Compliance or Complication?:
Management of Bloodstream Infections in Children with Long-Term Central Venous Catheters

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Updated Abstract (58789, Poster #693)

Background: Children with long-term central venous catheters (CVC) are at increased risk for bloodstream infections (BSI). National guidelines recommend CVC removal when BSI are caused by certain pathogens, however compliance with recommendations and subsequent patient outcomes are unknown.

Methods: Retrospective cohort analysis of children (age ≤ 21 years) with CVCs hospitalized from 1/2009-12/2015 with BSI due to *Staphylococcus aureus*, *Pseudomonas* spp., *Enterococcus* spp. or *Candida* spp. Relapse and recurrence were defined as isolation of the same pathogen from CVC blood cultures at 7- 14d and 15- 60d from the date of the initial BSI, respectively. Demographic, clinical, laboratory, and outcome data were recorded.

Results: Fifty-three children (median age 6.2 y, range 0.5-21 y), had 108 BSI episodes requiring 84 hospitalizations. Underlying medical conditions included malignancy (n=17, 32.1%), hematopoietic cell (n=17, 32.1%) or solid organ transplantation (n=4, 8%) recipients, and need for therapies via CVC (n=16 (30.1%): including immunosuppressant therapy, hemodialysis or parenteral nutrition). Results are summarized in Table 3. 97% of patients received appropriate antimicrobial therapy, and the median duration of antimicrobial therapy was 14d [range 0-58d]. Antibiotic lock therapy was administered in 5 (5%) episodes of bacteremia.

Conclusion: Despite national guidelines recommending removal for pathogen-specific BSIs, 59% of CVCs were retained in our cohort of patients, the majority of whom were immunocompromised. There was a stastically significant increased rate of complications in patients in whom the CVC was retained when compared with patients with lines removed at ≤ 7 days. This data supports the need for CVC removal, particularly in children with BSI from *Candida* spp. and *Pseudomonas* spp.

Background

- Children with long-term central venous catheters (CVC) are at increased risk for bloodstream infections (BSI).
- Clinical practice guidelines recommend CVC removal or consideration of removal when BSI are caused by distinct pathogens.
- Our objective was to evaluate the gap that exists between evidence based guidelines and clinical practice and the potential impact on patient outcomes.

Methods

- Retrospective cohort analysis of children with long-term CVCs, hospitalized from January 2009 to December 2015 with primary BSI with *Staphylococcus aureus*, *Pseudomonas* spp., *Enterococcus* spp., *Mycobacteria* spp., or *Candida* spp.
- Children were considered immunocompromised if they were receiving treatment for an underlying malignancy, or were solid organ transplant or hematopoietic cell transplant recipients.
- Complicated BSI was defined as evidence of a tunnel infection or endocarditis. Relapse was defined as isolation of the same pathogen within 7- 14 days and recurrence as isolation of the same pathogen 15- 60 days from the date of the initial BSI. Isolation of the same pathogen within 7 days of the initial episode was considered to be the same BSI.
- Demographic, clinical, laboratory, and outcome data were recorded.
- Statistics were performed using GraphPad v7.

Results

Table 1. Patient Characteristics

	N= 53 Patients
Age, in years (median, [range])	6.2 [6 mo-21y]
Male: Female	29:24
Ethnicity (n, %)	
White	33 (62)
Black	11 (20)
Hispanic	5 (9)
Other or unknown	4 (4)
Underlying diagnosis* (n, %)	
Immunocompromised	37 (70)
Malignancy	17 (32)
Hematopoietic Cell Transplantation	17 (32)
Solid Organ Transplantation	4 (8)
Miscellaneous**	16 (30)
CVC Type	
Implantable port	18 (17)
Broviac	42 (39)
PICC	30 (28)
Other#	7 (6)
2 or more CVCs	11 (10)
Number of BSI episodes	108
Number of hospitalizations	84
Days CVC in place before BSI (median,[range])	65 [2-929]
Days of bacteremia (median, [range])	1 [1-12]

BSI, bloodstream infection ; PICC, peripherally inserted central catheter; CVC, central venous catheter
* 1 patient is included twice (malignancy with 1st BSI and HCT with 2nd BSI)
**Patients with rheumatologic disease (N=4), aplastic anemia (N=1), insulin- dependent diabetes (N=1), and patients who are TPN-dependent (N=8) and hemodialysis-dependent (N=2)
CVC types: apheresis (N=1), hemodialysis (N=4), and short-term (internal jugular and femoral lines, N=2)

