CONCISE COMMUNICATION

Unnecessary Removal of Central Venous Catheters in Cancer Patients with Bloodstream Infections

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We evaluated the rate of central venous catheter (CVC) removal in 283 cancer patients with bloodstream infections (BSIs). Removal of CVCs occurred unnecessarily in 57% of patients with non-central-line-associated BSI (non-CLABSI), which was equivalent to the rate of CVC removal in patients with CLABSIs. Physician education and safe interventions to salvage the vascular access are warranted.

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Central venous catheters (CVCs) continue to be the lifeline for the critically ill and for cancer patients. However, such intravascular devices continue to be associated with infectious as well as mechanical complications such as arrhythmias, artery punctures, hematomas, and pneumothoraces.[1–5] Diagnosing catheter-related bloodstream infection (CRBSI) is imperative because it may guide the management of the patient. When the CVC is the likely source of BSI, the guidelines recommend removing of the CVC for most pathogens when possible, or alternatively using an antibiotic lock in an attempt to salvage the CVC.[6] However, if the CVC is not the source of the BSI, CVC may be retained.

In the current study, we compared the rate of CVC removal in patients with central-line–associated bloodstream infections (CLABSIs) versus non-CLABSIs.

METHODS

BSI and CVC Removal

From January 2013 to March 2014, we searched the infection control surveillance database and the microbiology laboratory database at our institution to identify all patients who had a CVC and presented with a bloodstream infection (BSI). The BSIs were classified as CLABSIs according to the Centers for Disease Control and Prevention (CDC) criteria or non-CLABSIs.[7] We only focused on patients who had 2 positive simultaneous blood cultures drawn from the CVC and peripheral site or a blood culture and a catheter-tip culture to be able to further categorize them into CRBSIs according to the Infectious Diseases Society of America (IDSA) definition.[6] Approval to conduct this retrospective study was obtained from our institutional review board and a waiver of informed consent was obtained.

Statistical Analysis

Descriptive statistics were used to summarize patients' demographics and clinical characteristics.

The χ^2 or Fisher exact tests were used to compare categorical variables, as appropriate. Continuous variables were compared using Wilcoxon rank-sum tests because of the data's deviation from normal distribution. All tests were 2-sided, and statistical significance was set at *P*-value of .05. The statistical analyses were performed using R statistical software (version 3.2.1; R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

We identified 283 patients who had a CVC and had simultaneous blood cultures drawn from the CVC and the peripheral site (Figure 1). Of those, 149 patients met the CDC criteria for CLABSI, while 134 patients did not (ie, the bacteremia was likely considered secondary to another source). Different data from a subset of patients with CLABSI were previously published.[8] Gram-positive organisms contributed to 52% of CLABSIs, followed by gram-negative (46%) and *Candida* (2%).

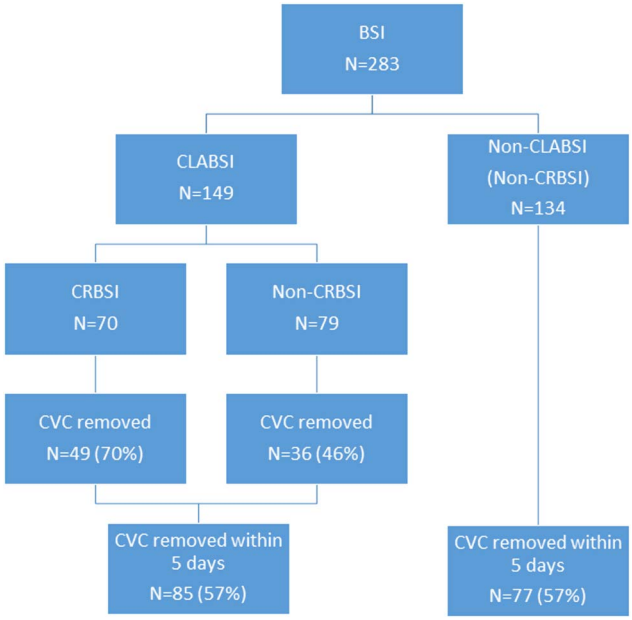

FIGURE 1. Patients with central venous catheters (CVCs) and bloodstream infections who had simultaneous blood cultures drawn from CVCs and peripheral sites. Abbreviations: BSI, bloodstream infection; CLABSI, central line-associated bloodstream infection; CRBSI, catheter-related bloodstream infection; CVC, central venous catheter.

