Successful treatment of peritoneal dialysis-related peritonitis caused by *Demacoccus nishinomiyaensis*

Akihito Tanaka¹ · Yu Watanabe¹ · Chiharu Ito¹ · Minako Murata¹ · Hibiki Shinjo¹ · Yasuhiro Otsuka¹ · Asami Takeda¹

Received: 7 December 2018 / Accepted: 19 February 2019 / Published online: 4 March 2019
© Japanese Society of Nephrology 2019

Abstract

A 53-year-old man receiving peritoneal dialysis (PD) for 4 months presented with PD-related peritonitis (abdominal pain, turbid peritoneal dialysate effluent, white blood cell in peritoneal dialysate effluent 5350/μL, C-reactive protein 25.56 mg/dL) caused by *Demacoccus* (*D.*) *nishinomiyaensis*. He was first treated empirically with cefazolin and ceftazidime. After detection of *D. nishinomiyaensis* in the peritoneal effluent culture collected on the first day of hospitalization, the antibiotics were changed to amoxicillin and vancomycin. After confirming negative-conversion of peritoneal effluent culture, treatment was continued for more than 6 weeks. The peritonitis resolved; he continues peritoneal dialysis without withdrawal from PD or catheter removal. *D. nishinomiyaensis* is part of resident microbiota of the skin, and its pathogenicity is rarely reported. To date, there is no report of PD-related peritonitis caused by *D. nishinomiyaensis*. Because it is a slow grower, it may be missed and the peritonitis categorized as culture-negative. Long-term culture is important to detect it. It is difficult to determine the antibiotics that can be used because susceptibility to antibiotics is unknown due to the organism's rarity. Furthermore, the appropriate treatment period is also unknown. Long-term treatment may be useful in PD-related peritonitis caused by *D. nishinomiyaensis* because it is a slow grower.

Keywords Peritoneal dialysis · Peritonitis · *Demacoccus nishinomiyaensis*

Introduction

Peritoneal dialysis (PD)-related peritonitis was recognized to have decreased dramatically after improvement of bag exchange and connection system in many countries. However, in 2009, the average number of months between episodes of peritonitis at 12 facilities in London was 14.7 for continuous ambulatory PD (CAPD) and 18.1 for automated PD and/or continuous cycling PD. Further, it was reported that there was a problem in treatment and caution was raised that “peritonitis is still the Achilles tendon of PD treatment” [1, 2]. In Japan, according to the research on PD withdrawal from April 2000 to September 2000 in 5391 patients with PD, performed by Kawaguchi et al., peritonitis is a major reason for withdrawal in patient groups with PD vintage less than 1 year, 1–4 years, and 4–8 years [3]. Furthermore,

studies performed around our local area also show that PD-related peritonitis is the most common reason for withdrawal from PD, and have been major obstacles preventing increases in the population of PD patients [4, 5].

Demacoccus (*D.*) *nishinomiyaensis* is gram-positive coccus, originally called *Micrococcus* (*M.*) *nishinomiyaensis*, but in 1995 the name and classification were changed [6]. *M. nishinomiyaensis* is reported to be mostly resident in the skin of the head and extremities [7]. It is a resident bacterium, and the pathogenicity of *D. nishinomiyaensis* has rarely been reported. There is a report that said that it was detected from hidradenitis suppurativa [8]. However, pathogenicity is unclear because the extent of involvement of the bacteria in hidradenitis suppurativa is not clear. There is also a report that it was detected in the urine of patients with urinary tract infection [9]. However, there is no report of PD-related peritonitis caused by *D. nishinomiyaensis*. From the online database, BacDive [10, 11], the incubation period (culture period) is assumed to be 10–14 days. Hence, it seems to be said that it is a slow grower. Therefore, among some facilities, there is a risk of failure to detect causative bacteria. To avoid this, long-term culture is considered to be

✉ Akihito Tanaka
zhangren_at_23@yahoo.co.jp

¹ Kidney Disease Center, Japanese Red Cross Nagoya Daini Hospital, 2-9, Myoken-cho, Showa-ku, Nagoya 466-8650, Japan

useful. In addition, because there is no report about selection of antibiotics and the treatment period, it is necessary to take these two parameters into consideration.

In the current case, we encountered PD-related peritonitis, caused by *D. nishinomiyaensis*, which is a very rare bacterium. Since there is no report in the past, it is necessary to consider the method of detection, antibiotic selection, and treatment period. Our case thus assumes importance.

