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Brief Report

Central line–associated bloodstream infections and completion of the central line insertion checklist: A descriptive analysis comparing a dedicated procedure team to other providers

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A primary strategy of central line–associated bloodstream infection (CLABSI) prevention is standardized, aseptic insertion of central lines. We compared hospital-wide CLABSI rate pre- and post-implementation of a dedicated procedure team as well as central line checklist completion and patient-specific variables between the procedure team and other providers. No significant differences were found. Further CLABSI prevention should focus on central line maintenance.

Central line–associated bloodstream infections (CLABSIs) are associated with increased mortality and higher health care costs.[1] Evidence-based central line insertion practices and checklists can reduce CLABSIs.[2] Established in June 2017, our institution's procedure team (PT) is a dedicated bedside service staffed by attending physicians who supervise interns and residents. The PT commonly performs thoracentesis, paracentesis, lumbar punctures, and placement of central lines. In addition to comparing the hospital-wide CLABSI rate pre- and post-PT, we compared central line checklist completion (CLCC) and patient-specific variables between the PT and other providers (OP).

METHODS

This study was conducted at Virginia Commonwealth University Medical Center, an urban 865-bed, tertiary care academic medical center. Central lines inserted by the PT and OP, from May 2015 to May 2018, were reviewed. The Centers for Disease Control and Prevention National Healthcare Safety Network (NHSN) surveillance definitions were used to determine CLABSI and CLABSI rate.[3] We did not assess other potential complications of central line insertion such as bleeding, hematoma, deep venous thrombosis, and pneumothorax. Hospital-wide CLABSI rates pre- and post-PT implementation were compared (excluding the neonatal intensive care unit), and OP and PT CLCC rates were compared. Only OP intensive care unit CLCC data were available. Additionally, the following patient-specific variables between the PT and OP were compared for identified CLABSIs: CLCC, 7-day consecutive chlorhexidine (CHG) bathing compliance, hypertension, infection occurring >6 days post-insertion, diabetes mellitus, CHG dressing, age, body mass index, number of CHG bathing days pre-insertion, catheter type, and anatomic location. Emergency cases, central lines inserted outside of the hospital, patients <2 months of age, and patients with missing documentation were excluded. We used a 2-proportion z test to compare CLCC between the PT and OP. We used a 2-proportion z test to compare hospital-wide CLABSI rates pre- and post-implementation of the PT and Fisher's exact test to compare patient-specific variables between the PT- and OP-identified CLABSIs.

RESULTS

No significant difference was observed for CLCC between PT and OP (92% vs 91%; $P = .78$). For all patients, most (66%) CLABSI events

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Table 1
Hospital-wide CLABSI rate pre- and post-PT

	Pre-PT (May 2015 to June 2017)	Post-PT (June 2017 to May 2018)	*P* value*
Hospital-wide CLABSI rate (CLABSI/1,000 device d)	1.02 (164/161.077)	0.96 (70/72.618)	0.47

CLABSI, central line–associated bloodstream infection; *OP*, other providers; *PT*, procedure team.
*The *z* test.

occurred >6 days post-insertion. As summarized in Table 1, no significant difference was observed between the hospital-wide CLABSI rate pre- and post-implementation of the procedure team (1.02 vs 0.96; $P = .47$). Patient-specific variables between the PT- and OP-identified CLABSIs are summarized in Table 2. No significant differences were observed across CLCC, 7-day CHG bathing compliance, hypertension, infection occurring >6 days post-insertion, diabetes mellitus, CHG dressing, catheter type, and anatomic location. Owing to small sample size, test of significance was not performed for mean age, body mass index, and bathing days pre-insertion.

DISCUSSION

CLABSIs increase length of stay, morbidity, mortality, and health care costs.[4,5] Standardized mechanisms and guidelines exist for central line insertion and maintenance.[6] We assessed the hospital-wide CLABSI rate pre- and post-PT implementation and CLCC between the PT and OP. In theory, trained PTs for standardized insertion of invasive devices should reduce infections. However, we observed no significant difference in hospital-wide CLABSI rate pre- and post-PT and no significant difference in CLCC between the 2 operator groups. To our knowledge, this study is the first to report a comparison of hospital-wide CLABSI rate pre- and post-PT and of CLCC between a PT and OP.

Study limitations include a single center design, therefore, limiting the generalizability of the findings. We were unable to obtain group-specific central line device days owing to the limitations with the NHSN data structure. Therefore, the analysis based on hospital-wide central line device days may have limited the ability to detect a difference in CLABSI rates between the 2 operator groups.

When we compared patient-specific variables between the PT and OP, we excluded 64 central lines inserted outside of the hospital, 6 emergency cases, 13 patients <2 months of age, and 13 PT patients with missing documentation. Of patients with missing documentation, 2 were missing the anatomic location of the line, 1 was missing line type, 3 were missing CHG dressing, and 7 were missing line type and CHG dressing. Study strengths included the structured review of data from the electronic medical record and the employment of standardized NHSN surveillance definitions for CLABSI and CLABSI rate.

