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Bacteremia in a pediatric hemodialysis unit secondary to *Enterococcus fecalis*

Leonard C. Hymes[1], Barry L. Warshaw[1], Bertha Clowers[1], Pamela Newsome[2], and Harry L. Keyserling[2]

[1] Division of Nephrology, Department of Pediatrics, Emory University School of Medicine and Egleston Children's Hospital, Atlanta, Georgia, USA
[2] Division of Infectious Diseases, Department of Pediatrics, Emory University School of Medicine and Egleston Children's Hospital, Atlanta, Georgia, USA

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Abstract. Bacteremia is often a serious and recurring problem in children with hemodialysis catheters. We report an outbreak of *Enterococcus* bacteremia in a pediatirc hemodialysis unit occurring from June 1992 to June 1993. During this period, 18 episodes of bacteremia occurred in eight children; 11 infections were polymicrobial. *Enterococcus fecalis* was associated with 13 infections in five patients (8 polymicrobial). Other pathogens included *Enterobacter cloacae* (5 infections), *Staphylococcus* (3), *Staphylococcus epidermidis* (2), and *Klebsiella pneumoniae* (2). All *Enterococcus* infections occurred in patients with dual-lumen subclavian venous catheters. Skin and catheter sites were culture negative, except in one patient. Rectal swabs were positive for *Enterococcus* in five patients. *Enterococcus* was not isolated from any source within the unit. Serotypes of all *Enterococcus* isolates were different, except for 2 isolates in the same patient. Starting in June 1993, catheters were flushed after dialysis with vancomycin or ampicillin. Since initiating this procedure, further episodes of *Enterococcus* bacteremia have not occurred. A questionnaire sent to other pediatric hemodialysis units failed to identify *Enterococcus* among 26 cases of bacteremia. In conclusion: (1) *Enterococcus* is an unusual pathogen for hemodialysis-related bacteremia in children; (2) patients with dialysis catheters were predisposed to this infection; (3) a common source for *Enterococcus* could not be identified by either culture or by serotyping; (4) flushing catheters with antibiotics after dialysis was effective prevention.

Key words: Bacteremia – Hemodialysis – *Enterococcus fecalis*

Correspondence to: L.C. Hymes, Emory University School of Medicine, Department of Pediatrics, Division of Nephrology, 2040 Ridgewood Drive, N. E., Atlanta, Georgia 30322, USA

Introduction

Dual-lumen venous catheters are widely used for vascular access in hemodialysis patients. These catheters are especially useful in children when surgical construction of ateriovenous fistulas is difficult, if not impossible. By providing vascular access in small patients, dual-lumen catheters have permitted the employment of chronic hemodialysis in infants and children who otherwise could not receive this life-sustaining treatment.

However, patients with hemodialysis catheters are at risk for blood-borne bacterial infections. Catheter-related bacteremia may be mild and easily treated with intradialytic antibiotics, but can also be associated with significant problems, including recurrences of infection, loss of vascular access site, septic shock, and the development of drug hypersensitivity with the repeated use of antibiotics. In this paper, we report an outbreak of bacteremia secondary to *Enterococcus fecalis* in a pediatric hemodialysis unit. Our investigation for the source of infection and our method for eradicating the problem are discussed.

Patients and methods

The pediatric hemodialysis unit is a four-station facility situated within Egleston Children's Hospital in Atlanta, (Georgia, USA) and provides hemodialysis to 12 children. The water supply is provided from a

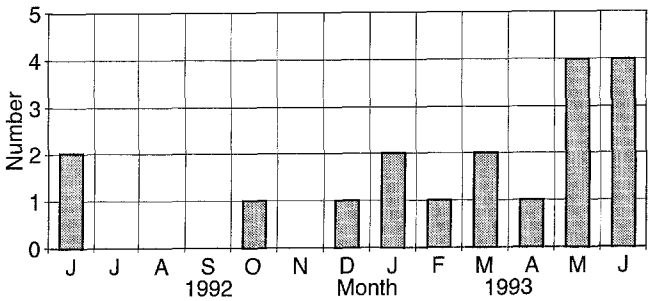

Fig. 1. Hemodialysis bacteremia: number of episodes by month from June 1992 to June 1993

