Secondary Pulmonary Alveolar Proteinosis of Occupational Etiology: A Case Report

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Abstract

Pulmonary alveolar proteinosis is a rare disease of alveolar surfactant accumulation. Primary, autoimmune etiology accounts for 90% of cases. This report presents a case of secondary alveolar proteinosis, a metal worker with a pulmonary infection who was subsequently diagnosed with alveolar proteinosis based on the results of bronchoalveolar lavage and lung biopsy. He underwent complete resolution of the alveolar proteinosis after whole lung lavage and change of his workplace. Long term follow-up hasn’t shown any sequelae and he has suffered no relapse. This favorable disease course is representative of secondary alveolar proteinosis with a reversible causative agent.

Keywords: Secondary alveolar proteinosis; Metal exposure; Infection; Whole lung lavage

Introduction

Pulmonary alveolar proteinosis (PAP) is a rare disease with an estimated incidence of 0.36 per million [1]. It is characterized by the abnormal alveolar accumulation of surfactant-derived phospholipids and protein components, caused by their diminished clearance by alveolar macrophages [1]. Based on the etiology, two forms of PAP are currently recognized: the primary form that includes cases of hereditary/congenital and autoimmune origin and the secondary form. Of these, primary PAP is by far the most common, representing 90% of all cases [2]. In this report, we present a case of secondary PAP, due to occupational exposure to mineral dust and the long-term follow-up after treatment with whole lung lavage.

Case Report

In 2000, a 36-year-old male non-smoker without previous history of chronic disease presented at the Department of Infectious diseases of the University Medical Center Ljubljana with a fever of 39 degrees Celsius, chills and productive cough with expectoration of yellow sputum. He was an electronics worker for 13 years and was daily exposed to colophony and mineral dust (zinc, silver, cadmium) and chemical fumes. He had had no previous health issues. He had a raised white blood cell count and C-reactive protein level and was diagnosed as a bilateral pneumonia (Figure 1). However, sputum cultures were negative, probably due to a previous course of antibiotic therapy. He was treated with cefalexin and cefuroxim and his condition improved. He was discharged after 13 days. Despite treatment, he did not feel he had completely recovered and complained of an inability to completely clear his lungs with coughing and had mild dyspnea on exertion. The follow-up chest X-ray one month later showed interstitial changes and he was referred to our Department for Pulmonary diseases and Allergy for evaluation. On examination, his physical status was normal with a pulse rate of 84/min, blood pressure 120/80, respiratory rate of 14/min and oxygen saturation of 96%, without abnormal respiratory phenomena. He had a repeat chest X-ray that showed diffuse reticulonodular opacities, especially in the lower lobes, more on the right side than on the left (Figure 2). Contrast-enhanced computed tomography of the thorax revealed centrolobular ground-glass opacities and interstitial thickening with markedly thickened interlobular septae, most evident in the lower lung lobes (crazy-paving pattern). The process was relatively well demarcated and subpleural parts of the lungs were exempt. Lung function tests showed an abnormality of alveolo-capillary diffusion with

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a DLCO of 70%, while the lung volumes were normal and the normal ratio of FEV1 to FVC ("Tiffneau index") was maintained (Table 1). We prescribed clarithromycin until the scheduled bronchoscopy.

Bronchoscopy with Bronchoalveolar Lavage (BAL) and transbronchial biopsy was performed in January 2001 (Figure 3). The instilled volume was 200 ml with an output volume of 168ml. The sample was milky in appearance with a cellular concentration of 337/microliter, cell viability of 58%, 23% epithelial cells, 47% macrophages, 40% lymphocytes, 13% neutrophils and globular Periodic-Acid-Schiff (PAS) positive extracellular material. Biopsy samples showed eosinophilic granular intra-alveolar material and foamy macrophages consistent with alveolar proteinosis (Figure 4). It was presumed to be idiopathic, pending more studies. Due to the patient's state of good health, whole lung lavage was not attempted at this point, but upon discharge he was instructed to seek immediate medical help if he experienced any difficulty breathing.

He returned later in 2001. He had high fever and an intermittent cough that was worse while exposed to irritants at his workplace. His laboratory tests revealed raised white blood cell count and C-reactive protein levels. In the previous 4 months he had been exposed to more dust than usual. He was admitted to the hospital with bilateral pneumonia and was successfully treated with ciprofloxacin. Two weeks later, his condition worsened, with increased dyspnea and exertional cough. His lips were cyanotic and rales and inspiratory crackles were heard bilaterally over the lower lung lobes. The initial oxygen saturation on room air was 88%. Arterial blood gas analysis showed a pH of 7.469, PCO2 5.4 kPa; PO2 7.9 kPa, HCO3 21.4 mEq/L on 3 L/min supplemental oxygen via nasal cannula. Laboratory tests including blood tests and sputum were normal. Pulmonary function tests showed lung diffusing capacity for carbon monoxide decreased to 47% (Table 1).