Prior studies report evidence-based central line insertion practices and checklists for the reduction of CLABSIs.[6] In our institution, we have achieved a high level of CLCC across all operator types, with both groups achieving greater than the institutional goal of 90% CLCC. This, along with a similarity of patient-specific variables across both CLABSI groups, may have resulted in no significant difference between the hospital-wide CLABSI rate pre- and post-implementation of the PT for central line and other invasive procedures. Importantly, we observed that most (66%) CLABSIs occurred >6 days post-insertion. Patient-specific variables and CLCC were not significantly different between cases that occurred >6 days post-insertion and earlier infections. These observations suggest that catheter maintenance, as opposed to suboptimal insertion practice, was the most critical issue in cases that occurred >6 days post-insertion. Prior studies indicate poor execution of post-insertion care as a significant risk factor for CLABSI.[7,8]

We add to the growing body of literature on the importance of standardized central line insertion and checklist protocols with a particular focus on dedicated invasive devices procedure teams. In institutions with highly reliable central line insertion practices, either by PTs or OP, most CLABSIs occur >6 days post-insertion, underscoring the importance of central line maintenance.[9] Further studies are required to define and implement central line maintenance best practice protocols.

Table 2
Patient-specific variables between PT- and OP-identified CLABSIs

Patient-specific variables	PT CLABSIs (N = 3)	OP CLABSIs (N = 123)	*P* value†
CLCC	2 (67)	113 (92)	.24
CHG bathing compliance (7 d)	0	23 (19)	1
HTN	1 (33)	33 (27)	1
CLABSI >6 d post-insertion	2 (67)	81 (66)	1
DM	1 (33)	24 (20)	.49
CHG dressing	3 (100)	120 (98)	1
Multilumen	2 (67)	29 (24)	.15
Trialysis	0	12 (10)	1
PICC	0	42 (34)	.55
Hickmann/Groshong/Portacath	0	23 (19)	1
Sorenson	0	5 (4)	1
MAC/Cordis	0	1 (1)	1
Permacath	1 (33)	9 (7)	.22
Multilumen and Trialysis	0	1 (1)	1
Hickmann/Groshong/Portacath, and Permacath	0	1(1)	1
Internal jugular	2 (67)	41 (33)	.55
Arm	0	38 (31)	.55
Femoral	0	17 (14)	1
Subclavian	1 (33)	26 (21)	1
Transhepatic	0	1 (1)	1
Mean BMI	48.83	28.29	‡
Mean age	31.67	48.88	‡
Mean bathing preinsertion (d)	3.67	4.02	‡

BMI, body mass index; *CHG*, chlorhexidine; *CLABSI*, central line–associated bloodstream infection; *CLCC*, central line checklist completion; *HTN*, hypertension; *ICU*, intensive care unit; *MAC*, multilumen access catheters; *OP*, other providers; *PICC*, peripherally inserted central catheter; *PT*, procedure team.
†The Fisher's exact test.
‡The PT sample size is too small to perform significance test.

CONCLUSIONS

In institutions with optimized central line insertion practices, heightened CLABSI risk reduction should focus on catheter maintenance. Further studies on post-insertion central line maintenance are needed.

References

1. Pronovost P, Needham D, Berenholtz S, Sinopoli D, Chu H, Cosgrove S, et al. An intervention to decrease catheter-related bloodstream infections in the ICU. N Engl J Med 2006;355:2725-32.
2. Marsteller JA, Sexton JB, Hsu Y, Hsiao C, Holzmueller CG, Pronovost PJ, et al. A multicenter, phased, cluster-randomized controlled trial to reduce central-line associated bloodstream infections in intensive care units. Crit Care Med 2012;40:2933-9.
3. Centers for Disease Control and Prevention, National Healthcare Safety Network. NHSN patient safety and component manual. Available from:https://www.cdc.gov/nhsn/pdfs/pscmanual/pcsmanual_current.pdf. Accessed July 19, 2018.

4. Stevens V, Geiger K, Concannon C, Nelson RE, Brown J, Dumyati G. Inpatient costs, mortality and 30-day re-admission in patients with central-line associated bloodstream infections. Clin Microbiol Infect 2013;20:O318-24.
5. Goudie A, Dynan L, Brady PW, Rettiganti M. Attributable cost and length of stay for central line-associated bloodstream infections. Pediatrics 2014; 133:1-8.
6. Marschall J, Mermel LA, Fakih M, Hadaway L, Kallen A, O'Grady NP, et al. Strategies to prevent central line—associated bloodstream infections in acute care hospitals: 2014 update. Infect Control Hosp Epidemiol 2014;35:753-71.
7. Shapey IM, Foster MA, Whitehouse T, Jumaa P, Bion JF. Central venous catheter-related bloodstream infections: improving post-insertion catheter care. J Hosp Infect 2009;71:117-22.
8. Drews FA, Bakdash JZ, Gleed JR. Improving central line maintenance to reduce central line-associated bloodstream infections. Am J Infect Control 2017;45:1224-30.
9. Klintworth G, Stafford J, O'Connor M, Leong T, Hamley L, Watson K, et al. Beyond the intensive care unit bundle: implementation of a successful hospital-wide initiative to reduce central line-associated bloodstream infections. Am J Infect Control 2014;42:685-7.

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