



Reversible bronchiectasis caused by influenza virus mimicking Williams–Campbell syndrome

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Abstract

The term bronchiectasis refers to permanent enlargement of the bronchi. It is increasingly diagnosed because of high-resolution computed investigations. It can be congenital or acquired, the latter mostly following infection. Williams–Campbell syndrome is a rare form of congenital non-cystic fibrosis bronchiectasis. Here we report a 5-month-old girl with reversible bronchiectasis treated with extracorporeal membrane oxygenation for acute respiratory distress syndrome (ARDS) caused by influenza virus following surgery for congenital heart disease. Chest CT showed an abnormally large bronchial tree mimicking Williams–Campbell syndrome. At 9 months later, chest CT showed regression of bronchiectasis and normalized caliber of previously collapsed segments in both lungs. This atypical course illustrates that influenza virus can cause reversible bronchiectasis in infants and mimic congenital disease such as Williams–Campbell syndrome.

Keywords Acute respiratory distress syndrome · Bronchiectasis · Computed tomography · Extracorporeal membrane oxygenation · Infant · Influenza virus · Williams–Campbell syndrome

Introduction

The definition of bronchiectasis, whether congenital or acquired, refers to permanent enlargement of the bronchi. It can be shown radiologically or pathologically. Pneumonia caused by influenza virus is one of the acquired causes of bronchiectasis [1]. Williams–Campbell syndrome is a rare cause of congenital non-cystic fibrosis bronchiectasis [2]. The pathological anatomy is the absence or dysfunction of one or more cartilages, usually in the fourth to sixth division of the bronchial tree. Diagnosis often requires showing the characteristic findings of dilatation and collapsing of segmental airways during inspiration and expiration, respectively, on radiologic investigation, and excluding

other causes of bronchiectasis [3]. Here we report an infant treated with extracorporeal membrane oxygenation (ECMO) for acute respiratory distress syndrome caused by influenza virus who showed pulmonary radiologic findings similar to those in Williams–Campbell syndrome.

Case report

A 7-day-old girl was referred to our hospital with suspicion of a congenital heart disease because of cyanosis during feeding and strong murmur on physical examination. She was born by caesarian section to non-consanguineous parents at 32 weeks of gestation because a placental tumor reached about 2 cm and impaired the perfusion. Fetal US showed no abnormality except one umbilical artery and vein, and other screening tests were normal. She gradually became sick and had poor weight gain postnatally. Family history involved several relatives who had chronic obstructive pulmonary disease and sensorineural hearing loss (Fig. 1). On physical examination, her weight and height were both 2 standard deviations below normal for age. She had a 2/6 pansystolic murmur and mild cyanosis. Her chest radiograph was normal (Fig. 2). Echocardiography and cardiac

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Fig. 1 Diagram shows the girl's family history of chronic obstructive airway disease and sensorineural hearing loss. The arrow indicates the patient

