

Case Report

A Complex Pediatric Case: Cerebral Palsy Complicated by Severe Pneumonia and Atelectasis

Kasus Pediatrik yang Kompleks: Cerebral Palsy dengan Komplikasi Atelektasis dan Pneumonia Berat

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ABSTRACT

*Cerebral palsy (CP) is a non-progressive motor and cognitive disorder resulting from brain injury during development. Cerebral palsy (CP) promotes the development of respiratory disorders, including pneumonia and atelectasis. In this case, an 8-year-old male with cerebral palsy presented with complaints of shortness of breath, intermittent fever, productive cough, and decreased appetite. His respiratory rate was 28 beats per minute, SpO₂ was 85%, and temperature was 37°C. Chest X-ray showed right pleural effusion with atelectasis, pneumonia in the left lung, emphysematous lung, and thoracic scoliosis. Bronchoscopy examination showed total atelectasis in the middle lobe of the right lung, with *Streptococcus mitis* or *Streptococcus oralis* identified through microbiological examination. Individuals with CP are susceptible to respiratory diseases due to neuromuscular impairment of the laryngeal muscles. This impairment can progress to atelectasis and pneumonia, representing the most common respiratory complications in CP.*

Keywords: Atelectasis, cerebral palsy, pathophysiology, pneumonia

ABSTRAK

*Cerebral palsy (CP) merupakan gangguan motorik dan kognitif non progresif yang disebabkan oleh cedera otak selama masa perkembangan. Cerebral palsy (CP) meningkatkan berkembangnya gangguan pernapasan, termasuk pneumonia dan atelektasis. Laki-laki, 8 tahun dengan cerebral palsy, mengeluh sesak napas disertai demam intermiten dan batuk produktif serta penurunan nafsu makan. Laju pernapasan 28 kali per menit, SpO₂ 85%, dan suhu 37°C. Rontgen dada menunjukkan efusi pleura kanan disertai atelektasis, pneumonia pada paru kiri, paru emfisematosa, dan skoliosis toraks. Pemeriksaan bronkoskopi menunjukkan atelektasis total pada lobus tengah paru kanan. Pemeriksaan mikrobiologi ditemukan *Streptococcus mitis* atau *Streptococcus oralis*. Individu dengan CP rentan terhadap penyakit pernapasan akibat dari gangguan neuromuskuler pada otot laring, yang dapat berkembang pada atelektasis dan pneumonia, yang merupakan komplikasi pernapasan tersering pada CP.*

Kata Kunci: Atelektasis, cerebral palsy, patofisiologi, pneumonia

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DOI: <http://dx.doi.org/10.21776/ub.jkb.2022.033.03.11>

INTRODUCTION

Cerebral palsy (CP) is a significant global public health issue, standing as the most prevalent physical disability among young children. CP is characterized by nonprogressive motor and cognitive impairments arising from brain injuries during early development. These injuries have a profound impact on health outcomes, quality of life, and life expectancy. The estimated global occurrence and frequency of cerebral palsy are around 2–2.5 instances per 1,000 live births and 1–4 instances per 1,000 live births, respectively (1). Unfortunately, individuals with CP often experience a shorter life expectancy compared to the general population, and survival rates are influenced by the severity of disability (2).

Research indicates that children diagnosed with CP frequently develop multiple systemic disorders, particularly respiratory conditions. Respiratory diseases, including pneumonia, are the leading causes of morbidity and mortality in individuals with CP. Pneumonia, in particular, accounts for a significant proportion (up to 40%) of total fatalities (3). Respiratory infections and subsequent respiratory failure play a substantial role, contributing to approximately 53%–58.6% of deaths among children diagnosed with CP (1).

Pulmonary atelectasis, characterized by the collapse and non-aeration of lung tissue leading to a loss of lung volume and capacity, is a known complication of cerebral palsy. This complication arises due to the typically limited physical activity levels observed in children with CP. Reduced physical activity impedes the full expansion and contraction of the thoracic cage, thereby restricting optimal body movement.

