***Pasteurella multocida* peritonitis associated with a cat in a peritoneal dialysis patient using an automated cyclor device**

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Abstract *Pasteurella multocida* (*P. multocida*) is an aerobic Gram-negative coccobacillus, which is found as part of the natural oral flora of many animals, including most healthy cats and dogs. However, it can cause a variety of infections in humans, usually as a result of the patient being bitten or scratched by a cat or dog. There have been 22 reported cases of *P. multocida* peritonitis in patients undergoing peritoneal dialysis (PD). Of these, 66.7 % occurred within 12 months of the initiation of PD. Only two cases (11.1 %) developed more than 60 months after the commencement of PD. We report a case of *P. multocida* peritonitis involving a 45-year-old patient who had been undergoing continuous ambulatory peritoneal dialysis (CAPD) for 84 months without a previous history of peritonitis, who developed *P. multocida* peritonitis associated with a domestic cat on the very night on which he began using an automated cyclor device to switch from CAPD to continuous cyclic peritoneal dialysis (CCPD). Patients maintained on PD who keep pets such as cats or dogs at home should be educated about the risk of developing peritonitis related to their domestic pets, and this warning should be repeated when such patients switch from CAPD to CCPD. Physicians should consider using empiric therapy to prevent *P. multocida* in pet-owning PD patients who present with a history of PD fluid leakage and peritonitis, especially in patients who use cyclor devices.

Keywords Peritoneal dialysis · *Pasteurella multocida* · Peritonitis · Cyclor device

Introduction

Peritonitis in patients undergoing peritoneal dialysis (PD) is a major cause of hospitalization, transfer to hemodialysis, and catheter removal. *Staphylococcus epidermidis* and *S. aureus* are the major pathogens implicated in PD peritonitis [1]. However, *Pasteurella multocida* (*P. multocida*) is a rare cause of peritonitis in PD patients.

Pasteurella multocida is a small aerobic Gram-negative coccobacillus found in the oropharynxes of many animals, such as cats (50–90 %) and dogs (50–66 %) [2]. Worldwide, 22 cases of PD-associated *P. multocida* peritonitis have been reported to date [3–23], and in Japan, there have been only two cases [13, 23].

We report a patient who remained peritonitis-free during 84 months of PD who suffered from *P. multocida* peritonitis associated with a domestic cat on the very night on which he began to use an automated cyclor device, together with a review of the literature.

Case report

A 45-year-old man who developed end-stage renal failure after IgA nephropathy had been maintained on continuous ambulatory peritoneal dialysis (CAPD) without developing peritonitis for 84 months. However, on the first night on which he used an automated cyclor device to switch from CAPD to continuous cyclic peritoneal dialysis (CCPD) because of a decline of residual renal function, he became aware of dialysate leakage from the PD solution bag.

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He immediately disconnected himself from the automated peritoneal dialysis (APD) system and drained the dialysis fluid using the twin-bag system, before filling the peritoneal cavity with new solution. When he exchanged his dialysate the next morning, he noted that his effluent was cloudy. Shortly afterwards, abdominal pain developed, and he visited our hospital and was admitted.

On physical examination, he had a temperature of 38.9 °C, a pulse rate of 84 beats/min, a respiratory rate of 16 breaths/min, and a blood pressure value of 110/72 mmHg. His abdomen was diffusely tender and displayed rebound tenderness. His exit site and catheter tunnel showed no evidence of infection. There was no lymphadenopathy noted, which would suggest a complication of cat-scratch disease.

His laboratory data on admission showed a white blood cell (WBC) count of 12400/mm³, with 82 % segmented neutrophils, and a C-reactive protein level of 1.20 mg/dl. An analysis of his turbid dialysis fluid found a cell count of 3370 WBC/mm³, with 86 % neutrophils. Gram staining of the dialysis fluid was negative. Samples of his dialysate were collected in blood culture bottles. No blood cultures were obtained. The patient was treated under a suspicion of peritonitis of unknown origin and received 1 g vancomycin (VCM) i.v. once and intraperitoneal ceftazidime (CAZ) 1 g (with a 6-h dwell time) as an empirical treatment. On the second admission day, an analysis of his peritoneal fluid demonstrated an increased WBC count of 9220/mm³, with 91 % neutrophils, but his symptoms improved rapidly 48 h later. On the fifth admission day, an analysis of his dialysate revealed that his total WBC count had decreased to 107/mm³ (53 % neutrophils). The final culture results indicated that the organism was *P. multocida*. The isolated organism was sensitive to ampicillin, piperacillin, cefazolin, cefotiam, CAZ, levofloxacin, gentamicin, and imipenem. VCM was discontinued. The patient was switched to oral levofloxacin (200 mg/day) after 7 days of intraperitoneal CAZ treatment. There was no evidence of a decrease of peritoneal function nor ultrafiltration failure by this peritonitis episode.

