Case Report

Community-acquired *Pseudomonas aeruginosa* pneumonia in previously healthy patients

Shingo Tsuji,¹ Takeshi Saraya,¹ Yasutaka Tanaka,¹ Hiroshi Makino,² Shota Yonetani,² Koji Araki,² Daisuke Kurai,¹ Haruyuki Ishii,¹ Hajime Takizawa¹ and Hajime Goto¹

Correspondence

Takeshi Saraya
saraya@ks.kyorin-u.ac.jp

¹Department of Respiratory Medicine, Kyorin University School of Medicine, 6-20-2 Shinkawa, Mitaka City, Tokyo, Japan

²Department of Laboratory Medicine, Kyorin University School of Medicine, 6-20-2 Shinkawa, Mitaka City, Tokyo, Japan

Introduction: *Pseudomonas aeruginosa* community-acquired pneumonia is an extremely rare clinical presentation but has been recognized in anecdotal reports, even in previously healthy patients.

Case presentation: We describe a previously healthy man who developed *P. aeruginosa* community-acquired pneumonia (CAP). He died of septic shock with rapidly progressive pulmonary consolidation in the right upper lobe (RUL). We reviewed the literature for *P. aeruginosa* CAP and identified 19 patients of whom 85 % ($n=17$) had cavitations and/or consolidations in the RUL. We found that the odds ratio for death of shock at initial presentation was 8.333 ($P=0.046$, 95 % confidence interval 1.034–67.142). We also found that *P. aeruginosa* CAP should be considered when individuals present with rapidly expanding cavitary pneumonia and/or consolidations in the RUL accompanied by septic shock, even if they have no known severe underlying disease and were previously healthy.

Conclusion: We showed here that radiological findings of *P. aeruginosa* CAP, such as cavitary pneumonia and/or consolidation in the RUL, might be a clinical clue to a diagnosis of CAP as well as the presence of septic shock.

Keywords: *Pseudomonas aeruginosa*; cavity; community-acquired pneumonia; septic shock.

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Introduction

Published studies have indicated that the incidence of community-acquired pneumonia (CAP) caused by *Pseudomonas aeruginosa* ranges from 0.4 % (Torres and Menendez, 2010) to 5 % (Leroy *et al.*, 1999) and that the disease has a 30 % mortality rate (Hatchette *et al.*, 2000). These infections usually occur in patients with severe underlying disease, and rarely in healthy individuals. Only 19 patients without any known severe underlying disease have been reported in the literature since 1968. Here, we describe a previously healthy man who developed *P. aeruginosa* CAP and present a review of the literature.

Case report

A 61-year-old man was referred to our hospital with a 3 day history of productive cough and right chest pain. He had felt well enough to work full time until the onset of

symptoms but appeared ill upon presentation. He had worked as an office worker for 40 years, and denied any dust exposure or illicit drug use, or contact with sick people. He had been administered with oral anti-hyperglycaemic agents to treat controllable type 2 diabetes mellitus for over 15 years. His vital signs were as follows: blood pressure, 104/66 mmHg; heart rate, 128 beats min^{-1} ; respiratory rate, 24 min^{-1} ; body temperature, 38.7 °C; and 98 % oxygen saturation with ambient air, suggesting systemic inflammatory response syndrome.

Physical findings were normal except for mildly decreased respiratory sounds over the anterior aspect of the right upper lung field. A chest X-ray showed a homogeneous infiltrate in the right upper lobe (RUL) (Fig. 1a), indicating CAP. Thoracic CT (Fig. 1b, c) taken on admission showed consolidation with an air bronchogram in the RUL together with ground-glass opacities. His serum laboratory findings were as follows: normal white blood cell count ($8200 \mu\text{l}^{-1}$) and remarkably elevated C-reactive protein at 40.0 mg dl^{-1} . There was no detailed medical history on admission, while haemoglobin A1c

Abbreviations: CAP, community-acquired pneumonia; RUL, right upper lobe.

