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Serratia marcescens peritoneal dialysis peritonitis: a clinical case and therapeutic approach

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Abstract. *Peritoneal dialysis (PD) is increasingly used as a kidney replacement therapy in end-stage kidney disease, especially for its benefits in patient management and quality of life. However, PD peritonitis, particularly when caused by Serratia marcescens, can be a challenging complication that may require catheter removal. We present the case of a 17-year-old patient who had three PD peritonitis episodes in less than six months, caused by Serratia marcescens that led to catheter removal. This bacteria is known for its resistance to antibiotics and potential for systemic dissemination, making prompt recognition and management crucial. Catheter removal may be necessary early on to prevent further complications and improve patient outcomes.*

Keywords: *catheter removal; peritonitis; peritoneal dialysis; Serratia marcescens*

Introduction

Peritonitis remains the most dreadful complication of peritoneal dialysis (PD). The diversity of germs and the appearance of antibiotic-resistant strains present a challenge in terms of the choice of treatment, with the aim of preserving the peritoneum from anatomical changes.

Aside from peritonitis refractory to antibiotics, repeated episodes of peritonitis may require the removal of the PD catheter. In addition, there are certain episodes of Gram-negative bacillus peritonitis which preferably indicate catheter removal from the very first episode, and the attempt to "save the catheter" may lead to serious complications ranging from septicemia to septic shock, as described in several studies, such as *Serratia marcescens* (SM) peritonitis [1].

This enterobacterium is an opportunistic Gram-negative bacterium. It is often found in the urinary, gastrointestinal and respiratory tracts, and is transmitted by direct contact. Risk factors include prolonged hospitalization, intravenous, intraperitoneal, urinary catheterization and airway instrumentation. SM is difficult to treat because of its ability to produce beta-lactamase, giving it high intrinsic resistance to broad-spectrum antibiotics such as cefazolin, ampicillin and tetracycline. *Serratia marcescens* peritonitis is not frequently reported in the literature, and its outcome is generally unfavorable.

We report the case of repeated *Serratia marcescens* peritonitis in a patient requiring removal of the PD catheter.

Clinical case

This is a 17-year-old female patient with end-stage chronic kidney failure secondary to reflux nephropathy, who has been on automated peritoneal dialysis (APD) since the age of 11.

She is autonomous, has a Charlson score of 2, is well-monitored and well-balanced (nPcr > 0.8), with purification and fluid balance appropriate for peritoneal dialysis (Kt/V > 2.5 and CHC > 55 ml/min).

Six years after the PD catheter placement, she presented a *Serratia marcescens* peritonitis, with a cloudy dialysate effluent, without any digestive disorder or abdominal pain, the leukocytes in the dialysate were 6,300/mm^3, predominantly neutrophilic, she was initially treated according to our department protocol with cefazolin 1 g, ceftazidime 1 g and gentamicin 7 mg/kg intraperitoneally (IP), then adapted to the antibiogram and only ceftazidime was maintained for a period of three weeks, with a favorable clinical course and clearing of the effluent after five days of antibiotic therapy.

Two months later, she was admitted for repeated peritonitis caused by the same germ (*Serratia marcescens*), with cloudy dialysate effluent, vomiting and abdominal pain. The white blood cells in the dialysate were 16,000/mm^3, predominantly neutrophilic. The evolution was remarkably favorable, with good clinical improvement and a clearing of the effluent after five days of antibiotic therapy.

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Four months after her second episode of peritonitis, the patient presented with abdominal pain, vomiting without diarrhea, and a cloudy peritoneal dialysate for 3 days.

She was clinically stable, with biological inflammatory syndrome (Table 1).

Cytobacteriological examination of the dialysate revealed the presence of *Serratia marcescens* with leukocytes at 4,370/mm^3, 90 % of which were neutrophils. Aerobic and anaerobic cytocultures revealed the same germ.

After having received probabilistic antibiotic therapy, only IP ceftazidime 1 g/d (adapted to the antibiogram) was maintained for a 3-week period.

The clinical course was characterized by regression of abdominal pain and vomiting after two days and clearing of the dialysate fluid after five days of antibiotic treatment.

