J Infect Chemother (2011) 17:278–282
DOI 10.1007/s10156-010-0114-0

CASE REPORT

Pseudomonas putida bacteremia in adult patients: five case reports and a review of the literature

Yusuke Yoshino · Takatoshi Kitazawa · Mahoko Kamimura · Keita Tatsuno · Yasuo Ota · Hiroshi Yotsuyanagi

Received: 7 June 2010 / Accepted: 28 July 2010 / Published online: 1 September 2010

Abstract *Pseudomonas putida* belongs to the fluorescent group of *Pseudomonas species*, a group of opportunistic pathogens that primarily cause nosocomial infections. However, few cases of *P. putida* bacteremia in adult patients have been reported. We report five cases of *P. putida* bacteremia in adult patients and review 23 previously reported cases. Our five patients consisted of three cases of catheter-related bloodstream infection (CRBSI), one case of indwelling biliary drainage tube-related cholangitis, and one case of cholecystitis. Many of the 23 previously reported cases also included CRBSI. Of the clinical backgrounds, in all 28 reported cases including ours, 24 (85.7%) were immunocompromised. Of the clinical management, in CRBSI, devices were removed in almost all cases (92.9%). Antibiotic susceptibility data of our five cases and another previous case showed that patients with bacteremia had a high susceptibility of *P. putida* to anti-pseudomonal β-lactams. The prognosis for bacteremia with *P. putida* was good, as 26 (92.9%) of the total 28 cases were cured.

Keywords *Pseudomonas putida* · Bacteremia · Antimicrobial susceptibility

Y. Yoshino · T. Kitazawa (✉) · M. Kamimura · K. Tatsuno · H. Yotsuyanagi
Department of Infectious Diseases,
Graduate School of Medicine, The University of Tokyo,
7-3-1 Hongo, Bunkyo-ku, Tokyo 113-8655, Japan
e-mail: tkitazaw-tky@umin.ac.jp

Y. Ota
Department of Medicine, Teikyo University School of Medicine,
2-11-1 Kaga, Itabashi-ku, Tokyo 173-8606, Japan

Introduction

Pseudomonas spp. are aerobic Gram-negative bacteria. Due to their ability to metabolize a wide range of compounds, members of this species are able to colonize soil, fresh water and moist environments [1, 2]. These bacteria can act as opportunistic pathogens that primarily cause nosocomial infections. *Pseudomonas aeruginosa* is the most prevalent pathogen among the genus *Pseudomonas*, yet non-*aeruginosa* Pseudomonas have also been associated with clinical infections [3–5]. *Pseudomonas putida*, which belongs to the fluorescent group of *Pseudomonas* spp., has been recognized as a rare pathogen of bacteremia. Most reported cases of bacteremia with *P. putida* have been neonatal infections or outbreak infections due to transfusion of contaminated blood or fluid [6–8]. *P. putida* can acquire broad resistance to β-lactam antibiotics, and some isolates of this organism are capable of producing metallo-β-lactamases [9–12]. Despite this, there have been few reports about antimicrobial susceptibilities in bacteremia. Clinical courses of bacteremia with *P. putida* have not been precisely described due to the rarity of reported infections from *P. putida*, which comprises mostly immunocompromised patients and newborns [6–8, 13]. We report five adult cases of *P. putida* bacteremia occurring in our hospital between April 2003 and March 2007. Upon a brief review of the literature, we were able to identify clinical characteristics of *P. putida* bacteremia and antimicrobial susceptibility of *P. putida* in these bacteremic patients.

Cases

Case 1

A 79-year-old man was admitted for gastrectomy due to gastric cancer. After the surgery, cefmetazole was administered for 6 days because of postoperative prophylaxis. At 7 days post-operation, he became febrile. Peripheral catheter-associated bacteremia was suspected because he developed skin flare and pain at the insertion region with no other findings at the site of infection. The catheter was removed and cefmetazole was replaced with meropenem. *P. putida* was identified on blood culture. The patient fully recovered, and antibiotic treatment was continued for 10 days.

