JOURNAL OF CLINICAL MICROBIOLOGY, Sept. 2004, p. 4399–4402 Vol. 42, No. 9
0095-1137/04/$08.00+0 DOI: 10.1128/JCM.42.9.4399–4402.2004

Continuous Ambulatory Peritoneal Dialysis-Related Peritonitis Associated with Lancefield Group G Beta-Hemolytic Streptococcus: Report of Two Cases Requiring Tenckhoff Catheter Removal

Patrick C. Y. Woo, Samson S. Y. Wong, Susanna K. P. Lau, and Kwok-yung Yuen*

Department of Microbiology, Queen Mary Hospital, The University of Hong Kong, Hong Kong

Received 4 March 2004/Returned for modification 7 May 2004/Accepted 27 May 2004

We describe the first two cases of continuous ambulatory peritoneal dialysis-related peritonitis associated with Lancefield group G beta-hemolytic streptococci in the literature. Both patients presented with abdominal pain and turbid dialysis effluent with or without fever. Both had concomitant gastrointestinal tract disturbance. Both did not respond to intraperitoneal cefazolin and tobramycin and required removal of the Tenckhoff catheters.

CASE REPORTS

Case 1. A 38-year-old Chinese woman was admitted to the hospital in November 2003 because of abdominal pain and cloudy dialysis effluent for 1 day. She had a history of end stage renal disease as a result of hypertensive nephrosclerosis, for which continuous ambulatory peritoneal dialysis (CAPD) had commenced 6 years ago. She had an episode of *Pseudomonas aeruginosa* peritonitis in 1999, which required removal and reinsertion of the Tenckhoff catheter. She had 3 days of constipation prior to the development of abdominal pain and cloudy dialysis effluent. On admission, she was afebrile with generalized abdominal tenderness and turbid dialysis effluent. The hemoglobin was 7.2 g/dl; the total white cell count was 17.2 $\times$ 10^9/liter, with a neutrophil count of 15.0 $\times$ 10^9/liter, a lymphocyte count of 0.7 $\times$ 10^9/liter, a monocyte count of 1.3 $\times$ 10^9/liter, and an eosinophil count of 0.2 $\times$ 10^9/liter; and the platelet count was 376 $\times$ 10^9/liter. The serum urea and creatinine levels were 26.2 mmol/liter and 1,110 μmol/liter, respectively, with normal levels of liver enzymes except an elevated alkaline phosphatase level of 164 U/liter. The total leukocyte count of the dialysis fluid was 3,315 $\times$ 10^6/liter. A Gram stain of the dialysis effluent after centrifugation revealed only numerous leukocytes; no microorganisms were seen. Intraperitoneal cefazolin and tobramycin were started for empirical treatment of CAPD peritonitis.

Culture of the dialysis effluent obtained on admission yielded pure growth of a gram-positive coccus in chains. It appeared on horse blood agar as beta-hemolytic, white, smooth colonies 1 mm in diameter after incubation at 37°C in 5% CO_2 for 24 h. It did not grow on MacConkey agar. The isolate was catalase negative. Lancefield serogrouping with Streptex (Murex Biotech Ltd., Dartford, United Kingdom) revealed that it was group G. It was identified as *Streptococcus dysgalactiae* by the Vitek GPI system (bioMerieux Vitek, Hazelwood, Mo.) with >99% confidence. 16S rRNA gene sequencing, using primers and the protocol described in our previous publication (16) and *Streptococcus pyogenes* (ATCC 19615) as the control, showed that it was *S. dysgalactiae* subsp. *equisimilis*. The isolate was sensitive to penicillin, erythromycin, clindamycin, and vancomycin.

The patient did not respond to cefazolin and tobramycin, which were stopped on day 4, and intraperitoneal vancomycin and amikacin were commenced. As the response was still unsatisfactory after another 4 days, intravenous ceftazidime and amikacin were commenced and the Tenckhoff catheter was removed. The two sets of blood cultures taken on admission were negative for bacteria after 7 days of incubation. The patient received 2 weeks of intravenous ceftazidime and amikacin. Due to the presence of extensive peritoneal adhesions, the patient was subsequently put on long-term hemodialysis.

