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Case Report

Pulmonary hemorrhage and lung abscess caused by community-acquired pseudomonas aeruginosa in a previously healthy infant

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Abstract: Pseudomonas aeruginosa (P. aeruginosa) infections occur mostly in children immunocompromised by chronic glucocorticoids, immunosuppressive agents, or immune deficiency. When P. aeruginosa disease occurs in previously healthy children, it progresses rapidly, and most patients die of septic multiorgan failure. This case describes a 9-month-old previously healthy girl who presented with cough, fever, tachypnea, heart failure, pulmonary hemorrhage and shock. Blood and sputum cultures grew P. aeruginosa. She responded to culture-guided treatment and recovered by the 49th day of admission. We can learn more about P. aeruginosa in healthy children in the absence of ecthyma gangrenosum in this case. It would help diagnosis and treatment of this disease.

Keywords: Infant, community-acquired P. aeruginosa, heart failure, pulmonary hemorrhage

Introduction

P. aeruginosa is widespread in the environment and considered to have weak virulence. The annual incidence of P. aeruginosa bacteremia in the Calgary health region (population: approx. 1.2 million) during the period from 2000 to 2006 was 3.6/100,000, with community-acquired cases accounting for 21% of the cases [1]. Importantly, patients with community-acquired P. aeruginosa had a significantly higher mortality rate than either healthcare-associated cases or nosocomial cases [1]. Community-acquired P. aeruginosa infections occurred primarily in patients older than 50 years, and only rarely in children [2]. Most children with community-acquired P. aeruginosa sepsis were infants [3], usually presenting with fever and cough or diarrhea [4]. Similar cases published are shown in **Table 1**. We describe a case of community-acquired P. aeruginosa in a previously healthy infant.

Case report

A nine-month-old girl was admitted to the pediatric intensive care unit with a 4-day history of cough and diarrhea, 1-day history of fever and 10-hour history of tachypnea. There had been no vomiting, abnormal urine frequency or volume, cold symptoms, altered sensorium, or convulsions. The infant had been previously healthy except for an upper respiratory tract infection at 7 months which cured by itself. She had a normal birth and perinatal history. She had been vaccinated with BCG, and for hepatitis B, polio, DPT and measles reasonably close to standard protocol. She had no family members with known immune deficiency or chronic cutaneous infections. Her home environment was clean, in an urban setting. On physical examination, she had a fever of 38.3 degree Celsius, with a heart rate of 203/min, respiratory rate of 56/min, and blood pressure 92/60 mmHg. Transcutaneous oxygen saturation was 89%. Her face was ashen and lips cyanotic. Prominent suprasternal and intercostal retractions were noted. Auscultation revealed wheezing and rales in both lungs. Her liver was tender and palpable 3.5 cm below the costal margin in the midclavicular line. Sclera was anicteric; there was no jaundice or rashes.

Blood and hypopharyngeal sputum aspirate were obtained for culture. Initial blood investigations revealed elevated levels of C-reactive

Table 1. Community-acquired P. aeruginosa sepsis cases reported in mainland China and taiwan between 2008 and 2016

Data source	Time	Cases	Infants (percentage)	Clinical manifestations
Beijing [5]	1993-2010	34	21 (61.76%)	Fever, diarrhoea, abdominal distens-ion, tachypnea, impetigo of skin
Hefei [6]	2013	2	2 (100%)	Fever, cough, pleural effusion, lung nec-rosis, lung abscess
Jiangmen [7]	2008-2014	15	10 (66.67%)	Fever, cough, vomiting, diarrhea, breath-ing difficulty, twitch, rash, impetigo of skin
Taiwan [8]	2003-2012	27	24 (88.89%)	Fever, diarrhoea, shock
Wenzhou [4]	2003-2007	9	6 (66.67%)	Fever, cough, diarrhoea, shock

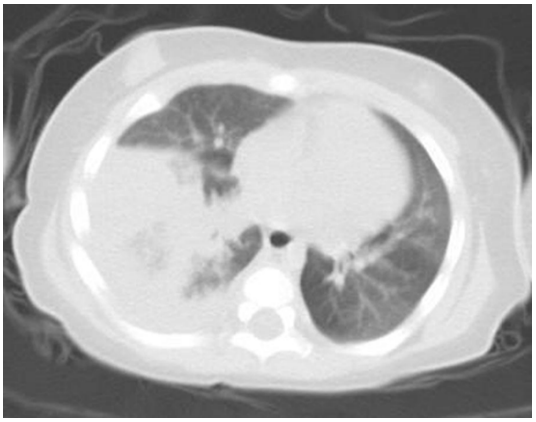

Figure 1. CT scan revealing high density shadows in the right lung when the infant was admitted.

