PULMONARY ALVEOLAR PROTEINOSIS TREATED WITH WHOLE LUNG LAVAGE IN INTENSIVE CARE UNIT

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Abstract

Pulmonary alveolar proteinosis (PAP) is an unusual interstitial lung disease. The characteristic of the disease is the revealing of periodic acid Schiff (PAS) positive lipoproteinaceous material-filled alveoli on chest radiographs. The standard treatment of PAP is to remove the lipoproteinaceous materials from the lung through the whole lung lavage (WLL) procedure, which is mostly performed in operating rooms under general anaesthesia. In this article, we report the case of a 53-year-old male patient who visited to our chest outpatient clinic due to progressive shortness of breath for 2 months prior to being hospitalized. Chest radiographs indicated bilateral perihilar infiltrate with haziness. A high resolution computed tomography (HRCT) scan of the chest showed ground glass opacification of alveolar spaces with typical crazy paving pattern. A subsequent bronchoscopic lung biopsy confirmed the diagnosis of PAP. The patient underwent the WLL procedure in the intensive care unit and significant improvements have been observed on patient symptoms and chest radiographs after the treatment. A one year of follow up showed that the patient is in stable condition. Thus, we conclude that the lung lavage procedure can also be safely performed in the intensive care unit instead of in an operating room.

Key words: Pulmonary alveolar proteinosis (PAP), Whole lung lavage (WLL)

Introduction

Pulmonary alveolar proteinosis (PAP), also known as pulmonary alveolar phospholipopo-proteinosis, was first described by Rosen et al in 1958.¹ It is an unusual diffuse lung disease characterized by the accumulation of amorphous, periodic acid-Schiff (PAS) positive lipoproteinaceous material in the distal air spaces.¹⁻³ There is little or no lung inflammation, and the underlying architecture is preserved. The median age at diagnosis is 39 years. The ratio of male to female is 2.65:1.² The clinical presentation of patients with PAP is generally marked by variable degrees of dyspnea associated with concomitant hypoxemia. More than 90% of all cases of PAP
occur as a primary (or idiopathic) disorder of unknown etiology, not associated with any familiar predisposition. Occasionally, the condition is secondary to other conditions or inhalation of chemicals. The typical routine laboratory is usually normal. The serum level of LDH is frequently slightly elevated. Asymmetric unilateral or bilateral patchy consolidation is found on chest radiography. The appearances on the HRCT scan of the thorax often suggest the diagnosis, and it should be confirmed by examination of bronchoalveolar lavage fluid or biopsy specimens.

In a retrospective analysis of 343 cases, the five-year survival rate was about 75% of the deaths in that study, 72% were directly due to respiratory failure from PAP and 20% were due to PAP with uncontrolled infection. Because of the unknown pathogenesis, WLL remains the most effective form of treatment, and it is a safer technique in experienced hands. However, the severe hypoxemia in PAP patients and the difficulty of the technique have limited its application to medical centers. Now, we would like to report our experience in treating a 53-year-old man with PAP using the lung lavage technique in the ICU. He has experienced clinical and functional improvement persistently for more than one year.

Case Report

A 53-year-old man who was a punching machine worker and heavy cigarette smoker of 30 years visited our outpatient clinic due to progressive shortness of breath for 2 months. He has had a history of allergic rhinitis for 10 years. Physically, he was mildly tachypneic but was not cyanotic. Clubbing fingers were also noted. There were diffused crackles over both lungs. His chest radiograph revealed bilateral perihilar infiltrate and haziness with normal heart size (Fig. 1). A high resolution computed tomography (HRCT) scan showed ground glass opacification of alveolar spaces and thickening of the interlobular...
and intralobular septa with no architectural distortion, giving the typical “crazy paving” appearance of alveolar proteinosis (Fig. 2). The air space opacification was demarcated from surrounding normal lung tissue creating a “geographic” pattern. No mediastinal or hilar lymphadenopathy was noted. Echocardiogram revealed normal heart function.

His PaO2 at the time of hospital admission was 87.9 mmHg and PCO2 was 28.7 mmHg in breathing room air. A pulmonary function test revealed a TLC of 89% and a DLCO of 48% predicted. Other laboratory data revealed slight elevation of LDH: 220 IU/L. PAP was diagnosed via transbronchoscopic lung biopsy. Microscopically, the section showed that the alveolar septa were only slightly thickened and the alveolar architecture was preserved. The alveoli were filled with a pink homogeneous material that was PAS positive. He was scheduled for WLL.

The procedure was performed in the ICU with standard monitoring of heart rate, respiratory rate, blood pressure and oxygen saturation. The patient was sedated with intravenous Propofol and muscle relaxant. A double lumen endotracheal tube was inserted by anesthetist. Then, both lungs were ventilated at 1.0 FiO2 with a mechanical ventilator for 15 min to wash out the nitrogen. The right lung was gradually filled with normal saline warmed to 37°C until a volume equal to the calculated functional residual capacity (FRC) of the lung. Thereafter, aliquots of 500 ml were run in and out. The effluent fluid was drained into a bottle by gravitational flow. The returning lavage fluid was initially milky (Fig. 3) and gradually became clearer. We also applied both manual percussion and portable ultrasonic vibra-
tors on the patient’s chest wall alternately for continuous vibration during lavage. Periodic transbronchoscopic suction with fiberoptic bronchoscope by pulmonologist and periodic arterial blood gas was collected in case of SaO2 dropping.

