INTERNAL MEDICINE

□ CASE REPORT □

Respiratory Failure of Williams-Campbell Syndrome is Effectively Treated by Noninvasive Positive Pressure Ventilation

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Abstract

Williams-Campbell syndrome is a rare disease, characterized by a congenital deficiency of cartilage in the fourth to sixth order bronchi, leading to chronic respiratory failure with recurrent pulmonary infections. An effective and practical treatment has not yet been established. A 31-year-old man who was diagnosed as Williams-Campbell syndrome by inspiratory and expiratory computed tomography findings developed recurrent pulmonary infections and showed progressive deterioration of dyspnea. Domiciliary NPPV was administered, followed by a dramatic improvement of respiratory failure and a decrease in the episodes of pulmonary infections. NPPV may have an advantage in adults with Williams-Campbell syndrome who have severe respiratory failure and recurrent pulmonary infections.

Key words: noninvasive positive pressure ventilation (NPPV), Williams-Campbell syndrome, bronchiectasis

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Introduction

Williams-Campbell syndrome a rare disease first reported in 1960, is characterized by a congenital deficiency of cartilage in the fourth to sixth order bronchi (1). The chest high resolution computed tomography (CT) findings show severe bronchiectasis collapsing in the expiratory phase (2); this syndrome demonstrates obstructive pulmonary disorder and recurrent pulmonary infections (1, 3). Many cases are usually found in childhood, resulting in death during childhood due to recurrent pulmonary infections (3). The effective and practical treatment is still unknown except for home oxygen therapy and lung transplantation (4). Here, we describe an adult case of Williams-Campbell syndrome in whom noninvasive positive pressure ventilation (NPPV) is effective as a supportive treatment.

Case Report

A 31-year-old man who had been treated for bronchial asthma and recurrent pneumonia since childhood was diagnosed as having Williams-Campbell syndrome by inspiratory and expiratory CT at the age of 30. He had a history of admission to the hospital due to pneumonia once or twice a year. Even after the diagnosis of Williams-Campbell syndrome was established, however, he still developed recurrent pulmonary infections and showed progressive deterioration of dyspnea. He was admitted to our hospital for the treatment of his respiratory condition at the age of 31.

On examination, his height was 166.5 cm, his body weight was 85.4 kg and he had a reddish face, central cyanosis, bilateral pretibial edema, but no clubbed fingers. Chest examination demonstrated wheezes and rhonchi over the bilateral lung fields. He did not have any past history of sinusitis.

Arterial blood gas analysis showed severe respiratory fail-

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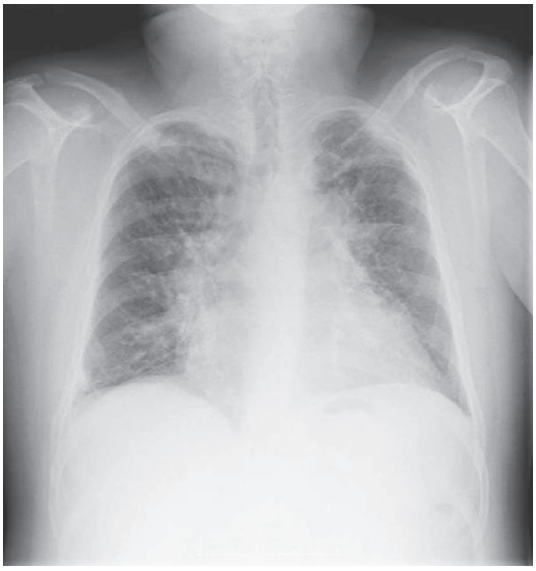

Figure 1. **Chest X-ray on admission.**

ure (pH 7.26, PaO_2 39.2 mmHg, $PaCO_2$ 79.7 mmHg). Laboratory data on admission demonstrated polycythemia (Hb 20.9 g/dL), but there was no elevation of white blood cells (8,200/mm^3) or CRP (0.31 mg/dL), although there was a marked elevation of brain natriuretic peptide (BNP) (175 pg/mL). Although respiratory functional tests one year previously demonstrated a mixed obstructive and restrictive ventilator defect [VC 2.31 L (50.5% of predicted), FEV_1 1.36 L (34.0% of predicted, FEV_1/FVC 56.7%, TLC 4.39 L (77.2% of predicted), RV 2.08 L (146.4% of predicted), D_{LCO} 24.97 mL/min/mmHg (84.4% of predicted), D_{LCO}/V_A 7.64 mL/min/mmHg/L (136.4% of predicted)], respiratory function tests on admission demonstrated more severe pulmonary function disorders [VC 1.46 L (36.2% of predicted), FEV_1 0.63 L (16.9% of predicted), FEV_1/FVC 44.4%]. Echocardiogram showed normal wall motion of the left ventricle (ejection fraction 54%), marked elevation of tricuspid regurgitation pressure gradient (52.1 mmHg) and D-shape of the left ventricle due to enlargement of the right ventricle. Chest x-ray showed reticular shadow, pulmonary congestion in the bilateral lung fields and enlargement of the heart (Fig. 1). A thin slice chest CT scan was obtained in both the inspiratory and expiratory phases. CT showed reticular shadow and bronchiectasis in bilateral lung fields in the inspiratory CT. CT also showed bilateral cystic bronchiectasis and collapse of the dilated bronchi in the expiratory phase (Fig. 2A and 2B). Figure 3A and 3B show an airway tree in the inspiratory and expiratory phases. These images demonstrate the collapse of the affected bronchi in the expiratory phase.