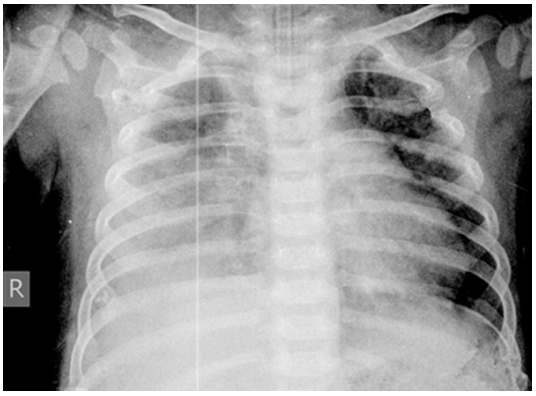

Figure 2. Severn hours after admission, areas of parenchymal infiltrates were seen in both lungs in the infant's chest X-ray film.

protein (CRP 91 mg/l) and procalcitonin (PCT 10.5 ng/ml). Coagulation tests were as follows: Prothrombin time (PT) 20.4 s, Activated Partial Thomboplastin Time (APTT) 98 s, Thrombin Time (TT) 27 s, Fibrinogen (FIB) 3.14 g/l, platelet count 213 × 109/l. B-type natriuretic peptide (BNP) was significantly increased (22,077 pg/ml). The level of creatine kinase (CK) and CK-MB were normal, while the ECG revealed sinus tachycardia. Thoracic spiral CT suggested right pneumonia, with pleural effusion and pleural thickening **Figure 1**.

She met diagnostic criteria of heart failure. Meanwhile she had clinical manifestation of shock in relative compensation stage. So small doses of furosemide (0.5 mg/kg) was used once by intensive care, especially ambulatory blood pressure. CPAP mode mechanical ventilation was employed; invasive blood pressure monitoring was initiated; cardiac inotropes, vasodilators, cefoperazone/sulbactam and vancomycin were empirically started by intravenous infusion. Fresh frozen plasma transfusion and globulin were administered.

Heart Doppler ultrasound performed several hours after admission and initiation of therapy was normal, and her ejection fraction was 77%. The infant continued to deteriorate. 7 hours after admission, her blood pressure decreased to 62/39 mmHg. Intubation and invasive mechanical ventilation were established successfully without trauma. Nasogastric and urinary catheters were placed. Vasodilators and diuretics were stopped. Normal saline and human albumin were initiated.

8 hours after admission, bloody frothy sputum was aspirated from the endotracheal tube, suggesting pulmonary hemorrhage. Ventilator settings were adjusted, and PEEP was increased to 10 cmH_2O. X-ray film of the chest was examined in **Figure 2**. Her central venous pressure remained near 10 cmH_2O. Dopamine (10 μg/kg·min), dobutamine (10 μg/kg·min) and epinephrine (0.2 μg/kg·min) were needed to maintain blood pressure. She continued to deteriorate.

The next day, PCT rose to 30.8 ng/ml, and her platelet count declined to 50 × 109/l. Gastric

Table 2. Laboratory data from infant with community-acquired P. aeruginosa sepsis on admission

Hospital day	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 9	Day 11	Day 13	Day 14	Day 43
PCT ng/ml	10.5	30.8	22.9	14.9	7.4	3.5	0.6	-	-	0.30	0.17
CRP mg/l	90.9	10.4	99.6	100.8	-	5.5	18.3	39.6	31.4	22.9	4.5
WBC 109/l	7.1	30.9	8.4	13.8	-	9.5	7.4	23.4	14.6	9.4	5.8
BNP pg/ml	22077	1166	-	-	1040	-	767	-	-	394	62

"-" indicates no measurement made that day. PCT: procalcitonin. CRP: C-reactive protein. WBC: white blood cell. BNP: B-type natriuretic peptide.