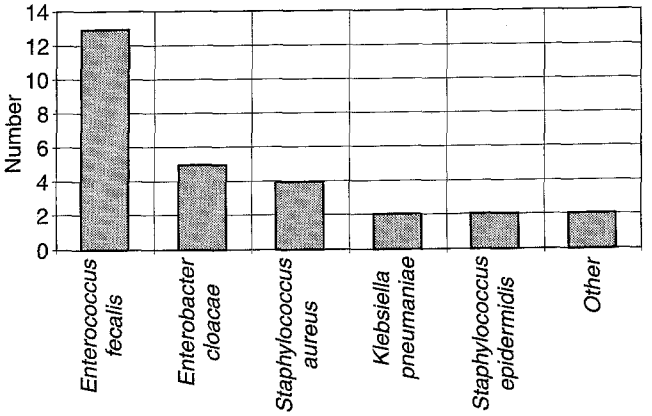

Fig. 2. Hemodialysis bacteremia: frequency of pathogens

central source and purified by a reverse osmosis system (Continental Water Systems, Atlanta, Ga., USA). Bacterial cultures are obtained routinely every month from each individual dialysis machine (Fresenius USA, Concord, Calif., USA) and from the reverse osmosis system. Blood cultures were obtained in all febrile patients directly from hemodialysis catheters. Exit site care was performed by dialysis nurses after each treatment. In June 1993, additional cultures were obtained from stool, skin catheter exit sites, waste disposal devices, and medication vials. Isolates of *Enterococcus fecalis* from blood cultures were sent to the Centers for Disease Control in Atlanta, Georgia for serotyping. Serotyping of fecal cultures was not performed.

Results

Eighteen episodes of bacteremia in eight children occurred from June 1992 to June 1993 (Fig. 1). All patients were febrile (>38 °C). Vascular access in these patients included a polytetrafluoroethylene graft in the lower extremity of one child; the other seven children had permanent (cuffed) subclavian venous catheters. All catheters were inserted in the operating suites by qualified surgeons. Infections were treated with appropriate antibiotics for 2 weeks. One patient required hospitalization.

Enterococcus fecalis was the most prevalent organism identified during this 12-month period and was associated with 13 infections in five patients, all with permanent subclavian venous catheters (Fig. 2). From June 1992 to December 1992, 2 episodes of *Enterococcus* bacteremia occurred in one patient (Table 1). Starting in January 1993, 11 episodes of *Enterococcus* bacteremia occurred in five patients. Eight infections with *Enterococcus* were polymicrobial, and included 3 infections with *Enterobacter cloacae*, 3 infections with *Staphylococcus aureus*, and 2 infections with *Staphylococcus epidermidis* (Table 1). Five infections with *Enterococcus* in four children were monomicrobial. Three polymicrobial and 2 monomicrobial infections were not associated with *Enterococcus* (Table 1).

Enterococcus bacteremia occurred in one child within 3 days of catheter placement; all other infections occurred 4 weeks or later after catheter insertion. Another patient development *Enterococcus* bacteremia shortly after transferring from another dialysis center where there was no previous history for infection using the same catheter. One

Table 1. Patients with bacteremia: month and organisms

Date	Patient no.	Organisms
1992		
June	1	*Klebsiella pneumonia*/Enterobacter cloacae
	2	*Enterococcus fecalis*/*S. aureus*
October	2	*Enterococcus fecalis*/*S. aureus*
December	2	*Klebsiella pneumoniae*
1993		
January	3[a]	*S. aureus*
	4	*Enterococcus fecalis*
February	5	*Enterococcus fecalis*/*Enterobacter cloacae*
March	4	*Enterococcus fecalis*/*S. aureus*
	6	*Enterococcus fecalis*/*Enterobacter cloacae*
April	6	*Enterococcus fecalis*/*Enterobacter cloacae*
May	6	*Enterococcus fecalis*
	4	*Enterococcus fecalis*
	7	*S. xylasus*/*Klebsiella oxytoca*/Acinetobacter calcoaceticus
	2	*Enterococcus fecalis*
June	2	*Enterococcus fecalis*/*S. epidermidis*
	7	*Enterobacter aerogenes*/*Xanthomonas maltiphilia*
	8	*Enterococcus fecalis*
	6	*Enterococcus fecalis*/*S. epidermidis*

S. aureus, *Staphylococcus aureus*; *S. xylosus*, *Staphylococcus xylosus*; *S. epidermidis*, *Staphylococcus epidermidis*

[a] Polytetrafluoroethylene graft

patient underwent catheter removal and reinsertion at the contralateral subclavian site after two infections with *Enterococcus* in June 1992 and Octoberer 1992 and with *Klebsiella* in December 1992. *Enterococcus* bacteremia recurred in May 1993 and June 1993.

The cause for this outbreak could not be determined. Fecal contamination of dialysis lines which were held over waste disposal cannisters during saline priming was considered a possible source but could not be verified. *Enterococcus* was not isolated from any source within the dialysis unit, including the waste disposal devices, central water supply, dialysis baths, intravenous solutions, or medication vials. Skin and catheter sites were culture negative for *Enterococcus*, except in one patient. Rectal swabs were positive for *Enterococcus* in all five children with *Enterococcus* bacteremia and in one child with bacteremia secondary to *S. aureus*. A common dialysis machine could not be identified for each infection with *Enterococcus*. Serotypes of all *Enterococcus* isolates were different, except for 2 isolates from the same patient.

Starting in June 1993, catheters were flushed after dialysis with vancomycin or ampicillin in all patients with dialysis catheters. The technique is as follows: 1 ml of vancomycin (50 mg/ml) was added to 250 ml of normal saline; 0.25 ml (50 μg) was mixed with heparin sulfate (5,000 units/ml) to a total volume appropriate for catheter size (0.9–1.3 ml) and instilled into each lumen after completion of dialysis. For ampicillin, the procedure was the same except that 0.50 ml (100 μg) was added to heparin sulfate (10,000 units/ml).