Case 2

A 76-year-old man was admitted for colectomy due to sigmoid colon adenocarcinoma. He had liver cirrhosis with hepatitis C virus and hepatocellular carcinoma. After the colectomy, cephazolin was administered for 5 days as a means of postoperative prophylaxis. At 6 days post-operation, he had a fever and diarrhea. As catheter-associated bacteremia and *Clostridium difficile*-associated diarrhea were suspected, the peripheral vein catheter was removed. Cephazolin was replaced with intravenous ceftazidime and oral vancomycin. *P. putida* was identified on cultures from blood and the catheter. The stool examination tested positive for *C. difficile* toxin. The patient fully recovered and antibiotic treatment was continued for 10 days.

Case 3

A 52-year-old woman with Burkitt lymphoma was admitted for induction chemotherapy. On day 15 post-chemotherapy, her neutrophil count reduced to 240/μl and she developed a fever of 39.5°C. For febrile neutropenia treatment, meropenem administration was initiated, and a central vein catheter was removed. *P. putida* was isolated on cultures from blood and the central vein catheter. She recovered from fever 3 days after antibiotic therapy, although meropenem was switched to ciprofloxacin on day 20 post-chemotherapy because the strain was resistant to almost all β-lactams. Antibiotic therapy with ciprofloxacin was continued for 10 days.

Case 4

A 48-year-old man with liver cirrhosis due to hepatitis B virus and hepatocellular carcinoma underwent liver transplantation. He was discharged with an indwelling biliary drainage tube and continuing to take 11 mg of tacrolimus and 12 mg of methyl prednisolone. Two months after discharge, he visited the emergency room with a fever and shivering. On the blood test, his C reactive protein level was 5.63 mg/dl, and white blood cell count was 18,100/μl. Hepatobiliary enzyme levels were not elevated. Indwelling drainage tube was clogged. Abdominal ultrasonography showed slight dilation of the biliary duct, which was suggestive of device related acute cholangitis. The biliary drainage tube was removed and endoscopic retrograde biliary drainage was performed. Intravenous administration of ceftazidime and vancomycin was initiated. *P. putida* was identified on blood culture, although no organism was cultured from bile. He fully recovered and antibiotic therapy was continued for 10 days.

Case 5

A 27-year-old man was admitted to hospital with fever that had persisted for 4 weeks and cough that had persisted for 5 days. He had common variable immunodeficiency after developing autoimmune hemolytic anemia at the age of 24 years and has been taking 15 mg of prednisolone daily. On chest CT, ground glass-like infiltrates were identified in the bilateral lung, and because the blood (1 → 3)-β-D-glucan level was 293.1 pg/ml, *Pneumocystis jirovecii* pneumonia (PCP) was suspected. After 2 weeks of treatment with trimethoprim–sulfamethoxazole, the patient recovered. On day 4 after the termination of PCP treatment, however, he became febrile again. On the blood test, the aspartate aminotransferase level was 131 IU/l, the alanine aminotransferase level was 310 IU/l, and total bilirubin was 3.3 mg/dl. Panipenem–betamipron was initiated. Abdominal CT showed thickening of the gallbladder wall and fluid around the gall bladder, which was indicative of acute cholecystitis. Percutaneous transhepatic gallbladder drainage was performed. *P. putida* and *Klebsiella oxytoca* were identified on blood cultures. No organism was cultured from bile. He fully recovered and treatment was continued for 18 days.

Discussion

P. putida has been recognized as a rare pathogen of bacteremia in adult patients. The five reported cases of *P. putida* bacteremia in our hospital accounted for 0.22% of the 2307 cases of bacteremia that occurred from April 2003 to March 2007. In the literature, only 23 cases have been reported, excluding paediatric and outbreak cases due to transfusion of contaminated blood or fluid (Table 1) [14–19].