Fig. 1. Chest X-ray (a) showing massive infiltration in the right upper lung field, and thoracic CT taken on admission (b, c) showing consolidation with an air bronchogram accompanied by ground-glass opacities in the RUL.

levels showed only a mild elevation (7.2 %). This might indicate moderately controlled hyperglycaemia (Nathan *et al.*, 2008). Sputum Gram staining showed a dominant Gram-negative bacillus with other bacteria, and these results were scored as Geckler classification 3. Thus, no apparent pathogens were identified at that time. Based on the data, we immediately treated him with ampicillin/sulbactam (9 g day⁻¹) upon admission, but he went into shock 7 h later and required aggressive treatment including intubation. In addition, increased serum procalcitonin (71.8 ng ml⁻¹) and endotoxin (179.9 pg ml⁻¹) were found, suggesting that he was in septic shock. At that time, the treatment was immediately changed to doripenem hydrate (0.75 g day⁻¹). Thereafter, *P. aeruginosa* grew in both sputum and blood cultures on day 2 after hospital admission (hospital day 2). All isolates of *P. aeruginosa* were non-mucoid type and susceptible to commonly used anti-pseudomonal β -lactam antibiotics. In addition, the PFGE profiles suggested that these isolates were identical (see Fig. S1 available in the online Supplementary Material). On day 3, his general status rapidly deteriorated and he died of septic shock.

Our review of the literature (Table 1) uncovered descriptions of *P. aeruginosa* CAP arising in 19 previously healthy individuals, as well as the present patient. The ratio of females to males in the total of 20 patients was 7:13 [age (median $\pm$ SD), 45.9 $\pm$ 13.6 years]. The initial symptoms were non-specific, but 15 (75 %), 14 (70 %) and 12 (60 %) of these patients presented with cough, pleuritic pain and pyrexia, respectively. The duration from initial onset to admission ranged from 1 to 30 days (median, 3 days), that from admission to intubation was within 24 h and the mortality rate was 35 % ($n=7$) over a range of 9 hospital days (median, 1.5 days). Kaplan–Meier analysis confirmed a 61.1 % survival probability at hospital day 9

(Fig. 2). Only five (25 %) of the cultures were positive for *P. aeruginosa* in sputum, whereas 15 (75 %) sputum plus blood cultures were positive, suggesting a high rate of bacteraemia upon admission. Eight (40 %) of the patients were in shock at initial presentation and seven of them had *P. aeruginosa* bacteraemia. Univariate analysis identified septic shock at initial presentation (odds ratio, 8.333; 95 % confidence interval, 1.034–67.142; $P=0.046$), but not inappropriate initial antimicrobial therapy (50 %, $n=10$), as a significant factor for mortality. Importantly, the RUL was involved in 17 (85 %) patients with radiological findings such as cavitations and/or consolidations.

Discussion

Approximately 4 % of normal adults can harbour *P. aeruginosa* in their pharynx or colon or on the skin (Rose *et al.*, 1983). Diabetic patients have impaired polymorphonuclear functions including chemotaxis, adherence, phagocytosis and intracellular killing, as well as T-lymphocyte dysfunction (Gupta *et al.*, 2007). This may induce the propagation of pathogens including *P. aeruginosa*. However, whether the presence of diabetes mellitus influences the infection-related mortality and infection itself is still under debate (Knapp, 2013). For example, a multivariate analysis by Torres and Menendez (2010) showed that independent predictors for CAP due to *P. aeruginosa* included chronic respiratory disease and enteral tube feeding but not diabetes mellitus, which supports the findings of Pennington *et al.* (1973). The portal of entry for *P. aeruginosa* septicaemia is always pneumonia (Ishihara *et al.*, 1995), and this is almost universally fatal (Baltch and Griffin, 1977), as in our patient. Our search identified a mortality rate of 35 %, which was similar to that of a previous report (30 %) (Hatchette *et al.*, 2000); we also found that mortality was significantly associated with having septic shock at the time of initial presentation (odds ratio, 8.333). However, empirically appropriate therapy for *P. aeruginosa* did not contribute to a favourable prognosis. Based on these findings, we speculated that *P. aeruginosa* CAP occurring in previously healthy persons typically results in bacteraemia, which is sequentially followed by septic shock irrespective of the use of appropriate anti-pseudomonal antibiotics. In accordance with this viewpoint, the increased serum endotoxin level in our patient supported this hypothesis. Although various bacterial factors such as surface components, the type III secretion system, quorum sensing, and scavenging of iron and other extracellular products has been reported (Sadikot *et al.*, 2005; Williams *et al.*, 2010), it is possible that the large amount of endotoxin derived from the pathogen led to excessive inflammation and resulted in systemic inflammatory response syndrome in the present case.

Okada *et al.* (2012) recently concluded from thin-section CT findings of 29 patients with *P. aeruginosa* pulmonary infection that ground-glass attenuation or bronchial wall

Table 1. Clinical and radiological findings of *Pseudomonas aeruginosa* CAP in healthy individuals.

