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CASE REPORT

Peritoneal dialysis-associated catheter infection caused by *Mycobacterium abscessus* in an elderly patient who was successfully treated with catheter removal

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Abstract An 89-year-old Japanese man on peritoneal dialysis (PD) was suspected of having a PD-associated catheter infection. He visited the hospital because of the discharge of pus from the exit site of his catheter. Gram staining of the pus showed Gram-positive bacilli, but these were acid-fast bacilli. The rapidly growing nontuberculous mycobacteria, *Mycobacterium abscessus,* was isolated. PD catheter removal and debridement were immediately performed. The patient received combination antibiotic therapy. His clinical course was good, but he required hemodialysis due to the discontinuation of PD. However, the patient and his family chose not to continue hemodialysis even when the symptoms of uremia appeared. Best supportive care was arranged by his primary care physician. *M. abscessus* is a rare causative organism for PD-associated catheter infections and is difficult to treat. In our case, a rapid and precise diagnosis was made using acid-fast staining and *Mycobacterium* culture. The risk of nontuberculous mycobacterial infections should be considered in patients on PD.

Introduction

Peritoneal dialysis (PD)-associated catheter infection is one of the most serious complications, because it leads to the discontinuation of PD [1]. Exit-site infection (ESI) is a major predisposing factor for peritonitis [2]. Nontuberculous mycobacteria (NTM) also cause PD-associated catheter infection, but the prevalence is relatively low. The first case of NTM peritonitis was reported in a PD patient in 1982 [3]. NTM is a collective term for describing acid-fast bacilli other than *Mycobacterium tuberculosis* and *Mycobacterium leprae* [4]. They are abundant in the natural environment. NTMs are usually not virulent unlike *M. tuberculosis*. However, PD-associated catheter infections due to rapidly growing NTMs (RGNTMs) are associated with a high rate of catheter loss [5]. *Mycobacterium abscessus* is an RGNTM and is difficult to treat, because it is one of the most resistant species to anti-microbial drugs. Combination antibiotic therapy is needed, but this infection can be refractory to treatment [6]. *M. abscessus* peritonitis is characterized by a relatively higher complication rate than other NTM peritonitis and a 3-month mortality rate [7]. The duration of therapy remains unclear for patients with PD-associated catheter infection due to *M. abscessus*, and catheter removal is one of the radical treatments. The diagnosis of *M. abscessus* infection is challenging, because early diagnosis is the key to appropriate treatment. Here, we present a case of PD-associated catheter infection caused by *M. abscessus*, which was successfully treated with catheter removal because of a prompt diagnosis.

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Case report

An 89-year-old Japanese man on continuous ambulatory peritoneal dialysis (CAPD) visited the hospital because of the discharge of pus from the exit site of the catheter. One month prior to admission, routine follow-up revealed that PD fluid cell counts were increased. The white blood cell (WBC) count of the PD fluid was 74/μL (monocytes 57/μL; polynuclear leukocytes 17/μL). Blood tests showed that the C-reactive protein (CRP) level was elevated (5.45 mg/dL). However, the patient was asymptomatic at that time. We considered PD-associated peritonitis despite the fact that the WBC count of the PD fluid was 100/μL, and it was not polynuclear leukocyte predominant, indicating a less likely possibility of peritonitis [8]. The patient refused hospitalization and chose outpatient follow-up. Levofloxacin was prescribed. Culture of the skin smear from the exit site and the PD fluid were also performed, but both were negative. During the treatment, the patient did not develop a fever or abdominal pain; his bowel movements were also good. One month later, the patient visited the hospital because of pus from the exit site.

Due to end-stage renal disease (ESRD), PD had been initiated at 6 months prior to the current admission. He did not experience any PD-associated issues before this admission. He had a history of diabetes, hypertension, angina pectoris, and congestive heart failure. An ointment containing bacitracin and fradiomycin sulfate was used for exit-site care.

