Xenophilus aerolatus Peritonitis in a Six-Year-Old Boy on Maintenance Peritoneal Dialysis

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Peritonitis remains a significant complication of peritoneal dialysis (PD). Although most patients can be treated successfully with antibiotics and continue PD, the poorest outcomes are noted in patients with peritonitis secondary to gram-negative organisms, which may lead to temporary or permanent technique failure. Biofilm formation may result in failure of appropriate antibiotic therapy to eradicate infection, necessitating catheter replacement or a switch to hemodialysis. Here, we report the first case of gram-negative peritonitis caused by Xenophilus aerolatus *in a 6-year-old boy on continuous cycling PD. This case highlights the importance of close monitoring of clinical response and of collaboration with the microbiologist and microbiology lab in the identification of unusual organisms, their antimicrobial susceptibilities, and their expected characteristics.*

Key words
Peritonitis, gram-negative organisms

Introduction

Peritonitis is a major complication of peritoneal dialysis (PD). It can lead to irreversible technique failure, and it is the primary reason for modality change. Infectious complications are the most frequent cause of hospitalization among children receiving automated PD (APD).

Recently, the distribution of causative microorganisms has changed, with the incidence of gram-positive peritonitis declining and, by consequence, the incidence of gram-negative peritonitis rising (1). Gram-negative infections can be caused by a wide variety of organisms, which are usually introduced by touch contamination, intra-abdominal pathology, or a catheter-related infection. Gram-negative peritonitis is particularly troublesome, because many of these organisms form a biofilm, making them unresponsive to antibiotic therapy alone. Gram-negative peritonitis may also cause irreparable damage to the peritoneal membrane, leading to an inability to continue on PD (2). Removal of the PD catheter should be seen as part of recommended peritonitis management when leaving the catheter in place is unlikely to result in a successful outcome, because the primary goal in managing peritonitis should always be protection of the peritoneum (3).

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Case report

A 6-year-old boy who had been on APD for 4 years was admitted with abdominal pain, undocumented fever, and cloudy effluent. His end-stage renal disease was a result of renal dysplasia. His PD access, which had been inserted 2 years earlier, was a double-cuffed swan-neck coiled catheter with a downward-directed exit site. His APD prescription was 7 nocturnal cycles in 10 hours, with a fill volume of 1000 mL/m^2 of Physioneal (Baxter Healthcare Corporation, Deerfield, IL, U.S.A.), and a day dwell of 428 mL/m^2 Extraneal (Baxter Healthcare Corporation). Exit-site care since the start of PD included a shower routine, with application of mupirocin cream at each dressing change. Pertinent past medical history included an episode of *Acinetobacter* peritonitis 3 years earlier and gastrostomy tube feeding. Because of malfunction, the former PD catheter had been replaced subsequent to the earlier peritonitis episode. Just before the current presentation, the boy had travelled to both Cleveland and Hawaii. He denied swimming, and he had experienced no vomiting or diarrhea.

On presentation, the patient appeared well; he

was afebrile. There was mild abdominal tenderness, but no rebound or guarding. The peritoneal effluent was cloudy, with a leukocyte count of 3080×10^6/L, with 84% neutrophils. Gram stain was negative, and the preliminary culture subsequently grew a gram-negative bacillus. Blood culture was negative for bacterial growth. The peripheral white blood cell count was 9.5×10^6/L, with 5.6×10^6/L neutrophils.

The boy was admitted and treated with a loading dose of intraperitoneal (IP) cefazolin 250 mg/L and gentamicin 8 mg/L (Table I). He improved clinically within 24 hours and was discharged on IP ceftazidime 125 mg/L and cefazolin 125 mg/L per the usual protocol.

At a clinic visit 10 days later, the boy was clinically well, but his peritoneal effluent was cloudy, with an elevated leukocyte count (1640×10^6/L, with 67% neutrophils). Preliminary presumptive susceptibilities on the unidentified gram-negative bacillus from the original culture had only just become available and suggested susceptibility to gentamicin [minimal inhibitory concentration (MIC) $\leq$ 2 mg/L], tobramycin (MIC $\leq$ 2 mg/L), trimethoprim–sulfamethoxazole (MIC $\leq$ 0.5 mg/L and 9.5 mg/L), and ciprofloxacin (MIC $\leq$ 0.5 mg/L). The MICs for meropenem (8 mg/L), ceftazidime (16 mg/L), and piperacillin ($\leq$256 mg/L) were all elevated, suggestive of resistance to those agents.