Table 2. Management of Bloodstream Infections

	Episodes of Bacteremia N=108
Antimicrobial choice (n, %)	
Appropriate, targeted	90 (83)
Appropriate, not most narrow	15 (14)
Not appropriate*	3 (3)
Total days of antimicrobial therapy (median, [range])	14 [0-58]
Candida spp.	15 [3-48]
Staphylococcus aureus	15 [0-49]
Enterococcus spp.	13 [3-58]
Pseudomonas spp.	14 [0-27]
Followed guidelines recommendations (n, %)	
Duration of antimicrobial therapy	81 (75)
CVC removal within 14 days	44 (41)
Infectious disease consult obtained (n, %)	61^ (56)
Infectious disease recommendation regarding CVC (n, %)	51
Remove	29 (57)
Retain	19(37)
No recommendation	3 (6)
Overall CVC management	
Retained (n, %)	64 (59)
Removed (n, %)	44 (41)
Days to CVC removal from 1st + blood culture (median, [range])	4 [1-39]
≤ 3 days (n, %)	24 (55)
4-7 days	13 (30)
8-14 days	7 (16)
Days from CVC removal to new CVC placement#	1 [0-16]
Adjunctive Lock Therapy (n, %)**	5 (5)

*N=2 patients died before treatment could be initiated
^There were 10 additional infectious disease consults that were completed for antibiotic management only
In 4 patients, new line was placed prior to infected line being removed
**Gentamicin lock therapy (N=3), vancomycin lock therapy (N=1), amphotericin lock therapy (N=1)

Table 3. Patient Outcomes Based on Management Decisions

	Time to CVC Removal from First + Blood Culture			P value*
n=108 episodes	≤ 7 days n=37	8-14 days n=7	Retained CVC n=64	
Complicated BSI (n, %)	3 (8)	0	0	**0.046**
Complications (n, %)	2 (5)	6 (86)	15 (23)	**0.026**
Relapse	0	1 (17)	2 (13)	0.53
Recurrence	1 (50)	5 (83)	7 (47)	0.25
Time to Recurrence (in days; median [range])	58	41 [16-57]	28 [15-55]	-
Death**	1 (50)	0	6 (40)	0.42
Number of PICU admissions within 72 hours of positive culture (n, %)	15 (41)	4 (57)	18 (28)	0.27
Duration of Hospitalization (in days; median, [range])	21 [3-193]	119 [39-160]	24.5 [2-393]	0.59

BSI, bloodstream infection; PICU, pediatric intensive care unit
*p-value (Fisher's exact test for categorical variables, Mann-Whitney for continuous values) is comparing removal ≤ 7 days to retained CVC
**7 infections resulting in 6 deaths: *Candida* spp. (3), *Pseudomonas* spp. (2), polymicrobial (1, *Candida* spp. and *Pseudomonas* spp.)

Table 4. Outcomes by Pathogen

	Complicated BSI n=3	Relapse n=3	Recurrence n=13	Death n=7
Candida spp. (n,%)	1 (33)	0	0	4 (57)
Staphylococcus aureus	2 (67)	1 (33)	3 (23)	0
Methicillin resistant	1	1	1	
Methicillin susceptible	1	0	2	
Enterococcus spp.	0	0	7 (54)	0
Pseudomonas spp.	0	2 (67)	3 (23)	3 (43)

Figure 1. CVC Management by Pathogen

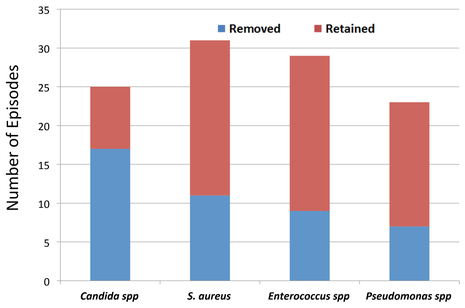
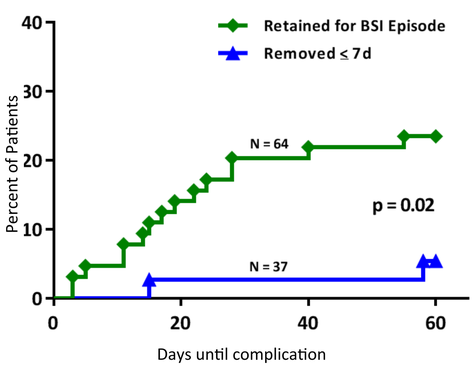


Figure 2. CVC Complications after BSI



Conclusions

- In our cohort of patients, the majority of whom were immunocompromised (70%), compliance with guideline recommendations for CVC removal was only 41%. Compliance with appropriate antibiotic choice was 97% and for total duration of antimicrobial therapy was 75%. The minority of patients (5%) received adjunctive antimicrobial lock treatment.
- Patients whose CVCs were removed ≤ 7 days from first positive blood culture had significantly fewer CVC-related complications than patients with late removal or CVC retention. In addition, these patients had fewer PICU admissions and a shorter duration of hospitalization.
- Death was only a complication in children with BSIs from *Candida* spp. and *Pseudomonas* spp.
- There is a gap between evidence based guideline recommendations and clinical practice. Additional contemporary, pediatric-specific data are required to ascertain the optimal management of BSI in children who require long-term CVCs.

References

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