The patient reported that he owned two domestic cats that were free to enter his bedroom before he started PD.

Discussion

Peritonitis remains a leading complication in PD patients. In addition, severe and prolonged peritonitis leads to peritoneal membrane failure and is a major cause of PD discontinuation and switching to hemodialysis. Therefore, preventing peritonitis is one of the most important considerations for PD patients and medical staff. Most episodes of PD-related peritonitis are caused by organisms

that colonize human skin, such as *S. epidermidis* and *S. aureus*, via touch contamination or PD technique failure. In addition, a wide variety of other organisms can cause PD-related peritonitis. However, *P. multocida* is a rare cause of PD-related peritonitis, and only 22 cases of PD-related peritonitis involving *P. multocida* have been reported to date [3–23] (Table 1).

P. multocida is an aerobic Gram-negative coccobacillus, which is found as part of the natural oral flora of many animals, including most healthy cats (50–90 %) and dogs (50–66 %), and approximately 20 % of cats have *Pasteurella* species on their claws [2, 23].

Almost all reported cases of peritonitis complications associated with this pathogen were due to puncturing of the dialysis tubing by cats or close contact with cats. Only one reported case of *P. multocida* peritonitis was due to contact with dogs [20].

It is worth noting that, although the majority of patients on PD use CAPD, most of the reported cases (77.3 %) involved patients using a cycler device, such as CCPD or nightly intermittent peritoneal dialysis (NIPD). It is also possible that the trembling of the dialysis tube and the sound produced by the pump make the cycler device an attractive toy for cats.

In our case, the patient had remained healthy without any episodes of peritonitis during the 84 months in which he had been undergoing PD, in spite of the fact that he owned two cats. We got the impression that he took great care with his personal hygiene and dialysis procedure, and that he took appropriate measures to protect against peritonitis.

However, he developed peritonitis associated with *P. multocida* on the first day on which he used the cycler device. This episode suggests that using a cycler device is a major risk for cat-associated PD peritonitis.

In a review of *P. multocida* peritonitis, the period from the initiation of PD to the onset of peritonitis was found to be <12 months in most cases (66.7 % of 18 cases), and it only occurred after more than 60 months in two cases (11.1 %). Therefore, our case was considered to be representative of this rare condition.

There was evidence of PD fluid leakage in 50 % of cases. PD patients using a cycler device who also own a cat might need to be started on antibiotic therapy in order to protect against this organism, even if there is no evidence of leakage.

In our review of the literature, 20 of 22 cases recovered from peritonitis without catheter removal. *P. multocida* is susceptible to many kinds of antibiotic agent that affect Gram-negative organisms.

Empiric antibiotic combination therapy for PD-related peritonitis affects not only Gram-positive but also Gram-negative organisms. Therefore, empirical therapy involving antibiotics for Gram-negative bacteria might affect

Table 1 Reported cases of *Pasteurella multocida* peritonitis in peritoneal dialysis patients