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TABLE 1. Characteristics of Patients With CLABSIs and Non-CLABSIs

Characteristics	CLABSI (n = 149), No. (%)[a]	Non-CLABSI (n = 134), No. (%)[a]	*P* Value
Age, median y (range)	55 (4–87)	58 (15–84)	.39
Gender, male	90 (60)	69 (51)	.13
Type of cancer			.43
Hematologic malignancy	110/148 (74)	94 (70)	
Solid tumor	38/148 (26)	40 (30)	
No cancer	1		
Bone marrow transplant	34 (23)	18 (13)	.04
Neutropenia	81 (54)	88 (66)	.07
Organism identified			
Gram-positive bacteria	77 (52)	47 (35)	.005
Staphylococci aureus	18 (12)	11 (8)	
CNS	27 (18)	2 (1)	
Streptococci	15 (10)	15 (11)	
Enterococcus	11 (7)	17 (13)	
Streptococci and *Enterococcus*	1 (1)		
Other	5 (3)	2 (1)	
Gram-negative bacteria	69 (46)	77 (57)	.06
Escherichia coli	31 (21)	30 (22)	
Klebsiella	8 (5)	16 (12)	
E. coli and *Klebsiella*	1 (1)		
Pseudomonas	11 (7)	16 (12)	
Enterobacter	3 (2)	6 (4)	
Other	15 (10)	9 (7)	
Candida	3 (2)	7 (5)	.20
Other organisms[b]	0	3 (2)	.10
Polymicrobial infection	2 (1)	16 (12)	<.001
CVC management (within 5 d)			.94
CVC removal/exchange	85 (57)	77 (57)	
Days between CVC insertion and bacteremia, median (range)			
All patients	58 (0–3,508)	35 (0–1,779)	.36
Gram-positive bacteria	60 (0–3,508)	30 (0–1,185)	.47
Gram-negative bacteria	62 (0–2,204)	37 (1–1,779)	.81
Candida	18 (7–41)	22 (2–67)	.91
CVC removal/exchange (within 5 d)			
All patients	85 (57)	77 (57)	.94
Gram-positive bacteria	39/77 (51)	26/47 (55)	.61
Gram-negative bacteria	44/69 (64)	45/77 (58)	.51
Candida	2/3 (67)	5/7 (71)	>.99
Staphylococci aureus	14/18 (78)	8/11 (73)	>.99
Coagulase-negative *Staphyloccus*	11/27 (41)	1/2 (50)	>.99
Streptococci	6/16 (38)	6/15 (40)	.89
Enterococcus	6/12 (50)	10/17 (59)	.64
Other gram-positive bacteria	2/5 (40)	1/2 (50)	>.99
E. coli	18/32 (56)	15/30 (50)	.62
Klebsiella	7/9 (78)	10/16 (63)	.66
Pseudomonas	6/11 (55)	9/16 (56)	>.99
Enterobacter	2/3 (67)	5/6 (83)	>.99
Other gram-negative bacteria	12/15 (80)	6/9 (67)	.63
Bone marrow transplant	23/34 (68)	8/18 (44)	.10
Days between bacteremia and CVC removal, (within 5 d) median (range)			
For all patients	2 (0–5)	2 (0–5)	.70
For gram-positive bacteria	2 (0–5)	3 (0–5)	.50
For gram-negative bacteria	1 (0–5)	2 (0–5)	.48
For *Candida*	2 (2–2)	2 (0–5)	.83

NOTE. CVC, central venous catheter.

[a]Unless otherwise specified.

[b]Other organisms included 2 non-*Candida* fungal infections and 1 polymicrobial infection, which included both gram-positive and gram-negative bacteria.

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Gram-negative organisms were the main etiologic pathogens for 57% of the non-CLABSIs, followed by gram-positive (35%), *Candida* (5%), and other rare organisms (2%) (Table 1). Infection occurred after a median of 58 days from CVC insertion in the CLABSI group and earlier, after 35 days, in the non-CLABSI group (Table 1). *Candida* pathogens caused the BSIs that occurred earlier, followed by gram-positive then gram-negative organisms (Table 1).

