

Rhizobium radiobacter-Induced Peritonitis: A Case Report and Literature Analysis

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Abstract

Rhizobium radiobacter (*R. radiobacter*) is a gram-negative bacterium, primarily a soil contaminant and rarely pathogenic to humans. Only a few cases of peritonitis secondary to *R. radiobacter* have been reported worldwide. A 66-year-old male with end-stage renal disease who was on peritoneal dialysis (PD) developed *R. radiobacter*-induced peritonitis. We have treated the infection successfully with intraperitoneal antibiotics and managed to keep his PD catheter intact without interruption in PD treatment. More prolonged antibiotic therapy and frequent clinical follow-up is required to treat this infection. Better clinician awareness is needed to prevent this rare infection.

Keywords: *Rhizobium radiobacter*; Peritonitis; Peritoneal dialysis; End-stage renal disease

Introduction

One of the popular dialysis modalities for end-stage renal disease (ESRD) patients is peritoneal dialysis (PD). It benefits from performing uninterrupted daily dialysis at home with better blood pressure and phosphorus control. It gives the patients a better quality of life than in-center dialysis. However, it comes with the severe risk of peritonitis if not performed under proper sterile technique. Peritonitis is caused mainly by gram-positive organisms. *Rhizobium radiobacter* (*R. radiobacter*), a gram-negative bacterium, is an atypical microorganism that

is an infrequent cause of peritonitis in PD patients. Only a few cases of infectious peritonitis have been attributed to it, with almost half of them requiring PD catheter removal.

Case Report

Investigations

A 66-year-old male with newly diagnosed ESRD secondary to a long-standing history of diabetes and hypertension was referred to our clinic to establish care. He has just moved from a different town for job-related issues. He only underwent two training sessions in the city where he lived before moving. His home medications were long-acting insulin, losartan 50 mg twice daily, and amlodipine 10 mg daily. Two days after he moved, he developed severe abdominal pain and discomfort and had to go to the emergency room (ER) for evaluation. Vital signs were unremarkable, with a blood pressure of 110/60 mm Hg, a heart rate of 69 beats/min, a temperature of 98 °F, and a respiratory rate of 16 breaths/min with normal oxygen saturation. Physical findings revealed a well-built male with no apparent distress, with only mild abdominal tenderness. There were no signs of distension and rebound tenderness and no organomegaly. His bowel sounds were intact. The rest of the systemic examination was unremarkable.

Diagnosis

He had elevated white blood cell (WBC) count of 12,500/mm³ (normal 4,000 - 11,000/mm³) and low hemoglobin of 10.5 g/dL (normal 14 - 17 g/dL in male). The rest of the labs were unremarkable apart from elevated blood urea nitrogen (BUN) of 67 mg/dL (normal 6 - 20 mg/dL) and serum creatinine of 5.6 mg/dL (normal 0.7 - 1.3 mg/dL). Computed tomography (CT) of the abdomen and pelvis done in ER was unremarkable with no intra-abdominal acute pathology and no feature suggestive of an abscess. He had peritoneal fluid sent from the ER and was initiated on broad-spectrum intravenous antibiotics vancomycin and piperacillin-tazobactam because of high suspicion of peritonitis. He was discharged from ER to follow up in a dialysis clinic the next day. He was evaluated in our clinic the following day, where his PD was resumed. He only did two manual exchanges during the daytime, each

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for 4 h with 1.5% dextrose in each dwell, consisting of 2 L of dialysate in each bag. The PD fluid returned positive for an elevated WBC count of 230 cells with 76% neutrophils. Two days later, the fluid grew a gram-negative bacterium confirmed as *R. radiobacter*. The antibiotic susceptibility testing was as follows: susceptible to amikacin, cefepime, ceftriaxone, ciprofloxacin, gentamicin, meropenem, tobramycin, trimethoprim/sulfamethoxazole, intermediate to piperacillin/tazobactam and resistant to aztreonam.