Case report

The case pertains to a 53-year-old man who was found to have urinary protein at a university health checkup when he was 20 years old. Subsequently, urine protein was detected every time at company health checkups. However, he did not go to a hospital for a long time. He has a past history with hypertension, but without diabetes or liver disease. He started visiting a hospital from 2015, and started coming to our hospital from 2016. His renal function deteriorated gradually, and a PD catheter was placed in April 2017. He started PD in April 2018. He learnt the technique of PD and was performing PD without any problem. He started PD with a regimen comprising 1.5 L of 7.5% icodextrin solution (Extraneal, Baxter, Tokyo, Japan) in daytime and about 6.8 L of 1.5% glucose solution (Dianeal-N PD-4 1.5%, Baxter, Tokyo, Japan) by automated PD overnight. However, he had fever and fatigue in early September 2018. Subsequently, he had difficulty having meals due to the feeling of fullness of the abdomen. He visited our hospital in mid-September. On admission, physical examination revealed clear respiratory and heart sounds. He demonstrated mild abdominal tenderness, but rebound pain was not observed. The exit site of the PD catheter was in the lower left abdomen and it was clear. The peritoneal dialysate effluent was turbid. He was not aware of effluent turbidity because he did not observe carefully. The body temperature was 37.2 °C, blood pressure was 111/91 mmHg, and heart rate was 115 beats/min with sinus rhythm. Clinical laboratory data are shown in Table 1. At the time of admission, the patient's prescription for oral therapy included alfacalcidol (2.5 µg/day), febuxostat (10 mg/day), calcium carbonate (1500 mg/day), azosemide (60 mg/day), trichlormethiazide (1 mg/day), and cinacalcet (25 mg/day). Based on the indications of abdominal pain, turbid peritoneal dialysate effluent, and white blood cell (WBC) elevation in peritoneal dialysate effluent (5350/µL), we diagnosed the condition as PD-related peritonitis. Peritoneal dialysate effluent culture is performed according to International Society for Peritoneal Dialysis (ISPD) guidelines [12], such as plating the pellet on a solid medium and infusing into blood culture bottles after concentration by centrifugation and directly infusing into blood culture bottles adjunctively. Based on physical examination

Table 1 Laboratory data on admission

Parameters	
Examination of the blood	
WBC (/µL)	9200
Hb (g/dL)	7.6
Plt (10 ⁴ /µL)	30.8
TP (g/dL)	5.41
Alb (g/dL)	1.84
AST (U/L)	7
ALT (U/L)	10
ALP (U/L)	283
AMY (U/L)	13
UA (mg/dL)	3.54
BUN (mg/dL)	50.7
Cr (mg/dL)	12.28
Na (mEq/L)	128
K (mEq/L)	5.1
Ca (mg/dL)	8.7
P (mg/dL)	5.6
CRP (mg/dL)	25.56
Examination of peritoneal dialysate effluent	
WBC (/µL)	5350

WBC white blood cells, Hb hemoglobin, Plt platelet, TP total protein, Alb albumin, AST aspartate aminotransferase, ALT alanine transaminase, ALP alkaline phosphatase, AMY amylase, UA uric acid, BUN blood urea nitrogen, Cr creatinine, Na sodium, K potassium, Ca calcium, P phosphate, CRP C-reactive protein

and abdominal computed tomography, tunnel infection and abdominal abscess were not suspected. Hence, we considered infection route is touch contamination. Figure 1 shows the clinical course of the patient. The PD regimen was changed to CAPD (1.5% glucose solution, 1500 mL, 4 times/day). First, empirically, cefazolin (1 g/day) and ceftazidime (1.5 g/day) were administered intraperitoneally. Gram stain revealed gram-positive coccus with bacterial phagocytosis by WBCs. The abdominal pain gradually improved, and the peritoneal dialysate effluent gradually became clearer. However, we felt that this was incongruous because the decrease of WBC was slow and the peritoneal dialysate effluent culture was not positive yet (our hospital routinely cultivated in 5.5 days). For this reason, we assumed there was a slow-growing bacterium and performed long-term culture. Thus, on day 8 after hospitalization, *D. nishinomiyaensis* was detected in the peritoneal dialysate effluent culture that had been collected on the first day. Later, from the peritoneal dialysate effluent culture collected on the third day, the same bacterium was detected. Table 2 shows minimum inhibitory concentration (MIC) of antibiotics. After *D. nishinomiyaensis* was detected, the antibiotics were changed to cefazolin and vancomycin (1.5–2.0 g/5–7 days to keep the trough level 15–20 µg/mL), which were administered intraperitoneally.

