Renal Replacement Therapy

CASE REPORT

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A case of *Moesziomyces antarcticus* peritonitis in a patient undergoing peritoneal dialysis

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Abstract

Background: Fungal peritonitis is a common and serious complication associated with peritoneal dialysis (PD), and it is often refractory to treatment.

Case presentation: A 70-year-old patient undergoing peritoneal dialysis was admitted to our hospital with fever and cloudy PD fluid. A diagnosis of yeast-like fungal peritonitis was made by examining the PD fluid. After starting intravenous caspofungin acetate, the PD catheter was removed. A fungal pathogen was isolated from the peritoneal fluid and identified as *Cryptococcus* sp. Based on the results of antifungal susceptibility testing, the treatment was changed to oral voriconazole and continued for 6 weeks. However, because of the discrepancy between the morphological findings and culture results, we performed genetic analysis, which uncovered *Moesziomyces antarcticus*. This patient was diagnosed with PD-related peritonitis caused by *M. antarcticus* and was successfully treated with voriconazole and removal of the PD catheter.

Conclusions: Reports of human infection by *M. antarcticus* are rare, and only two cases have been recognized. This may be the first case of infection detected in PD fluid.

Keywords: Peritoneal dialysis, Peritoneal dialysis-related peritonitis, *Moesziomyces antarcticus*, Voriconazole

Background

Peritonitis is one of the most common complications associated with peritoneal dialysis (PD). Although the incidence of peritonitis is only 5%, it can be fatal and a direct cause of death in patients undergoing PD [1]. Of the different types, fungal peritonitis is a rare but serious complication associated with high mortality. Even when it does not lead to death, it is often refractory to treatment and subsequent withdrawal from PD [2].

Moesziomyces antarcticus (formerly known as *Pseudozyma antarctica*), a basidiomycete yeast, was originally isolated from sediment samples obtained from Lake Banda in Antarctica, and later reports indicated that it is mainly present on plant surfaces [3]. The species has been classified and described as M. *antarcticus* since 2015 [4]. Current reports of human infection by *M. antarcticus* are scarce, and to the extent that they have been confirmed, they include a case reported in 2003 in Thailand that was identified from blood [5]. In 2019, a 93-year-old Chinese patient with chronic kidney disease, chronic obstructive pulmonary disease, and dementia was diagnosed with *M. antarcticus* infection in blood [6]. A summary of each case is presented in Table 1. In the present study, we experienced a case of peritonitis caused by *M. antarcticus* in an adult patient on PD. To the best

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Table 1 Cases of *M. antarcticus* infections in human

No	Age/sex	Sample	Country	Underlying condition	Clinical presentation	Outcome
#1	N/A	Blood	Thai	N/A	N/A	N/A
#2	93/M	Blood	China	Hypertension Chronic renal insufficiency Alzheimer's disease Cerebral infarction	Chronic obstructive pulmonary disease	Cure
#3	70/M	PD fluid	Japan	Chronic renal failure Hypertension	Peritonitis	Cure

N/A not available

#1 Thai, 2003 (Sugita et al. [4]), #2 China, 2019 (Liu et al. [5]), #3 this case

of our knowledge, this is the first report of the successful treatment of PD-related peritonitis associated with *M. antarcticus* using voriconazole and catheter removal.

Case presentation

A 70-year-old man with hypertensive nephropathy had been receiving continuous ambulatory peritoneal dialysis (CAPD) since the age of 69. The patient's life history included gardening as a hobby. The patient did not use a sterile connection ultraviolet flush device when changing the PD bag, and the procedure was performed manually. At 70 years of age, CAPD was changed to the combination of PD and hemodialysis (HD). The PD bag exchange protocol was as follows: 1.5 L of 1.5% glucose-based solution three times a day during the daytime and 2 L of icodextrin solution overnight. He was not treated with any immunosuppressive therapies, and a serological test for human immunodeficiency virus was negative. The patient had experienced PD-related peritonitis for 1 month prior to this episode. At that time, *Streptococcus salivarius* was detected and eradicated using cefazolin.