Treatment

He was started on 1 g daily of intraperitoneal cefepime, which was continued for 3 weeks. He was gradually transitioned to four manual exchanges of PD in the daytime: 4 h dwell each exchange with alternate 1.5% and 2.5% dextrose and each dwell with 2 L dialysate. His repeat PD fluid cell count sent 3 days after initiating treatment came down to 4 WBC cells with no red blood cell (RBC). The PD fluid was clear with no cloudy effluent. His abdominal symptoms abated in 2 days with no recurrence after that. The timeline of events spanned over 4 weeks from diagnosis to treatment completion, with no hospitalization required during this event.

Follow-up and outcome

Surveillance PD fluid sent 2 weeks after completing therapy was also unremarkable with no signs of infection. One year after the peritonitis episode, he continues to do PD at home with no further infections reported.

Discussion

Peritonitis is a serious problem hindering effective PD worldwide in the ESRD population. Peritonitis most commonly presents with clinical symptoms of abdominal pain, nausea/vomiting, and fever. The peritoneal fluid can be cloudy and often patients may develop hypotension if they become septic. Mostly it is caused by bacterial organisms, 45-65% being gram-positive organisms, while 15-35% being gram-negative species [1, 2].

Whitty et al, in one extensive study, concluded that *Staphylococcus* species were responsible for nearly 60% of infectious peritonitis cases among gram-positive organisms and 39% of an overall infectious cause. The causative common bacterial organisms were *Streptococcus*, *Enterococcus*, *Corynebacterium*, *Pseudomonas*, *Klebsiella*, and *E. coli* [3]. Among fungal causes, *Candida parapsilosis* and *Candida albicans* are the most prevalent [4].

The microorganism *R. radiobacter* is a gram-negative aerobic pathogen frequently found in plants and soil. Soil contamination is the most common means of infection. The first reported case of peritonitis secondary to the organism in PD patients was reported in 1990 [5]. This bacterium was known as *Agrobacterium* and was later reclassified based on 16srDNA sequencing. These are motile, oxidase-positive, aerobic, non-

spore-forming gram-negative microorganisms. There are various *Rhizobium* species like *R. rhizogenus*, *R. radiobacter*, *R. undicola*, *R. vitis*, *R. rubi*, etc. Among them, *R. radiobacter* is an opportunistic human pathogen. Bacteremia from the organism is common and is secondary to intravenous catheter use [6].

Few cases of peritonitis secondary to this microorganism have been reported, as shown in Table 1 [5, 7-21]. Almost half of the cases reported have suggested catheter removal to treat this pathogen [7, 9-12, 14, 18, 19]. In the first reported case by Rodby and Glick in 1991, the patients initially responded to antibiotics but later relapsed and had the catheter removed [7]. Of the six infected patients reported by Alnor et al in 1994, all were immunocompromised and responded only to therapy after removing the catheter [9]. They postulated colonization of the bacteria to the catheter as a reason for no response to antibiotics alone. Of the cases reported by others, the bacteria initially responded to antibiotics but relapsed shortly within a few days, and thus the dialysis catheter had to be removed. Possibly soil contamination and unsterile techniques could explain relapsed infection in these cases, and thus catheter required removal. Of the 15 reported instances of *R. radiobacter*-induced peritonitis, six successfully kept the peritoneal catheter intact and resumed PD [8, 13, 16, 17, 20, 21]. Our case adds to this complicated organism's successful treatment of peritonitis.

Various antibiotics have been reported in successfully treating these microorganisms. Cephalosporins are among the most used antibiotics, especially ceftazidime [11, 12, 14-19, 21]. Other antibiotics that have been effective include piperacillin-tazobactam, meropenem, and ciprofloxacin. However, it can be argued that in cases where catheter removal was not required, ceftazidime was the most used antibiotic and thus can be recommended as a treatment choice [13, 16, 17, 21]. Three weeks of duration were pursued in a few cases because of the risk of catheter removal. We also continued antibiotics for 3 weeks, and the repeat peritoneal fluid test after 2 weeks suggested the absence of peritonitis. However, soil contamination has been shown in many cases [12, 16, 17, 21], although our patient did not recollect any exposure to soil recently. Thus, strict hygienic techniques, avoiding soil contamination, and cephalosporins like ceftazidime or cefepime may be a better means to treat this rare microorganism.