At the initial presentation, the patient was afebrile and asymptomatic. His vital signs were stable. There was no tenderness on abdominal examination. However, pus was being discharged from the exit site. Reddening and swelling of the skin around the exit site and induration of the skin from the exit site up to the area above the second cuff was also noted (Fig. 1). The PD fluid was not cloudy. The WBC count of the PD fluid was decreased to 8/μL (monocytes 5/μL; polynuclear leukocytes 3/μL). Complete blood count revealed that his WBC count was 5700/μL; red

blood cell count 374×10^4/μL; hemoglobin level 10.2 g/dL; and platelet count, 15.8×10^4 /μL. Blood chemistry tests showed that the levels of Na were 137 mEq/L; K 3.1 mEq/L; Cl 97 mEq/L; P, 3.6 mg/dL; Ca 8.4 mg/dL; albumin 2.5 g/dL; blood urea nitrogen (BUN) 47.4 mg/dL; creatinine 4.75 mg/dL; aspartate aminotransferase 12 U/L; alanine aminotransferase, 7 U/L; and HbA1c 5.7%. CRP levels were decreased but still slightly elevated (1.87 mg/dL). Computed tomography (CT) showed an increased attenuation of fatty tissue around the PD catheter from the area of the second cuff to the exit site.

We initially suspected bacterial ESI and tunnel infection according to the clinical manifestations and CT findings [9]. We performed gram staining and culture of the pus and PD fluid. Gram staining of the pus revealed Gram-positive bacilli. Culture of the PD fluid was negative. Although cefazolin had been administered since admission, the amount of pus was markedly increased and included a small amount of blood on day 3. It seemed that cefazolin was not an effective antibiotic against the infection. On day 4, we performed acid-fast staining, which was positive. According to the bacterial growth rate, we considered RGNTM. We initiated combination antibiotic therapy using amikacin, imipenem, and clarithromycin on day 4. *M. abscessus* was isolated from the pus culture on day 8 by using DNA–DNA hybridization (DDH *Mycobacterium* "KYOKUTO," KYOKUTO PHARMACEUTICAL INDUSTRIAL CO., LTD., Tokyo, Japan).

We consulted urologists in our hospital and decided to perform catheter removal surgery, because *M. abscessus* infections are usually difficult to treat and fatal. The operation was performed on day 14. During the operation, pus and inflammatory changes were unremarkable along the subcutaneous tunnel. Debridement and lavage using normal saline were also performed. Part of the infection-suspected skin was surgically removed. Incisions at the exit site and second cuff remained open wounds to be cleaned after the operation. *Mycobacterium* cultures of the tip of the catheter, first cuff, and second cuff were examined, and

Fig. 1 Images of the catheter exit site in the patient on the day of admission (**a**) and right after the initiation of peritoneal dialysis (**b**). Pus discharge was present from the right side of the exit site (an *arrow*), and reddening and swelling are also seen around the exit site in **a**
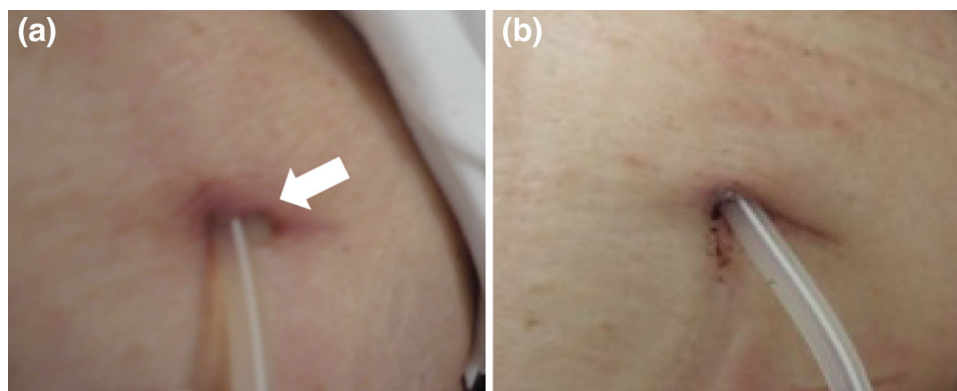
the results were negative, negative, and positive for *M. abscessus*, respectively. According to culture results, ESI and tunnel infection were more likely than peritonitis. After catheter removal surgery, the patient's condition stabilized. On day 16, antibiotic sensitivity testing revealed that the *M. abscessus* isolated from the patient was resistant to almost all types of antibiotics, including isoniazid, rifampicin, streptomycin, enviomycin, ethionamide, ethambutol, cycloserine, and levofloxacin.