We considered that recurrent pulmonary infections resulted in irreversible pulmonary disorder and continuous hypoxemia caused secondary polycythemia and heart failure. Therefore, we initiated bilevel noninvasive positive pressure ventilation (NPPV) in addition to supplementary oxygen therapy. The ventilation was set to S/T mode; inspiratory positive airway pressure (PAP) of 16 cmH_2O, expiratory PAP of 6 cmH_2O, and the respiratory rate of 20 times/min with 4 L/min oxygen. Arterial blood gas analysis at discharge showed marked improvement of respiratory condition (pH 7.33, PaO_2 90.5 mmHg, $PaCO_2$ 62.4 mmHg at 4 L/min of O_2). The patient received domiciliary NPPV during sleep and supplementary oxygen therapy after discharge. Laboratory data 2 months after the initiation of NPPV showed marked improvement of polycythemia and heart failure (Hb 14.4 g/dL, BNP 5.94 pg/mL). Respiratory condition was maintained fairly well after the initiation of NPPV. Arterial blood gas analysis one year after the initiation of NPPV showed pH 7.36, PaO_2 88.8 mmHg, $PaCO_2$ 67.4 mmHg at 3 L/min of O_2. Pulmonary functional tests showed an improvement [VC 1.92 L (42.4% of predicted), FEV_1 0.94 L (23.8% of predicted), FEV_1/FVC 48.7%]. He gained 6 kg through the two years after the initiation of NPPV. He has not been admitted to hospital for 26 months since the initiation of NPPV. His episodes of pulmonary infections have dramatically decreased after the initiation of NPPV. Health related-quality of life (QOL) of the patient has dramatically improved since the initiation of NPPV.

Discussion

The present case demonstrates that domiciliary NPPV may have an advantage in adult patients with Williams-Campbell syndrome who have severe respiratory failure and recurrent pulmonary infections. This is important information for respiratory physicians since Williams-Campbell syndrome is considered as an intractable disorder.

Williams and Campbell first reported five pediatric cases of Williams-Campbell syndrome in 1960 (1). The most common clinical features of this disease include cough, wheezing and recurrent pulmonary infection episodes developing in early infancy (5) and the number of cases with long-term follow-up remains limited. Patients who survive into adulthood demonstrate recurrent pulmonary infections, and have limitations on physical activity (6).

There is no well-established treatment for Williams-Campbell syndrome except for lung transplantation and home oxygen therapy. Lung transplantation is the only definitive treatment. Palmer et al reported a 28-year-old man who underwent sequential lung transplantation for Williams-Campbell syndrome (4). In their case, although the patient's pulmonary function dramatically improved after transplantation, he developed recurrent bacterial pulmonary infections and died 13 months after transplantation. Lung transplantation carries two high risks. One is the risk of complications due to surgery, and the other is pulmonary infection related to proximal airway collapse and immunosuppressive agents. In contrast, NPPV has a limited risk of complications. NPPV has been reported to improve hypercapnic ventilatory failure, quality of life and survival in restrictive chest wall disease and neuromuscular disease (7, 8). It was also reported that NPPV shows improvement of chronic respiratory