Table 3. All sputum cultures and susceptibility results at time of the infant's hospitalization

Hospital day	Sputum cultures	Sensitive drugs	Resistant drugs
Day 1	P. aeruginosa	Amikacin, ceftazidime, ciprofloxacin, imipenem, piperacillin, piperacillin/tazobactam, cefoperazone, cefoperazone sulbactam, meropenem	None
Day 3	P. aeruginosa	Amikacin, ceftazidime, ciprofloxacin, imipenem, piperacillin, piperacillin/tazobactam, cefoperazone, cefoperazone sulbactam, meropenem	None
Day 6	P. aeruginosa	Amikacin, ceftazidime, ciprofloxacin, imipenem, piperacillin, piperacillin/tazobactam, cefoperazone, cefoperazone sulbactam, meropenem	None
Day 10	P. aeruginosa	Amikacin, ciprofloxacin, imipenem, meropenem	Ceftazidime, piperacillin, piperacillin/tazobactam, cefoperazone, cefoperazone sulbactam
Day 15	P. aeruginosa	Amikacin, ciprofloxacin, imipenem, meropenem	Ceftazidime, piperacillin, piperacillin/tazobactam, cefoperazone, cefoperazone sulbactam
Day 22	Normal flora	-	-
Day 28	Normal flora	-	-
Day 38	Normal flora	-	-

"-" indicates no susceptibility result made that day.

aspirates were brown. Her coagulation parameters did not respond to targeted therapy. Fresh frozen plasma transfusion, etamsylate and vitamin K1 injection were initiated and continued for three days. On the third day, blood and sputum cultures revealed P. aeruginosa sensitive to piperacillin, ceftazidime, cefoperazone/sulbactam and meropenem. Based on the susceptibility test results, treatment with vancomycin was discontinued and cefoperazone/sulbactam treatment was continued as definitive therapy. On the fourth day, bloody frothy sputum decreased. BNP and PCT declined significantly. Investigations of PCT, CRP and white blood cell (WBC) in the following days are shown in **Table 2**.

Repeat sputum cultures on the 10th day revealed P. aeruginosa with a different sensitivity pattern which was resistant to cefoperazone/sulbactam. All sputum cultures and susceptibility results at the time of her hospitalization are shown in **Table 3**. Accordingly, the antibiotic regimen was changed to meropenem. Strict hand hygiene was maintained. On the 15th day, the infant met the standards for extubation. She was extubated and supported with non-invasion ventilation by nasal CPAP. Repeat CT scan on the 19th day revealed a lung abscess in **Figure 3**. The following day, the infant underwent pulmonary resection. Frozen pathological sections of her resected lung tissue revealed chronic suppurative inflammation. Meropenem treatment was continued for 14 days, and then ceftazidime was selected for de-escalation therapy. After 14 days, ceftazidime was stopped. She was fed with Neocate via orogastric tube feeding initially, but was able to eat normally through much of her hospital stay.

Four weeks after the pulmonary resection for lung abscess, she was able to leave the hospital. Repeat CT scan at discharge was provided

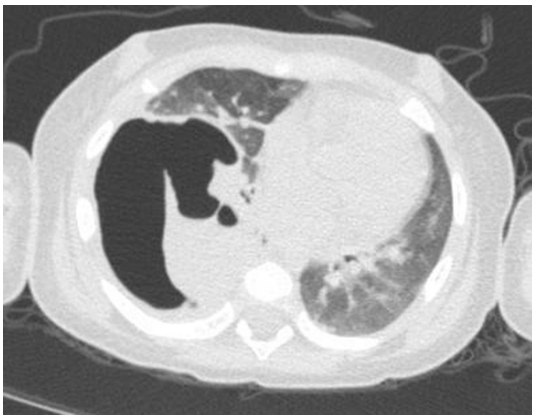

Figure 3. Repeat CT scan of the infant's lung on the 19th day after admission revealed lung abscess.