The CVC was removed within 5 days in a similar proportion of patients in both CLABSI and non-CLABSI groups (57% and 57%, respectively; $P = .94$) after a median of 2 days (range, 0–5 days). In 70% of patients with CRBSI, CVCs were removed within 5 days. In addition, CVCs were removed in 51% of patients with gram-positive CLABSIs and 55% of patients with gram-positive non-CLABSIs ($P = .61$); in 64% of patients with gram-negative CLABSIs and 58% of patients with gram-negative non-CLABSIs ($P = .51$); and in 67% of patients with *Candida* CLABSIs and 71% of patients with *Candida* non-CLABSIs ($P > .99$) (Table 1). The rate of CVC removal for each specific pathogen was also similar in both groups (Table 1).

DISCUSSION

Our findings indicate that CVCs are removed similarly and often unnecessarily in patients with CLABSIs and with non-CLABSIs (57% vs 57%; $P = .94$). The management of the catheters in patients with BSIs can be challenging. Currently, the IDSA guidelines recommend the removal of the CVC and reinsertion of a catheter at a different vascular site in patients with CRBSI.[6] Because multiple studies have demonstrated the successful salvage of the indwelling CVC through effective antimicrobial catheter lock, even in the setting of documented CRBSI,[4] the IDSA guidelines have supported such a practice for some organisms (eg, coagulase negative staphylococci, gram-negative organisms, etc).[6] However, the current practice in critically ill and/or immunocompromised cancer patients often goes to the other extreme of removing the CVC and reinserting it, even in the setting of suspected CLABSI or even any BSI in a patient with indwelling CVC rather than documented CLABSI or CRBSI.

The CVC is often removed with the assumption that it is the source of the BSI (ie, suspected CLABSI) simply because the BSI occurred in a patient with an indwelling CVC. The high rate of CVC removal (57%) in patients who neither had CLABSI nor CRBSI is surprising (Figure 1). Frequently, these patients require the insertion of a new CVC to continue their chemotherapy course. This practice may result in a substantial number of unnecessary removals and reinsertions of CVCs in this high-risk patient population with limited vascular access despite the fact that clinical and microbiologic data could be obtained and easily used to determine whether the CVC is the source of the bacteremia.

Despite the guidelines and the availability of microbiological data that could help determine whether the CVC is the source of the BSI, physicians taking care of cancer patients continue to disregard these meaningful data and decide to remove the CVC irrespective of the source of the BSI. Although we observed that the CVC removal rate in patients with CLABSIs who met the CRBSI definition was higher than in those who did not meet the CRBSI definition, which emphasizes the benefit of available resources such as quantitative blood cultures in the management of CLABSI, the rate of CVC removal in patients with non-CLABSIs remains considerable. Hence, there is a universal need for intense, targeted physician education. It is possible that many healthcare providers think that any BSI in a patient with an indwelling CVC is a CLABSI or has the potential of becoming a CLABSI or CRBSI. This assumption is based on the perception that any pathogen causing the BSI could potentially seed the CVC. Electron microscopy studies at our center have shown that the risk of hematogenous seeding of the CVC by organisms causing the BSI is very low.[9] Therefore, the CVC could be retained in non-CLABSI cases and in many documented non-MBI-CLABSI/CRBSI cases, an effective antimicrobial lock could help salvage and retain the indwelling CVC.

A potential limitation of the study is the retrospective, nonrandomized design of the study, with a relatively small number of patients whose CVC management was left at the discretion of the treating physician. Another limitation is that we did not collect information on the infectious outcome of the BSIs. However, previous small studies that evaluated different modalities of CVC management have been published.[4,10]

In conclusion, this study shows that CVCs are unnecessarily removed in 57% of cancer patients with non-CLABSIs. Intense physician education is necessary to instruct healthcare providers to avoid unnecessary removal of the CVC, particularly in patients with secondary BSIs. Further development of catheter salvage strategies (that would include an effective antimicrobial catheter lock) even in the setting of documented CLABSI are warranted.

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Potential conflicts of interest: Dr I. I. Raad is coinventor of technology related to minocycline and rifampin-coated catheters. This technology is licensed to Cook, Inc. Dr Raad receives royalties related to this technology, which is owned by The University of Texas MD Anderson Cancer Center (UTMDACC). Dr Raad is a coinventor of the minocycline-EDTA-ethanol lock solution technology, which is owned by UTMDACC and has been licensed to Novel Anti-Infective Technologies, LLC, of which UTMDACC, I. Raad, and J. Rosenblatt are shareholders. Drs I. I. Raad and J. Rosenblatt, UTMDACC, are inventors of the nitroglycerin-based catheter lock solution technology also licensed to Novel Anti-Infective Technologies, LLC.

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