CASE REPORT

Bordetella bronchiseptica pneumonia: beware of the dog!

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Accepted 19 April 2018

SUMMARY

We report the case of a 35-year-old quadriplegic male with confirmed *Bordetella bronchiseptica* pneumonia, manifesting with acute hypoxic respiratory failure on a background of chronic hypercarbia requiring mechanical ventilation in intensive care.

B. bronchiseptica are known to colonise the upper respiratory tracts of many mammals but are very rarely responsible for acute respiratory tract infections in humans.

A review of the literature suggests preponderance for immunocompromised or immunoincompetent patients who have experienced environmental exposure to colonised animals. The disease pattern of *B. bronchiseptica* infection is non-uniform and while it is rarely described as a commensal or colonising organism, very few case reports describe severe respiratory infections.

BACKGROUND

Bordetella bronchiseptica in human disease is a rare occurrence and a challenging microbiological diagnosis. This is one of the few documented cases in the UK of severe respiratory infection associated with *B. bronchiseptica*, and this case report proffers useful diagnostic considerations in patients with severe immunocompromise or advanced respiratory disease presenting with acute respiratory failure.¹

CASE PRESENTATION

This 35-year-old cigarette smoker was admitted via the emergency department with a short history of worsening dyspnoea and a cough productive of green sputum.

His medical history was significant for quadriplegia secondary to a childhood spinal injury. There had been a prior hospital admission with community-acquired pneumonia 1 year previously, which was uncomplicated, and the patient suffered chronic type 2 respiratory failure in consequence of pronounced kyphoscoliosis of the thoracolumbar spine. The patient had no history of chronic airway disease, denied respiratory occupational and environmental exposures and resided in a nursing home.

On admission, he was feverish (38°C), tachypnoeic and hypoxic, with a SpO₂ of 91%. Coarse crepitations were audible in the lung fields and chest X-ray evidenced marked thoracolumbar scoliosis, a chronically elevated right hemidiaphragm and bilateral pulmonary infiltrates.

Inflammatory markers were elevated (C-reactive protein 110.2 mg/L; white cell count $12 \times 10^9/L$) and renal function was preserved. Respiratory viral screen was sent in addition to sputum and blood cultures, and he was commenced on intravenous amoxicillin and clarithromycin for likely community-acquired pneumonia.

On the second day of his admission, the patient experienced an acute deterioration in his clinical condition. He was found apnoeic with a Glasgow Coma Scale score of 5 and arterial blood gas sampling revealed acidaemia secondary to severe type 2 respiratory failure (pH 6.9, partial pressure of carbon dioxide 21 kPa, partial pressure of oxygen 8 kPa). The patient was intubated and mechanically ventilated, and then transferred to the intensive care unit (ICU). Ventilation was initially difficult with high airway pressures (peak 31 cm H₂O) and fractional inspired oxygen (FiO₂) requirements (0.8) to maintain adequate oxygenation. Bronchoscopy identified bilateral mucopurulent secretions which were sent for bacteriology and virology analyses.

The patient's initial sputum sample, along with two bronchoalveolar lavage samples returned positive cultures for *B. bronchiseptica* identified via PCR. No further organisms were detected in sputum or lavage samples, and the atypical pneumonia screen, blood cultures and urinary antigens were negative. Amoxicillin was escalated to piperacillin/tazobactam and the patient was commenced on nebulised gentamicin, given his clinical deterioration requiring intubation and ventilation. This was based on verbal advice from microbiology—full antibiotic sensitivities were not available to the clinical team.

OUTCOME AND FOLLOW-UP

The patient improved clinically with escalation of antimicrobial therapy. Mechanical ventilation was gradually weaned over the course of 7 days, with FiO₂ weaned from 0.8 to 0.3 and positive end-expiratory pressure weaned from 10 to 5. He was successfully extubated to Airvo which was gradually de-escalated to humidified nasal cannulae.

He completed a 7-day course of piperacillin/tazobactam and a 3-day course of nebulised gentamicin. Following improvement of symptoms, inflammatory markers and chest X-ray appearances, he was discharged from the critical care setting to the medical ward for further rehabilitation.

To cite: Clements J, McGrath C, McAllister C. *BMJ Case Rep* Published Online First: [please include Day Month Year]. doi:10.1136/bcr-2018-224588

DISCUSSION

B. bronchiseptica, a gram-negative rod-shaped coccobacillus, is primarily a zoonotic organism that is infrequently pathogenic in humans.