He presented to our hospital with complaints of fever and cloudy PD fluid. His vital signs were as follows: blood pressure, 142/86 mmHg; pulse, 87 beats/min; respiratory rate, 17 breaths/min; and temperature, 37.1 °C. Physical examination revealed mild abdominal tenderness but no muscular defenses. The clinical laboratory data at admission were as follows: peripheral white blood cell (WBC) count, 6600 cells/mm^3 (neutrophils, 66.2%; lymphocytes, 24.1%; eosinophils, 3.8%); hemoglobin level, 10.1 g/dL; and C-reactive protein (CRP) level, 0.32 mg/dL. A Tenckhoff catheter had been placed in the left lower quadrant, and it did not appear to be infected. The WBC count in the first cloudy PD fluid sample was 295 cells/μL. Blood cultures collected at admission were negative. We initially treated the patient with intraperitoneal tobramycin and cefazolin in combination. Gram staining of the centrifuged PD fluid sediment was performed, and yeast-like fungi were identified by microscopy. This result was also confirmed in PD fluid on day 5. These findings suggested fungal peritonitis, and the administration of intravenous caspofungin acetate was initiated. However, the number of WBCs in the PD fluid remained above 100/μL. The peritoneal catheter was removed on day 11 after admission according to the recommendation of the International Society for Peritoneal Dialysis (ISPD) guidelines [7]. PD catheter removal was successful without any adverse events. There was no sign of infection around the cuffs, and cultures of the tip of the catheter were negative. Subsequently, HD was performed as renal replacement therapy. A fungal pathogen grew from the initial PD fluid, and the isolate was identified as a *Cryptococcus* species (*C. laurentii*) by a commercial laboratory (method: matrix-assisted laser desorption ionization–time-of-flight mass spectrometry) 15 days after admission. On the basis of the antifungal susceptibility test results, the treatment was switched to oral voriconazole. The patient's CRP levels improved, and he was discharged on day 22 after admission. However, because of the discrepancy between the morphological findings (Fig. 1) and culture results, we asked the Medical Mycology Research Center, Chiba University (Chiba, Japan) to perform an additional detailed examination. We ultimately identified the strain as *M. antarcticus* based on sequencing of the internal transcribed spacer and D1/D2 regions of the 28S ribosomal DNA by performing a Basic Local Alignment Search Tool search in GenBank. We continued voriconazole administration for 6 weeks and then terminated the treatment. The clinical course is summarized in Fig. 2. The patient has been in good condition for more than 1 year after completing antibiotic therapy.

Discussion and conclusions

The causes of peritonitis in patients undergoing PD are touch contamination, exit site or tunnel infection, and gastrointestinal infection [8]. Eisenberg et al. [9] identified the following risk factors for the development of fungal peritonitis: bacterial peritonitis within the past month, the use of antibiotics, hospitalization within the past 10 days, extraperitoneal infection, bowel perforation, peritoneal-vaginal traffic, and the use of immunosuppressive drugs. In this case, there were no signs of tunnel or gastrointestinal infections, but there was prior bacterial peritonitis 1 month before presentation. *Staphylococcus*