Case 2. A 41-year-old Chinese man was admitted to the hospital in December 2003 because of fever, chills, rigor, abdominal pain, watery diarrhea (10 times per day), and cloudy dialysis effluent for 1 day. He had end stage renal disease of unknown etiology, for which CAPD had commenced 18 years ago. He had had a cadaveric renal transplant in 1991, complicated by acute graft rejection on day 6 after transplant, with graft kidney nephrectomy in 1997. He also had secondary hyperparathyroidism with total parathyroidectomy and left forearm autotransplantation in 2000. On admission, he had a temperature of 39°C with generalized abdominal tenderness and turbid dialysis effluent. The hemoglobin was 10.6 g/dl; the total white cell count was 5.4 $\times$ 10^9/liter, with a neutrophil count of 4.2 $\times$ 10^9/liter, a lymphocyte count of 0.6 $\times$ 10^9/liter, a monocyte count of 0.0 $\times$ 10^9/liter, an eosinophil count of 0.6 $\times$ 10^9/liter, and a basophil count of 0.0 $\times$ 10^9/liter; and the platelet count was 191 $\times$ 10^9/liter. The serum urea and creatinine levels were 28.5 mmol/liter and 1,106 μmol/liter, respectively, with normal levels of liver enzymes. The total leukocyte count of the dialysis fluid was 5,432 $\times$ 10^6/liter. A Gram stain of the dialysis effluent after centrifugation revealed only numerous leukocytes; no microorganisms were seen. Intraperitoneal cefazolin and tobramycin were started for empirical treatment of CAPD peritonitis.

* Corresponding author. Mailing address: Department of Microbiology, The University of Hong Kong, University Pathology Building, Queen Mary Hospital, Hong Kong. Phone: (852) 28554892. Fax: (852) 28551241. E-mail: hkumicro@hkucc.hku.hk.

Culture of the dialysis effluent obtained on admission yielded two organisms. The first one was a gram-positive coccus in chains that appeared on horse blood agar as beta-hemolytic, white, smooth colonies 1 mm in diameter after incubation at 37°C in 5% CO_2 for 24 h. It did not grow on MacConkey agar. The isolate was catalase negative. Lancefield serogrouping with Streptex (Murex Biotech Ltd.) revealed that it was group G. It was identified as *S. dysgalactiae* by the Vitek GPI system (bioMerieux Vitek) with >99% confidence. 16S rRNA gene sequencing showed that it was *S. dysgalactiae* subsp. *equisimilis*. The isolate was sensitive to penicillin, erythromycin, clindamycin, and vancomycin. The second one was a gram-negative strictly anaerobic bacillus. It appeared on horse blood agar as nonhemolytic, smooth, gray colonies 1 mm in diameter after incubation at 37°C in an anaerobic environment for 24 h. It was identified as *Bacteroides fragilis* by the Vitek ANI system (bioMerieux Vitek) with >99% confidence.

The patient did not respond to cefazolin and tobramycin, which were stopped on day 4, and intraperitoneal vancomycin and amikacin were commenced. As the response was still unsatisfactory after another 4 days, intravenous penicillin was commenced and the Tenckhoff catheter was removed. The two sets of blood cultures taken on admission (Bactec 9240; Becton Dickinson) were negative for bacteria after 7 days of incubation. Stool for aerobic culture, *Clostridium difficile* culture and cytotoxin detection, and parasitic ovum and cyst examination performed on admission were all negative. The patient received 2 weeks of intravenous penicillin. Due to the discovery of a carcinoma in the sigmoid colon with carcinomatosis and peritoneal metastasis 1 month after the episode of CAPD-related peritonitis, the patient was put on long-term hemodialysis.

Lancefield groups A, B, C, and G are the major groups of beta-hemolytic streptococci causing infections in humans (8, 14, 16, 19). Although it has been shown in various studies that group G beta-hemolytic streptococci are the commonest cause of beta-hemolytic bacteremia in some parts of the world (12, 16), relatively little is known about the other diseases caused by group G beta-hemolytic streptococci versus those caused by group A or group B beta-hemolytic streptococci. In our recent study, we showed that 52, 26, and 12% of patients with group G beta-hemolytic streptococcal bacteremia had primary bacteremia, cellulitis, and bed sore or wound infection, respectively, and that the remaining 10% had infective endocarditis, pneumonia, abscess, and septic arthritis (16).

