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Case Report

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Should Neonatologists Rule Out Tracheobronchomalacia in Every Premature Baby With Bronchopulmonary Dysplasia?

Marie-Claude Fadous Khalife[a, b, e], Hala Feghali[a, b], Zakhia Saliba[a, b], Mode Al-Ojaimi[c], Issa Issa[a, b], Juliana Menassa[a, b], Peter Noun[a, b], Robert Sacy[a, b], Pierre Hajj[c], Reva Matta[c], Ahmad Fneich[a, b], Perla Matta[a, b], Souheil Hallit[a, d]

Abstract

The incidence of primary tracheobronchomalacia (TBM) in pediatric patients is 1/2100 and its prevalence in very premature infants with bronchopulmonary dysplasia is 10-46%. We report the case of a 26-week-old baby with recurrent infections and stunting. He was diagnosed for TBM.

Keywords: Bronchopulmonary dysplasia; Recurrent infections; Tracheobronchomalacia

Introduction

Bronchopulmonary dysplasia (BPD) is a chronic inflammatory lung disease that affects mainly premature infants; it results from the damage to the immature lungs from mechanical ventilation and prolonged use of oxygen. They suffer from obstructive lung disease. Concomitant tracheobronchomalacia (TBM) is rare but must be diagnosed early because it is life-threatening. We hereby report the case of a premature infant with BPD who presented with recurrent lung infections and stunting. This patient was diagnosed to have coexisting TBM.

Case Report

A premature 26-week infant was admitted to the neonatal intensive care unit (NICU) for respiratory distress syndrome at birth. He was born by cesarean section because of placental abruption, premature labor, and rupture of membranes to a 42-year-old woman by *in vitro* fertilization. His mother had received two courses of corticosteroids for 36 h prior to cesarean; and baby Apgar scores at birth were 7 and 8 at 1 and 5 min respectively. He weighed 1,010 g and had a head circumference of 25 cm.

On admission, the patient was 35 °C, the blood pressure 51/29 mm Hg, the pulse 160 beats per minute, and the respiratory rate 34 breaths per minute. Blood glucose level was 39 mg/dL. His skin was pink and well perfused with ecchymosis on his back and lower limbs. The patient was non-dysmorphic and was grunting. He had subcostal retractions and breath sounds were audible bilaterally. Heart sounds were normal. The remainder of the examination was normal for his gestational age. He was intubated at 30 min for worsening of his respiration on continuous positive airway pressure (CPAP) and assisted ventilation was started with high oxygen levels to maintain pulse oximetry levels in the mid-90% range, and one dose of surfactant was administered. Chest radiography showed features consistent with respiratory distress syndrome of the newborn. An umbilical venous catheter was placed. Ampicillin and cefotaxime were administered for 10 days. Echocardiography revealed pulmonary hypertension with an atrial septal defect (ASD).

He was intubated at birth and extubated on day 3 of life. Respiratory distress recurred 2 days post extubation on day 5. Arterial blood gases revealed respiratory acidosis due to hypercapnia: pH 7.22, pCO_2 48.2, pO_2 40.1, HCO_3 -19. He was put on nasal ventilation than high nasal flow for 20 days. Two courses of hydrocortisone were administered on the 18th day and 30th day of life for his bronchopulmonary dysplasia.

Feeding by nasogastric tube was started on day 4 of life after extubation then stopped for 2 days during the episode of respiratory distress. Enteral feeding was restarted and continued until day 34.

On the 34th day of life, the patient showed signs of sepsis: tachycardia and abdominal distention. Necrotizing enterocolitis was suspected. The blood tests showed a hemoglobin concentration of 12.4 g/dL, hematocrit: of 36.1%, white blood cells: 15,200/µL, neutrophils: 41%, lymphocytes: 44.6%, platelets of 204,000/µL, C-reactive protein (CRP): 0.21 mg/L, procalcitonin: 0.238 ng/mL. The thoraco-abdominal X-ray showed left basal consolidation, and right infra-hilar infiltrates. He was put on cefotaxime, metronidazole and amikacin