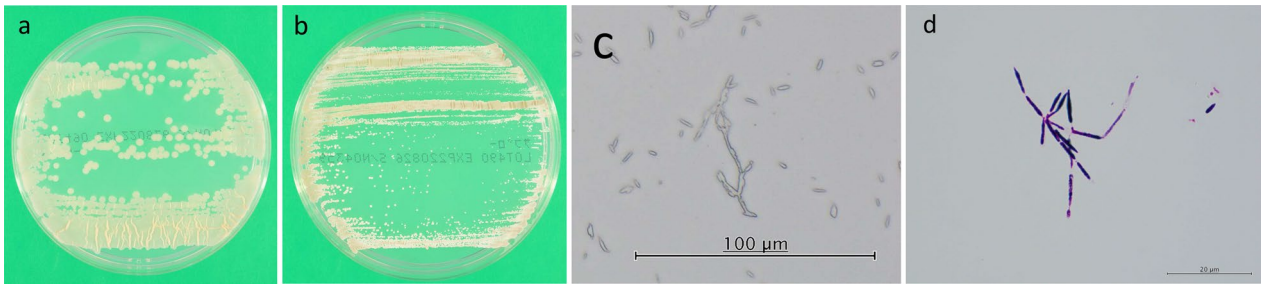

Fig. 1 Morphological and physiological characteristics of the isolated *Moesziomyces antarcticus* specimen. **a** Smooth colonies of *M. antarcticus* after 3 days growth on Sabouraud medium at 30 °C. **b** Colony morphology of *M. antarcticus* after 3 days growth on Sabouraud medium at 35 °C. **c** Direct microscopic examination of fungi in blood culture flasks. **d** Gram staining of fungi in blood culture flasks

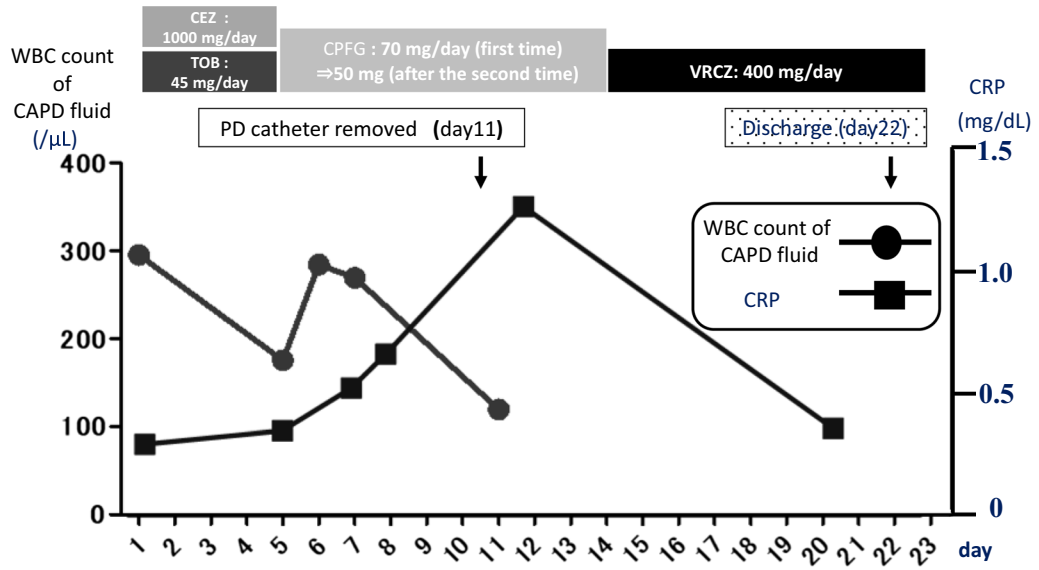

Fig. 2 The patient's clinical course. The left Y-axis indicates the white blood cell count in continuous ambulatory peritoneal dialysis fluid (/μL), and the right Y-axis indicates the C-reactive protein level (mg/dL). CEZ, cefazolin; TOB, tobramycin; CPFG, caspofungin; VRCZ, voriconazole

epidermidis and *S. aureus* are the most common causative organisms of peritonitis secondary to PD, and fungal peritonitis is a common subsequent microbial infection. Fungal peritonitis is a serious complication in patients undergoing PD, leading to death in approximately 25% of episodes [10, 11]. According to recommendations from the ISPD, catheters should be removed immediately after the diagnosis of fungal peritonitis in addition to initiating antifungal therapy [7].

In the Wright Valley, South Victoria Land, Antarctica in 1965, a research team dispatched from Japan isolated a basidiomycetous yeast strain from the sediment of Lake Vanda and named it *S. antarcticus* [12]. After several taxonomic changes, the species was combined with the genus *Pseudozyma* and described as *P. antarctica* in 1995 [13]. In 2015, *P. antarctica* was transferred to the genus *Moesziomyces*, and the strain was named *M. antarcticus* [4]. *Moesziomyces* species are mainly isolated from plant surfaces, and they provide natural sources of protection against powdery mildews. Several *Moesziomyces* species have been reported to exhibit biological activity against biodegradable plastics, which are typically used in a number of industrial processes [14]. In recent years, some cases of patients infected by plant fungus have been reported [5, 15]. As previously mentioned, reports of human infection by *M. antarcticus* are rare, with only two cases recognized. In a previous report of human infection by *M. antarcticus*, both cases were detected in blood samples. This may be the first case of infection detected in PD fluid.