It is known to infect a wide range of mammals, causing tracheo-bronchitis in cats and dogs—parochially known as ‘kennel cough’—and atrophic rhinitis in pigs. Vaccination against ‘kennel cough’ is common practice in domestic pets; however, this live attenuated vaccine may in theory confer human transmission.²

Very few cases have documented severe sepsis and respiratory failure associated with acute *B. bronchiseptica* infection. Typically, this organism manifests in immunocompromised or immunoincompetent patients with at least one predisposing condition, such as severe chronic obstructive pulmonary disease, previous lung transplantation, AIDS, acute lymphocytic leukaemia, Crohn’s disease, lung cancer and cystic fibrosis.^{3–4} While this patient did not suffer from immunocompromise, it is likely that infection with *B. bronchiseptica* was potentiated by chronic restrictive respiratory disease and neurological status.

Infection predominantly occurs following contact with animals harbouring *B. bronchiseptica* and in this case, it emerged that the patient was regularly in contact with a dog in his nursing home, a most probable source of infection in this instance.

There is no clear guidance regarding the duration of therapy in *B. bronchiseptica* infection, and antimicrobial administration should be guided by sensitivities as evidence of resistant strains of *B. bronchiseptica* exists in the literature. *B. bronchiseptica* is generally sensitive to antipseudomonal penicillins, carbapenems, fluoroquinolones and aminoglycosides, but not to erythromycin, in contrast to other *Bordetella* species. Antimicrobial duration is determined on a case-by-case basis, but treatment with one that has good intracellular penetration is essential because of the organism’s ability to invade epithelial cells and phagocytes.⁵

In this case, piperacillin/tazobactam and gentamicin were chosen based on sensitivities, with duration guided by clinical response. Nebulised gentamicin theoretically allows for higher drug concentration at the desired site with less risk of systemic toxicity. Nebulised aminoglycosides have been shown to improve lung function, slow the rate of respiratory decline and decrease the need for intravenous treatment in *Pseudomonas* infection in patients with cystic fibrosis and bronchiectasis.⁶

There are no distinctive radiological features of *B. bronchiseptica* infection. Chest X-ray will typically evidence lobar consolidation, interstitial or lobular infiltrations or, in rare instances, cavitation.

In this case, the patient met acute respiratory distress syndrome (ARDS) criteria as per the Berlin definition (acute onset, bilateral pulmonary infiltrates on chest radiograph, PaO₂/FiO₂ ratio <300 mm Hg). Unfortunately, during their stay in hospital, they did not undergo an echocardiogram to establish if any cardiac dysfunction co-existed. While increasingly difficult ventilation was well recognised, documented and managed appropriately, the term of ARDS was not documented in the clinical notes. This case potentially serves as a further reminder of the need to improve clinician recognition of this common and potentially fatal syndrome, which can be unrecognised in up to 40% of cases.⁷

Patients admitted to ICU with acute respiratory failure complicated by kyphoscoliosis also pose a unique ventilation challenge, and it is not uncommon to observe failure of non-invasive

ventilation in the setting of sepsis. Reduced pH, septic shock and invasive mechanical ventilation are usually associated with poorer outcomes for this cohort of patients.⁸

Learning points

- Immunocompromised patients who own cats or dogs should be cognisant of this small but non-negligible threat of airway contamination with *Bordetella bronchiseptica*. Vaccination of pets against ‘kennel cough’ may not confer protective benefit.
- The clinical disease pattern of *B. bronchiseptica* infection is non-uniform, ranging from asymptomatic colonisation to potentially fatal pneumonia.
- *B. bronchiseptica* express reasonable sensitivity to antipseudomonal penicillins, carbapenems, fluoroquinolones and aminoglycosides, but not to erythromycin, in contrast to other *Bordetella* species.
- Acute respiratory distress syndrome continues to be under-recognised or at least under-documented among clinicians, despite its high prevalence and associated mortality in patients in intensive care.

Contributors JC, lead author, was responsible for the concept and design of article, including composition of literature review and clinical summary and collection of the inset figure and submission of final draft. CMCg, co-author, was responsible for the care of the patient while in ICU, Craigavon, and contributed towards the clinical summary and provided ideas for literature review, including review of nebulised gentamicin; also reviewed various drafts and contributed to editing. CMA, co-author, was the supervising consultant on this project and provided advice on article structure and directed the literature review. He also was responsible for the delivery of inpatient care for this patient, was central to diagnostic and management decisions and provided approval of the final version submitted. All the authors agreed to be accountable for the article and ensure that all questions regarding the accuracy or integrity of the article are investigated and resolved.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

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