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Catheter-Salvage in Home Infusion Patients with Central Line-Associated Bloodstream Infection

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Abstract

In a retrospective study of home infusion patients with central line-associated bloodstream infection, use of a central venous port, cancer diagnosis, and the absence of systemic inflammatory response syndrome were associated with use of catheter-salvage. Relapse of infection was uncommon.

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Background

The practice of home infusion has increased substantially in recent years, due in part to interest in minimizing inpatient length of stay and costs [1]. When a central line-associated bloodstream infection (CLABSI) is diagnosed in a home infusion patient, a treatment plan that retains the original intravenous catheter (catheter-salvage) may be given special consideration due to ongoing need for infusion therapy and preserving vascular access sites. For treatment of CLABSI in patients with a long-term central venous catheter, guidelines allow catheter-salvage in the absence of complications (tunnel infection, port abscess, septic thrombosis, endocarditis, or osteomyelitis) or certain pathogens such as *S. aureus*, and recommend catheter-salvage in patients requiring long-term intravascular access for survival [2]. The decision to use catheter-salvage in home infusion patients is important as this may potentially increase the risk of recurrent CLABSI when the need for vascular access is ongoing. It is not known what clinical factors, if any, may prompt the use of catheter-salvage in the home infusion population. To better understand this decision, we performed a case-control study to evaluate the influence of clinical factors on the use of catheter-salvage in adult home infusion patients with CLABSI.

Methods

This was a retrospective case-control study of adult patients in the University of Pennsylvania's home infusion therapy program who were treated for CLABSI from 7/1/08 through 12/31/12. This study received expedited approval from the University of Pennsylvania's Institutional Review Board.

Study Setting and Subjects

The diagnosis of CLABSI was determined using the Center for Disease Control and Prevention's National Healthcare Safety Network surveillance definitions [3]. All patients in the home infusion database who underwent catheter-salvage for CLABSI (the catheter was left in place during and after treatment) were included as case subjects. Control subjects were selected from all database patients whose catheters were removed during treatment using a computer-generated random number sequence until a 3:1 ratio of controls to cases was reached. Exclusion criteria were death during hospitalization for CLABSI, hospice status, nonfunctional access device, a resolved need for home infusion therapy, CLABSI admission to a non-UPHS institution (due to lack of clinical data), and all recurrent CLABSIs.

Potential Catheter-Salvage Risk Factors

The following variables were examined at the time of CLABSI diagnosis: age, gender, disease category for home infusion therapy (hematologic/oncologic, gastrointestinal, other), Charlson Comorbidity Index [4], hospital admission date, admitting service (oncology, medicine, surgery), neutropenia (absolute neutrophil count less than 1,000/μL), presence of systemic inflammatory response syndrome (SIRS) [5] within 24 hours of admission, type of access device (peripherally-inserted central catheter, subcutaneous port, other), and organisms cultured from blood (*S. aureus*, other bacteria, or fungi).

Statistical Analysis

The association of each variable with catheter-salvage was evaluated in a univariate analysis. Characteristics with univariate p-value < 0.2 were examined in a multivariate logistic regression model with the outcome of catheter salvage [6]. Nested models were compared with likelihood ratio testing, and non-nested models were compared with the Akaike Information Criteria [7]. For each comparison, we selected the model that best explained the outcome of interest using the fewest covariates [8]. All analyses were performed using STATA version 11 (StataCorp, College Station, TX).

Results

Patient Characteristics

CLABSI occurred in 263 home infusion patients during the study period. Catheter-salvage occurred in 34 patients (13.3%). After applying exclusion criteria, 31 patients remained in the salvage group (one was excluded for hospice status at time of CLABSI, and two were excluded for death during initial hospitalization). It was necessary to randomly select 122 control patients to be left with 93 controls after applying exclusion criteria. Of the 24 excluded control subjects, six were excluded for death during initial hospitalization, five for nonfunctional devices, and 13 for a resolved indication for home infusion.

Risk Factors for Catheter-Salvage

Clinical factors increasing the odds of catheter-salvage in univariate analyses included admission to an oncology service (OR 3.7, 95% CI [1.36, 10.06]) and presence of a port (OR 5.26, 95% CI [1.62, 17.08]). The presence of SIRS criteria was strongly associated with catheter-removal (OR 0.29, 95% CI [0.12, 0.69]), as was gastrointestinal disease (OR 0.13, 95% CI [0.03, 0.59], compared to hematologic/oncologic disease as a reference). Although all fungal CLABSIs were treated with catheter-removal, CLABSI due to *S. aureus* was not a risk factor for salvage or removal. Adjusted analysis showed associations between catheter-salvage and hematologic/oncologic disease (adjusted OR {aOR} 11.03, 95% CI [2.13, 56.99], p=0.004), port (aOR 4.29, 95% CI [1.08, 17.09], p=0.04), and SIRS criteria (aOR 0.30, 95% CI [0.11, 0.85], p=0.02) (see Table). After treatment, the rate of CLABSI relapse was 12.9% in salvage patients and 7.5% in control patients (p=0.36). Among the four catheter-salvage patients with CLABSI due to *S. aureus*, no relapses occurred.

