

Routine Replacement of Peripheral Intravenous Catheters

Sanjay A. Patel, MD^{1*}, Michael M. Alebich, DO¹, Leonard S. Feldman, MD²

¹Division of Hospital Medicine, Department of Medicine, John H. Stroger, Jr. Hospital of Cook County, Chicago, Illinois; ²Departments of Medicine and Pediatrics, Johns Hopkins University School of Medicine, Baltimore, Maryland.

The “Things We Do for No Reason” (TWDFNR) series reviews practices which have become common parts of hospital care but which may provide little value to our patients. Practices reviewed in the TWDFNR series do not represent “black and white” conclusions or clinical practice standards, but are meant as a starting place for research and active discussions among hospitalists and patients. We invite you to be part of that discussion.

Hospitals and health systems worldwide have adopted policies for routine replacement of peripheral intravenous catheters (PIVCs) at prespecified time intervals (range, 48-96 hours). This practice accounts for a large number of PIVC reinsertions and places a significant cost burden on the healthcare infrastructure. The authors of this article examine the evidence that has been used to support this practice.

CASE PRESENTATION

A 67-year-old man with metastatic lung cancer presents to a hospital for pain control and “failure to thrive.” In the emergency department, a left antecubital peripheral intravenous catheter (PIVC) is placed. On admission, a prerenal acute kidney injury is noted. During the patient’s entire hospitalization, normal saline with parenteral hydromorphone is administered. On hospital day 4, the pain is still not adequately controlled, and the intravenous opioid is continued. On morning rounds, an intern notes that the PIVC is functioning well, and there are no signs of irritation. However, the nursing staff reminds the team that the PIVC should be changed because it has been in place for 4 days and is “due for replacement.” The patient does not want to receive another skin puncture for routine venous access. Does the PIVC need to be replaced, per routine?

WHY YOU MIGHT THINK ROUTINE PIVC REPLACEMENT IS HELPFUL

PIVC placement is easily the most common procedure performed in the United States. An estimated 200 million PIVCs are placed each year.¹ Given the number of inpatient hospital stays per year in the United States alone—more than 37 million^{1,2}—data regarding the care, maintenance, and

complications of PIVCs are essential to the healthcare infrastructure.

The recommendation to routinely replace PIVCs dates to 1981, when the Centers for Disease Control and Prevention³ (CDC) issued a guideline that calls for replacing PIVCs every 24 to 48 hours. Most of the data and studies that established that recommendation originated in the 1970s, when catheters varied in length and material, and precise definitions of complications, such as phlebitis—localized vein inflammation characterized by pain, erythema, tenderness, swelling, and a palpable cord^{4,5}—were not standardized across trials. Research at the time suggested higher rates of complications from IVCs dwelling longer than 48 to 72 hours. The latest (2011) CDC guidelines^{6,7} softened the recommendation but still concluded, “There is no need to replace peripheral catheters more frequently than every 72-96 hours.”

The 2011 recommendation^{6,7} is based on findings of a 1983 prospective observational study,⁸ a 1991 randomized controlled trial (RCT),⁹ and a 1998 prospective observational study.² The 1983 and 1991 studies found higher rates of PIVC complications after day 2 of cannulation.^{8,9} The 1998 study found no increase in the rate of complications after day 3 of catheterization, and its authors, recommending a reevaluation of the need to routinely replace PIVCs, wrote, “[The] hazard for catheter-related complications, phlebitis, catheter-related infections, and mechanical complications did not increase during prolonged catheterization.”²

Results of RCTs conducted by Barker et al.¹⁰ (2004) and Nishanth et al.¹¹ (2009) supported the claim that routine replacement of PIVCs leads to lower rates of thrombophlebitis. Nishanth et al. also included site pain and cannula dislodgement in their definition of phlebitis. Neither study compared blood stream infection rates, but both found higher rates of phlebitis between day 2.5 and day 3. However, *Cochrane* reviewers Webster et al.¹² questioned the findings of these 2 trials, given their missing data and possibly biased results and conclusions. In the Barker study, patient numbers (screened, eligible, dropout) were unclear; each patient group was unbalanced; protocol deviations were not reported (possibly a result of incomplete data reporting or inappropriate randomization); and varied definitions of phlebitis were allowed, which may have resulted in more events being included. In the Nishanth study, the 100% phlebitis rate for the clinically indicated replacement group seemed extreme, which suggested confounding by an unknown bias or chance. Last, both samples were small: 47 patients (Barker) and 42 patients (Nishanth). Given all these concerns,

*Address for correspondence and reprint requests: Sanjay A. Patel, MD, Division of Hospital Medicine, Department of Medicine, John H. Stroger, Jr. Hospital of Cook County, Room 570A, Administration Building, 1901 W Harrison St, Chicago, IL 60612; Telephone: 312-864-4522; Fax: 312-864-9958; E-mail: spatel30@cookcountyhhs.org