The most common pathogens associated with peritonitis in patients with CAPD are the gram-positive bacteria, which constitute 60 to 80% of all isolates. These include coagulase-negative staphylococci, *Staphylococcus aureus*, and diphtheroids, which are essentially part of the normal skin flora. The reason for their predominance as causative agents in CAPD-related peritonitis presumably is associated with the portal of entry along the Tenckhoff catheter in situ. Gram-negative bacteria are much less frequently isolated, with members of the *Enterobacteriaceae* and *Pseudomonas* species being the most commonly involved. Less frequently seen are *Acinetobacter* species, anaerobic bacteria, *Mycobacterium* species, and *Candida albicans*. Recently, we have reported cases of CAPD-related peritonitis caused by pathogens rarely associated with this condition (7, 15, 18). For CAPD-related peritonitis associated with *Streptococcus* and *Enterococcus* species, these bacteria account for about 10 to 15% of the total number of cases (5, 6, 9). Most of these cases were associated with *Enterococcus faecalis* or viridans group streptococci. On the other hand, as of January 2004, only 12 cases of CAPD-related peritonitis caused by beta-hemolytic streptococci have been reported in the English literature (1–6, 10, 11; T. P. Officer, J. Black, C. Rotellar, J. F. Winchester, and T. A. Rakowski, Letter, Am. J. Med. **87:**487, 1989; D. Pagniez, A. Fruchart, and P. Dequiedt, Letter, Nephron **71:**480, 1995; A. M. Yinnon, V. Jain, and C. R. Magnussen, Letter, Perit. Dial. Int. **13:**241, 1993). None of them was caused by group G beta-hemolytic streptococcus. In this article, we describe the first two cases of CAPD-related peritonitis associated with group G beta-hemolytic streptococci in the literature.

Compared to CAPD-related peritonitis caused by other gram-positive bacteria, such as coagulase-negative staphylococci, *S. aureus*, diphtheroids, enterococci, and viridans group streptococci, CAPD-related peritonitis associated with beta-hemolytic streptococci seems to be more difficult to treat. Including the present 2 cases, 14 cases of CAPD-related peritonitis caused by beta-hemolytic streptococci have been reported in the English literature (Table 1) (1–6, 10, 11; Officier et al., letter; Pagniez et al., letter; Yinnon et al., letter). Overall, 7 (58%) of the 12 cases with information available had bacteremia (cases 1, 6, and 9), required removal of the Tenckhoff catheter (cases 2, 6, 13, and 14), and/or died (cases 1 and 8). Early removal of Tenckhoff catheters should be considered in patients with CAPD-related peritonitis associated with beta-hemolytic streptococci.

The route of transmission in the present two cases of CAPD-related peritonitis caused by group G beta-hemolytic streptococci could be due to direct contamination of the connection device or bacterial translocation through the gastrointestinal tract. CAPD-related peritonitis has been reported to be associated with other bacteria that reside in the gastrointestinal tract and those that cause diarrhea (13, 18; W. Al-Wali, R. Baillod, J. M. T. Hamilton-Miller, and W. Brumfitt, Letter, Lancet **ii:**957, 1988). For some patients, it was obvious that they acquired their infections through direct contamination of the catheters (13; Al-Wali et al., letter). On the other hand, the other patients, especially those with histories of diarrhea, probably acquired the infection through the oral route. In these patients, the bacteria could have reached the peritoneal cavity by translocation across the intestinal wall into the peritoneal cavity or direct contamination of the connection device by the hands of patients that were contaminated with the bacteria. Both of our two patients with group G beta-hemolytic streptococcal CAPD-related peritonitis had concomitant gastrointestinal tract disturbance, and one also had colonic carcinoma and had *B. fragilis* recovered from the peritoneal dialysate. In fact, in a lot of the patients with group G beta-hemolytic streptococcal primary bacteremia, the gastrointestinal tract was believed to be the source of the group G beta-hemolytic streptococci (16). Furthermore, in one of our bacteremic patients infected with erythromycin-resistant group G beta-hemolytic streptococci, the erythromycin resistance methylase

TABLE 1. Characteristics of patients with CAPD peritonitis caused by beta-hemolytic streptococci reported in the literature