Discussion

In a device-associated infection such as CLABSI, treatment without removal of the device may increase the risk of recurrent infection. Thus, the initial management of CLABSI has implications for the prevention and incidence of future CLABSI episodes. In our investigation of CLABSI among home-infusion patients, hematologic/oncologic disease, subcutaneous port, and presence of SIRS independently affected the odds of catheter-salvage. The port is a strong risk factor for catheter-salvage, likely because of the relative difficulty of removal. The negative effect of SIRS on catheter-salvage is in accordance with IDSA guidelines on the management of CLABSI in hemodynamically unstable patients [2]. The association between catheter-salvage and hematologic/oncologic disease is consistent

with our clinical experience but more difficult to explain. We suspect that patient comfort, length of stay, prognosis, and avoidance of delays in chemotherapy may influence the choice of catheter-salvage for an oncology patient with CLABSI. Notably, certain clinical factors, such as neutropenia, leukocytosis, ICU admission, and microbiology were not found to influence the odds of catheter-salvage. CLABSI recurrence was uncommon in both salvage and removal groups. Interestingly, in the four *S. aureus* patients in whom salvage was attempted, relapse did not occur.

This study had several limitations. As an observational study, we were able to control for potential confounding by measured variables only in the primary analysis. Furthermore, these findings may not be generalizable to populations without high proportions of oncology patients or subcutaneous port use.

In conclusion, certain clinical factors influenced the management of CLABSI in home infusion patients. For hemodynamically stable outpatients with CLABSI, catheter-salvage may be a safe and appropriate strategy. Additional studies are needed to prospectively evaluate the risks and long-term outcomes of catheter-salvage in a home infusion population.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table

Characteristics associated with catheter-salvage in home infusion patients with CLABSI.

	Cases (n=31)	Controls (n=93)	Univariate Analysis	
			Odds Ratio (95% CI)	***P* value**
Age category (%):				
<45	8 (26)	33 (35)	Reference	
45–55	2 (6)	24 (26)	0.34 (0.07, 1.77)	0.20
56–65	13 (41)	27 (29)	1.99 (0.72, 5.49)	0.19
>65	8 (26)	9 (10)	3.67 (1.08, 12.50)	0.04
Male Sex (%)	15 (48)	41 (44)	1.19 (0.53, 2.69)	0.68
Admitting service (%):				
Hematology/Oncology	24 (77)	40 (43)	Reference	
Medicine (non-Oncology)	6 (19)	37 (40)	0.27 (0.10, 0.73)	0.01
Surgery	1 (3)	16 (17)	0.10 (0.01, 0.84)	0.03
Disease category (%):				
Hematology/Oncology[a]	28 (90)	53 (57)	Reference	
Gastrointestinal[b]	2 (6)	29 (31)	0.13 (0.03, 0.59)	0.008
Other[c]	1 (3)	11 (12)	0.17 (0.02, 1.40)	0.10
Neutropenia (%)	7 (23)	13 (14)	1.79 (0.64, 5.01)	0.26
Leukocytosis[d] (%)	7 (23)	24 (26)	0.84 (0.32, 2.19)	0.72
SIRS criteria[e] (%)	10 (34)	60 (65)	0.29 (0.12, 0.69)	0.006
Intensive care admission (%)	2 (7)	12 (13)	0.5 (0.11, 2.38)	0.38
CCI, median (IQR)	5 (3–8)	4 (2–5)	1.25 (1.07, 1.45)	0.004
Access type (%):				
PICC[f]	18 (58)	71 (76)	Reference	
Subcutaneous Port	8 (26)	6 (6)	5.26 (1.62, 17.08)	0.006
Other[g]	5 (16)	16 (17)	1.23 (0.40, 3.81)	0.72
Difficult access (%)	0 (0)	5 (5)	Not defined	--
Causative organism (%):				
Bacterial, not *S. aureus*	27 (87)	62 (67)	Reference	
S. aureus	4 (13)	18 (19)	0.51 (0.16, 1.65)	0.26
Fungal	0 (0)	13 (14)	Not defined	--
			Multivariate Analysis	
			Odds Ratio (95% CI)	*P* value
Age category:				
< 45			Reference	
45–55			0.23 (0.03, 2.14)	0.20
56–65			2.67 (0.81, 8.85)	0.11

	Cases (n=31)	Controls (n=93)	Univariate Analysis	
			Odds Ratio (95% CI)	*P* value
>65			3.10 (0.65, 14.53)	0.16
Access type:				
PICC			Reference	
Port			4.29 (1.08, 17.09)	0.04
Other			2.30 (0.58, 9.07)	0.24
SIRS criteria met			0.30 (0.11, 0.85)	0.02
Hematology/Oncology disease			11.03 (2.13, 56.99)	0.004

[a] All solid and liquid malignancies.

[b] Short gut syndrome and chronic bowel obstruction.

[c] Infection, heart failure, pulmonary hypertension, hemophilia, and sickle cell anemia.

[d] Leukocyte count greater than 11,000/μL.

[e] At least two of the following: pulse >90/min, respirations >20/min, temperature >38.3°C or <36°C, leukocyte count >12,000 or <4,000 / μL, or >10% band forms.

[f] Peripherally-inserted central catheter.

[g] Hickman, trans-lumbar, and tunneled internal jugular catheters.