Journal	Author	Year	Sex	Age	Initial symptoms	Duration from initial onset to admission	Bacteremia	Shock	Anti-PAB	Prognosis	Elapsed time to death/discharge	Affected area	Radiological findings
<i>Our patient</i>	Tsuji. S	2012	M	61	Fever, cough, right chest pain	3	+	—	—	D	4	RUL	Con
<i>Intern Med</i>	Kunimasa. K	2012	M	25	Fever, right back pain	1	-	+	+	A	28	RUL	Cav/Con
<i>Intern Med</i>	Okamoto. M	2012	F	39	Diarrhea, chest pain, cough	3	+	—	—	A	30	RUL	Con
<i>Neth J Med</i>	Shaulov. A	2011	M	44	Dyspnea, cough, hemoptysis	4	+	+	—	D	2	RUL/BLL	Cav/Con
<i>Infection</i>	Huhulescu. S	2011	F	49	Chest pain, cough	2	+	+	+	D	9	Left lobe	Con
<i>ClinInfect Dis</i>	Crnich. C.J	2003	M	40	Fever, chills, cough, blood and rust-colored sputum	3	—	—	—	A	12	RUL/RML	Cav
<i>ClinInfect Dis</i>	Hatchette. TF	2000	F	67	Diarrhea, cough, pleuritic chest pain	7	+	—	—	D	2	RUL/RML, LLL	Con
<i>Conn Med.</i>	Vicram. HR	1999	M	62	Cough, intermittent fevers, weight loss	30	—	—	—	A	NA	RUL	Cav/Con
<i>Intensive Care Med.</i>	Vicram. HR	1999	M	54	Cough, weight loss	14	—	—	—	A	13	RUL	Cav/Con
	Ishihara. S	1995	F	48	Back pain, dyspnea, fever	1	+	—	+	A	34	RUL	Con
<i>HospPract (Off Ed)</i>	Cirigliano. MD	1994	F	20	Fever, dyspnea, right pleuritic pain, chills	2	+	—	-	A	21	RUL	Con
<i>Intensive Care Med.</i>	Henderson, A	1992	M	52	Fever, cough, left sided pleurisy	2	+	+	+	D	1	RUL/LLL	Con
		1992	F	27	Dyspnea, cough, right pleuritic pain	1	+	+	+	D	1	RUL	Con
<i>Aust NZ J Med</i>	Quirk. JA	1990	F	40	Fever, mild diarrhea, left sided pleuritic pain	1	+	+	—	A	NA	LUL	Cav/Con
<i>West J Med</i>	Harris. AA	1984	M	39	Cough, rigors, drenching sweats, left pleuritic pain	5	+	+	+	A	53	LLL	Con
<i>JAMA</i>	Rose. HD	1983	M	47	Fever, malaise, pleuritic pain, cough, bloody sputum	3	—	—	+	A	23	RUL	Cav/Con
<i>South Med J</i>	Fishman. H	1983	M	29	Right pleuritic pain, chills, cough, dyspnea	2	—	—	+	A	15	RUL	Con
<i>Am Rev RespirDis</i>	Hoogwerf. BJ	1981	M	64	Dyspnea, intermittent fever, chills, cough, weight loss	30	+	—	+	A	35	RUL	Cav/Con
<i>Med J Aust</i>	Govan. J	1977	M	49	Pleuritic pain, fever, cough	21	+	+	—	D	1	RUL	Con
<i>Tex Med</i>	Hyslop, JR	1971	M	61	general malaise, fever	6	+	—	+	A	26	RML/RLL	Con

A; alive; Anti-P AB, anti-Pseudomonas antibiotics; BLL, bilateral lower lobe; Cav, cavitation; Con, consolidation; D, dead; ES, endotracheal secretion; LLL, left lower lobe; LUL, left upper lobe; RUL, right upper lobe; RML, right middle lobe; RUL, right upper lobe; Y, yes.

Fig. 2. Kaplan–Meier analysis for *P. aeruginosa* CAP in previously healthy patients.

thickening were the main findings, but only nine patients with CAP were included in that study.

The increasing importance of *P. aeruginosa* as a causal agent of CAP has recently been recognized, but radiological findings have not yet been defined. Furthermore, the initial symptoms of *P. aeruginosa* CAP are not specific enough for a precise diagnosis. From this perspective, we showed here that radiological findings of *P. aeruginosa* CAP, such as cavitory pneumonia and/or consolidation in the RUL, might be a clinical clue to a diagnosis of CAP, as well as the presence of septic shock. Further accumulation of such cases would be required for a more precise understanding of the CAP caused by *P. aeruginosa*.

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