Received: March 16, 2016; Revised: May 6, 2016; Accepted: May 9, 2016

2017 Society of Hospital Medicine DOI 10.1002/jhm.2676

TABLE. Sample Peripheral Intravenous Catheter Inspection Protocol for Local Complications^a

Phlebitis defined as ≥ 2 of the following:

Pain or tenderness reported by patient on questioning and on subsequent palpation by nursing staff (severity ≥ 2 on 10-point scale)

Erythema extending at least 1 cm from insertion site

Swelling extending at least 1 cm from insertion site

Purulent discharge

Palpable venous cord beyond peripheral intravenous catheter tip

^aMeasures repeated daily and 48 hours after removal (by telephone if already discharged).

the 2 trials were excluded from the *Cochrane* meta-analysis on the subject.¹²

In the 1980s and early 1990s, routine removal and exchange of PIVCs were supported by limited evidence. Current well-designed trial data cast doubt on the need for such a practice.

WHY YOU SHOULD NOT ROUTINELY REPLACE PIVCS

According to the CDC,^{6,7} the issue of routine PIVC replacement remains unresolved: “No recommendation is made regarding replacement of peripheral catheters in adults only when clinically indicated.”

Whereas earlier data showed a higher risk of complications with longer dwelling IVs, the majority of contemporary data has failed to support this conclusion. The recent (2015) *Cochrane* meta-analysis comparing routine with clinically indicated IVC replacement found “no evidence to support changing catheters every 72-96 hours.”¹² Of the 7 studies that fulfilled the criteria for qualitative analysis, only 5 were included (the studies by Barker et al.¹⁰ and Nishanth et al.¹¹ were excluded). The included studies assessed the endpoints of catheter-related blood stream infection (CRBSI), phlebitis, phlebitis per device-days, mortality, cost, and infiltration. Statistically significant differences were found only for cost (favoring clinically indicated replacement) and infiltration (occurring less with routine replacement).

The largest and most robust RCT in the meta-analysis¹² was conducted by Rickard et al.¹³ (2012). Their nonblinded, intention-to-treat study of 3283 patients used concealed allocation to randomly assign patients to either clinically indicated or routine PIVC replacement in order to evaluate a primary endpoint, phlebitis. Secondary endpoints were CRBSI, venous port infection, IVC tip colonization, infusion failure, number of IVCs needed per patient, IV therapy duration, cost, and mortality. Need for PIVC replacement was methodically monitored (Table) with extensive nursing education and interrater validation. The study found no difference in the groups' phlebitis rates; the rate was 7% for both routine and clinically indicated replacement (13.08% and 13.11%, respectively, adjusted for phlebitis per 1000 IVC days). In addition, there was no difference in the secondary outcome measures, except cost and number of catheters

used, both of which favored clinically indicated replacement. The most serious complication, CRBSI, occurred at essentially the same rate in the 2 replacement arms: 0.11% (routine) and 0% (clinically indicated). Per-patient cost for the entire course of treatment was A\$69.24 in the routine group and A\$61.66 in the clinically indicated group; the difference was A\$7.58 ($P < 0.0001$). Mean number of catheters used was 1.9 in the routine group and 1.7 in the clinically indicated group; the difference was 0.21 catheter per patient for the treatment course ($P < 0.0001$). Overall, the study found no important difference in significant outcomes between the 2 study arms.

The other 4 studies in the meta-analysis¹² duplicated these results, with none finding a higher rate of major adverse events.¹⁴⁻¹⁷ All 4 showed virtually equivalent rates of phlebitis, the primary outcome; 3 also examined the secondary outcome measure of blood stream infection, and results were similar, with identical rates of complications. Only 1 trial identified any bloodstream infections (1 per group).¹⁵ The meta-analysis did find that routine catheter replacement resulted in less catheter infiltration.

Most of the data on PIVC exchange involves phlebitis and other local complications. A prospective study by Stuart et al.¹⁸ and commentary by Collignon et al.¹⁹ underscore the need for further research targeting blood stream infections (sepsis and severe sepsis in particular) as a primary outcome. Blood stream infections, especially those related to PIVC use, are rare entities overall, with most recent data yielding an estimated rate of 0.5 per 1000 catheter-days.²⁰ Given this epidemiologic finding, researchers trying to acquire meaningful data on PIVC-related blood stream infections and subsequent complications would need to have tens of thousands of patients in routine and clinically indicated replacement arms to sufficiently power their studies.²⁰ As they are infeasible, such trials cannot be found in the scientific literature.