Fig. 1 Clinical course of white blood cell in peritoneal dialysate effluent and C-reactive protein. WBC white blood cell, CRP C-reactive protein, CEZ cefazolin, CAZ ceftazidime, AMPC amoxicillin, VCM

vancomycin, *I.p.* intraperitoneal, *P.o.* per os, PD WBC white blood cell in peritoneal dialysate effluent

Due to lack of data, the MIC level that would make the organism susceptible to antibiotics is unknown, and we were apprehensive of treatment failure via using a single agent. Abdominal pain also improved, and peritoneal dialysate effluent became clear. He was discharged on the 15th day after hospitalization. After discharge, amoxicillin (1000 mg/day) was given orally and vancomycin was given intraperitoneally. Because common cold was prevailing in the workplace after discharge, he caught common cold with elevated C-reactive protein and clear peritoneal dialysate effluent. He also had erythema affecting his entire body. We discontinued amoxicillin because we suspected the condition in which drug allergy easily occurs due to virus infection. After confirming repeated negative-conversion of peritoneal dialysate effluent culture, treatment was continued for more than 6 weeks. The peritonitis resolved, and the patient continues peritoneal dialysis without withdrawal from PD or catheter removal.

Discussion

We encountered PD-related peritonitis caused by *D. nishinomiyaensis*. *D. nishinomiyaensis* is a gram-positive coccus that resides in the skin and has been never reported to be a

causative bacterium of PD-related peritonitis. This is the first report regarding this particular condition. Furthermore, infections to other organs are also very rare. As of November 2018, performing a search with “*Dermacoccus nishinomiyaensis*” on PubMed, only the above-described hidradenitis suppurativa and urinary tract infection are found. It is probably an attenuated bacterium, which is presumed to have little pathogenicity. However, considering PD-related peritonitis, the resident bacteria of the skin can become sufficiently pathogenic bacteria. In this case, gram-positive coccus was detected by gram staining and phagocytosis by WBC was also recognized. In addition, *D. nishinomiyaensis* was repeatedly detected in the peritoneal dialysate effluent culture. Hence, we believe that there was no doubt for it to be the causative bacterium of PD-related peritonitis. The reason that *D. nishinomiyaensis* is not reported in PD-related peritonitis is because it is determined as being culture-negative peritonitis, and this is because of its slow growth. From the online database BacDive [10, 11], the incubation period is set to 10–14 days, which is much slower than 1–2 days for *Staphylococcus aureus*.

When referring to nontuberculous mycobacteriosis, there is the Runyon classification [13]. In this classification, those requiring more than 7 days to form colonies are defined as slow growers. In our case, it took 8 days to become positive

Table 2 Minimum inhibitory concentration (MIC) of *Dermaococcus nishinomiyaensis*

Antibiotics	MIC
Penicillin G	0.5
Ampicillin	2
Moxifloxacin	≤ 1
Ceftriaxone	8
Cefmetazole	≤ 16
Imipenem	≤ 0.5
Meropenem	≤ 0.25
Amoxicillin/clavulanate	4
Piperacillin/tazobactam	≤ 32
Amikacin	≤ 8
Gentamicin	≤ 4
Erythromycin	≤ 0.25
Clarithromycin	≤ 1
Clindamycin	0.5
Tetracycline	2
Doxycycline	≤ 1
Minocycline	≤ 1
Vancomycin	≤ 1
Sulfamethoxazole/trimethoprim	5
Ciprofloxacin	≤ 1
Levofloxacin	1
Linezolid	≤ 2
Rifampicin	≤ 0.5

for culture. We felt that it took too long time for apparent peritonitis at the beginning of the hospitalization to become positive conversion of peritoneal dialysate effluent culture. In our hospital, normal culture is discontinued as negative in 5.5 days. Therefore, there is a possibility that it was missed going by the normal culture period. In order not to misdiagnose, if clinical improvement is slower than expected and culture is still negative, long-term culture and repeating culture are important. In this case, since this bacterium has been confirmed, we performed long-term culture in this patient. The cultivation-negative rate will be 10–20% if the culture method according to the ISPD guidelines is adopted [14, 15]. However, it is still not 0%. We assumed that *D. nishinomiyaensis* may be included in culture-negative cases.

There are a few difficult aspects concerning treatment as well. Antibiotics for treatment are based on susceptibility tests, but there is very little data regarding *D. nishinomiyaensis*. Hence, there is no data on the presence or absence of susceptibility. The organism appears to be susceptible to amoxicillin from MIC, but there is no criterion for susceptibility. To avoid treatment failure, we added vancomycin this time. Furthermore, the appropriate treatment period is unknown. Considering that it is a slow grower, a longer treatment period than usual may be necessary. In

fact, although the WBC in peritoneal dialysate effluent had decreased steadily, we felt that it took a relatively longer time to complete negativization. It may be better to treat for longer compared to other gram-positive cocci. In this case, we set it at more than 6 weeks, which is more than twice as long as for *S. aureus*; however, it is unknown whether this period was optimal or not. Future accumulation of such cases is awaited.

