Hemodialysis Catheter–Related Bacteremia in Children: Increasing Antibiotic Resistance and Changing Bacteriological Profile

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Background: Catheter-related infections limit catheter survival. The success of antimicrobial therapy for the treatment of patients with hemodialysis catheter–related bacteremia (HD-CRB) depends on the infectious organisms. We determined whether the rate of positive blood culture results per tunneled catheter–days, the spectrum of bacterial isolates, and their antibiotic susceptibility changed over time in our pediatric dialysis unit.

Methods: Data were collected retrospectively for all positive blood culture results from long-term hemodialysis patients in our pediatric unit from July 1990 to July 1995 (period A) and July 2000 to July 2005 (period B).

Results: Rates of HD-CRB were similar between periods A and B (2.1 versus 2.2/1,000 catheter-days). In period A, 33% of isolates were coagulase-positive staphylococci, with *Staphylococcus aureus* accounting for 72% of these. In period B, the most common organism was *Staphylococcus epidermidis* (28%), whereas coagulase-positive staphylococci were identified in only 17%. There was a larger number of gram-positive bacilli in period B (20%) compared with period A (4%). A significant decrease in susceptibility to penicillins (40% to 5%; $P = 0.007$) and cephalosporins (58% to 21%; $P = 0.04$), but not aminoglycosides, was noted for gram-positive bacteria. There was no significant change in susceptibility of gram-negative bacteria to cephalosporins and aminoglycosides in either period.

Conclusion: Both types of organism and antibiotic sensitivity patterns have changed over time. Based on these data, we changed our empiric antibiotic combination for HD-CRB to vancomycin plus an aminoglycoside. *Am J Kidney Dis* 50:119-123. © *2007 by the National Kidney Foundation, Inc.*

INDEX WORDS: Hemodialysis; catheter-related bacteremia; antibiotic resistance; pediatrics.

Hemodialysis is used as the initial modality in 40.3% of pediatric patients with end-stage renal disease.[1] Catheters are the most common initial vascular access, more common than arteriovenous fistulas or arteriovenous grafts (69.3%, 19.3%, and 9.1%, respectively[1]) because of small patient size and early transplantation. However, catheter-related infections limit catheter survival, and hemodialysis catheter–related bacteremia (HD-CRB) is a major cause of morbidity and mortality.[2]

The success rate of antimicrobial treatment for patients with HD-CRB depends on the infectious organisms. For selection of empiric therapy, it is important to know the spectrum of pathogens and their relative frequency and antibiotic resistance in a particular hemodialysis unit.[3,4]

The objective of this analysis is to determine whether the rate of positive blood culture results per tunneled catheter–days, the spectrum of bacterial isolates, and their antibiotic susceptibility have changed over time in our pediatric dialysis unit.

METHODS

We retrospectively reviewed records of all pediatric patients who received long-term hemodialysis at our institution from July 1990 to July 1995 (period A) and July 2000 to July 2005 (period B). We excluded patients who received short-term hemodialysis through central catheters for acute renal failure. Only patients with cuffed catheters for long-term access were included in the analysis. All cuffed catheters were placed by our Interventional Radiology service or Pediatric Surgery service and were manufactured by Quinton Instrument Company (Seattle, WA) or Medical Components (Harleysville, PA).

During period A, the catheter exit site was cleaned with a topical povidone-iodine solution at the initiation and termination of each dialysis session and covered by a dry sterile gauze dressing during the interdialytic period. During period B, the exit site was cleaned once a week with a chlorhexidine gluconate and isopropyl alcohol solution and covered with a sterile dressing treated with

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Table 1. Demographics of Patients in Periods A and B