Stuart et al.¹⁸ tried addressing the question. Prospectively examining more than 5 million occupied-bed days and the incidence of bloodstream infections by type of intravascular device over a 5-year period, they found that 137 (23.5%) of 583 healthcare-associated *Staphylococcus aureus* bacteremia (SAB) cases were attributed to PIVC use. PIVC insertions were performed equally (39.6%) in emergency departments and medical wards. About 45% of PIVCs remained in place 4 days or longer. Stuart et al. noted the “significant issue of PIVC-associated SAB” and favored routine removal of PIVCs within 96 hours (4 days). However, 55% of patients in their PIVC-related SAB group had the device in place less than 4 days. In addition, overall incidence of SAB was low: 0.3 per 10,000 occupied-bed days. Further, their study did not adjust device-specific SAB incidence for frequency of device use. For example, the rate of healthcare-acquired SAB was 19.7% for central venous catheters and 23.5% for PIVCs, despite PIVCs being used significantly more often than central lines. Device-specific adjustments would show a vastly different absolute risk of SAB in relation to individual devices. Nevertheless, the overall benefit of and need

for routine PIVC replacement must be questioned. The percentage of PIVC-associated SAB in their study and the need for more research in this area should be noted. Given current information, their study and others in the literature underscore the need for selective use, appropriate maintenance, and timely removal of PIVCs.

Pure clinical outcomes are important, but procedural costs are as well. Clinically indicated replacement helps patients avoid an unpleasant procedure and saves money.²¹ If one third of the 37 million annual inpatient admissions require a PIVC for more than 3 days, then a strategy of “replacement when clinically indicated” could prevent almost 2.5 million unnecessary PIVC insertions each year. Equipment cost savings combined with savings of nearly 1 million staff hours could yield an estimated \$400 million in savings over a 5-year period.²² Given current data suggesting no harm from clinically indicated PIVC replacement and clear evidence that routine replacement increases needle sticks and costs, it seems time to end the practice of routine PIVC replacement.

RECOMMENDATIONS

Compared with clinically indicated catheter replacement, routine replacement in the absence of a clinical indication (eg, infiltration, phlebitis, infection) provides no added benefit. Studies have consistently found that rates of phlebitis and SAB are not affected by scheduled replacement, though the largest RCT may not have been powered to show a difference in SAB. The present authors’ recommendations for PIVC care are:

- Scrutinize each patient’s need for PIVCs and remove each PIVC as soon as possible.
- Do not make routine replacement of otherwise well-functioning, well-appearing clinically necessary PIVCs the standard of care.
- Regularly examine PIVC sites for signs and symptoms of infection.
- Remove a PIVC immediately on recognition of any clinical sign of a complication (eg, infiltration, phlebitis, localized infection, blood stream infection) and replace the PIVC only if there is a clinical need.
- If replacing PIVCs on a clinical basis, establish protocols for frequency of evaluation for complications; these protocols might mirror those from prior studies (Table).^{10,22}
- Replace as soon as possible any PIVC inserted during an urgent or emergent situation in which proper insertion technique could not be guaranteed.
- Conduct real-world observational studies to ensure that the switch to clinically driven replacement is safe and develop standardized definitions of complications.

Given the literature findings and the preceding recommendations, the authors conclude that the patient in the case example does not need routine PIVC replacement. His PIVC may remain in place as long as evaluation for local complications is routinely and methodically performed and

the device is removed as soon as it is deemed unnecessary (transition to oral opioid therapy).

CONCLUSION

The long-standing practice of routinely replacing PIVCs every 72 to 96 hours during a hospital stay does not affect any meaningful clinical outcome. Specifically, data do not show that routine replacement prevents phlebitis or blood stream infections. Furthermore, routine PIVC replacement increases patient discomfort, uses resources unnecessarily, and raises hospital costs. Most of the PIVC research has involved phlebitis and other local complications; more research on PIVC use and bloodstream infections is needed. Given the findings in the current literature, routine PIVC replacement should be considered a Thing We Do For No Reason.

Disclosure: Nothing to report.

Do you think this is a low-value practice? Is this truly a “Thing We Do for No Reason”? Share what you do in your practice and join in the conversation online by retweeting it on Twitter (#TWDFNR) and liking it on Facebook. We invite you to propose ideas for other “Things We Do for No Reason” topics by emailing TWDFNR@hospitalmedicine.org.

