Infection Control & Hospital Epidemiology (2020), **41**, 608–610
doi:10.1017/ice.2020.34

Concise Communication

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

Erica H. Lescinskas MD[1], Barbara W. Trautner MD, PhD[1,2], Sanjay Saint MD, MPH[3,5], John Colozzi BA[3], Katherine Evertsz MSN, RN[4], Vineet Chopra MD, MSc[3,5] and Sarah L. Krein PhD, RN[3,5]

[1]Department of Internal Medicine, Baylor College of Medicine, Houston, Texas, [2]Center for Innovations in Quality, Effectiveness and Safety, Michael E. DeBakey Veterans' Affairs Medical Center, Houston, Texas, [3]Center for Clinical Management Research, Veterans' Affairs Ann Arbor Healthcare System, Ann Arbor, Michigan, [4]Ben Taub General Hospital, Houston, Texas and [5]Department of Internal Medicine, University of Michigan Medical School, Ann Arbor, Michigan

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 (n = 63). The primary indication for patients with midline catheters was difficult venous access. Patients with midline catheters reported fewer complications than patients with peripherally inserted central catheters.

(Received 16 October 2019; accepted 25 January 2020; electronically published 4 March 2020)

Peripherally inserted central catheters (PICCs) are often used for patients requiring short-term venous access (eg, ≤5 days), 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. However, midline catheters have evolved, with newer materials and design,[6] but data regarding indications for use, patient experiences, and adverse events remain 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 midline catheters 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 time frame.

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 through May 2017 at an urban safety net hospital (ie, 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 catheter or PICC placed within 3 days of enrollment, (2) were ≥18 years old, and (3) were able to speak English or Spanish. Patients were excluded if they were unable or refused to provide consent or had previously participated in this study.

Author for correspondence: Erica H. Lescinskas, E-mail: Eh130119@bcm.edu

Cite this article: Lescinskas EH, *et al.* (2020). Use of and patient-reported complications related to midline catheters and peripherally inserted central catheters. *Infection Control & Hospital Epidemiology*, 41: 608–610, https://doi.org/10.1017/ice.2020.34

On average, during the study period, 111 midline catheters 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. Midline catheters were 10-cm Bard Powerglide 18-gauge catheters (Becton Dickinson, Franklin Lakes, NJ) inserted under ultrasound guidance. Double-lumen Bard PowerPICC catheters (Becton Dickinson) were used in the inpatient setting, and single-lumen catheters were used for home infusion.

The study was approved by the health system institutional review board (protocol H-36119).

Data collection

Data regarding indications and complications were collected from patients and via a review of the electronic medical record (EMR). Interviews with patients were conducted at enrollment and at 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, whether 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 interview on day 14 and on the prior 30 days at the interviews on days 30 and 70. 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 midline catheters versus PICCs were compared using

Table 1. Baseline Patient and Device Characteristics

Characteristic	Midline (N=50), No. (%)	PICC (N=63), No. (%)	*P* Value[a]
Age, mean y (SD)	49.1 (12.9)	45.5 (13.9)	.156
Sex, male	19 (38.0)	46 (73.0)	<.001
Race			.075
White	24 (48.0)	43 (68.3)	
Black	23 (46.0)	18 (28.6)	
Other (eg, Asian, American Indian, prefer not to answer)	3 (6.0)	2 (3.1)	
Hispanic	17 (34.0)	35 (55.6)	.029
Patient reported indication for placement			<.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 (eg, need medications)	14 (28.0)	8 (12.7)	
Experienced pain, discomfort, bleeding, or other trauma during insertion	10 (20.0)	20 (31.8)	.144
No. of devices during 70-d follow-up[b]			.018
1	38 (76.0)	33 (52.4)	
2	9 (18.0)	16 (25.4)	
≥3	3 (6.0)	14 (22.2)	
Initial device, dwell time[b]			.563
≤5 d	25 (50.0)	29 (46.0)	
6–14 d	19 (38.0)	26 (41.3)	
15–30 d	0	3 (4.8)	
>30 d	2 (4.0)	3 (4.8)	
Unknown	4 (8.0)	2 (3.2)	

Note. PICC, peripherally inserted central catheter.
[a]Fisher exact test.
[b]Information derived primarily from chart review data.

the Fisher exact test. All statistical tests were 2-sided and a *P*-value of 0.05 was considered significant. All analyses were performed using Stata MP version 15.1 software (StataCorp, College Station, TX).

Results

Of the 68 patients eligible after midline catheter 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. In total, 63 patients with PICCs hospitalized on the same inpatient units during the same period were selected as a comparison group. We did not detect any statistically significant differences between groups in terms of age or race (Table 1). We identified a significant difference, however, with respect to sex; the midline catheter group had more women than the PICC group. The most commonly reported reason for midline catheter insertion was difficult venous access (52.0%), and chemotherapy was the most common reason for PICC insertion (65.1%). Although not statistically significant, 20.0% of patients with midline catheters reported experiencing pain, discomfort, bleeding or other trauma during insertion compared with 31.8% of those with PICCs ($P = .144$). The device dwell time was ≤5 days for 50.0% of midline catheter patients and for 46.0% of patients with PICCs. Of those with the device for ≤5 days, difficult venous access was the indication reported for device insertion in 56.0% of patients with midline catheters versus 13.8% of those with PICCs ($P = .001$).

