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Major Article

Comparison of complications in midlines versus central venous catheters: Are midlines safer than central venous lines?

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Key Words:
Midline catheter
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Background: With the rising use of midline catheters (MCs), validation of their safety is essential. Our study aimed to evaluate the incidence of bloodstream infections (BSIs) and other complications related to the use of MCs and central venous catheters (CVCs).

Methods: A retrospective cohort study was performed at a tertiary care hospital in Detroit, Michigan, from March-September 2016. Adult patients with either MC or CVC were included. Outcomes assessed were catheter-related BSI (CRBSI), mechanical complications, hospital length of stay, readmission within 90 days of discharge (RA), and mortality. Statistical analysis was performed using SAS software.

Results: A total of 411 patients with MC and 282 patients with CVC were analyzed. More CRBSIs were seen in patients with CVC (10/282) than MC (1/411) (3.5% vs 0.2%, respectively; $P = .0008$). More mechanical complications were seen in patients with MC (2.6%) than CVC (0.3%; $P = .03$). Patients with CVC had a higher crude mortality (17.3% vs 5.3%; $P < .0001$), RA (58% vs 35%; $P \leq .0001$), line-related RA (2.8% vs 0.2%; $P = .0041$), and transfer to intensive care unit after line placement (9% vs 5%; $P = .01$). CVC was a significant exposure for a composite of mortality, CRBSI, mechanical issues, thrombosis, and readmission because of a line-related complication (odds ratio, 3.2; 95% confidence interval, 1.8-5.8).

Conclusions: Our findings show use of MC is safer than CVC, but larger studies are needed to confirm our findings.

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BACKGROUND

Intravenous catheters are routinely inserted for a variety of indications, such as administration of fluids, medications, and nutritional support. In medical centers across the United States, an estimated 150 million peripheral and 5 million central venous catheters (CVCs) are inserted annually.[1] Catheter-associated complications occur secondary to reasons such as prolonged dwell time and improper maintenance.[1,2] Patients with CVC are at risk of mechanical complications (5%-19%), infection-related complications (5%-26%), and thromboembolic complications (2%-26%).[2] Among patients with hospital-acquired condition (HAC)–related deaths, central line–associated bloodstream infection (CLABSI) accounts for one-third of the deaths with attributable mortality of 12%-25%.[1] CLABSI is associated with poor outcomes such as increased length of hospital stay and higher health care expenditures ranging from $3,700-$39,000 per episode.[3]

The Society of Healthcare Epidemiology of America has provided compendiums on measures to reduce HACs and for CLABSI.[4] In the effort to reduce CLABSIs, removal of central line and replacement with peripheral intravenous catheter (PIV) is a common practice. Midline catheters (MCs) are considered equivalent to peripheral venous catheters because they are shorter in length and are commonly inserted near the antecubital area with the tip terminating proximal to the central venous circulation at or below the axillary vein without extending into the veins of the chest. MCs are a convenient choice for short-term intravenous access (2-4 weeks) for medication or nutritional support.[5] The use of MCs has been growing because of ease in access, less patient discomfort, cost

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effectiveness, and avoidance of use of radiograph for confirmation of tip location.[6,7] In comparison with PIVs, MCs were associated with less phlebitis, needle-stick injuries, and need for recannulation.[6]

With the rising use of MCs, validation of their safety is essential. There are limited data available evaluating the safety of MCs compared with CVCs. The objective of this study was therefore to evaluate the incidence and difference in bloodstream infections (BSIs) and other catheter-related complications such as thrombophlebitis and deep venous thrombosis (DVT) in patients with midlines versus central lines.

METHODS

The study was approved by the Institutional Review Board of Detroit Medical Center and Wayne State University.

Study design and setting

This was a retrospective cohort study at the Detroit Receiving Hospital, Detroit, Michigan, which is a 250-bed tertiary care teaching hospital with full range of academic services. The hospital uses an electronic medical record system called Citrix (Cerner Corp, Kansas City, MO) for inpatients, which was used to collect data for the study. CVCs and MCs are commonly inserted by either the vascular access team or interventional radiology. At our institution, midlines are indicated for short-term use (up to 4 weeks) or for nonirritant and nonvesicant use.

Sample size

Using 2-tailed *t* test and assuming a moderate difference between the 2 groups, a minimal sample size of 314, with at least 157 in each group, was chosen to get a power of 95%. Study period of March 5, 2016-September 30, 2016, was chosen to get twice the minimal sample size.