Among the five cases reported herein, four had a medical device as the primary infection site. In 21 cases of

Table 1 Review of the literature, including our five cases

No.	Citation	Age/gender	Co-morbidities	Primary infection site	Indwelling device	Antibiotics	Outcome
1	[15]	65/female	Surgery for maxillary sinus carcinoma	Acute cholecystitis	VC	Kanamycin, cephalothin	Cured
2		30/female	Surgery for ectopic pregnancy	Unknown	VC	Nothing	Cured
3	[18]	19/female	ALL	CRBSI	CVC, removal	Moxalactam	Cured
4		45/female	CML	Unknown	CVC, removal	Ceftriaxone, amikacin	Cured
5		50/male	Lung cancer	Pneumonia	CVC	Cefoperazone, mezlocillin	Cured
6		72/male	Smoldering leukemia	Unknown	CVC	Piperacillin, ceftazidime	Cured
7		36/male	AML	CRBSI	CVC	Moxalactam, ticarcillin, tobramycin	Cured
8		25/male	AML	CRBSI	CVC, removal	Nothing	Cured
9–14	[14]	18–61[a]/male (3), female (3)	Lymphoma (4), AL (1), myeloma (1)	CRBSI (6)[b]	VC (6), removal (6)[c]	Nothing (5), antibiotic drug (1)[d]	Cured
15	[19]	18/female	APL	Thrombophlebitis	Unknown	Imipenem, amikacin	Cured
16		62/male	RHD, CHF	Unknown	Unknown	Ceftazidime	Died
17		32/male	Infective endocarditis	Unknown	Unknown	Imipenem, amikacin	Cured
18		70/female	Cerebral infarction	Acute tonsillitis	Unknown	Piperacillin	Cured
19		70/female	Carcinoma of cervix	Pneumonia	Unknown	Piperacillin, gentamicin	Cured
20		23/female	CHF	CRBSI	CVC, removal	Cefotaxime, oxacillin	Cured
21		23/female	Trauma	Unknown	Unknown	Cefoperazone, netilmicin	Cured
22		79/male	Gastric cancer	Unknown	Unknown	Cefazolin, gentamicin	Died
23	[16]	78/female	Nothing	Soft tissue infection	Nothing	Ceftazidime	Cured
24	Our cases	79/male	Post-gastrectomy (gastric carcinoma)	CRBSI	PVC, removal	Meropenem	Cured
25		76/male	LC, post-colectomy (colon carcinoma)	CRBSI	PVC, removal	Ceftazidime	Cured
26		52/female	Burkitt lymphoma	CRBSI	CVC, removal	Meropenem, ciprofloxacin	Cured
27		48/male	LC, post-liver transplantation (HCC)	Acute cholangitis	Biliary drainage tube, removal	Ceftazidime	Cured
28		27/male	CVID, AIHA	Acute cholecystitis	Nothing	Panipenem, betamipron	Cured

VC central venous catheter or peripheral venous catheter, *PVC* peripheral venous catheter, *CVC* central venous catheter, *CRBSI* catheter related blood stream infection, *ALL* acute lymphoblastic leukemia, *CML* chronic myelogenous leukemia, *AML* acute myelogenous leukemia, *AL* acute leukemia, *RHD* rheumatoid heart disease, *CHF* congestive heart failure, *LC* liver cirrhosis, *HCC* hepatocellular carcinoma, *CVID* common variable immunodeficiency, *AIHA* autoimmune hemolytic anemia

[a] Age range

[b] Definite (4) or probable (2)

[c] As primary (5) or secondary (1) treatment

[d] Antibacterial drug was administrated in one case as a primary treatment, but the name of the drug was not mentioned

Table 2 Antibiotic susceptibilities of *P. putida* in our five cases

Antibiotics	Susceptible	Intermediate	Resistant
Piperacillin	4 (80)	1 (20)	0 (0)
Ceftazidime	4 (80)	0 (0)	1 (20)
Cefotaxime	1 (20)	2 (40)	1 (20)
Aztreonam	1 (20)	2 (40)	2 (40)
Meropenem	4 (80)	0 (0)	1 (20)
Imipenem/cilastatin	3 (60)	0 (0)	2 (40)
Gentamicin	4 (80)	1 (20)	0 (0)
Amikacin	5 (100)	0 (0)	0 (0)
Ciprofloxacin	5 (100)	0 (0)	0 (0)