One week after the first lavage, bronchoalveolar lavage on the left lung was performed in the same manner. Follow up chest radiograph revealed almost complete clearing of alveolar infiltrate (Fig. 4) and HRCT revealed much resolved ground glass opacity and thickened interlobular and intralobular septa (Fig. 5). Further follow up chest radiographs revealed much improvement compared with the one taken just after lavage. The patient’s clinical status has been stable for more than one year with regular follow up.

Discussion

Before therapeutic bronchoalveolar lavage was introduced by Ramirez and his colleagues in 1965, initial therapies were empirical. These included corticosteroids, heparin, antibiotics, trypsin, and acetylcysteine, but none was effective.

In July 1964, Ramirez proceeded with a trial of WLL, under local anesthesia, using up to 3 L of saline with added heparin or acetylcysteine. The procedure provided significant improvements in symptoms and pulmonary function. Over the next four decades, this original procedure has been repeatedly improved through the routine use of general anesthesia, increased lavage volumes, the use of saline alone, the addition of concomitant chest percussion, and the successful completion of bilateral sequential WLL in the same treatment session.

Therapeutic bronchoalveolar lavage can be performed by several techniques: segmental irrigation through a catheter, WLL through a catheter, catheter lobar lavage, or lobar lavage by fiberoptic bronchoscopy (FOB).

Kariman et al reported that 24% of PAP patients had either spontaneous remission or were free of symptoms despite the presence of roentgenographic abnormalities. In general, these patients were less symptomatic and the pulmonary function and their gas exchange measurements revealed only a mild to moderate arterial hypoxemia.
Pulmonary alveolar proteinosis treated with whole lung lavage in intensive care unit

Fig. 4. Radiograph taken after bilateral lung lavage showing almost complete clearing of alveolar infiltrate.

Fig. 5. HRCT scan after bilateral lungs lavage shows decrease in both the patchy lung opacities and thickened interlobular and intralobular septa.
WLL is now considered the most effective form of treatment for PAP. The main indication for WLL is limitation in daily activities due to dyspnea. Specific indications for lung lavage include a definitive histologic diagnosis and that patients with a PaO2 of less than 70 mm Hg or a P(A-a)O2 of more than 40 mmHg.14

Some centers use manual chest percussion during lavage to improve the removal of intra-alveolar proteinaceous substances. Hammon et al reported that optical density of recovered lavage fluid for manual percussion was significantly superior to mechanical percussion or no percussion and increased the therapeutic results of broncho-pulmonary lavage for PAP.9

The major adverse effect from WLL is hypoxemia which can be improved by ventilation with a high inspired oxygen concentration.5,15,16 Arterial oxygenation improves during the filling phase due to the increase in alveolar pressure, regional pulmonary capillaries are collapsed and blood flow ceases. Pulmonary blood flow is shifted to the contralateral non-liquid-filled ventilated lung causing an increase of PaO2. Emptying of the lung causes a decrease in airway pressure and perfusion of the proteinaceous material filled alveoli creates a shunt in the lung undergoing treatment and hence a fall in PaO2.16

Hamodynamic changes occur with single lung ventilation5,16,17 but invasive monitoring is unnecessary in most cases.18

The process of WLL is slow (2-4 h) and requires an experienced team and postoperative facilities. The key components to ensuring safety is an anesthetist who is very skillful in the placement of the double lumen endotracheal tube and is capable of frequently checking and adjusting the tube during the lavage procedure. Avoid leakage of the lavage fluid into the contralateral ventilated lung. Slow instillation of large volumes of fluid to prevent barotrauma.14,19

Many articles14,19,20 have reported no major complications after therapeutic lavage. Multiple segmental or lobar lavage by fibreoptic bronchoscopy (FOB) is a possible alternative to WLL.15,21 Cheng and colleagues reported that lobar therapeutic lavage performed through FOB is useful for patients with PAP for whom lavage of an entire lung with general anesthesia may be hazardous, and for patients with less advanced disease from whose lung proteinaceous substances can be removed with a small volume of lavage fluid. The yield by this method is small with limited volume of lavage fluid and multiple lavages are required.

After WLL, patients feel dramatically better with improvement in exertional dyspnea. Literature revealed the clinical course is variable after WLL. 30-40% of patients require only one lavage,19,22 while others require repeated lung lavages at intervals of 6 to 24 months.

WLL is now considered the treatment of choice for patients with PAP. An experienced lavage team including nursing, anesthesiology, respiratory therapy, and pulmonary medicine is essential in performing this procedure. We performed WLL safely and efficiently to our PAP patient in the intensive care unit without the expense and difficulty of scheduling an operating room.

References
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Pulmonary alveolar proteinosis treated with whole lung lavage in intensive care unit

肺泡蛋白質沈著症在加護病房進行全肺灌洗術治療

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摘要

肺泡蛋白質沈著症是常見的間質性肺病。胸部X光特徵是肺泡充滿PAS染色陽性的脂蛋白物質。肺泡蛋白質沈著症的標準治療是施行肺灌洗術將脂蛋白物質洗出肺部。大部份肺灌洗術是在手術房全身麻醉下進行的。在這篇文章，報告一位53歲病人住院前兩個月因進行性呼吸困難至本院門診。胸部X光片顯示兩肺浸潤性變化。胸部電圖斷層呈現毛玻璃樣病灶及不規則石板拼舖型表徵。經支氣管鏡檢查確診為肺泡蛋白質沈著症。病人在加護病房施行全肺灌洗術。治療後病人症狀及胸部X光片明顯改善。一年後追蹤病人狀況良好。肺灌洗術可以無需在手術室操作而在加護病房內安全的施行。

關鍵詞：肺泡蛋白質沈著症，全肺灌洗術

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