Patient no.	Reference or source[c]	Sex/age (yr)	Underlying diseases other than end stage renal failure	Lancefield grouping (species, if available)	Presence of bacteremia	Other bacteria recovered in peritoneal dialysate	Anibiotic treatment[b]	Removal of Tenckhoff catheter	Outcome
1	5	NM[a]	NM	B	Yes	NM	NM	NM	Died
2	4	F/38	None	A	No	None	i.v. and oral cefalothin, i.v. penicillin G and benzathine penicillin	Yes	Remission
3	6	NM	NM	NM	NM	NM	NM	NM	NM
4	3	F/55	Amyloidosis	A	No	None	i.p. vancomycin	No	Remission
5	LA	NM	NM	A	NM	NM	NM	NM	Remission
6	11	M/1	None	B	Yes	None	i.p. cefazolin and tobramycin, i.v. antibiotics	Yes	Remission
7	11	M/5	None	B	No	None	i.p. cefazolin and tobramycin, i.v. antibiotics	No	Remission
8	2	M/52	None	B (*S. agalactiae*)	No	None	i.v. vancomycin and i.m and i.p. gentamicin	No	Died
9	LB	M/63	None	B (*S. agalactiae*)	Yes	None	i.p. vancomycin and gentamicin	No	Remission
10	1	M/70	HIV[d] infection, diabetes mellitus, acute gastroenteritis caused by *Cryptosporidium* and *Salmonella*[e]	A (*S. pyogenes*)	No	None	i.p. vancomycin and amikacin	No	Remission
11	LC	M/25	None	B	No	None	i.p. and i.v. piperacillin and cefalothin	No	Remission
12	10	F/23	None	B (*S. agalactiae*)	No	None	i.p. cefazolin and netilmicin	No	Remission
13	Present report (case 1)	F/38	None	G (*S. dysgalactiae*)	No	None	i.p. cefazolin and tobramycin, i.p. vancomycin and amikacin, i.v. ceftazidime and amikacin	Yes	Remission
14	Present report (case 2)	M/41	Secondary hyperparathyroidism with total parathyroidectomy and autotransplantation	G (*S. dysgalactiae*)	No	*B. fragilis*	i.p. cefazolin and tobranmycin, i.p. vancomycin and amikacin, i.v. penicillin	Yes	Remission

[a] NM, not mentioned.
[b] i.v., intravenous; i.m., intramuscular; i.p., intraperitoneal.
[c] LA, officer et al., letter; LB, Yinnon et al., letter; LC, Pagniez et al., letter.
[d] HIV, human immunodeficiency virus.
[e] *Salmonella enterica* serovar Paratyphi B.

gene (*erm*) was probably acquired by horizontal gene transfer of the *erm* gene from other bacteria in the gastrointestinal tract (17). Therefore, the origin of the group G beta-hemolytic streptococci in the present two cases was probably the gastrointestinal tract, although the portal of entry in them remains elusive.

This work is partly supported by the University Development Fund, University Research Grant Council, and the Committee for Research and Conference Grant, The University of Hong Kong, and the William Benter Infectious Disease Fund.