Inclusion and exclusion criteria

Patients age ≥18 years old admitted to the intensive care unit (ICU) or medical-surgical floor with either a central line or midline during the study period were included. Patients with copresence of both lines were excluded from the study.

Data collection

The study data were obtained through chart review of electronic medical record and recorded on a predesigned Microsoft Office 2007 Excel sheet (Microsoft, Redmond, WA). Patient characteristics including length of hospitalization, age, sex, body mass index, admission source and disposition (home, nursing home, rehabilitation center, or another hospital), admission to ICU, comorbidities, Charlson Comorbidity Index, and presence of burns were recorded. Line-specific information included the type of line (MC or CVC), type of CVC (peripherally inserted central catheter, internal jugular, subclavian, or femoral), line insertion and removal dates, indication, team inserting the line (interventional radiology or vascular access team), and chlorhexidine bathing for central lines. Catheterized patients were further followed to determine subsequent development of bacteremia or fungemia during hospitalization. Patients were assessed for outcomes based on incidence of BSI, duration of bacteremia-fungemia and subsequent clearance, complications related to BSI such as infective endocarditis (IE) or osteomyelitis, hospital length of stay, and mortality. Severity of infection was determined by the Sequential Organ Failure Assessment (SOFA) score, which was calculated for ±2 days from the date of positive blood culture, and the highest score was recorded. Other adverse events from catheterization such as thrombophlebitis and development of DVT were also assessed. Mortality outcome was based on in-hospital mortality. For patients who developed >1 episode of line-related infection or other complications, only the first occurrence of each complication was recorded. Readmission within 30 days from the date of discharge was recorded, which also included visits to the emergency room.

Definitions

Line-associated infection: National Healthcare Safety Network (NHSN) definition for CLABSI was also used for midline-associated BSI. Physician diagnosis was as documented in patient's chart. Sepsis was defined as SOFA score ≥9 for all patients. Chlorhexidine bathing was recorded as compliant if performance was documented during central line days. Systemic complications from a BSI were defined as documented IE, osteomyelitis, septic arthritis, prosthetic joint infection, or metastatic infections attributable directly to line-related BSI by the treating physician. Mechanical complication was defined as nonfunctional line because of disruption in patency, breakage, occlusion, or dislodging. Clinical cure for catheter-related BSI (CRBSI) was defined as clearance of bacteremia and no resultant systemic complications. Outcome was measured as a composite of mortality, CRBSI per the NHSN criteria, mechanical issues, thrombosis, and readmission because of a line-related complication.

Statistical analysis

Statistical analysis was performed using SAS software, version 9.3 (SAS Institute, Cary, NC). The frequency and different characteristics among all the groups were analyzed and compared. Categorical variables were presented as proportions and analyzed using χ^2 test and Fisher exact tests. Continuous variables were presented as mean with SD or as median with interquartile range and analyzed using Wilcoxon rank-sum test. To evaluate the impact of central lines and midlines on mortality and complications, all variables with $P < .05$ in univariate analysis were included, along with the catheter type in a multivariate model for mortality and catheter-associated complications. In this model, the events of interest were mortality and complications associated with catheter use (BSI, mechanical issues, thrombosis, or readmission secondary to catheter-related complications). $P < .05$ was considered statistically significant.

RESULTS

Table 1 shows baseline characteristics of the 2 groups. In comparison with patients with CVC, patients with MC were more likely to be admitted from home (74% vs 79%) and women (46% vs 55%). Patients with CVC were more likely to have the line present at admission (23.7% vs 0%) and have antibiotic delivery as the indication for the line (24% vs 19%). Other in the indication of antibiotics in Table 2 includes patients who had line for chemotherapy, drugs other than antibiotics (eg, vasopressors) or specialized products like epoprostenol, factor VIII, immunoglobulins, and enzyme replacement (eg, alpha-1-antitrypsin). Both the groups had comparable Charlson Comorbidity Index scores. For patients with CVC, 87.9% (n = 248) of patients received chlorhexidine bathing.

Table 2 shows association between different comorbidities and the type of catheter. Patients with myocardial infarction, diabetes mellitus, and burns were more likely to have MC. Patients with chronic kidney disease, liver disease, and hypertension were more likely to have CVC.

Table 3 shows outcomes of patients in the 2 groups. Patients with midlines were more likely to be discharged home (53% vs 49%), have

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