Because of the repeated episodes and the presence of a serious atypical germ, the PD catheter was removed despite good initial responses under antibiotic therapy adapted to the antibiogram. A new catheter was placed then in the contralateral side simultaneously, and ceftazidime was maintained for 2 additional weeks.

Four days after catheter insertion, APD was gradually resumed at low volume.

After one year, the patient was free of peritonitis.

Discussion

This case of repeated *Serratia marcescens* PD peritonitis in our 17-year-old patient highlights the challenges of managing this germ. *Serratia marcescens* is a Gram-negative opportunistic bacterium commonly found in healthcare settings, posing significant risks due to its intrinsic resistance to antibiotics and propensity to form biofilms on medical devices, including PD catheters. Despite its relatively low incidence, *Serratia marcescens* peritonitis can lead to serious complications, including sepsis and dissemination to other organs [2, 3].

In our case, the patient presented with several episodes of *Serratia marcescens* peritonitis over a relatively short period of time. This is consistent with previous literature documenting the potential for repeated infections with this pathogen in PD patients [4, 5].

Our patient's clinical history was complicated by the necessity to remove the catheter in view of repeated episodes of peritonitis due to the same germ, despite a satisfactory initial response to antibiotic therapy adapted to the antibiogram. This decision was taken in line with the recommendations of previous studies highlighting the importance of catheter removal in cases of repeated or refractory peritonitis, particularly when caused by multidrug-resistant organisms such as *Serratia marcescens* [6, 7].

Comparing our results with the existing literature, several studies have reported variable outcomes and treatment strategies for *Serratia marcescens* peritonitis (Table 2). While some cases were successfully managed with antibiotic therapy alone, others required catheter removal or even a switch to hemodialysis due to persistent infection or complications such as osteomyelitis [8].

The variability of outcomes underscores the need for individualized treatment approaches guided by factors like antibiotic susceptibility, patient co-morbidities and catheter status.

In addition, the emergence of multidrug-resistant strains of *Serratia marcescens* is a growing concern, limiting treatment options and potentially compromising patient outcomes [9]. This highlights the importance of prudent antibiotic management and infection control measures to prevent and control *Serratia marcescens* infections in PD patients.

However, SM is a group 3 Enterobacteriaceae, and according to CA-SFM 2023 [10], this group is sensitive *in vitro* to the third-generation cephalosporins. Monotherapy exposes the risk of selection of resistant mutants and its combination with an aminoglycoside could also lead to therapeutic failure through mutant selection.

Combination with fluoroquinolones is then recommended as a means of avoiding the selection of mutants resistant to third-generation cephalosporins, and the risk of selection is absent or greatly reduced with fourth-gene-

Table 1. Laboratory investigation results on the admission of the patient

Parameters	Obtained values	Reference ranges
Inflammatory markers		
Leukocytes (/mm^3)	16,100	4,000–10,000
Polymononuclear neutrophils (/mm^3)	14,800	1,500–7,500
C-reactive protein (mg/l)	118	< 6
Ferritin (ng/ml)	311	5–204
Cytobacteriological examination of the dialysate		
Leukocytes (/mm^3)	4,320	< 100
Polymononuclear neutrophils (%)	90	–
Lymphocytes (%)	10	–
Direct examination	Gram-negative bacteria	–
Cultures	*Serratia marcescens*	–
Aerobic and anaerobic cytocultures		
Serratia marcescens		

Table 2. Reported cases of Serratia marcescens PD peritonitis (1965–2024)