References

1. Mermel LA, Allon M, Bouza E, et al. Clinical practice guidelines for the diagnosis and management of intravascular catheter-related infection: 2009 update by the Infectious Diseases Society of America. *Clin Infect Dis*. 2009;49(1):1-45.
2. Bregenzler T, Conen D, Sakmann P, Widmer AF. Is routine replacement of peripheral intravenous catheters necessary? *Arch Intern Med*. 1998;158(2):151-156.
3. Centers for Disease Control Working Group. Guidelines for prevention of intravenous therapy-related infections. *Infect Control*. 1981;3:62-79.
4. Hershey CO, Tomford JW, McLaren CE, Porter DK, Cohen DI. The natural history of intravenous catheter-associated phlebitis. *Arch Intern Med*. 1984;144(7):1373-1375.
5. Widmer AF. IV-related infections. In: Wenzel RP, ed. *Prevention and Control of Nosocomial Infections*. 3rd ed. Baltimore, MD: Williams & Wilkins; 1997:556-579.
6. O’Grady NP, Alexander M, Burns LA, et al; Healthcare Infection Control Practices Advisory Committee (HICPAC). *Guidelines for the Prevention of Intravascular Catheter-Related Infections, 2011*. Centers for Disease Control and Prevention website. <http://www.cdc.gov/hicpac/pdf/guidelines/bsi-guidelines-2011.pdf>. Published April 1, 2011. Accessed November 5, 2016.
7. O’Grady NP, Alexander M, Burns LA, et al; Healthcare Infection Control Practices Advisory Committee (HICPAC). Guidelines for the prevention of intravascular catheter-related infections. *Clin Infect Dis*. 2011;52(9):e162-e193.
8. Rhode Island Nosocomial Infection Consortium; Tager IB, Ginsberg MB, Ellis SE, et al. An epidemiologic study of the risks associated with peripheral intravenous catheters. *Am J Epidemiol*. 1983;118(6):839-851.
9. Maki DG, Ringer M. Risk factors for infusion-related phlebitis with small peripheral venous catheters. A randomized controlled trial. *Ann Intern Med*. 1991;114(10):845-854.
10. Barker P, Anderson AD, MacFie J. Randomised clinical trial of elective re-siting of intravenous cannulae. *Ann R Coll Surg Engl*. 2004;86(4):281-283.
11. Nishanth S, Sivaram G, Kalayarasan R, Kate V, Ananthakrishnan N. Does elective re-siting of intravenous cannulae decrease peripheral thrombophlebitis? A randomized controlled study. *Int Med J India*. 2009;22(2):60-62.
12. Webster J, Osborne S, Rickard CM, New K. Clinically-indicated replacement versus routine replacement of peripheral venous catheters. *Cochrane Database Syst Rev*. 2015;(8):CD007798.
13. Rickard CM, Webster J, Wallis MC, et al. Routine versus clinically indicated replacement of peripheral intravenous catheters: a randomised controlled equivalence trial. *Lancet*. 2012;380(9847):1066-1074.
14. Webster J, Lloyd S, Hopkins T, Osborne S, Yaxley M. Developing a Research base for Intravenous Peripheral cannula re-sites (DRIP trial). A randomised controlled trial of hospital in-patients. *Int J Nurs Stud*. 2007;44(5):664-671.
15. Webster J, Clarke S, Paterson D, et al. Routine care of peripheral intravenous catheters versus clinically indicated replacement: randomised controlled trial. *BMJ*. 2008;337:a339.
16. Van Donk P, Rickard CM, McGrail MR, Doolan G. Routine replacement versus clinical monitoring of peripheral intravenous catheters in a regional hospital in

- the home program: a randomized controlled trial. *Infect Control Hosp Epidemiol*. 2009;30(9):915-917.
17. Rickard CM, McCann D, Munnings J, McGrail MR. Routine resite of peripheral intravenous devices every 3 days did not reduce complications compared with clinically indicated resite: a randomised controlled trial. *BMC Med*. 2010;8:53.
 18. Stuart RL, Cameron DR, Scott C, et al. Peripheral intravenous catheter-associated *Staphylococcus aureus* bacteraemia: more than 5 years of prospective data from two tertiary health services. *Med J Aust*. 2013;198(10):551-553.
 19. Collignon PJ, Kimber FJ, Beckingham WD, Roberts JL. Prevention of peripheral intravenous catheter-related bloodstream infections: the need for routine replacement [letter]. *Med J Aust*. 2013;199(11):750-751.
 20. Maki DG, Kluger DM, Crnich CJ. The risk of bloodstream infection in adults with different intravascular devices: a systematic review of 200 published prospective studies. *Mayo Clin Proc*. 2006;81(9):1159-1171.
 21. Tuffaha HW, Rickard CM, Webster J, et al. Cost-effectiveness analysis of clinically indicated versus routine replacement of peripheral intravenous catheters. *Appl Health Econ Health Policy*. 2014;12(1):51-58.
 22. Rickard CM, Webster J, Playford EG. Prevention of peripheral intravenous catheter-related bloodstream infections: the need for a new focus. *Med J Aust*. 2013;198(10):519-520.