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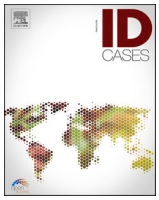

Case report

Septic shock due to *Pseudomonas fulva* potentially caused by percutaneous infection: A case report

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ABSTRACT

Pseudomonas fulva is a Gram-negative rod that was isolated from Japanese paddy rice, and few cases of infections due to trauma, catheters, or contaminated infusion products have been reported. We report a case of *P. fulva* infection in an older patient who developed septic shock due to *P. fulva* during hospitalization after treatment for aspiration pneumonia. Since signs of infection were seen at the skin epidermal exfoliation site, which had been present since admission, this was considered to be the route of infection. The patient recovered on treatment with piperacillin. It was suggested that *P. fulva* can infect minor wounds in older individuals and lead to sepsis, even if the infection is not caused by a medical device or from severe trauma from an accident. This means that even small wounds, especially in older individuals, should be treated with caution, and a full body examination, including the skin, is essential even at the onset of sepsis. Although *P. fulva* has been identified as *P. putida* in many cases by conventional bacterial identification tests, it is expected that more cases will be accurately identified with the widespread use of polymerase chain reaction and mass spectrometry.

Introduction

Pseudomonas fulva is a Gram-negative rod that was isolated from Japanese paddy rice in 1963 [1]. Infections caused by *P. fulva* have rarely been reported, and reports of bloodstream infections have been limited to cases of severe trauma by accidents and mass infections caused by contaminated infusion products. In this report, we describe a case of septic shock potentially caused by *P. fulva* percutaneous infection, along with previous reports of *P. fulva* infection.

Case

The patient was a 93-year-old man. The patient, originally a plasterer, had been receiving homecare from his wife for several years as his activity of daily living had declined with age. His medical history included bronchial asthma, chronic obstructive pulmonary disease, atrial fibrillation, chronic heart failure, *Clostridioides difficile* infection, and pyogenic spondylitis. His medications were apixaban, spironolactone, azosemide, torsemide, theophylline, montelukast, carbocisteine, esomeprazole, and aspartic potassium. One day, the patient aspirated during breakfast and complained of dyspnea. His family doctor suspected pneumonia, and he was referred to our hospital. Chest computed tomography revealed bilateral dorsal consolidation of the lower lobes, pulmonary edema, and bilateral pleural effusions. Sputum Gram staining revealed many epithelia and leukocytes phagocytosed by resident oral bacteria. Urinalysis results were normal, and blood culture was not performed. The patient was hospitalized because of aspiration pneumonia, and worsening heart failure. Treatment with ampicillin/sulbactam for 14 days and intravenous diuretics were initiated, and his respiratory status recovered. One week later, the patient developed fever, chills, and shivering. His consciousness was unclear. His vital signs were as follows: body temperature, 38.5 °C; blood pressure, 64/43 mmHg; pulse rate, 81/min; respiratory rate, 33/min; and SpO_2, 97 % (on ambient air). The peripheral extremities were cold, and septic shock was suspected. There were no signs of infection at the peripheral intravenous puncture site; however, there was an increase in the pale, bloody, and yellow exudate at the right elbow epidermal exfoliation site (5 × 10 mm) that was present before admission. Blood tests showed elevated white blood cell, 23,080/μl; C-reactive protein, 10.5 mg/dL; and procalcitonin, 29.9 ng/mL. Blood culture tests revealed Gram-negative bacilli in

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Table 1
Antibiotic susceptibility of *Pseudomonas fulva*.

Antimicrobial agent	MIC (μg/mL)	Interpretation
piperacillin	<=4	S
ampicillin-sulbactam	>16	NA
piperacillin-tazobactam	<=4	S
cefoxitin	>16	NA
cefotaxime	>2	NR
ceftriaxone	>2	NR
ceftazidime	2	S
cefepime	8	S
flomoxef	>32	NA
imipenem	<=0.5	S
meropenem	2	S
aztreonam	>8	NR
gentamicin	<=2	S
amikacin	<=8	S
minocycline	4	S
ciprofloxacin	<=0.5	S
levofloxacin	2	S
sulfamethoxazole- trimethoprim	>2	R

MicroScan WalkAway 40 Plus (Beckman Coulter Japan, Tokyo, Japan), Neg MIC EN2J.
MIC: minimum inhibitory concentration; S: sensitive; R: resistant; I: intermediate; NA: not available; NR: not reported.

two sets of aerobic bottles. Mass spectrometry (MALDI Biotyper, Bruker Japan, Kanagawa, Japan) identified *P. fulva* with a log score of 2.28. Bacteriological examination of the sputum and urine did not detect any significant bacteria. A previous bacteriological examination of sputum collected at the hospital detected *Pseudomonas aeruginosa*, but there was no history of detection of *P. fulva*. The patient was treated for septic shock with intravenous infusion of piperacillin/tazobactam and continuous intravenous noradrenaline. The patient recovered from the septic shock. Piperacillin/tazobactam was narrowed down to piperacillin with reference to the antibiogram (Table 1). Subsequently, a total of 14 days of antibiotic treatment was completed, with confirmation of negative blood cultures. The patient was transferred to a convalescent hospital 2 months later.