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[a]Faculty of Medicine and Medical Sciences, Holy Spirit University of Kaslik (USEK), Jounieh, Lebanon
[b]University Hospital-Notre Dame Des Secours, Byblos, Lebanon
[c]Faculty of Medicine, Balamand University, Koura, Lebanon
[d]Institut National de Sante Publique, Epidemiologie Clinique et Toxicologie (INSPECT-LB), Beirut, Lebanon
[e]Corresponding Author: Marie-Claude Fadous Khalife, Faculty of Medicine and Medical Sciences, Holy Spirit University of Kaslik (USEK), Jounieh, Lebanon. Email: mclaude454@hotmail.com

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for 14 days with a total parenteral nutrition, and then switched to an amino-acid based hypoallergenic formula.

During his stay at NICU, gastro-esophageal reflux was suspected and the patient was treated by a proton pump inhibitor (PPI); phototherapy was given for 3 days for indirect hyperbilirubinemia (total bilirubin of 9 mg/dL, and direct bilirubin of 1mg/dL); he had received red blood cell transfusions for three times for severe anemia: hemoglobin concentration of 8.3 g/dL, 8 g/dL and 8.3 g/dL respectively on days 14, 22 and 71 of life. At discharge, the patient weighed 2,030g, 41.5 cm of length, and head circumference of 32 cm. The control echocardiography revealed a resolution of the pulmonary hypertension and a persistent ASD. Brain magnetic resonance imaging (MRI), auditory and visual tests were normal. No oxygen was needed at discharge.

The patient was readmitted to the pediatric intensive care unit (PICU) several times for recurrent respiratory tract infections since 3 months of age. During his inpatient admissions, he was treated with a combination of antibiotics, corticosteroids, furosemide, and needed respiratory support: invasive and non-invasive ventilation. Inhalation due to gastroesophageal reflux (GERD) or tracheoesophageal fistula was suspected. An upper gastrointestinal (GI) series with barium was done and showed gastroesophageal reflux with no signs of fistulas. A computed tomography (CT) scan of chest revealed bilateral lung consolidations. The patient became oxygen-dependent. An explorative bronchoscopy was done and showed proximal tracheomalacia and left main bronchus malacia.

During his stay at PICU, the blood tests showed a high alkaline phosphatase of 2,025, low phosphorus (2.2 mg/dL) and high calcium (13.6 mg/dL). A pelvic radiography revealed diffuse demineralization. The patient was diagnosed with hungry bone syndrome.

The patient also presented at 6 months of age with a low weight gain of 1,250 g in 3.5 months. His diet consisted of an amino-acid based hypoallergenic formula, 60 mL bottles 7 - 8 times each day, and the patient was not able to reach a higher volume of milk intake due to respiratory distress.

Discussion

TBM in children is defined as weakening of the airway wall due to softening of the cartilaginous rings, decreased tone of the airway smooth muscle and collapse. This results in increased airway compliance and reduction of the size of the airway lumen during expiration [1, 2]. The clinical manifestations of malacia vary widely: barking cough, impaired mucous clearance, retractions, dyspnea and prolonged expiratory phase. Children can also have atelectasis and recurrent pneumonia leading sometimes to intubation and difficulty weaning from ventilator support. It may be associated with feeding difficulties [1, 3].

Epidemiological studies report an estimated incidence of 1/2100 for primary TBM in the pediatric population [4], whereas its prevalence in neonates with bronchopulmonary dysplasia undergoing bronchoscopy is 10-46% [5]. This incidence tends to increase due to greater survival from NICU and increase of bronchoscopies. It predominates in males aged less than 2 years old and it was most frequently observed in the right upper lobe [3].

Premature infants are particularly susceptible to TBM: aside from their elevated compliance, they often receive barotrauma from prolonged positive pressure ventilation and they develop BPD [2]. The fact that the frequency of TBM remains the same despite introduction of new modalities of treatment and management of preterm infants (corticosteroids protocols, post- natal surfactant, non-invasive ventilation, etc.) makes us wonder if there are other factors unrelated to mechanical ventilation contributing to the pathophysiology (GERD, high flow pressure, a process started *in utero* [5]). GERD is common in neonates with BPD, and has been associated with worsening pulmonary symptoms and variably linked to the pathogenesis of chronic lung disease of prematurity [6].