Cefazolin and ceftazidime were then discontinued. The boy was given an intramuscular loading dose of gentamicin (2.5 mg/kg) and started on IP gentamicin 4 mg/L for a planned 21-day course. With the use of partial 16S ribosomal RNA (rRNA) sequencing, the bacteria were identified 2 days later as *Xylophilus* species.

After 10 days of IP gentamicin therapy, the boy returned with mild abdominal pain and cloudy effluent; he nevertheless remained afebrile. His peritoneal effluent white cell count was 2190×10^6/L, with 42% neutrophils, and a culture was subsequently reported as positive for *Xylophilus* with the same antibiotic susceptibilities. He was admitted to hospital, and after consultation with the Infectious Diseases service, was started on intravenous (IV) ciprofloxacin (10 mg/kg daily). The PD catheter was removed. A central line was inserted for maintenance hemodialysis 3 days later. A total of 6 days of IV ciprofloxacin was followed by 7 weeks of oral ciprofloxacin (15 mg/kg daily), which was discontinued once a peritoneal fluid culture (obtained at the time of insertion of a new adult single-cuffed coiled PD catheter) was negative. Using the new catheter, the boy was successfully re-established on PD.

The bacterial isolate was later sent to the National Medical Microbiology Laboratory for confirmation of the identification. Complete 16S rRNA sequencing, conventional biochemical testing, and a whole-cell fatty-acids analysis revised this organism's identification to *Xenophilus aerolatus.*

Discussion

Xenophilus aerolatus is a newly described member in the family *Comamonadaceae.* It was first identified from air samples in South Korea and has never been associated with clinical infections. This gram-negative, non-spore-forming aerobic rod-shaped bacteria (4) is closely related to *Xylophilus ampelinus,* which has been known to produce biofilm in plants (5). Complete 16S rRNA sequencing of the bacteria isolated from our patient was found to be 100% homologous with *Xenophilus,* but only 97% with *Xylophilus*. Whether *Xenophilus aerolatus* is a biofilm producer is unknown.

Refractory peritonitis is defined as failure of effluent to clear after 5 days of appropriate antibiotic treatment. These infections should be managed by removal of the catheter to protect the peritoneal membrane for future use (6), particularly when gram-negative organisms, which are often associated with alterations in membrane integrity, are involved. Our patient's infection was not successfully eradicated with appropriate antibiotic therapy based on in vitro susceptibilities (10 days of IP gentamicin), and as a result, the decision to remove the PD catheter and to commence maintenance hemodialysis was made.

In the present case, several potential mechanisms of treatment failure with antibiotics alone warrant further investigation:

- the possibility of biofilm production, and
- the lack of standardized interpretive criteria for the MICs of antibiotics in clinical infections.

Conclusions

We here report the first documented case of PD-related peritonitis caused by *Xenophilus aerolatus.* Eradication of the infection was unsuccessful with appropriate antibiotic therapy alone. Although PD catheter removal and maintenance hemodialysis were required,

TABLE I Course of treatment

Variable	*On presentation*	*Day 1*	*Day 10*	*Day 20*	*Day 23*
Antibiotic therapy	Loading dose: IP cefazolin 250 mg/L and gentamicin 8 mg/L	Maintenance: IP cefazolin 125 mg/L and ceftazidime 125 mg/L	Loading dose: IM gentamicin 2.5 mg/kg; maintenance: IP gentamicin 4 mg/L	IV ciprofloxacin 10 mg/kg ×6 days, then 7 weeks PO ciprofloxacin 15 mg/kg; removal of PD catheter	Central venous line insertion and maintenance HD
Peritoneal fluid					
Leukocyte count ($\times 10^6$/L)	3080	222	1640	2190	
% Neutrophils	84	85	67	42	
Culture	Positive	Positive	Positive	Positive	

IP = intraperitoneal; IM = intramuscular; IV = intravenous; PO = oral; PD = peritoneal dialysis; HD = hemodialysis.

PD was subsequently successfully re-established. Identification of the organism was achieved through collaboration between the clinical microbiologist and the National Medical Microbiology Laboratory, highlighting the importance of a multidisciplinary approach to the care of patients on PD.

Disclosures

The authors have no financial conflicts of interest to disclose.

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