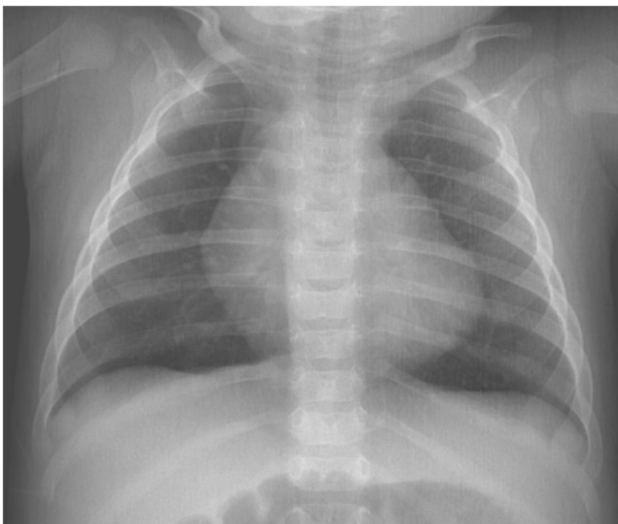
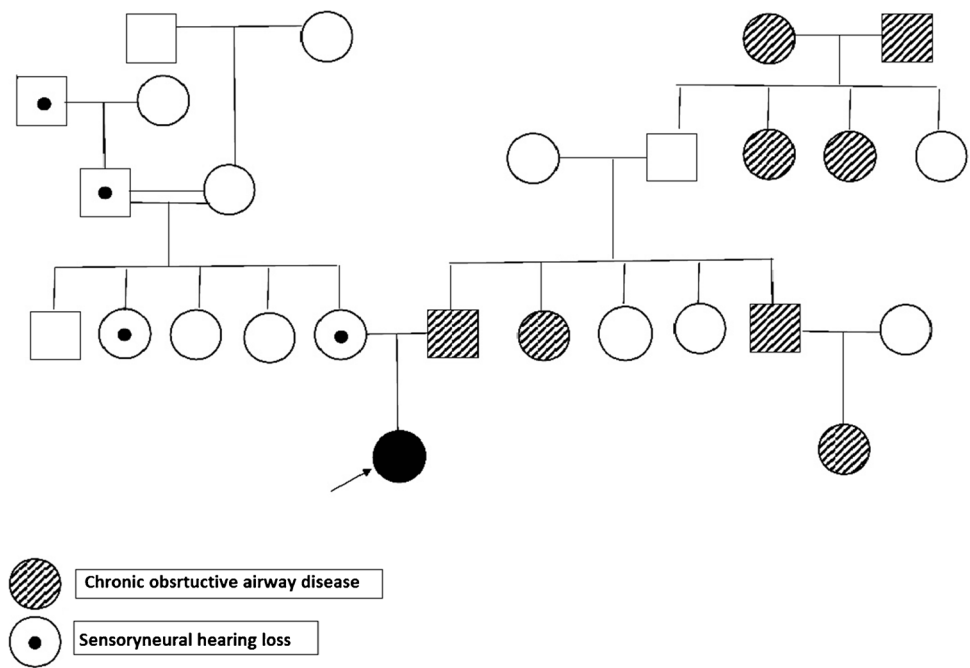


Fig. 2 Pre-surgery radiography. Anteroposterior chest radiograph of the girl at 5 months old, obtained on the second day of admission before the shunt surgery, shows normal findings

catheterization showed a right-sided aortic arch, double outlet right ventricle, a large ventricular septal defect and pulmonary infundibular stenosis.

Despite beta blocker treatment, she had frequent cyanotic spells and modified Blalock–Taussig shunt was performed when she was 5 months old. She was extubated 22 h after surgery but was reintubated 21 h after extubation because of gradually worsening respiratory distress. Meanwhile, chest radiograph showed new parenchymal infiltrates (Fig. 3) and nasal aspirate was positive for

influenza B virus. She had severe and persistent hypoxia requiring high pressures on conventional ventilation; thus, we started high-frequency oscillatory ventilation. Eight days later, a chest radiograph showed improvement of infiltrates in both lungs, as well as suspicion of bronchiectasis in the left lung (Fig. 3). She was mechanically ventilated for 43 days overall with high-frequency oscillatory ventilation and synchronized intermittent mandatory ventilation modes for 20 days and 23 days, respectively. During this time, due to repeated extubation failures, chest CT angiography was performed. CT revealed known cardiovascular anomalies with patent Blalock–Taussig shunt. In addition, bronchial dilatation was detected in both lungs (Fig. 4).