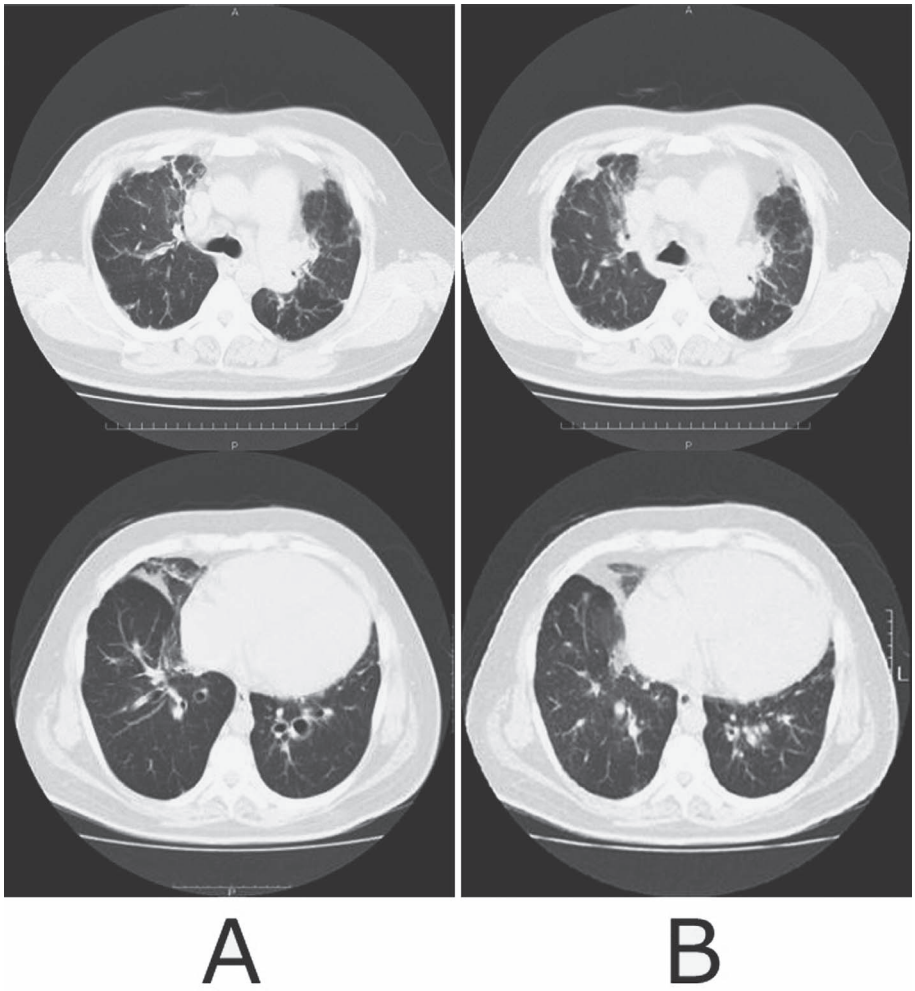

Figure 2. **Chest CT in both the inspiratory and expiratory phase. Chest CT showed reticular shadow in bilateral upper and middle lobe. Inspiratory CT (A) shows bronchiectasis and expiratory CT (B) shows collapse of the affected bronchi.**

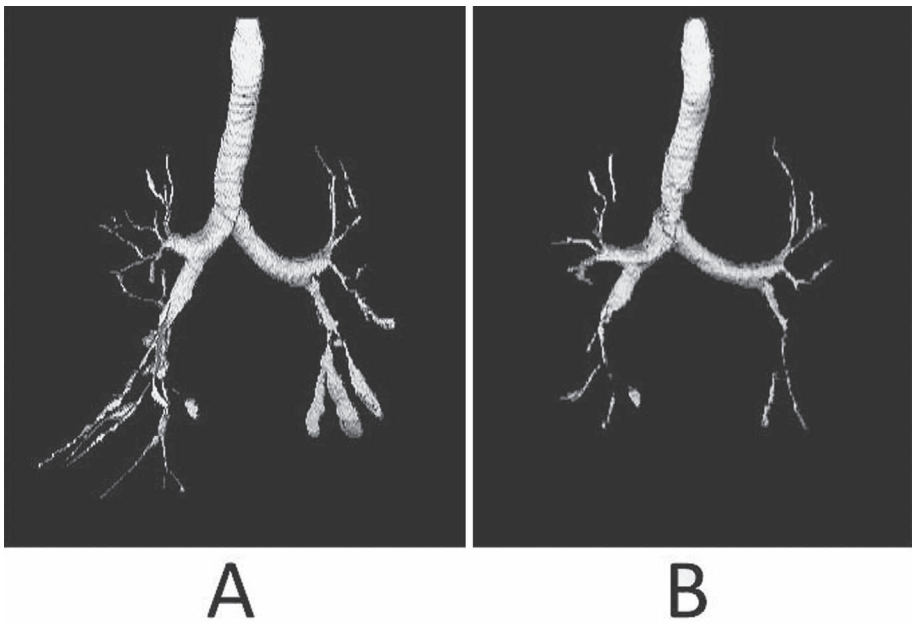

Figure 3. **Three-dimensional CT of inspiratory (A) and expiratory (B) airway tree showed collapse of the affected bronchi.**

failure in patients with bronchiectasis (9). NPPV combined with long-term home oxygen therapy decreases carbon dioxide retention and improves dyspnea and health-related QOL in hypercapnic chronic obstructive pulmonary disease (COPD) (10). Moreover, long-term NPPV may decrease acute exacerbation and recurrent hospitalization in stable hypercapnic COPD (11) and decrease the level of $PaCO_2$ (12).

Williams-Campbell syndrome is an obstructive disorder similar to COPD and NPPV has the possibility of improving dyspnea, carbon dioxide retention, and health-related QOL and the possibility of decreasing acute exacerbation in advanced adult cases of Williams-Campbell syndrome. The prevention of recurrent hospitalization due to pulmonary infections leads to an improvement in the prognosis and health-related QOL. Thus, we think NPPV may be a noninvasive and practical supportive treatment for adults with Williams-Campbell syndrome.

In conclusion, we describe the first case in which domiciliary NPPV was effective for an adult patient with Williams-Campbell syndrome. NPPV may have an advantage in adults with Williams-Campbell syndrome who have severe respiratory failure and recurrent pulmonary infections.

The authors state that they have no Conflict of Interest (COI).

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