Authors, year	Patients (n)	Antibiotic regimen	Duration	Outcome
McCracken A.W. et al., 1965 [6]	3	Polymyxin E	NA	Two died, one was transferred to HD
Hortling L. et al., 1984 [7]	1	Aztreonam	NA	Success without catheter removal
Connacher A.A. et al., 1988 [14]	1	IP gentamicin and cefuroxime or piperacillin, and cotrimoxazole (4 episodes)	4 months	Transferred to HD
Bizette G.A. et al., 1995 [8]	1	NA	NA	Complicated with osteomyelitis
Grabe D.W. et al., 1997 [15]	1	Gentamicin and ceftizoxime	14 days	Success without catheter removal
Krishnan M. et al., 2002 [16]	7	NA	NA	One was cured
Zhao et al., 2007 [5]	1	IP ceftazidime and cefazolin, followed by IV cefotaxime, finally IV imipenem	41 days	Transferred to hemodialysis
Kang J.H. et al., 2013 [17]	1	IP cefazolin and ceftazidime, followed by IP gentamicin and ceftazidime, and finally oral ciprofloxacin	20 days	Transferred to hemodialysis
Bhave P. et al., 2016 [18]	1	IP cefazolin and gentamicin, followed by IP meropenem	21 days	Success without catheter removal
Sarihan I. et al., 2017 [19]	1	IP cefazolin, secondly IP gentamicin, followed by oral ciprofloxacin	21 days	Success without catheter removal
Kilic I. et al., 2018 [4]	1	IV cefazolin and ceftazidime, secondly piperacillin tazobactam	35 days	Transferred to hemodialysis
Yang N. et al., 2020 [12]	1	IP cefazolin and ceftazidime, followed by levofloxacin, then cefoperazone sodium and sulbactam sodium, meropenem, and finally amikacin	29 days	Success without catheter removal
Xie R. et al., 2024 [11]	1	IP ceftazidime and oral levofloxacin	2 weeks	Success without catheter removal

Notes: HD — hemodialysis; IV — intravenous; NA — not available.

ration cephalosporins (cefepime, cefpirome) which are not hydrolyzed by cephalosporinases, whatever their level of production. This recommendation is supported by the case reported by Xie R. et al. in 2024 [11], who successfully managed *Serratia marcescens* peritonitis with antibiotic therapy based on ceftazidime and levofloxacin, without the need for catheter removal.

Another alternative could be meropenem. In fact, in 2020, Ning Yang et al. [12] described a case of *Serratia marcescens* that was treated successfully with meropenem after the failure of antibiotic treatment with levofloxacin, and the catheter was not removed. However, another recent SM PD peritonitis case reported in 2023 by Carranza [13] was treated with meropenem but failed to respond, requiring the definitive switch to hemodialysis, since multiple adhesions and purulent material was found while removing the catheter, and the peritoneal cavity was not useful for peritoneal dialysis anymore. These cases demonstrate the virulence and resistance of *Serratia marcescens*.

Ultimately, our case highlights the challenges we have had in managing repeated *Serratia marcescens* peritonitis, despite *in vitro* susceptibility to the third-generation cephalosporins. The CA-SFM 2023 recommendations are prompting the adoption of new therapies for Enterobacteriaceae, which could reduce the recurrence of such peritonitis and prolong the survival of the technique in the future.

Conclusions

Serratia marcescens is one of the Gram-negative bacteria most responsible for repeated peritonitis, with a poor prognosis.

Peritonitis caused by *Serratia marcescens*, like any other Enterobacteriaceae, requires vigilant management, and early and aggressive antibiotic treatment adapted to the recommendations using fluoroquinolones as first-line antibiotics, despite *in vitro* sensitivity to third-generation cephalosporins, which may improve the survival of the technique while preserving the catheter.

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Спричинений *Serratia marcescens* перитоніт, асоційований із перитонеальним діалізом: клінічний випадок і терапевтичний підхід

Резюме. Перитонеальний діаліз (ПД) все частіше використовується як замісна ниркова терапія при термінальній стадії захворювання нирок, особливо через його переваги в лікуванні пацієнтів і поліпшенні якості життя. Однак перитоніт при ПД, особливо спричинений *Serratia marcescens*, може бути серйозним ускладненням, яке часто потребує видалення катетера. У статті описано клінічний випадок у 17-річної пацієнтки, яка мала три епізоди ПД-асоційованого перитоніту, викликаного *Serratia marcescens*, протягом менше ніж шести місяців, що призвело до видалення катетера. Ця бактерія відома своєю стійкістю до антибіотиків і здатністю до системного поширення, що робить своєчасне виявлення й лікування вкрай важливим. Видалення катетера на ранніх етапах може бути необхідним для запобігання подальшим ускладненням і покращення результатів лікування.

Ключові слова: видалення катетера; перитоніт; перитонеальний діаліз; *Serratia marcescens*