Numbers shown in parentheses represent the percentage of cases that are susceptible or resistant to the different antibiotics

Antibacterial susceptibility assays to determine the minimum inhibitory concentrations (MICs) of antibacterial agents were performed by broth microdilution according to guidelines recommended by the Clinical Laboratory Standards Institute (CLSI)

identified primary infection sites including our cases, 13 (61.9%) were device related, and among these cases, 12 were CRBSI (92.9%). Of the device-associated infections, the ability of microorganisms to adhere to materials and to promote the formation of a biofilm appears to be the most important feature of their pathogenicity [20]. *P. putida* are able to form biofilms [21]. For treatment of *P. putida* bacteremia, the medical device was removed in 12 (92.3%) of the 13 cases. Thus, when *P. putida* is isolated on blood culture of a patient with a medical device, device-related bacteremia should be mostly suspected and the device should be removed.

In addition to device-related infection, acute cholecystitis was evident in 2t cases (9.5%) and pneumonia in 2 cases (9.5%). *P. putida* has been reported to cause urinary tract infection as well as pneumonia in several cases [19]. We thought that like *P. aeruginosa*, *P. putida* could also colonize the respiratory tract and urinary tract in immunocompromised patients. Since *P. putida* can be detected in the normal oropharyngeal flora [22, 23], it may also cause cholecystitis by colonizing the intestinal tract.

Considering the clinical background, 24 (85.7%) of the 28 cases were in an immunocompromised state (from the use of immunosuppressive drugs, liver cirrhosis, malignancy or other immunosuppressive diseases, or post-operation). Although this factor might be biased as the previous cases comprised those from a cancer center only, limiting the clinical background to cancer patients. Our five cases were all in an immunocompromised state. *P. putida*, therefore, could cause bacteremia, particularly in an immunocompromised patient, though the overall incidence of bacteremia with *P. putida* still remains low.

The rate of susceptibility of *P. putida* to antibiotics in our five cases is shown in Table 2. In case 3, *P. putida* was found to be resistant to both ceftazidime, an anti-pseudomonal cephalosporin, and to carbapenem, while in the other four cases, *P. putid*a was susceptible to those antibiotics. In case 4, *P. putida* was resistant to imipenem/cilastatin but not to meropenem. We speculate that a long duration of imipenem/cilastatin use in this case would be related to resistance to imipenem/cilastatin, as in the case of *P. aeruginosa* which develops resistant strains that survive during antibiotic use [24]. In previous reports, *P. putida* isolated from the urinary tract, tracheal aspiration, and areas other than blood of bacteremia patients, has been found to acquire metallo-β-lactamases and were resistant to most β-lactams, including carbapenems [10–12]. On the other hand, Anaissie reported that of most of the clinical isolates, *P. putida* in bacteremic patients was susceptible to ceftazidime, imipenem, and ciprofloxacin [18]. We considered that in order to investigate the cause of high-rate susceptible strains in the blood, comparing susceptibilities of *P. putida* in patients with pneumonia or urinary tract infections to that in patients with bacteremia is imperative.

Prognosis of *P. putida* bacteremia was good, whereby 26 (92.9%) out of 28 cases were cured. Yang reported that in one of two cases where the patient died, inappropriate antibiotic therapy to other co-pathogens was a possible contributing factor [19]. Bacteremia with another *Pseudomonas sp.*, *P. aeruginosa* is known to result in poor prognosis of the disease. Mortality of *P. aeruginosa* bacteremia has been reported at over 30% [25, 26]. We believe the reason for a better prognosis from *P. putida* bacteremia was that the major cause of the bacteremia was device related, and infected devices were removed in most cases. However, we cannot exclude the possibility of bacteriological factors causing bacteremia, such as pyocyanin, exotoxin A, or the type III secretion system that can arise from *P. aeruginosa* infection but not from *P. putida* [27].

In conclusion, we report five adult cases of *P. putida* bacteremia. These cases displayed clinical characteristics: device relatedness as a major cause of bacteremia, an immunocompromised host, a high susceptibility of strains to β-lactams, and a good prognosis overall.

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