The patient needed to continue renal replacement therapy; however, PD was not recommended in this case considering the risk of recurrent infections, because *M. abscessus* is ubiquitous in natural environments such as soil and water [10]. The PD catheter was not replaced due to a high rate of PD catheter loss (80%) in PD patients with *M. abscessus* infections [6]. We talked with the patient and his family and the patients decided on initiating hemodialysis. Arteriovenous graft surgery was performed on day 19. A few days after hemodialysis was initiated, the patient refused to continue dialysis due to severe boring pain. He also exhibited a depressive mood. Finally, the patient and his family decided not to continue dialysis even when the symptoms of uremia appeared. Imipenem was switched to faropenem, and amikacin was discontinued on day 29 due to respect for the patient's opinion. Then, we continued to administer faropenem and clarithromycin until day 47. He was discharged on day 48, and we arranged a primary care physician to provide the best supportive care for the patient.

Discussion

Mycobacterium abscessus is an RGNTM categorized in Runyon Group IV, which includes *M. fortuitum* and *M. chelonae* [11]. These organisms require only 3–7 days to grow. *M. abscessus* was first isolated from a knee abscess by Moore et al. [12]. It was named after its ability to produce deep subcutaneous abscesses. *M. abscessus* and *M. chelonae* were initially considered to belong to the same group; however, *M. abscessus* was reclassified as an individual species in 1992 [13]. It commonly causes skin infections, soft tissue infections, and respiratory infections, but it can also cause various infections in almost all human organs [14].

Song et al. [15] reviewed 57 cases of PD-associated NTM peritonitis. Among them, the most prevalent organism was *M. fortuitum* (38.6%), followed by *M. chelonae* (14.0%). The incidence of *M. abscessus* was relatively low (8%). The PD catheter needed to be removed in 52 (92.9%) of 56 cases. Renaud et al. [6] reported that ESIs occurring due to RGNTMs constituted 3% of all ESIs. Infections due to *M. abscessus* are refractory, because this organism is intrinsically resistant to currently available anti-tuberculous drugs and antibiotics. Drugs recommended for the treatment of *M. abscessus* infections are a combination therapy of clarithromycin with one aminoglycoside and one other injectable drug such as cefoxitin or imipenem [16]. Macrolides are the only active oral antibiotic against *M. abscessus* [17].

In ESRD patients, uremia is associated with immune dysfunction of both the innate and adaptive immune systems alternately, leading to a high infection rate in patients with ESRD [18]. In PD patients, impaired maturation of helper T-cells has been seen, which might be the cause of susceptibility to infection [19]. In our case, the patient was old (aged 89 years) and had diabetes without medication; in addition, he was on CAPD. These could be the causes for the susceptibility to NTM infections. Bacitracin and fradiomycin ointment use might be a risk factor for NTM infections in this case, considering that a retrospective observational study comparing the incidence of NTM infections between patients receiving prophylactic gentamicin cream (2.71%) and those receiving alternative exit-site care (0.102%) reported that gentamicin cream might be a risk factor for atypical mycobacterial infection because of selective pressure on other micro-organisms [20]. Conversely, other double-blind randomized controlled trials have demonstrated no statistical difference between topical mupirocin and gentamicin cream [21]. Further clinical researches will be needed to provide a better exit-site care for preventing NTM infections.

In this study, we concluded that our case was limited to tunnel infection, according to the results of PD fluid analysis. The patient did not have either a fever or abdominal pain, which was compatible with the diagnosis of tunnel infection [22, 23]. If there has been a delay in diagnosis, the infection would have progressed to peritonitis, and treatment would have been difficult. We identified nine cases of ESIs and/or tunnel infections due to *M. abscessus* [6, 20, 24, 25] in the literature (Table 1). Our patient was the oldest, with the shortest duration of PD among patients with ESI due to *M. abscessus*. Making an accurate diagnosis of PD-associated catheter infection due to NTM is challenging. Maeda et al. reported a case of PD-associated peritonitis due to *M. abscessus* [26]. In that case, *M. abscessus* was isolated after 2 years of recurrent ESIs. In patients with refractory or recurrent PD-associated ESI and peritonitis, NTMs should be considered as causative organisms.