REFERENCES

1. **Abraham, G.** 1995. *Streptococcus pyogenes* peritonitis associated with genital swelling and gastroenteritis caused by *Cryptosporidium* and *Salmonella paratyphi* B in an HIV infected patient on CAPD. Nephrol. Dial. Transplant. **10:**140–141.
2. **Borra, S. I., J. Chandarana, and M. Kleinfeld.** 1992. Fatal peritonitis due to group B beta-hemolytic streptococcus in a patient receiving chronic ambulatory peritoneal dialysis. Am. J. Kidney Dis. **19:**375–377.
3. **Cavalieri, S. J., J. M. Allais, P. M. Schlievert, D. L. Dworzack, and R. B. Clark.** 1989. Group A streptococcal peritonitis in a patient undergoing continuous ambulatory peritoneal dialysis. Am. J. Med. **86:**249–250.
4. **Dadone, C., L. Bonnoldi, G. Giltri, L. Vigore, and R. Redaelli.** 1983. Severe peritonitis during CAPD due to beta hemolytic streptococcus Lancefield group A. Perit. Dial. Bull. **3:**109.
5. **Fenton, S., G. Wu, D. Cattran, A. Wadgymar, and A. F. Allen.** 1981. Clinical aspects of peritonitis in patients on CAPD. Perit. Dial. Bull. **1:**94–96.
6. **Krothapalli, R. K., H. O. Senekjian, and J. C. Ayus.** 1983. Efficacy of intravenous vancomycin in the treatment of gram-positive peritonitis in long-term peritoneal dialysis. Am. J. Med. **75:**345–348.
7. **Lau, S. K. P., P. C. Y. Woo, S. K. Chiu, K. W. Leung, R. W. H. Yung, and K. Y. Yuen.** 2003. Early diagnosis of *Exophiala* CAPD peritonitis by 18S ribosomal RNA gene sequencing and its clinical significance. Diagn. Microbiol. Infect. Dis. **46:**95–102.
8. **Lau, S. K. P., P. C. Y. Woo, T. C. Yim, A. P. C. To, and K. Y. Yuen.** 2003. Molecular characterization of a strain of group A streptococcus isolated from a patient with psoas abscess. J. Clin. Microbiol. **41:**4888–4891.
9. **Rubin, J., W. A. Rogers, H. M. Taylor, E. D. Everett, B. F. Prowant, L. V. Fruto, and K. D. Nolph.** 1980. Peritonitis during continuous ambulatory peritoneal dialysis. Ann. Intern. Med. **92:**7–13.
10. **Scanziani, R., B. Dozio, I. Baragetti, P. Grillo, L. Colombo, S. De Liso, and M. Surian.** 1999. Vaginal colonization with group B streptococcus (*Streptococcus agalactiae*) and peritonitis in a woman on CAPD. Nephrol. Dial. Transplant. **14:**2222–2224.
11. **Schroder, C. H., M. C. de Jong, and L. A. Monnens.** 1991. Group B streptococcus: an unusual cause of severe peritonitis in young children treated with continuous ambulatory peritoneal dialysis. Am. J. Kidney Dis. **17:**231–232.
12. **Skogberg, K., H. Simonen, O. V. Renkonen, and V. V. Valtonen.** 1988. Beta-haemolytic group A, B, C and G streptococcal septicaemia: a clinical study. Scand. J. Infect. Dis. **20:**119–125.
13. **Taylor, R., M. McDonald, G. Russ, M. Carson, and E. Lukaczynski.** 1981. *Vibrio alginolyticus* peritonitis associated with ambulatory peritoneal dialysis. Br. Med. J. **283:**275.
14. **Wang, T. K. F., A. M. Y. Fung, P. C. Y. Woo, K. Y. Yuen, and S. S. Y. Wong.** 2002. *Streptococcus agalactiae* (Lancefield group B) bacteraemia in non-pregnant adults. Eur. J. Clin. Microbiol. Infect. Dis. **21:**140–142.
15. **Wong, S. S. Y., P. C. Y. Woo, P. L. Ho, and T. K. F. Wang.** 2003. Continuous ambulatory peritoneal dialysis-related peritonitis caused by *Streptococcus bovis*. Eur. J. Clin. Microbiol. Infect. Dis. **22:**424–426.
16. **Woo, P. C. Y., A. M. Y. Fung, S. K. P. Lau, S. S. Y. Wong, and K. Y. Yuen.** 2001. Group G beta-hemolytic streptococcal bacteremia characterized by 16S ribosomal RNA gene sequencing. J. Clin. Microbiol. **39:**3147–3155.
17. **Woo, P. C. Y., A. P. C. To, H. Tse, S. K. P. Lau, and K. Y. Yuen.** 2003. Clinical and molecular epidemiology of erythromycin resistant beta-hemolytic Lancefield group G streptococci causing bacteremia. J. Clin. Microbiol. **41:**5188–5191.
18. **Woo, P. C. Y., S. K. P. Lau, S. S. Y. Wong, and K. Y. Yuen.** 2004. Two cases of continuous ambulatory peritoneal dialysis-associated peritonitis due to *Plesiomonas shigelloides*. J. Clin. Microbiol. **42:**933–935.
19. **Yuen, K. Y., W. H. Seto, C. H. Choi, W. Ng, S. W. Ho, and P. Y. Chau.** 1990. *Streptococcus zooepidemicus* (Lancefield group C) septicaemia in Hong Kong. J. Infect. **21:**241–250.