Case Report

Empyema due to a highly transmissible *Pseudomonas aeruginosa* strain in an adult cystic fibrosis patient

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Chronic pulmonary infection with *Pseudomonas aeruginosa* occurs in up to 85 % of individuals with cystic fibrosis (CF) by the time they reach adulthood, and is the major cause of morbidity and mortality: nearly all patients die from progressive respiratory failure due to repeated pulmonary exacerbations. However, despite the predilection of this organism for the lungs of CF people, infection of the pleura is much less common and is not well described in the CF population. We describe what is believed to be the first case of pleural empyema due to a particularly pathogenic transmissible strain of *P. aeruginosa* (the Liverpool epidemic strain) in an adult CF patient.

Case report

A 34-year-old woman with cystic fibrosis (CF) ($\Delta F508/\Delta F508$) was admitted to the Liverpool Heart and Chest Hospital in 2008 following a 2 week history of left-sided chest pain, breathlessness and a worsening productive cough. She was a non-smoker and had no history of CF-related diabetes or chronic liver disease. Since 2003, she had been infected with the Liverpool epidemic strain (LES) and a unique *Pseudomonas aeruginosa* strain, but required only one course of intravenous (i.v.) antibiotics per year for pulmonary exacerbations. Prior to this, her sputum cultures had intermittently grown *Staphylococcus aureus*. Her baseline forced expiratory volume in 1 s (FEV_1) was around 54 % (predicted) and her body mass index was 20 kg m^{-2} . Her medication included inhaled salbutamol, and a combination of a steroid and a long-acting beta 2 agonist as an inhaled therapy for asthma, and she had been on a maintenance dose of 10 mg prednisolone for 9 months for allergic bronchopulmonary aspergillosis.

On examination she was pyrexial (38.2°C), with tachypnoea (respiratory rate of 25 min^{-1}) and hypoxaemia (blood oxygen saturation 91 % with room air). Chest auscultation revealed reduced breath sounds on the left and her FEV_1 had fallen to 34 %. Serological investigations showed a white cell count of $31.6 \times 10^3 \text{ cells dl}^{-1}$ (91 % neutrophils), a platelet count $945 \times 10^9 \text{ platelets l}^{-1}$ and

418 mg C-reactive protein l^{-1} . Immunoglobulin levels (IgG, IgA, IgM) were normal.

A chest X-ray showed consolidation in the left mid zone and a left pleural effusion (Fig. 1). Diagnostic aspiration of this under ultrasound guidance revealed frank pus and subsequently 2.5 l purulent fluid was drained through a 16 F Seldinger chest drain. A subsequent computed tomography

Fig. 1. Chest X-ray showing left-sided consolidation and pleural effusion with a mediastinal shift to the right.

Abbreviations: CF, cystic fibrosis; FEV_1 , forced expiratory volume in 1 s; i.v., intravenous; LES, Liverpool epidemic strain; tds, three times a day.

chest scan revealed a residual left pleural fluid collection with consolidation and atelectasis of the left lower lobe. PCR assays (Smart *et al.*, 2006), and array tube genomic fingerprinting (Wiehlmann *et al.*, 2007) of the *P. aeruginosa* isolates confirmed the presence in the pleural fluid of both the unique and the LES strains found in her sputum. The unique strain was identified as having the hexadecimal code A41A, making it different from any of the *P. aeruginosa* isolates subjected to array tube genotyping in the study by Wiehlmann *et al.* (2007). All the LES isolates had the diagnostic hexadecimal code 4C12. Blood cultures did not reveal any organisms and pleural fluid culture for other bacteria, including *Mycobacteria* sp., was ultimately negative.

The patient was treated with 3 g i.v. ceftazidime three times a day (tds) and 160 mg tobramycin tds, supplementary inhaled oxygen and chest physiotherapy. Following this, her condition improved and she was discharged 17 days after admission, only to be readmitted 2 weeks later with a recurrent left effusion that required a further chest drain insertion. She was given 2 g i.v. meropenem tds and 160 mg tobramycin tds. She was discharged in a state of wellness 2 weeks later and a repeat chest X-ray at 2 months showed minimal blunting of the left costophrenic angle only (Fig. 2).

Discussion

CF is characterized by lung inflammation and a progressive deterioration in pulmonary function. Chronic bacterial infection occurs early in life, and is associated with significant morbidity and mortality, and by adulthood up to 85 % of patients will be infected by *P. aeruginosa*. Of the many genotypic strains of *P. aeruginosa*, the LES is an aggressive, frequently multiresistant, type that is highly transmissible between CF patients and is prevalent in most UK CF centres (Scott & Pitt, 2004). It is recognized that chronic infection by this strain is a poor prognostic factor due to its association with a more intense inflammatory

response in the lung, causing an accelerated decline in lung function and increased morbidity (Al-Aloul *et al.*, 2004). However, such chronic infection is not known to be associated with other pulmonary complications. Whilst empyema secondary to *S. aureus* (Taussig *et al.*, 1974), *Burkholderia gladioli* (Khan *et al.*, 1996) and the *Burkholderia cepacia* complex (Noyes *et al.*, 1994) have been documented, we report what is to the best of our knowledge the first case of empyema caused by the LES of *P. aeruginosa* in an adult CF patient. Although there is one case of *P. aeruginosa* empyema in the literature, the genotype of the strain is not known (Mestitz & Bowes, 1990).

Despite early and profuse bacterial infection of the respiratory tract, pleural empyema is rarely seen in CF patients. This may relate to the use of aggressive microbiological surveillance, targeted antibiotic treatment, chest physiotherapy and the presence of an intact immunological defence mechanism in CF. Furthermore, it has been postulated that the host defence mechanisms restrict the infection to the airways (Mestitz & Bowes, 1990). Empyema in CF has largely been observed in infants (before the diagnosis of CF has been established) where the innate immunity is low (Taussig *et al.*, 1974). More recently empyema has been reported in patients with CF-related complications, such as immunosuppression following lung transplant (Khan *et al.*, 1996; Noyes *et al.*, 1994), liver disease with portal hypertension (Griffiths & Massie, 2006) and in a diabetic patient on long-term oral prednisolone (25 mg per day) (Mestitz & Bowes, 1990). The likely mechanism of empyema in our patient was due to an infected parapneumonic effusion in the setting of bacterial pneumonia secondary to a virulent strain (LES) of *P. aeruginosa*. Blood cultures were negative and there were no comorbidities, such as diabetes or chronic liver disease. However, long-term oral prednisolone may have been a risk factor for the development of empyema.

We present what is to the best of our knowledge the first case of empyema caused by the *P. aeruginosa* LES in an adult CF patient, which was successfully managed with chest-tube drainage and appropriate antibiotics. Physicians are likely to encounter more patients with empyema associated with CF-related complications as the prevalence of virulent transmissible organisms increases, highlighting the need for microbiological surveillance coupled with effective segregation strategies to prevent their spread.

Fig. 2. Chest X-ray at 2 months showing residual minimal blunting of the left costophrenic angle.

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