A second operation was performed for total repair to decrease the pulmonary blood flow. After surgery, she was supported with veno-arterial ECMO for 6 days, due to low cardiac output syndrome and acute respiratory distress syndrome (ARDS). After ECMO decannulation, the need for ventilatory pressures decreased remarkably but she still could not be extubated. Control chest CT was performed because of the failure of extubation, and progressive dilated and collapsed segments were observed in the bronchial tree of both lungs in comparison to previous CT, mimicking Williams–Campbell syndrome (Fig. 5). Conventional flexible bronchoscopy demonstrated severe tracheobronchomalacia. Although she was intubated, to show normal ciliary functions and rule out primary ciliary dyskinesia, a nasal ciliary function test was performed and found to be impaired. We decided to repeat the test under more appropriate conditions and suggested a genetic test

Fig. 3 Post-surgery radiography. **a** Anteroposterior chest radiograph of the girl at 5 months old, obtained 2 days after shunt surgery, shows parenchymal consolidation in the lower zone of the right lung and ground-glass infiltrates in the upper and lower zones of the left lung. Nasal aspirate was positive for influenza virus. **b** Control chest radiograph taken 8 days later shows resolving of the infiltrates in both lungs, as well as suspicion of bronchiectasis in the left lung (*arrows*)

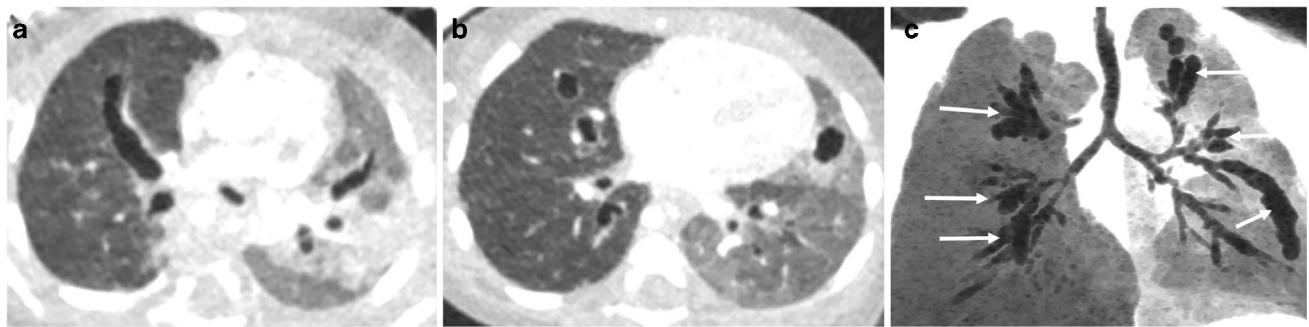
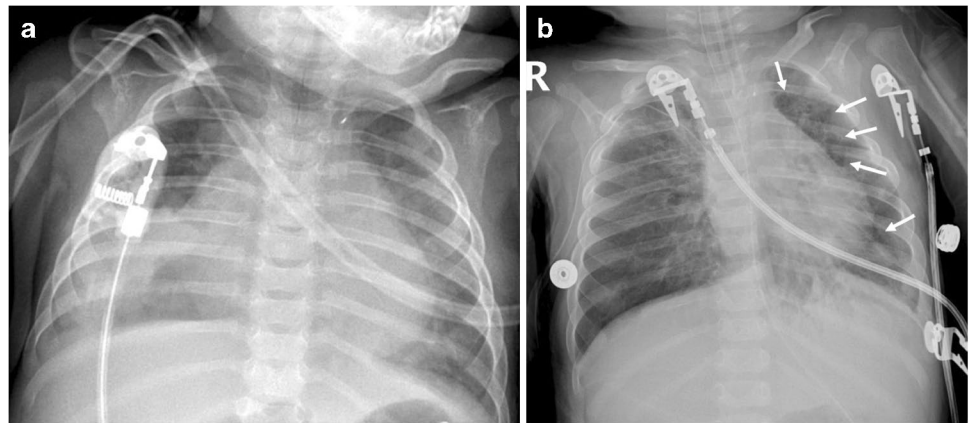