Acid-fast staining is not routinely performed in patients with PD-associated catheter infections in our faculty, but it was a key diagnostic examination in this case. We should consider NTM infections in PD patients. For an early diagnosis of NTM infections, acid-fast staining is highly recommended, because it can quickly evaluate the

Table 1 Comparison between published case reports of exit-site infections due to *Mycobacterium abscessus* and the present case

Case number	Reference	Age/sex	Underlying diseases	PD modality	Duration of PD	AFB stain	Tunnel infection	Catheter removal	Antibiotics and duration of the treatment	Clinical outcome
Case 1	The present case	89/M	DM, IHD, HTN	CAPD	6 months	Yes	Yes	Yes	AMK (4 weeks), CAM (47 days), IPM (4 weeks), FRPM (19 days)	Converted to hemodialysis temporally, then palliative care
Case 2	[6]	63/M	DM, IHD, HTN	APD	18 months	N/A	Yes	Yes	CAM (6 weeks)	Converted to hemodialysis
Case 3	[6]	81/M	DM, HTN	CAPD	21 months	No	No	No	Untreated	Palliative care
Case 4	[6]	69/F	DM, IHD, HTN	APD	40 months	No	No	Yes	CAM (6 weeks), EB (2 weeks)	Converted to hemodialysis
Case 5	[20]	81/F	DM, HTN, IgAN	CAPD	>12 months	N/A	No	Yes	AMK (8 weeks), CAM (28 weeks), LVFX (4 weeks), MEPM (2 weeks)	PD catheter was replaced
Case 6	[20]	58/F	DM	CAPD	49 months	N/A	No	No	AMK (14 weeks), CAM (14 weeks)	Died
Case 7	[20]	82/F	MPA	CAPD	19 months	N/A	No	No	AMK (8 weeks), CAM (48 weeks)	CAPD was continued without catheter removal
Case 8	[20]	56/M	DM, HTN, Af	CAPD	>22 months	N/A	Yes	Yes	CAM (11 weeks)	Converted to hemodialysis
Case 9	[24]	28/F	N/A	CAPD	N/A	Yes	No	Yes	AMK (13 weeks), CAM (20 weeks) OFLX (16 weeks), TMP/SMX (16 weeks)	Converted to hemodialysis temporally, then PD catheter was replaced
Case 10	[25]	14/F	SLE	CAPD	N/A	N/A	Yes	Yes	AMK (34 days), DOXY (24 days), CAM (34 days), RFP (14 days)	Converted to hemodialysis temporally, then PD catheter was replaced

N/A not available, *M* male, *F* female, *DM* diabetes mellitus, *IHD* ischemic heart disease, *HTN* hypertension, *IgAN* immunoglobulin A nephropathy *MPA* microscopic polyangiitis, *Af* atrial fibrillation, *SLE* systemic lupus erythematosus, *PD* peritoneal dialysis, *CAPD* continuous ambulatory peritoneal dialysis, *APD* automated peritoneal dialysis, *ESI* exit-site infection, *AFB* acid-fast bacilli, *AMK* amikacin, *CAM* clarithromycin, *IPM* imipenem, *FRPM* faropenem, *EB* ethambutol, *LVFX* levofloxacin, *MEPM* meropenem, *OFLX* ofloxacin, *TMP/SMX* trimethoprim/sulfamethoxazole, *DOXY* doxycycline, *RFP* rifampicin

existence of NTM. After making a diagnosis, immediate catheter removal was effective in our case. Although the patient's refusal for hemodialysis was an unexpected event, other renal replacement therapies and the consequences of PD catheter removal should also be considered.

Compliance with ethical standards

Conflict of interest The authors declare no conflict of interest associated with this manuscript.

Human and animal rights The article does not contain any studies involving human or animal participants.

Informed consent Informed consent was obtained from the patient's family due to the patient's ineligibility in the present study.

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