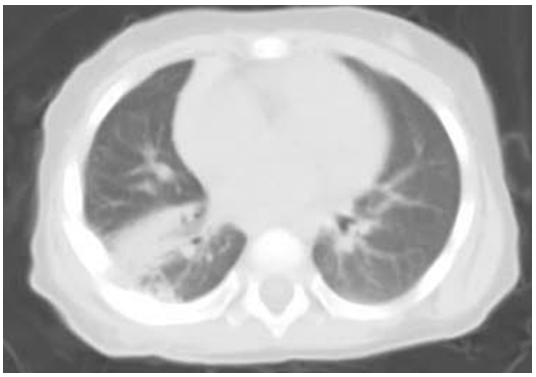

Figure 4. CT scan at discharge showed the lung had healed up.

in **Figure 4**. In multiple follow up visits after discharge, the infant remained healthy without evidence of residual pulmonary parenchymal disease from the pulmonary hemorrhage.

Discussion

When community-acquired P. aeruginosa occurs in a healthy child, it usually is in an infant. Most cases occur during May to October in the northern hemisphere [9]. The initial presentation of serious cases of community-acquired P. aeruginosa is nonspecific: fever, cough, diarrhea, rash [4]. Ecthyma gangrenosum (EG) is considered as one of characteristic manifestations of P. aeruginosa septicemia [10], but was not present in our case.

BNP is a hormone secreted predominantly by the cardiac ventricles. Studies have confirmed the utility of measurement of plasma BNP to assist in diagnosis of patients presenting with acute dyspnea [11]. A high plasma concentration of BNP is found in subjects with heart failure (HF) [12]. It is reported that patients with HF have higher BNP levels than patients with dyspnea caused by respiratory diseases [13]. In our case, the infant had no underlying heart disease, but presented with symptoms and physical findings consistent with heart failure along with an elevated BNP. Initially we directed therapy toward heart failure, but also treated for presumptive infection. Echocardiography and subsequent course supported sepsis as the more correct diagnosis.

Appropriate antibiotics intervention should be performed within 1 h of recognition of critical infections [14, 15]. But P. aeruginosa infection as an etiology is not commonly considered in healthy patients without risk factors. Its diagnosis generally awaits positive results of cultures. Clinicians should change this thinking and consider P. aeruginosa as a potential etiology in healthy children.

We need to learn more about P. aeruginosa in healthy children. In the absence of ecthyma gangrenosum, a clinician is left with little to raise suspicion of P. aeruginosa as a causative agent of non-specific symptomatology. P. aeruginosa readily develops antibiotic resistance, which is enhanced by empiric therapy directed at more likely infecting organisms. Multidrug resistance is a significant risk factor for 30-day mortality in patients with P. aeruginosa bacteremia [16]. In our case, sensitivities of the P. aeruginosa changed during ten days. Clinicians should frequently monitor microbiology laboratory data, and adjust treatment regimens as indicated.

P. aeruginosa is a purulent bacterium, and it can cause extensive lesions involving the perineal region, abdomen, middle ear, brain and lung. It is important to adopt infectious control measures, and to use surgical incision and drainage when gangrene or abscess develops [17].

The elastase of P. aeruginosa not only possesses fibrinogenolytic and fibrinolytic activities, but it also directly affects endothelial cells and destroys the basement membrane of blood vessels to cause hemorrhage [18]. In 2014, Elsen et al. successfully isolated a P. aeruginosa strain from an adult patient with fatal hem-

orrhagic pneumonia. It possessed a hemolysin/hemagglutinin family pore-forming toxin, and secreted exolysin to induce hemorrhagic pneumonia [19]. Pulmonary hemorrhage in P. aeruginosa in previously healthy children is rare. We suspect pulmonary hemorrhage in our case may have resulted from any one or more of the following causes: 1) local direct hemorrhage from the pneumonia; 2) broad capillary injury in the pulmonary bed resulting from infection and inflammation; 3) coagulation disturbance. The hemorrhage occurred 8 hours after admission, when diuretics, cardiac inotropes and vasodilators had been administered, and ejection fraction was normal, so heart failure may not likely the causative factor.

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Disclosure of conflict of interest

None.

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