously in this study.

On average, during the study period, 111 midlines and 120 PICCs were placed monthly by the hospital vascular access nurse team, who used the Michigan Appropriateness Guide for Intravenous Catheters (MAGIC)[9] criteria for device selection. Midlines were 10cm Bard Powerglide® 18-gauge catheters inserted under ultrasound guidance. Double lumen Bard PowerPICC® catheters were used in the inpatient setting and single lumen catheters for home infusion.

The study was approved by the health system Institutional Review Board (protocol H-36119).

Data Collection

Data about indications and complications were collected from patients and via EMR review. Interviews were conducted at enrollment, then 14, 30, and 70 days after device placement. During follow-up assessments, patients were asked structured questions to determine whether the device was in place, if another device had been inserted, and whether they had signs or symptoms of a complication potentially related to the device. They were asked to reflect on the prior 7 days at the 14th-day interview and on the prior 30 days during the 30th and 70th-day interviews. Patients were also asked to share any other problems with the device. Study staff reviewed the EMR during the same 70-day time frame and collected information on insertion and removal dates, number of devices placed, and complications. Documentation of a DVT or bloodstream infection required an explicit statement of the condition by a medical provider in the EMR.

Data Analysis

We conducted a descriptive analysis. Characteristics of patients receiving midlines versus PICCs were compared using a Fisher’s exact test. All statistical tests were two-sided with alpha set to 0.05. All analyses were performed using STATA MP version 15.1 (College Station, Texas).

RESULTS

Of the 68 patients eligible after midline placement, 58 consented (85.3%). Of those, 50 were included in the analysis. We excluded patients with no response to the initial interview or to any of the 3 follow-up interviews. A total of 63 patients with PICCs hospitalized on the

same inpatient units during the same time frame were selected as a comparison group. There was no statistically significant difference between groups in terms of age or race (Table 1). There was a significant difference, however, with respect to sex, with more females in the midline than in the PICC group. The most commonly reported reason for midline insertion was difficult venous access (52.0%), while chemotherapy was the most common reason for PICC insertion (65.1%). Although not statistically significant, 20.0% of patients with midlines reported experiencing pain, discomfort, bleeding or other trauma during insertion compared with 31.8% of those with PICCs (p=0.144). The device dwell time was ≤ 5 days for 50.0% of midline patients and 46.0% of patients with PICCs. Of those with the device for five days or less, difficult venous access was the reported indication for device insertion in 56.0% of patients with midlines versus 13.8% of those with PICCs (p=0.001).

Patient- and medical record-sourced complications are listed in Table 2. One midline patient reported seeing a doctor for signs suggestive of an infection and was told that they had a bloodstream infection due to the catheter, while 6 PICC patients (9.5%) reported signs of potential infection requiring them to see a doctor, but none reported being told they had a bloodstream infection. Compared to those with midlines, more patients with PICCs reported minor complications, such as redness at insertion site or removal difficulty. No patients with midlines were documented as having a DVT in the chart, compared to 14.5% of patients with PICCs. Likewise, none of the midline patients had a bloodstream infection documented in the chart, whereas one patient with a PICC did.

DISCUSSION

Our study has two main findings. First, in our study population, difficult venous access was a primary indication for patients with midlines, but not for PICCs. Second, patients with midlines reported fewer potential complications compared to those with PICCs. Likewise, we found no medical record documentation of serious complications among midline patients, supporting prior studies that suggest complication rates are lower with midline catheters compared to PICCs.[4,5]

Our findings add to a growing evidence base that suggests midline catheters may be a viable and safer alternative than PICCs for patients who require short-term venous access for peripherally-compatible therapies. MAGIC[9] recommends a midline over a PICC if the proposed duration of a peripherally-compatible therapy is ≤ 14 days. Accordingly, at our study site, the vascular access nurses call the ordering provider when a PICC request does not meet MAGIC criteria and, if appropriate, recommend a midline. This approach, our findings suggest, led to more appropriate (and possibly safer) device use with 52.0% of patients having a midline for an indication of difficult venous access versus 11.1% of those with a PICC. Other sites implementing midline programs targeting patients with difficult venous access have also achieved lower rates of PICC placement.[10]

Our study has limitations. First, this was a small study of patients recruited from a single hospital, so results may not be generalizable to other patient populations. There were more female patients in the midline than the PICC group, which could affect the results. Sampling was not random, and data collected by interviewing the patient has the potential for recall

bias. Also, we only reviewed medical records at the study hospital and affiliated clinics, so data on documented complications may be incomplete if patients received care elsewhere. In addition, EMR derived complications were based on provider documentation and not objectively verified.

Limitations notwithstanding, our study found that the primary reason for midline insertion was difficult venous access while chemotherapy infusion was the most common reason provided for requiring a PICC. Midline catheters also appear to be potentially effective options for short-term venous access.

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Table 1:

Baseline Patient and Device Characteristics

Characteristic	Midline N = 50 No. (%)	PICC N = 63 No. (%)	p-value (Fishers exact test)
Age in years, mean (SD)	49.1 (12.9)	45.5 (13.9)	0.156
Male	19 (38.0)	46 (73.0)	<0.001
Race			0.075
White	24 (48.0)	43 (68.3)	
Black	23 (46.0)	18 (28.6)	
Other (e.g., Asian, American Indian, prefer not to answer)	3 (6.0)	2 (3.1)	
Hispanic	17 (34.0)	35 (55.6)	0.029
Patient reported indication for placement			<0.001
Long term antibiotics	6 (12.0)	7 (11.1)	
Difficult venous access	26 (52.0)	7 (11.1)	
Chemotherapy	4 (8.0)	41 (65.1)	
Other or unknown (e.g., need medications)	14 (28.0)	8 (12.7)	
Experienced pain, discomfort, bleeding, or other trauma during insertion	10 (20.0)	20 (31.8)	0.144
Number of Devices during 70-day follow-up period *			0.018
1	38 (76.0)	33 (52.4)	
2	9 (18.0)	16 (25.4)	
3 or more	3 (6.0)	14 (22.2)	
Initial device, dwell time *			0.563
≤ 5 days	25 (50.0)	29 (46.0)	
6 – 14 days	19 (38.0)	26 (41.3)	
15 – 30 days	0	3 (4.8)	
> 30 days	2 (4.0)	3 (4.8)	
Unknown	4 (8.0)	2 (3.2)	

* Information derived primarily from chart review data

PICC = peripherally inserted central catheter

Table 2:

Complications up to 70 Days after initial Midline or PICC Placement

	Midline N = 50 No. (%)	PICC N = 63 No. (%)
Patient Reported:		
Fevers, chills, or other symptoms suggestive of an infection that required them to see a doctor	1 (2.0)	6 (9.5)
Doctor indicated might be due to an infection related to the device or was admitted to the hospital (n = 1)	1/1 (100.0)	0
Prescribed antibiotics (n = 1)	1/1 (100.0)	1/6 (16.7)
Redness, pain or swelling in the hand, arm or shoulder in the arm where the line was inserted	2 (4.0)	6 (9.5)
Redness around insertion site	0	7 (11.1)
Discomfort, inadvertent removal, migration or difficulty when removed	3 (6.0)	4 (6.4)
Bloodstream infection indicated in medical record	0	1 (1.6)
Deep vein thrombosis indicated in medical record	0	9 (14.5)

PICC = peripherally inserted central catheter