In this case, he had fever and fatigue in early September 2018. Then, he visited our hospital in mid-September. He was exhausted with loss of appetite, showing anemia and hypoalbuminemia. We regard these as a series of episodes. The course of PD-related peritonitis caused by *D. nishinomiyaensis* may be slow.

We encountered, for the first time, a case of peritoneal dialysis associated-peritonitis caused by *D. nishinomiyaensis*. In such cases, we have to consider the difficulty in detection. There is little data to go with for treatment, and it is necessary to carefully select the type of antibiotics and the treatment period.

Funding None.

Compliance with ethical standards

Conflict of interest The authors have declared that no conflict of interest exists.

Research involving human participants and/or animals This article does not contain any studies with human participants or animals performed by any of the authors.

Informed consent Informed consent was obtained from all individual participants included in the study.

References

1. Davenport A. Peritonitis remains the major clinical complication of peritoneal dialysis: the London, UK, peritonitis audit 2002–2003. *Perit Dial Int.* 2009;29(3):297–302.
2. Mactier R. Peritonitis is still the achilles' heel of peritoneal dialysis. *Perit Dial Int.* 2009;29(3):262–6.
3. Kawaguchi Y, Ishizaki T, Imada A, Oohira S, Kuriyama S, Nakamoto H, et al. Searching for the reasons for drop-out from peritoneal dialysis: a nationwide survey in Japan. *Perit Dial Int.* 2003;23(Suppl 2):175–7.
4. Mizuno M, Ito Y, Suzuki Y, Sakata F, Saka Y, Hiramatsu T, et al. Recent analysis of status and outcomes of peritoneal dialysis in the Tokai area of Japan: the second report of the Tokai peritoneal dialysis registry. *Clin Exp Nephrol.* 2016;20(6):960–71.
5. Mizuno M, Ito Y, Tanaka A, Suzuki Y, Hiramatsu H, Watanabe M, et al. Peritonitis is still an important factor for withdrawal from peritoneal dialysis therapy in the Tokai area of Japan. *Clin Exp Nephrol.* 2011;15(5):727–37.
6. Stackebrandt E, Koch C, Gvozdiak O, Schumann P. Taxonomic dissection of the genus *Micrococcus*: *Kocuria* gen. nov.,

- Nesterenkonia* gen. nov., *Kytococcus* gen. nov., *Dermacoccus* gen. nov., and *Micrococcus* Cohn 1872 gen. emend. Int J Syst Bacteriol. 1995;45(4):682–92.
7. Kloos WE, Musselwhite MS. Distribution and persistence of *Staphylococcus* and *Micrococcus* species and other aerobic bacteria on human skin. Appl Microbiol. 1975;30(3):381–5.
 8. Katoulis AC, Koumaki D, Liakou AI, Vrioni G, Koumaki V, Kontogiorgi D, et al. Aerobic and anaerobic bacteriology of hidradenitis suppurativa: a study of 22 cases. Skin Appendage Disord. 2015;1(2):55–9.
 9. Seifu WD, Gebissa AD. Prevalence and antibiotic susceptibility of Uropathogens from cases of urinary tract infections (UTI) in Shashemene referral hospital, Ethiopia. BMC Infect Dis. 2018;18(1):30.
 10. In: BacDive. <https://bacdive.dsmz.de/strain/3922>. Accessed 1 Dec 2018.
 11. Reimer LC, Vetschinnova A, Sardà Carbasse J, Söhngen C, Gleim D, Ebeling C, et al. BacDive in 2019: bacterial phenotypic data for high-throughput biodiversity analysis. Nucleic Acids Res. 2018. <https://doi.org/10.1093/nar/gky879>.
 12. Li PK, Szeto CC, Piraino B, de Arteaga J, Fan S, Figueiredo AE, et al. ISPD peritonitis recommendations: 2016 update on prevention and treatment. Perit Dial Int. 2016;36(5):481–508.
 13. Runyon EH. Anonymous mycobacteria in pulmonary disease. Med Clin North Am. 1959;43(1):273–90.
 14. Alfa MJ, Degagne P, Olson N, Harding GK. Improved detection of bacterial growth in continuous ambulatory peritoneal dialysis effluent by use of BacT/Alert FAN bottles. J Clin Microbiol. 1997;35(4):862–6.
 15. Azap OK, Timurkaynak F, Sezer S, Çağır U, Yapar G, Arslan H, et al. Value of automatized blood culture systems in the diagnosis of continuous ambulatory peritoneal dialysis peritonitis. Transplant Proc. 2006; 38(2):411–2.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.