Micrococcus Peritonitis Complicating Peritoneal Dialysis

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ABSTRACT

Peritonitis, a serious complication of peritoneal dialysis (PD), can be caused by opportunistic pathogens like *Micrococcus species* on rare occasions. We present a case of *Micrococcus sp* peritonitis in a 55-year-old female with end-stage kidney disease on continuous cycling peritoneal dialysis for one year who presented with cloudy effluent. Initial treatment against *Micrococcus sp* with vancomycin, gentamicin, and prophylactic oral nystatin was successful. However, one month later, the patient presented with abdominal pain and dialysate culture again grew *Micrococcus sp*. Treatment with vancomycin was unsuccessful in resolving culture positivity. The patient was transitioned to hemodialysis for non-medical reasons and then was later restarted on PD without further peritonitis episodes. *Micrococcus sp* peritonitis in PD poses treatment challenges due to limited guidelines. Intraperitoneal vancomycin is commonly used to target Micrococcus isolates although there is a high incidence of treatment failure. This case report highlights the need for continued reporting to enhance identification, prevention, and patient outcomes in *Micrococcus sp* peritonitis during PD.

KEYWORDS: peritonitis, micrococcus species, peritoneal dialysis, PD-associated peritonitis

CASE REPORT

A 55-year-old female with a history of end stage kidney disease (ESKD) on PD secondary to diabetic kidney disease on continuous cycling peritoneal dialysis (CCPD) for one year presented to the PD clinic with cloudy effluent. She had been in her usual state of health until the evening prior to the day of presentation. Her PD prescription was automated peritoneal dialysis with 5 exchanges of 2.5 liters of dianeal (concentrations per weight/BP) over 9.5 hours with a 2-liter icodextrin day dwell. Past medical history was also significant for insulin dependent diabetes mellitus, coronary artery disease with coronary artery bypass grafting, peripheral arterial disease, hypertension, hepatitis C treated with direct acting antivirals, and gastroesophageal reflux. She had no prior episodes of peritonitis and reported no breaks in technique. She had no recent antibiotic administration and applied gentamicin ointment to her exit site daily. There were no known drug allergies.

On examination, the temperature was 98.6°F, the blood pressure was 138/82 mmHg, the heart rate was 91 beats per minute, and the respiratory rate was 20 breaths per minute. Cardiopulmonary exam was unremarkable. The mucous membranes were moist. Abdominal exam revealed a soft, non-tender abdomen without rebound or guarding. The peritoneal catheter exit site was mildly tender to palpation but did not show any drainage, granulation tissue, or erythema. Edema was absent. Effluent was hazy in appearance. The remainder of the physical examination was unremarkable.

Effluent leukocyte count was 204 cells/uL with 58% neutrophils. Peritonitis was diagnosed and treatment commenced with intraperitoneal (IP) vancomycin and gentamicin as well as oral nystatin for fungal prophylaxis. Cloudiness cleared within 48 hours. Peritoneal effluent culture grew *Micrococcus sp*. IP vancomycin was continued for 3 weeks due to intermittent low troughs. After completion of treatment, there was a complete resolution of symptoms and peritoneal cell count.

Cell count and culture were repeated one month later during evaluation of abdominal pain that was eventually found to be due to constipation. Leukocyte count was 6 cells/uL but culture again grew *Micrococcus sp*. After culture was repeated once more and remained persistently positive, repeat treatment to eradicate was attempted with two more weeks of IP vancomycin, but cultures remained positive. There were no breaks in technique. Eventually the catheter was removed due to a change in living situation, and the patient was transitioned to hemodialysis (HD).

After five months of HD, peritoneal catheter was replaced and the patient was restarted on PD, after which time she did not have any peritonitis episodes.

DISCUSSION

PD as an initial therapy for kidney replacement therapy has grown in recent years in the United States.[1] This trend is expected to continue with the launch of The Advancing American Kidney Health Initiative in 2019. The initiative included a goal that by 2025, 80% of incident ESKD individuals receive a home modality of dialysis or a kidney transplant.[2] Therefore, complications of PD need to be

Table 1. Summary of published cases of *Micrococcus sp* complicating PD

Reference number	Year Published	Age	Sex	Dialysis Modality*	Symptoms	Antibiotic Regimen	Catheter Removal for Improvement	Outcome
18	1983	36	M	CAPD	Abdominal pain, turbid effluent	Cefazolin Tobramycin	No	Two episodes of peritonitis. Improvement with antibiotic therapy.
29	1990	42	F	CAPD	Unknown	Cefuroxime	Yes	Seven episodes of peritonitis. No improvement with antibiotic therapy. Catheter removed with improvement.
29	1990	77	M	CAPD	Unknown	Vancomycin Cefuroxime	No	Two episodes of peritonitis. Improvement with antibiotic therapy.
29	1990	56	M	CAPD	Unknown	Vancomycin	No	Improvement with antibiotic therapy.
30	2009	56	F	CAPD	Fever, abdominal pain, nausea, turbid effluent	Teicoplanin	No	Improvement with antibiotic therapy.
15	2014	63	M	APD	Fever, abdominal pain, turbid effluent	Cefazolin Ceftazidime Vancomycin	Yes	No improvement with antibiotic therapy. PD replaced with HD.
15	2014	40	M	APD	Abdominal pain, turbid effluent	Cefazolin Ceftazidime	No	Thirteen episodes of peritonitis, 7 of which were Micrococcus-related. Improvement with antibiotic therapy. PD replaced with HD.
15	2014	54	M	APD	Abdominal pain, turbid effluent	Vancomycin	No	Improvement with antibiotic therapy.
17	2019	59	F	CAPD	Abdominal pain, turbid effluent	Cefazolin Ceftazidime Vancomycin	Yes	No improvement with antibiotic therapy. Catheter removed with improvement. Catheter reinsertion 1 month later with no subsequent complications.
31	2023	69	F	CAPD	Turbid effluent	Cefazolin Ceftazidime	No	Three episodes of peritonitis. Improvement with antibiotic therapy.