Fig. 4 Chest CT was performed at 5 months old, on the 13th day after shunt surgery. **a–c** Axial chest CT images passing through the upper lung zone (**a**) and through the middle and lower lung zones (**b**) and

coronal reformatted image (**c**) show bronchial dilatation in all lobes of both lungs (*arrows*)

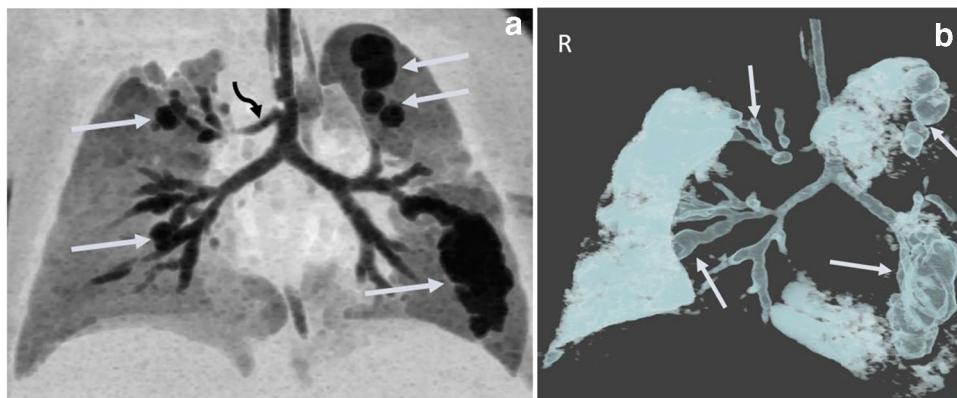


Fig. 5 Cardiac total repair operation was performed 20 days after the first shunt surgery. This chest CT was obtained at 6 months old, on the 20th day after the total repair operation. **a, b** Coronal reformatted (**a**) and anterior view three-dimensional (3-D) volume rendered (**b**) chest CT images show progression of bronchial dilatation (*white*

arrows) and narrow segments between them in both lungs “like a bunch of grapes” mimicking Williams–Campbell syndrome. There is also pig bronchus anomaly originating from the trachea (**a**, *black arrow*)

to her family. CT scans of the affected relatives showed no typical findings of Williams–Campbell syndrome. Because of extubation failure she was discharged with a home-type ventilator attached via tracheostomy. She gradually gained

weight and was weaned from the ventilator over 9 months. After 9 months, chest CT showed reduction of the bronchiectasis and re-expansion of the collapsed segments of the bronchial tree in both lungs (Fig. 6).

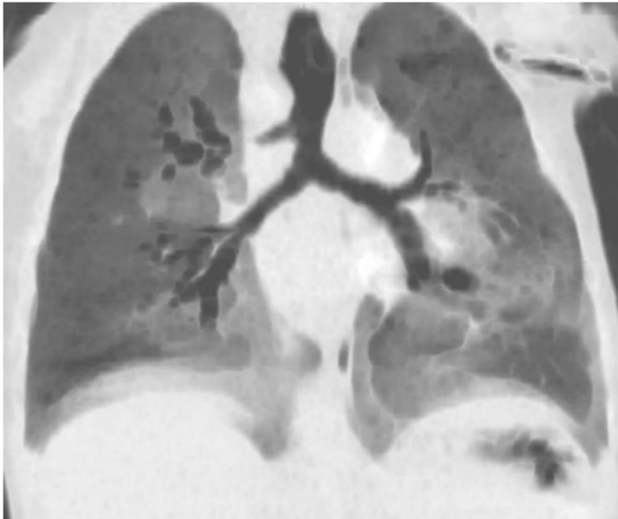


Fig. 6 Chest CT performed at 15 months old, 9 months after discharge. Coronal reformatted image shows reduction of dilated and collapsed segments of bronchial tree and patchy ground-glass appearance in both lungs

Discussion

Regardless of the underlying cause of bronchiectasis, the main pathophysiological mechanism is the destruction of the bronchial wall, caused by an infection, congenital anomaly or compression from outside the bronchi. The anatomical changes are believed to be irreversible. However, comparison of sequential CT scans by Gaillard et al. [4] showed that it might be a reversible condition in children, especially when there is no underlying progressive disease. In our case, the bronchiectasis resolved, showing that, contrary to the classic definition, whether from a congenital or acquired cause, it was not permanent — which makes the diagnostic label of reversible bronchiectasis possible.