	Period A	Period B	*P*
Dialysis population (n)	36	32	
Catheter-days	11,428	20,909	
Mean age (y)	15.9 ± 6.46	13.7 ± 6.10	NS
Male (%)	63.8	56.2	NS
African American (%)	61.1	40.6	NS
White (%)	38.9	40.6	NS
Hispanic (%)	0	18.8	0.008
Disease process			
Glomerulonephritis (%)	50	43.7	NS
Obstructive uropathy (%)	16.6	15.6	NS
Dysplasia (%)	8.3	28.1	0.03
Other (%)	25.1	12.6	NS

Note: Values expressed as mean ± SD or percent.
Abbreviation: NS, not significant.

chlorhexidine gluconate. During period A, the gauze dressing was changed 3 times weekly with each hemodialysis session, whereas during period B, the dressing was changed once weekly. No topical or systemic antibiotic prophylaxis was used in any patient. Blood cultures were obtained from the hemodialysis catheter when there was clinical suspicion of an infection. Peripheral-blood cultures were not routinely collected. We ascertained all positive blood culture results submitted for these patients during these 2 periods. All blood cultures, for inpatients and outpatients, were analyzed at the University of Florida Shands Hospital central microbiology laboratory. Isolated organisms and their antibiotic susceptibility patterns were recorded and compared between the 2 periods.

Statistical comparison of the 2 groups in periods A and B for baseline differences was performed using Mann-Whitney *U* test (for continuous variables) or Fisher exact test (for categorical variables), as appropriate. Comparison of antibiotic sensitivity percentages between the 2 periods was made using Fisher exact test. The rate of positive blood culture results was determined according to the Centers for Disease Control and Prevention recommendations and expressed as number of positive blood culture episodes during the observation period per 1,000 catheter-days.[5] Total number of catheter-days was determined as the sum of all days with a catheter for each patient during the specific period. *P* of 0.05 or less is considered significant.

RESULTS

Medical records of all patients who received long-term hemodialysis during the 2 periods were reviewed. Thirty-six patients in period A and 32 patients in period B were included for analysis. Table 1 lists patient characteristics for both study periods. Patients' ages were grossly similar for both groups. A total of 82 and 61 catheters were used for vascular access in periods A and B, respectively (Table 2). Most catheters were placed in the subclavian vein during period A, whereas the internal jugular site was used more often in period B. Only 6 catheters in period B were placed by Interventional Radiology; the remainder of catheters in period B and all catheters in period A were placed by Pediatric Surgery. Twenty-four episodes of positive blood culture results were documented during period A, and 46 episodes, during period B. However, rates of positive blood culture results were almost identical, with 2.1 episodes/1,000 catheter-days during period A and 2.2 episodes/1,000 catheter-days during period B. The majority of patients in both groups with HD-CRB were hospitalized; only a small percentage required admission to the intensive care unit. All patients were treated with intravenous antibiotics, even if they were not admitted to the hospital. During period A, the choice of empiric antibiotic therapy was based on physician preference. Combinations of cefazolin, oxacillin, or vancomycin plus an aminoglycoside or third-generation cephalosporin were used. During period B, vancomycin plus cefepime or ceftriaxone were routinely administered. Antibiotic locks were used in only 5 patients during period B. The catheter was salvaged in 3 patients who received antibiotic locks. The number of patients receiving antibiotic locks was small, and the catheter exchange rate in this group was not different from the overall rate observed during

Table 2. Catheter Characteristics

	Period A	Period B	*P*
No. of catheters used	82	61	
No. of new catheter insertions	33	24	NS
No. of catheter exchanges	36	22	NS
Internal jugular (%)	40.2	67.2	0.0008
Subclavian (%)	57.3	24.6	0.0007
Femoral (%)	2.5	4.9	NS
Other (%)	0	3.3	NS
Positive BCx events (episodes/1,000 catheter-d)	2.1	2.2	NS
Patients with >1 positive BCx	5	11	NS
Associated catheter malfunction (n)	4	1	0.039
Hospitalization (%)	73.9	63	NS
Intensive care unit hospitalization (%)	5.8	13	NS
Required catheter removal (%)	43.4	36.9	NS

Abbreviations: NS, not significant; BCx, blood culture.