*CAPD: Continuous ambulatory peritoneal dialysis; APD: Automated peritoneal dialysis

addressed to improve treatment and prevention. Peritonitis is a common but serious complication of PD, causing both morbidity and mortality. The most common causative organisms include gram-positive organisms up to 46% and gram-negative organisms up to 21%.[3] Other organisms include mixed growth (17%), fungal (2%), mycobacterium (2%), anaerobes (1%), and 11% were negative on culture.

Micrococcus sp are catalase-positive, coagulase-negative, gram-positive cocci that are commonly found on the skin, mucosal membranes, soil, and water. Although these organisms are not considered pathogenic, they have been implicated in immunocompromised individuals and in patients with indwelling catheters. There are some reports of micrococci, particularly *Micrococcus luteus*, causing meningitis, central nervous system shunt infections, endocarditis, septic arthritis, and pneumonia.[4-6]

Individuals with ESKD are in an immunocompromised state. Several hypotheses have been proposed to explain why these individuals are at a higher risk for infections: The retention of uremic toxins impair the normal functions of leukocytes, monocytes, lymphocytes, and antigen-presenting cells.[7-9] Hemodialysis itself has been seen to cause a decrease in T lymphocyte response due to premature activation, likely contributing to an immunocompromised state.[9] Low titer responses to vaccines may suggest a reduced ability to produce antibodies.[10-12]

Ten cases of *Micrococcus sp* complicating PD have been reported in the English literature (**Table 1**). There are reported cases in the non-English literature, but they were not included in our literature review. The median age of the 10 cases included was 56 years old but ranged from 36 to 77 years old. Six were males and four were females. Seven were on continuous ambulatory PD (CAPD) and three were on automated PD (APD). Vancomycin and cefazolin were the most used antibiotics, each in five cases. Other antibiotics used include ceftazidime, cefuroxime, teicoplanin, and tobramycin. Seven of the cases improved with antibiotic therapy and three did not, requiring removal of catheter or transition to hemodialysis. Four cases hypothesized resulting peritonitis was due to technique failures.

The International Society for Peritoneal Dialysis (ISPD) 2022 guidelines do not mention treatment recommendations for *Micrococcus sp*.[13] However as seen in our case, IP antibiotics were started immediately as recommended by the ISPD.[13] The National Committee for Clinical Laboratory Standards (NCCLS) does not provide disk diffusion susceptibility standards for *Micrococcus sp*, and any existing data in the literature is not updated.[14,15] The majority

of *Micrococcus* isolates are susceptible to many antibiotics including penicillin, methicillin, vancomycin, gentamicin, and erythromycin. Although resistance to these antibiotics has been reported, vancomycin is still the preferred choice for empiric therapy.[15-17] In our case, vancomycin was effective in treating the first episode of peritonitis but not effective in the second episode of peritonitis. However, as seen in the literature review, there are reports of antibiotic regimens without vancomycin that have treated *Micrococcus sp* PD peritonitis successfully.[18]

Prevention of PD-associated peritonitis is essential to improving costs and patient outcomes. Various preventative strategies have been endorsed and proposed. The use of double-bag Y system and flush-before-fill approaches have shown to significantly decrease peritonitis rates.[19-22] The ISPD recommends prophylactic antibiotics at the time of PD catheter insertion and the use of topical antibiotics at the catheter exit site.[13] The guidelines also recommend that catheter removal should be considered in a timely manner if treatment is refractory. This outcome was seen in the case presented here and in three cases in the literature. Patient education and retraining have been shown to reduce peritonitis rates; however, the frequency and intensity of retraining has not been well studied.[23,24] Patient education is likely dependent on the patient and their learning style.[25] To further decrease peritonitis incidence, a national standardized reporting system of PD-associated peritonitis for the U.S. has been proposed.[26] Existing systems seen in Australia and New Zealand have been shown to reduce peritonitis rates due to increased awareness, transparency, and accountability, serving as a potential framework for U.S.[27,28]

We present the eleventh case of *Micrococcus sp.* peritonitis in a PD patient, a rare and unusual causative organism of peritonitis. Prior cases have been associated with breaks in technique and have shown a pattern of recurrence with resultant technique failure being very common.

CONCLUSION

Although PD-associated peritonitis secondary to *Micrococcus sp*. is rare, the treatment is challenging due to a lack of data on the infections and effective antibiotic regimens. Further cases and their treatment regimen need to continue being reported to improve identification, prevention, and patient outcomes.

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