Discussion

P. fulva is a Gram-negative bacterium belonging to the genus Pseudomonas, and is currently classified in the *Pseudomonas putida* group [2]. Microbiologically, it is often misidentified as *Pseudomonas putida* using the widely used Vitek2 system (bioMérieux, France) and other systems [3–6,8]. In this case, *P. fulva* can be accurately classified using mass spectrometry. In addition, most *P. fulva* infections are medically acquired, such as through ventricular drainage [3,4], contaminated injectable solutions [5], or transmitted from the environment to the bloodstream after severe trauma due to accidents [6–8]. In this case, a definite route of infection could not be proven by bacteriological examination.

A possible route of infection is the epidermal exfoliation site of the right elbow. Epidermal exfoliation was already present on admission, but the cause was considered to be senile fragility of the skin rather than outdoor trauma, as previously reported. Due to the increased exudate, *P. fulva* may have been identified if a culture examination of the site had been performed. The patient had never engaged in rice farming or other agricultural activities, and his only contact with the natural world was golf. Although *P. fulva* was never detected in the sputum or urine cultures, the possibility that the patient was carrying the organism cannot be ruled out. In addition, it is unlikely that the patient was infected by bringing it from outside the hospital, because the visit was at a time when there were few visitors during the coronavirus disease 2019 pandemic. However, although there were no signs of infection at the intravenous puncture site, the possibility of catheter-associated bloodstream infection remained, given the patient's sudden septic shock. No

Table 2
Published *Pseudomonas fulva* infection reports.

No.	Cause	Age (y/o)	Sex	Country	Diagnosis	Symptom	Culture	Identification test	Treatment	Outcome	Ref.
1	IDS (meningitis)	2	female	Argentina	ventriculitis	N/A	cerebrospinal fluid	PCR	CL, TZP	died	[3]
2	IDS (SAH)	55	female	USA	ventriculitis	fever	cerebrospinal fluid	PCR	LVFX, RFP	survived	[4]
3	trauma	56	male	Korea	sepsis	fever	blood	PCR	TZP, CLM	survived	[6]
4	trauma	73	male	Spain	skin and soft-tissue infection	swelling, erythematous	blood	MALDI-TOF MS	CAZ	survived	[7]
5	trauma	45	male	Pakistan	sepsis	fever	blood	MALDI-TOF MS	TZP, VCM	died	[8]
6–21	contaminated IV fluids	33–91	12 males, 4 females	China	sepsis	N/A	blood	PCR	AMC, AZI, CXM, CMZ, CSL, CMNX, FOX, LEV, MOX, OFX, TZP	15 survived, 1 died	[5]
22	non-trauma	N/A	N/A	Italy	N/A	N/A	rectal swab	N/A	N/A	N/A	[9]
23	non-trauma	85	female	Sweden	cystitis	dysuria, lower abdominal discomfort	urine	MALDI-TOF MS	PMPC	survived	[10]
24(Present case)	skin injury	93	male	Japan	Septic shock	fever	blood	MALDI-TOF MS	PIPC	survived	–

Abbreviations: AMC, amoxicillin–clavulanic acid; AZI, azithromycin; CL, colistin; CLM, clindamycin; CAZ, ceftazidime; CMZ, cefmetazole; CMNX, cefminox; CIP, ciprofloxacin; BH, buflomedil hydrochloride; CXM, cefuroxime; CSL, cefoperazone–sulbactam; FOX, cefoxitin; IDS, intracranial drainage systems; LEV, levofloxacin; MALDI-TOF MS: Matrix-assisted laser desorption/ionization Time-of-Flight mass spectrometry; MOX, moxifloxacin; N/A, Not available; OFX, ofloxacin; PCR, polymerase chain reaction; PIPC, piperacillin; PMPC, pivmecillinam; SAH, subarachnoid hemorrhage; TZP, piperacillin-tazobactam; VCM, vancomycin.

other cases of *P. fulva* have been detected at our facility, and there is no evidence of contamination with pharmaceuticals or other intra-hospital transmission of the infection.

Previous case reports of *P. fulva* are summarized in Table 2. Most infections occur via medical devices or after severe trauma due to accidents, with only two non-traumatic cases of cystitis and microbiological surveillance [9,10]. *P. fulva* infections have also been reported worldwide, with three deaths out of 22 cases described. The finding that *P. fulva* can infect an older person from a minor injury and cause septic shock, as in the present case, is an important clinical finding.

Previously, *P. fulva* was commonly misidentified as *P. putida*, which may be one reason for the low number of reports on *P. fulva* infections. However, the widespread use of polymerase chain reaction or mass spectrometry has enabled more accurate identification of the strains. Therefore, the number of such reports is expected to increase.

Ethics

Not applicable.

Consent

Written informed consent was obtained from the patients for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

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CRediT authorship contribution statement

Hiroki Kohno: Conceptualization, Writing – original draft. **Takuji Omoto:** Involved in the clinical care of the patients. **Tomohiro Taniguchi:** Writing – review & editing, Supervision.

Declarations of interest

None.

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Data statement

Not applicable.

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