Case, author, reference	Year	Age/ sex	Kidney disease	Duration (months)	Cycler device	Animal exposure	Leakage	Treatment	Outcome
1. Paul and Rostand [3]	1987	55/F	HTN	4	Yes	Cat	+	VCM + GM → GM	Improved
2. Frankel and Cassidy [4]	1991	55/M	PAN	15	No	Cat	–	VCM + GM → GM + CPFX	Improved
3. London and Bottone [5]	1991	54/M	HTN	6	Yes	Cat	+	VCM + GM → CEZ	Improved
4. Elsey et al. [6]	1991	25/M	Alport's	≤24	Yes	Cat	–	Cephadrine + GM	Improved
5. Kitching et al. [7]	1996	75/M	HTN	6	No	Cat	+	VCM → CMD	Improved
6. Uribarri et al. [8]	1996	42/M	HTN	108	Yes	Cat	+	PC + GM	Improved
7. Loghman-Adham [9]	1997	12/F	FSGS	7	Yes	Cat	Unknown	CEPR → GM	Improved
8. MacKay et al. [10]	1997	73/M	CGN	Unknown	No	Cat	–	VCM + CAZ → CAZ	Improved
9. Joh et al. [11]	1998	55/M	HTN	12	Yes	Cat	+	GM → ABPC/ST	Improved
10. Musio and Tiu [12]	1998	46/F	DMN type1	7	Yes	Cat	–	PIPC → CPFX	Improved
11. Hamai et al. [13]	1999	49/M	IgAN	4	Yes	Cat	+	CAZ → TOB	Improved
12. Van Langenhove et al. [14]	2000	22/F	PCK	12	Yes	Cat	+	VCM + AMK → AMK	Improved
13. Kanaan et al. [15]	2002	42/F	Pyelonephritis	7	Yes	Cat	–	VCM + CPFX → CPFX	Improved
14. Sillery et al. [16]	2004	48/F	ESRD	36	No	Cat	–	CEZ + GM	Improved
15. Cooke et al. [17]	2004	73/F	PCK	8 and 12	Yes	Cat	Unknown	1st: GM, 2nd: GM + CPFX	Improved
16. Mat et al. [18]	2005	52/M	IgAN	3	Yes	Cat	+	CEZ + AMK → CEZ	Improved
17. Malik et al. [19] (case 1)	2005	21/F	Small kidney	36	Yes	Cat	+	GM + PIPC/TAZ → GM + CEZ	Improved
18. Malik et al. [19] (case 2)	2005	58/M	Cyclosporin N	12	Yes	Cat	+	VCM + GM → GM	Improved
19. Antony and Oglesby [20]	2007	48/F	DMN type2	Unknown	No	Dog	–	CEZ + GM	Improved
20. Rondon-Berrios and Trevejo-Nunez [21]	2010	38/M	ANCA	60	Yes	Cat	+	VCM + CAZ → VCM + PIPC/TAZ → PIPC/TAZ → ABPC/ST → LVFX	Improved and catheter removal
21. Mugambi and Ullian [22]	2010	36/F	SLE, DM, HTN	Unknown	Yes	Cat	–	VCM + GM → CPFX	Improved and catheter removal
22. Satomura et al. [23]	2010	58/M	DMN type2	Unknown	Yes	Cat	–	CEZ + CAZ → LVFX	Improved
23. Reported case	2011	45/M	IgAN	84	Yes	Cat	+	VCM + CAZ → LVFX	Improved

HTN hypertension, PAN polyarteritis nodosa, FSGS focal segmental glomerulosclerosis, CGN chronic glomerulonephritis, DMN diabetic mellitus nephropathy, IgAN IgA nephropathy, PCK polycystic kidney, ESRD end-stage renal disease, Cyclosporin N cyclosporin nephropathy, ANCA antineutrophil cytoplasmic antibody, SLE systemic lupus erythematosus, VCM vancomycin, GM gentamicin, CPFX ciprofloxacin, CEZ cefazolin, CMD cefamandole, PG penicillin, CEPR cephalirin, ABPC ampicillin, SBT sulbactam, CAZ ceftazidime, PIPC piperacillin, TOB tobramycin, AMK amikacin, TAZ tazobactam, LVFX levofloxacin

P. multocida too. In 11 of 23 cases, including our case, VCM was administered at the initiation of treatment, but was discontinued after Gram-negative bacilli were found by Gram staining or *P. multocida* was identified in peritoneal dialysate cultures. Gentamicin was the most frequently used antibiotic (11 cases) and was effective in each case. CAZ was used in five cases, including our case, and was effective in four cases. However, it was ineffective in one case. In this case, the treatment was changed from CAZ to piperacillin/tazobactam. Finally, ampicillin was found to be effective, and then the patient recovered. In the latest two reports (9.1 %), it was necessary to transfer the patient to an intensive care unit, as they had developed sepsis [21, 22]. The two cases were improved by changing them to appropriate antibiotic therapy and PD catheter removal.

Pasteurella species might be penicillin-resistant because they produce β -lactamase; therefore, ampicillin/sulbactam, piperacillin/tazobactam, and amoxicillin/clavulanate are recommended for the treatment of *P. multocida* [24, 25]. Patients that display cloudy effluent after being treated with appropriate antibiotics for 5 days have refractory peritonitis and should have their catheter removed [26].

In conclusion, *P. multocida* peritonitis is rare in PD patients, and only 22 such cases have been reported. Its transmission almost always involves a cat biting or scratching the PD tubing or bags.

Patients maintained on PD who keep pets such as cats or dogs at home should be educated about the possibility of developing peritonitis related to their domestic pets. When these patients switch from CAPD to CCPD, they should be given information about the risk of pet-associated peritonitis.

Physicians should consider empiric therapy against *P. multocida* in pet-owning PD patients who present with a history of PD fluid leakage and peritonitis, especially in patients who use cyclers devices.

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