Conclusion

R. radiobacter is a rare microorganism that can cause peritonitis in ESRD patients on PD. Clinicians must be aware of this rare organism as an etiology of peritonitis and be prepared to manage this disease accordingly. Only a few cases have been reported, and half of them required catheter removal, unlike our case. Through this case vignette, we would like to bring to the attention of clinicians this organism causing peritonitis and summarize treatment options for the same.

Learning points

Our case highlights this rare cause of peritonitis and attempts

Table 1. Published Articles in Chronological Order

Year	Authors	Organism	Age (years)	Soil contact	Catheter removal	Treatment
1990	Harrison et al [5]	<i>Agrobacterium tumefaciens</i>	n/a	Not available	Not available	Gentamicin, ciprofloxacin
1991	Rodby and Glick [7]	<i>Agrobacterium radiobacter</i>	66	No	Yes	Amikacin, vancomycin, sulfamethoxazole-trimethoprim (ST)
1993	Hulse et al [8]	<i>Agrobacterium</i> species	20	Not available	No	Gentamicin, ticarcillin, ST
1994	Alnor et al [9]	<i>Agrobacterium radiobacter</i>	56	Not available	Yes	unknown
1997	Melgosa-Hijosa and Ramos-Lopez [10]	<i>Agrobacterium radiobacter</i>	11	No	Yes	Tobramycin, vancomycin, imipenem
2005	Lui and Lo [11]	<i>Agrobacterium radiobacter</i>	43	No	Yes	Netilmicin, cefuroxime
2005	Levitski-Heikkila and Ullian [12]	<i>Agrobacterium radiobacter</i>	41	Yes	Yes	Gentamicin, ceftazidime
2006	Minguela et al [13]	<i>Rhizobium radiobacter</i>	63	No	No	Ceftazidime, vancomycin, gentamicin
2007	Rothe and Rothenpieler [14]	<i>Rhizobium radiobacter</i>	41	No	Yes	Ciprofloxacin, cefepime
2007	Han and Han [15]	<i>Rhizobium radiobacter</i>	42	Not available	Not available	Ciprofloxacin, ceftazidime
2011	Marta et al [16]	<i>Rhizobium radiobacter</i>	5	Yes	No	Ceftazidime, ceftazidime, piperacillin-tazobactam
2013	Tsai [17]	<i>Rhizobium radiobacter</i>	42	Yes	No	Ceftazidime, ceftazidime
2014	Misra et al [18]	<i>Rhizobium radiobacter</i>	54	No	Yes	Tobramycin, ceftazidime
2014	Badrising et al [19]	<i>Rhizobium radiobacter</i>	47	Not available	Yes	Ceftazidime, cefepime, ciprofloxacin, meropenem
2019	Karadeniz et al [20]	<i>Rhizobium radiobacter</i>	26	Not available	No	Ciprofloxacin, vancomycin
2019	Hashiba et al [21]	<i>Rhizobium radiobacter</i>	62	Yes	No	Ceftazidime, ceftazidime, levofloxacin

to guide clinicians with the means to treat this challenging microorganism without the requirement of changing dialysis modality. *R. radiobacter* is a rare microorganism, and clinicians need to be more aware and vigilant of this bacterium for effective diagnosis and accurate, timely therapy.

This microorganism has resulted in PD interruption in half of the reported cases, which is always a setback to PD and can be avoided if properly managed.

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Financial Disclosure

None to declare.

Conflict of Interest

The authors have no conflict of interest to declare.

Informed Consent

The patient consented for publication of this study.

Author Contributions

Each author has been individually involved in and has made substantial contributions to conceptions and designs, acquisition of data, analysis, interpretation of data, drafting, and editing the manuscript. Sasmit Roy contributed to the treatment, interpretation of data, and editing of the manuscript and with final submission. Debargha Basuli contributed to the designs, interpretation of data, drafting, and editing of the manuscript. Sohil N. Reddy contributed to the drafting and interpretation of data. Ebad U. Rahman contributed to the analysis and editing of the manuscript. Sreedhar Adapa contributed to the designs, acquisition of data, analysis, interpretation of data, drafting, and editing of the manuscript.

Data Availability

The authors declare that data supporting the findings of this

study are available within the article.

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