A chest x-ray revealed bilateral pulmonary infiltrates (Figure 5), while contrast-enhanced chest computed tomography showed ground glass opacities on a reticular background of septal and interstitial thickening resembling a crazy paving pattern (Figure 6a and 6b). Bronchoscopy with Bronchial Alveolar Lavage (BAL) and a transbronchial lung biopsy of the right lower lobe were performed. Bronchoscopy showed proteinaceous secretions in both bronchial trees. The BAL fluid was milky and opaque. Microscopically, the transbronchial lung biopsy showed preserved alveolar architecture with complete filling of the alveoli with periodic-acid-Schiff-positive granular material. The patient was diagnosed with PAP.

Whole-lung lavage was performed under general anesthesia in

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### Table 1: Lung function test results.

<table>
<thead>
<tr>
<th></th>
<th>FVC (% of predicted)</th>
<th>FEV1 (% of predicted)</th>
<th>FEV1 to FVC ratio (%)</th>
<th>DLCO (% of predicted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>In 2000</td>
<td>93</td>
<td>93</td>
<td>77</td>
<td>70</td>
</tr>
<tr>
<td>2001 before WLL</td>
<td>93</td>
<td>93</td>
<td>69</td>
<td>47</td>
</tr>
<tr>
<td>2001 after WLL</td>
<td>96</td>
<td>95</td>
<td>69</td>
<td>81</td>
</tr>
<tr>
<td>2014</td>
<td>95</td>
<td>86</td>
<td>71</td>
<td>77</td>
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</tbody>
</table>
Pulmonary alveolar proteinosis (PAP) is a rare diffuse lung disorder that was first described by Rosen et al. [3]. It is characterized by the diffuse intra-alveolar accumulation of amorphous, periodic acid-Schiff (PAS)-positive lipoproteinaceous material, primarily surfactant phospholipids and apoproteins. This accumulation is caused by a disturbance in the balance of either the production of surfactant or its clearance by alveolar macrophages and apoproteins. This imbalance results in impaired gas transfer between the alveoli and blood [2].

The congenital form is a genetic disease, caused by defective genes for surfactant proteins B or C or granulocyte-macrophage colony stimulating factor (GM-CSF) receptors [2]. The acquired or idiopathic PAP is by far the most common, we could not exclude an autoimmune etiology at the time of diagnosis (anti-GM-CSF antibody tests were not available at the time of our institution). The mineral and resin dusts (with the possible exception of cadmium, due to observations in animals) our patient was exposed to have not been previously implicated in the pathogenesis of PAP in humans, but due to the paucity of cases of secondary etiology, this is not to be wondered at. However, the fact that he underwent complete resolution after WLL and change of workplace and has since suffered no relapse or shown any sequelae on CT exams makes our diagnosis of secondary PAP far more likely.

His environmental exposure to mineral and resin dusts was longstanding, but despite this a chest X-ray performed 5 years before his first hospital admission showed no consequences of exposure. His alveolar proteinosis might have been induced by lung infection in combination with environmental exposure but after his removal from the hazardous workplace subsequent pneumonias failed to induce disease recurrence, showing that these factors might work together in the pathogenesis of PAP in susceptible subjects. Alternately, his pneumonias might have themselves been a consequence of the deranged pulmonary local immunity in the setting of PAP [1].

Patients with secondary alveolar proteinosis are few, but their prognosis in the presence of a known, reversible cause is much more optimistic, whereas up to 66% of patients with primary PAP may require a repeat lavage due to disease relapse [1,17].

Conclusion

Secondary alveolar proteinosis is an extremely rare disease. The diagnosis must be considered when radiologic changes do not comply with the sequelae of lung infection and occupational history reveals exposure. In a susceptible patient, a combination of mineral and resin dust exposure and lung infection presents a high risk for the development of PAP. Whole lung lavage in combination with the timely removal of the offending agent is an efficient treatment option for patients with secondary pulmonary alveolar proteinosis due to work-related dust exposure. It is crucial for the patient to change his work environment. The occupational history of patients with this rare disease is thus an important part of their diagnostic workup.