Williams–Campbell syndrome is a rare cause of congenital non-cystic fibrosis bronchiectasis [2, 3]. Case reports are sporadic, but in 1976, Wayne and Taussig [5] identified a possible familial form showing autosomal-recessive inheritance, supporting that it is a congenital disorder. Williams–Campbell syndrome differs from post-infectious bronchiectasis because of its unique pathological changes. In cases with lobectomy, marked diffuse dilatation has been observed in distal bronchial segments [2]. The CT findings with dilated and collapsed airway (like a bunch of grapes) and accompanying congenital cardiac defect led us to the possibility of a Williams–Campbell diagnosis without proof from a pathological specimen. However, the girl's later course with resolution of the radiologic findings excluded Williams–Campbell syndrome and supported influenza virus infection as the underlying cause of reversible bronchiectasis in this child. Rarely, cases of post-infectious “resolving

bronchiectasis” have been reported. The more appropriate term “reversible bronchiectasis” is used to describe such a radiologic condition because bronchial dilatation is temporary and improves over time with or without treatment. However, it remains unclear whether reversible bronchiectasis represents an early reversible stage in the pathogenesis of bronchiectasis or is a separate clinical entity. Wood et al. [6] showed that human immunodeficiency virus was more detectable in human broncho–alveolar lavage fluids than proximal bronchial fluids and parotid saliva. They interpreted their results as being related to the plasma viral load and lymphocyte compound of the respiratory tract. However, the effect of influenza virus on specific areas of the bronchial tree remains unclear.

Extracorporeal membrane oxygenation cannulas were inserted into the right atrium and ascending aorta, unrelated to any part of the bronchial tree or lung parenchyma. Further, the oxygenation of blood is provided by the extracorporeal membrane oxygenator, and very small amounts of blood flow into the lungs, which theoretically decreases the volume of the lung. Therefore, ECMO is extremely unlikely to be a contributing factor for the bronchiectasis in this girl. On the other hand, high-frequency oscillatory ventilation uses very high airway pressures to make oxygen diffuse from alveoli to blood because of the impaired and destroyed alveoli–capillary membrane. High-pressure ventilation might also have contributed to respiratory tract damage triggered by influenza infection. However, no significant destruction was observed in animal models, which assessed the destructive effects of positive pressure ventilation on the airways [7]. The resolution of the significant changes in the bronchial tree might also be accounted for by the ability of the young lung to mature. We concluded that the combined effect of influenza virus infection and high mean airway pressure increased the severity of the radiologic findings.

Primary ciliary dyskinesia is a rare genetic condition caused by impaired ciliary function. Ciliary activity is required for the clearance of the airway and middle ear. It often accompanies heterotaxy defects [8]. Congenital heart defects, severe bronchiectasis and family history of chronic obstructive pulmonary disease and hearing loss indicate the need to test for primary ciliary dyskinesia. However, decreased ciliary function is seen in many conditions other than primary ciliary dyskinesia, as in this girl. Therefore, it is not a gold standard but rather a screening test. Both Williams–Campbell syndrome and primary ciliary dyskinesia are genetic disorders, so obtaining a family history and a brief family tree was important for the initial workup of this child.

In conclusion, this atypical course draws attention to the influenza virus as an agent causing reversible bronchiectasis in infants and one that can mimic congenital disease such as Williams–Campbell syndrome.

Declarations

Conflicts of interest None

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