Neurological conditions, such as CP, increase the likelihood of developing various respiratory dysfunctions, including pneumonia and atelectasis. It is important to note that CP does not directly induce airway or lung dysfunction; rather, it is the neuromuscular impairments associated with CP that contribute to these conditions (4). Therefore, the aim of this study is to investigate the association between cerebral palsy and the risk of pneumonia and atelectasis.

CASE REPORT

An 8-year-old boy, accompanied by his mother, presented at the emergency department (ED) complaining of a one-week persistent shortness of breath. The symptoms had intensified in the four hours preceding the hospital admission. The patient also experienced intermittent fever over the past week, infrequent cough with difficult expectoration, decreased appetite, and no nasal congestion. Notably, the patient has a medical history of cerebral palsy.

During the physical examination, the patient appeared alert and conscious, but exhibited signs of tachypnea with a respiratory rate of 28 breaths per minute, along with tachycardia indicated by a heart rate of 158 beats per minute. The body temperature of the patient was measured at 37°C, and the oxygen saturation level (SpO₂) on room air was 85%. Pulmonary auscultation further revealed vesicular breath sounds with rhonchi in both lung fields.



Figure 1. Chest Xray showing right pleural effusion with atelectasis, indicative of suspected left lung pneumonia, emphysematous lung, and thoracic scoliosis

Several diagnostic tests were performed, including a complete blood count and chest X-ray (CXR). The complete blood count showed no abnormalities, while the CXR (Figure 1) examination of the patient revealed several significant findings. On the right hemithorax, opacity was observed encompassing the region of the right cardiac border, right hemidiaphragm, and right costophrenic angle. This suggests the presence of right pleural effusion with an atelectasis component, a potential key contributor to the patient's respiratory status decline. Additionally, there was an impression of infiltrate in the mid-left lung base, supporting the suspicion of pneumonia in the left lung of the patient. On the right lung, hyperaeration was observed, suggesting the development of chronic lung disease in this case. The results of the CXR also depict tracheal deviation to the right, which could be elucidated by the presence of pleural effusion and atelectasis on the right side.

Furthermore, there was an indication of thoracic scoliosis, potentially contributing to patient anatomical alterations and disrupted normal respiratory mechanics. Further investigations were conducted, including bronchoscopy and bacterial culture. The bronchoscopy examination (Figure 2) revealed total atelectasis of the middle lobe of the right lung. The bacterial culture identified the presence of *Streptococcus mitis* or *Streptococcus oralis*. Consequently, the patient was diagnosed with severe pneumonia and atelectasis in the context of cerebral palsy.

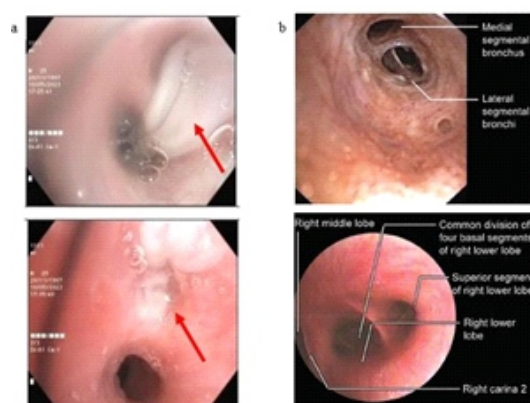


Figure 2. (a) Bronchoscopy image showing total atelectasis of the middle lobe of the right lung compared with (b) Normal bronchoscopy of the middle lobe of the right lung

DISCUSSION

Cerebral palsy (CP) is a neuromotor disorder characterized by impairments in movement, muscle tone, and posture (5). It stands as the most prevalent cause of disability in children, resulting from nonprogressive brain injuries during the prenatal and neonatal periods (6). The specific areas of the brain affected or damaged directly contribute to the resulting disabilities. Although primarily a motor disorder, CP can also be accompanied by additional developmental disabilities such as cognitive impairment, contingent upon the extent of brain damage (7). Systems affected by CP include the neurological, respiratory, gastrointestinal, and genitourinary systems, among others (5).