However, no correlation was identified between the severity of respiratory tract infections and extent of malacia. Additionally, no correlation was observed between the extent of pneumonia and the severity of malacia [7].

There are two types of malacia. The primary or idiopathic type is associated with prematurity, congenital cartilaginous weakness, congenital syndromes and other congenital anomalies such as tracheoesophageal fistula. The acquired type is most commonly associated with prolonged mechanical endotracheal intubation (with more significant effect in premature infants), severe tracheobronchitis and external tracheal compression (double aortic arch, innominate artery compression, vascular rings, left atrial enlargement, skeletal structures such as pectus excavatum and scoliosis, lymph nodes or tumors) [1].

Clinical suspicion of TBM is raised by one of the following: 1) Inability to wean from invasive mechanical ventilation; 2) Need for high positive end expiratory pressure; 3) Episodes of profound episode of desaturation and bradycardia while on the ventilator usually precipitated by agitation; 4) The need for ventilator support disproportionate to the infant parenchymal lung disease.

Bronchoscopy is the gold standard for diagnosis of TBM. CT angiography or angio-MRI has been commonly used in the diagnosis of vascular anomalies responsible for the acquired type. Echocardiography could assist to find the secondary causes of malacia but is not always conclusive [2, 3].

There is no clear definition for mild, moderate or severe TBM and there is a lack of general consensus on when to treat it interventionally. Life-threatening TBM is an indication for invasive treatment. We consider the pathology to be severe and requiring treatment when the patients depended on ventilation (invasive or non-invasive), had blue spells, were limited severely by increased work of breathing or recurrent chest infections that required frequent prolonged hospitalization often with intubation [4].

The choice of treatment of TBM depends on the etiology as well as on its clinical severity. Primary TBM in infancy is usually a self-limiting condition between 1 and 2 years of age. For that reason and because of the complexity of the treatment with the potential of severe complications, only patients with severe life-threatening TBM are treated invasively. Surgical interventions for TBM include other than aortopexy, tracheostomy and stent placement [8]. The decision of which inter-

vention is chosen depends upon the location and length of the malacia, the presence of any correctable extrinsic compression and the long-term prognosis of the malacia condition itself. The indication of tracheostomy is to support the lumen of the trachea, ventilation requirement or both [4]. It can improve symptoms in many different forms of TBM. Its goal is to improve breathing while waiting for the child to grow and for the malacia to improve spontaneously. Even if breathing normalizes with cannula in place, quality of life is reduced, the management is very demanding for the family and there are associated risks. Therefore, stenting is only indicated in absolutely necessary and there are no other treatment options. Stent placement is associated with 16.9% mortality post-intervention, 33% is the rate of complications (stent fracture, stent removal, etc.) with no death related directly to the stent placement [4]. Secondary TBM due to vascular compression in children can be treated by correction of the vascular anomaly (aortopexies, tracheopexies, and other pexies) which may not result in complete resolution of TBM due to persistent weakness and increased compliance of the tracheal wall [1].

After review of literature about TBM, we can conclude that we are dealing with a case of TBM with BPD in very early preterm baby. Diagnosis was made by bronchoscopy which showed more than 50% collapse of the left bronchus lumen. According to the literature, our baby's malacia is severe since history shows recurrent respiratory infections with distress and difficulty weaning from positive pressure ventilation and the need lately for intubation and mechanical ventilation for severe pneumonia and difficulty mucous clearance. Several factors led to the worsening clinical course: long stay on mechanical ventilation and non-invasive positive pressure after birth (barotrauma), recurrent intubations and infections besides the eventual presence of congenital and constitutional defect of the cartilaginous part of the respiratory tree. Secondary causes of TBM such as vascular rings or other cardiac malformations were ruled out via chest CT scan with contrast and echocardiography respectively.

Conclusions

In very premature babies with BPD, if you have recurrent lung infections and failure to thrive, don't forget tracheobronchomalacia.

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None.

Conflict of Interest

The authors declare no conflict of interest.

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