We employed the antibiotic-heparin flush technique for 12 months in children with dialysis catheters, and further episodes of *Enterococcus* bacteremia did not occur during this period. Currently, we are not initiating this procedure in

new patients with catheters and have discontinued this procedure in all but two children. As of 1 January 1995, *Enterococcus* bacteremia has not occurred in any patient receiving dialysis in our unit.

Discussion

The recurrences of catheter-related bacteremia with *Enterococcus fecalis* led to an exhaustive search for the cause of this outbreak, but the source of contamination could not be identified by cultures. Additionally, serotyping of enteroccocal isolates suggested that there was not a common source for infection. *Enterococcus fecalis* was recovered from the stool in all five patients with enterococcal bacteremia, suggesting that stool colonization may have served as a reservoir for this pathogen. Ultimately, by instilling catheter lumens with a solution of heparin and antibiotics, we were able to prevent recurrences of *Enterococcus* bacteremia.

Bacterial colonization of hemodialysis catheters has been reported in 21.6% of adult patients and catheter-related bacteremia in 9.4% [1], with *S. epidermidis* and *aureus* the most frequently isolated organisms from blood cultures [1, 2]. The source of infection is usually the skin exit site or intraluminal contamination [2, 3]. Additionally, *S. aureus* nasal carriers are at a higher risk for staphylococcal septicemia than are noncarriers [4]. Rarely, other organisms such as *Enterococcus fecalis* are found in isolated cases [2, 5]. Outbreaks of bacteremia with *Enterococcus*, such as we described, have not been reported. A questionnaire was sent to 15 pediatric hemodialysis units to determine if bacteremia is a frequent problem among children with permanent catheters. Eight units responded and reported 26 cases of bacteremia. Seven units considered bacteremia a significant problem, but did not employ prophylactic antibiotics. *S. aureus* was the most prevalent pathogen; *Enterococcus fecalis* was not reported from any unit.

Several techniques for prevention of catheter-related infections have been described. Levin et al. [4] reduced the incidence of bacteremia with the application of topical povidone-iodine ointment to catheter exit sites. The beneficial effect of this technique was most apparent in *S. aureus* nasal carriers who were considered a high-risk group. Others have prevented recurrences of bacteremia by changing the catheter over a guidewire [6]. The practice of flushing catheter lumens with antibiotics was first described in a case of recurrent *Proteus mirabilis* bacteremia [7] and in a child with *Staphylococcus* and *Klebsiella* infections [8]. We adopted this technique when our efforts to identify a source for enterococcal infection proved to be futile. We had considered removing catheters in children with recurring infections. This policy would have resulted in loss of vascular access sites, and we also feared that bacteremia would recur in new catheters. One patient did have recurrences of *Enterococcus* bacteremia after catheter replacement. By using an antibiotic-heparin flush solution, we prevented recurrences of *Enterococcus* infection and preserved vascular access sites. Potentially, this procedure could increase the risk for infections with vancomycin-resistant *Enterococcus*, a problem which was recently reported from another dialysis center [5]. Despite this concern, the antibiotic-heparin flush procedure could be considered before catheter removal is deemed necessary in patients with vascular access problems and recurring catheter infections.

References

1. Dahlberg PJ, Yutuc WR, Newcomer KL (1986) Subclavian hemodialysis catheter infections. Am J Nephrol 7: 421–427
2. Admirall J, Gonzalez J, Rello J, Campistol JM, Montoliu J, Puig de la Bellacas J, Revert L, Gatell JM (1989) Infection of hemodialysis catheters: incidence and mechanisms. Am J Nephrol 9: 454–459
3. Cheesebrough JS, Finch RG, Burder RP (1986) A prospective study of the mechanisms of infection associated with hemodialysis catheters. J Infect Dis 154: 579–589
4. Levin A, Mason AJ, Jindal KK, Fong IW, Goldstein MB (1991) Prevention of hemodialysis subclavian vein catheter infections by topical povidone-iodine. Kidney Int 40: 934–938
5. Ramos E, Morris JG, Polish L, Schalbe RS, Spar B, Thomas R, Light PD. Clinical and epidemiological features of vancomycin resistant enterococcus bacteremia in a dialysis center. Proceedings of the 27th Annual Meeting of the American Society of Nephrology, Orlando, 26–29, 1994, p. 472.
6. Carlisle EJ, Blake P, McCarthy F, Vas S, Uldall R (1991) Septicemia in long-term jugular hemodialysis catheters; eradicating infection by changing the catheter over a guidewire. Int J Artif Organs 14: 150–153
7. Dimoto DT, Kennedy DJ (1987) Antibiotic treatment of chronic central venous hemodialysis catheter infection without catheter removal. Int J Artif Organs 10: 239–240
8. Sheth KJM, Henrickson KJ (1993) Prevention of recurrent central venous catheter infections with a novel flush solution in a patient on long-term hemodialysis (letter). Pediatr Nephrol 7: 506