Respiratory issues in children with CP significantly contribute to morbidity, mortality, and reduced quality of life (8). Since the 1970s, respiratory failure has emerged as a leading cause of death in this population. The prevalence of respiratory symptoms is notably high among children with CP, with manifestations such as pneumonia, atelectasis, bronchiectasis, and restrictive lung disease. Pneumonia and atelectasis are particularly common in children with CP (9,10).

Effective respiratory function relies on the presence of optimal respiratory mucus, which plays a pivotal role in maintaining respiratory health. The chemical and physical components of normal mucus function serve as essential defense mechanisms against infections. These mechanisms encompass an effective cough reflex, a functioning mucociliary apparatus, and unobstructed airways (10). Additionally, swallowing mechanisms involving muscle contractions in the pharynx and esophagus contribute to preventing the aspiration of foreign objects into the respiratory tract. However, CP, which becomes a neuromotor disorder, impairs these mechanisms (11).

Swallowing is a complex process requiring coordinated muscle actions in the mouth, pharynx, larynx, esophagus, and diaphragm. In CP, poor coordination leads to oropharyngeal motor dysfunction and direct sequential aspiration. Oromotor dysfunction is a common occurrence in children with CP, resulting in recurrent aspiration, chronic cough, colonization of the airways by pathogens, and progressive damage to lung tissue. Dysphagia in one or all phases of swallowing is often observed in children with CP, whereas muscle weakness primarily contributes to pharyngeal residue after swallowing in neuromuscular disorders. These conditions collectively decrease lung function, making children with CP susceptible to pneumonia (12).

Effective airway clearance through coughing is crucial for

preventing pulmonary infections. Normal respiration relies on the coordinated actions of the diaphragm, abdominal, chest, neck, and throat muscles, along with the structural stability of the trunk and head. This coordination allows for forceful inspiration, expiration, and effective coughing. However, in patients with neurological conditions like CP, a weak cough is insufficient for clearing lower airway secretions and protecting against aspiration due to respiratory muscle weakness and/or poor coordination. Consequently, inadequate clearance of secretions predisposes children with CP to infections and atelectasis (13).

Impairment of movement and posture is a hallmark feature in the diagnosis of CP. From a motor perspective, multiple causal pathways likely contribute to respiratory diseases. Children who cannot sit without support face challenges in co-contracting paraspinal and abdominal muscles, leading to an instant collapse of the mid-trunk and a slouched posture that evolves into persistent kyphoscoliosis over time. Spinal malalignment further disrupts lung expansion, contributing to reduced gas exchange, hypoxemia, hypercapnia (increased partial pressure of carbon dioxide), increased breathing resistance, and an elevated risk of atelectasis and pneumonia due to uneven lung expansion (9).

On the other hand, the results of bacterial culture examination in the patient indicate that *S. mitis* has become the etiology of pneumonia development. *S. mitis*, a normal inhabitant of the oral cavity, is now reported as a new emerging pathogen in the pediatric age group. This bacterium most commonly causes bloodstream infections and rarely leads to pneumonia. Systematic review analysis results indicate that invasive infections caused by *S. mitis* predominantly occur in immunocompromised patients with neutropenia. In our case, the most potential predisposing factor is decreased appetite, leading to compromised immune function (14).

Children with cerebral palsy (CP) are highly vulnerable to respiratory infections and face an increased risk of mortality. The underlying neuromuscular impairments, including oropharyngeal disorders and loss of muscle tone in the pharynx, play a significant role in these complications. These factors contribute to the potential development of pneumonia and atelectasis, further emphasizing the importance of early detection, appropriate management, and preventative measures to mitigate the respiratory risks faced by children with CP.

ACKNOWLEDGEMENT

We extend our gratitude to the management of Persada Hospital Malang for their valuable contributions.

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