Table 2 Results of drug susceptibility testing in previous reports and in this case

No	MIC								Treatment
	FLC	ITC	VRCZ	AMB	CPFG	5FC	MCZ	MCFG	
#1	0.5	0.06	N/A	0.12	N/A	> 64	N/A	N/A	N/A
#2	128	4	8	< 0.05	N/A	> 16	N/A	N/A	CPFG ⟹ LAMB
#3	> 64	0.25	0.5	1	16	> 64	8	> 16	CPFG ⟹ VRCZ

MIC minimum inhibitory concentration, *FLC* fluconazole, *ITC* itraconazole, *VRCZ* voriconazole, *AMB* amphotericin B, *CPFG* caspofungin, *5FC* flucytosine, *MCZ* miconazole, *MCFG* micafungin, *LAMB* liposomal amphotericin, *N/A* not available

#1 Thai, 2003 (Sugita et al. [4]), #2 China, 2019 (Liu et al. [5]), #3 this case. Testing was performed according to the CLSI-M27-E4 Guidelines

Since its discovery in Antarctica, *M. antarcticus* has also been isolated from rice paddies, water bodies, and oceans in regions in East Asia, including Japan. The microbe was also detected on an ovary of barnyardgrass (*Echinochloa crus-galli*) in Japan [16]. It is presumed that this patient had extensive contact with plants based on his hobby of gardening and thus opportunities to be exposed to *M. antarcticus*. Microbial substitution from the most recent episode of bacterial peritonitis may have also contributed to the onset of this episode. An *M. antarcticus* strain isolated by Sugita and colleagues in Thailand in 2003 was sensitive to fluconazole and itraconazole. Conversely, an isolate identified by Liu et al. in China in 2009 was resistant or weakly susceptible to flucytosine, fluconazole, voriconazole, and itraconazole and was only sensitive to amphotericin B (Table 2). In this case, the fungus was resistant to fluconazole and flucytosine, and it had relatively low susceptibility to caspofungin. We chose voriconazole because it has good sensitivity results, it is available in an oral form, and it is relatively simple to adjust its dose [17], even in patients with renal failure. We believe the patient's CRP level clearly improved after catheter removal, suggesting that this was the most effective treatment in this case. We believe that voriconazole effectively prevented postoperative wound infection and recurrent or refractory peritonitis.

Experience regarding the optimal duration of treatment for *M. antarcticus* infection is limited because of the small number of reported cases and the lack of controlled trial data. In the present case, treatment was successful after 6 weeks of voriconazole administration and removal of the peritoneal catheter. In the future, the accumulation of data on cases of successful treatment should facilitate selection of the optimal antifungal agent and optimization of the duration of treatment for PD-related peritonitis associated with *M. antarcticus*.

Abbreviations

CAPD: Continuous ambulatory peritoneal dialysis; CRP: C-reactive protein; HD: Hemodialysis; ISPD: International Society for Peritoneal Dialysis; PD: Peritoneal dialysis; WBC: White blood cell.

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Author contributions

SN, MY, YK, YA, MH, TY, TO, and TS participated in discussions of this case. SN drafted the manuscript, and this author is responsible for the final version of the manuscript. MO and KK discussed the fungus in detail. SN, KK, and TS reviewed and revised the manuscript. All authors read and approved the manuscript and agreed with its submission to this journal.

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Availability of data and materials

All data and materials were included in the manuscript.

Declarations

Ethics approval and consent to participate

This report has been prepared in compliance with the Declaration of Helsinki. Ethical approval was not required for this type of case report.

Consent for publication

Written informed consent was obtained from the patient for the publication of this case report.

Competing interests

The authors declare no competing interests.

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