Complications based on patient report and medical records are listed in Table 2. One midline catheter patient reported seeing a doctor for signs suggestive of an infection and was told that they had a bloodstream infection due to the catheter, whereas 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 midline catheters, more patients with PICCs reported minor complications, such as redness at insertion site or removal difficulty. No patients with midline catheters were documented as having a DVT in the chart, compared to 14.5% of patients with PICCs. Likewise, none of the midline catheter patients had a bloodstream infection documented in the chart, whereas 1 patient with a PICC did.

Discussion

We report 2 main findings of our study. First, in our study population, difficult venous access was a primary indication for patients

https://doi.org/10.1017/ice.2020.34 Published online by Cambridge University Press

Table 2. Complications up to 70 Days After Initial Midline or PICC Placement

Patient Report	Midline (N=50), No. (%)	PICC (N=63), No. (%)
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	1/1 (100.0)	0
Doctor prescribed antibiotics	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)

Note. PICC, peripherally inserted central catheter.

with midline catheters, not PICCs. Second, patients with midline catheters reported fewer potential complications compared to those with PICCs. Likewise, we found no EMR documentation of serious complications among midline catheter patients, supporting prior studies reporting that complication rates are lower with midline catheters than with PICCs.[4,5]

Our findings add to a growing evidence base suggesting that midline catheters may be a viable and safer alternative to PICCs for patients who require short-term venous access for peripherally compatible therapies. MAGIC[9] recommends a midline catheter 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, they recommend a midline catheter. This approach, our findings suggest, has led to more appropriate (and possibly safer) device use with 52.0% of patients having a midline catheter for an indication of difficult venous access versus 11.1% of patients with a PICC. Other sites implementing midline catheter programs targeting patients with difficult venous access have also achieved lower rates of PICC placement.[10]

Our study has several limitations. First, this was a small study of patients recruited from a single hospital, so results may not be generalizable to other patient populations. Also the midline catheter group had more women than the PICC group, which may have affected 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 revealed that the primary reason for midline catheter insertion was difficult venous access, whereas 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.

Acknowledgments. We thank the patients who so graciously participated and provided data for this study. The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Department of Veterans' Affairs or the US federal government.

Financial support. This material is based upon work supported by the Department of Veterans' Affairs, Veterans' Health Administration, Office of Research and Development, Health Services Research & Development Service (grant no. IIR 12-395 and RCS 11-222). Dr Trautner's work is supported in part by the Houston Veterans' Affairs Health Services Research & Development Center for Innovations in Quality, Effectiveness and Safety (grant no. CIN 13-413).

Conflicts of interest. All authors report no conflicts of interest relevant to this article.

References

1. Paje D, Conlon A, Kaatz S, *et al.* Patterns and predictors of short-term peripherally inserted central catheter use: a multicenter prospective cohort study. *J Hosp Med* 2018;13:76–82.
2. Chopra V, Anand S, Hickner A, *et al.* Risk of venous thromboembolism associated with peripherally inserted central catheters: a systematic review and meta-analysis. *Lancet* 2013;382:311–325.
3. Chopra V, O'Horo JC, Rogers MA, Maki DG, Safdar N. The risk of bloodstream infection associated with peripherally inserted central catheters compared with central venous catheters in adults: a systematic review and meta-analysis. *Infect Control Hosp Epidemiol* 2013;34:908–918.
4. Xu T, Kingsley L, DiNucci S, *et al.* Safety and utilization of a peripherally inserted central catheters versus midline catheters at a large academic medical center. *Am J Infect Control* 2016;44:1458–1461.
5. Mushtaq A, Navalkele B, Kaur M, *et al.* Comparison of complications in midlines versus central venous catheters: are midlines safer than central venous lines? *Am J Infect Control* 2018;46:788–792.
6. Cawcutt KA, Hankins RJ, Micheels TA, Rupp ME. Optimizing vascular-access device decision-making in the era of midline catheters. *Infect Control Hosp Epidemiol* 2019;40:674–680.
7. Chopra V, Kaatz S, Swaminathan L, *et al.* Variation in use and outcomes related to midline catheters: results from a multicenter pilot study. *BMJ Qual Safety* 2019;28:714–720.
8. Krein SL, Saint S, Trautner BW, *et al.* Patient-reported complications related to peripherally inserted central catheters: a multicenter prospective cohort study. *BMJ Qual Safety* 2019;28:574–581.
9. Chopra V, Saint S, Woller SC, *et al.* The Michigan appropriateness guide for intravenous catheters (MAGIC): results from a multispecialty panel using the RAND/UCLA appropriateness method. *Ann Intern Med* 2015;163 suppl 6:S1–S40.
10. DeVries M, Lee J, Hoffman L, Infection free midline catheter implementation at a community hospital (2 years). *Am J Infect Control* 2019;47:1118–1121.

https://doi.org/10.1017/ice.2020.34 Published online by Cambridge University Press