Lobectomy on ECMO as a Life-Saving Procedure following Necrotizing Pneumonia in a Toddler: A Case Study

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Abstract

Keywords

- necrotizing pneumonia
- ECMO
- lobectomy

Necrotizing pneumonia is a severe form of pneumonia that is mainly treated with conservative treatment, including antibiotics. We report a unique case of necrotizing pneumonia due to group A streptococcus infection in an 18-month-old boy who required extracorporeal membrane oxygenation (ECMO) support. Following surgical lobectomy, the child was weaned off ECMO and recovered uneventfully.

Introduction

Necrotizing pneumonia is characterized by the formation of abscesses and cavitations in the lung parenchyma.¹ The mainstay of treatment is antibiotic therapy, while surgical intervention remains controversial and sparsely reported. We contribute a case of necrotizing pneumonia in a toddler who was treated with antibiotics and required extracorporeal membrane oxygenation (ECMO). He underwent a right upper lobectomy, after which he was weaned off ECMO and recovered uneventfully.

Case Report

An 18-month-old boy was admitted to the pediatric intensive care unit (PICU) during the winter months due to 1 day of fever, dyspnea, and altered mental status. His past medical history included preterm birth at 31 weeks and hyperactive airway disease treated with inhaled bronchodilators. He was also up to date on all his recommended vaccinations. His family history was unremarkable for severe or recurrent infections. Of note, in the days prior to his admission, the child's mother was ill with streptococcal pharyngitis.

Upon admittance, the child was in a state of septic shock and multiorgan failure. He was lethargic, hypotensive, and

tachycardic, with an oxygen saturation of 90% in room air. Initial blood tests showed metabolic acidosis with elevated lactate, blood urea nitrogen (BUN), creatinine, and transaminases levels and prolonged prothrombin time. A chest radiograph demonstrated consolidation of the right lung with a large pleural effusion. He was intubated and mechanically ventilated, and intravenous ceftriaxone and clindamycin were initiated. His blood pressure was maintained at marginal levels under extensive inotropic support over the following 2 days. He required increasing ventilation pressures, and two chest tubes were inserted for an empyema and pneumothorax. Cultures from blood and pleural fluid were collected and were positive for group A streptococcus, which was susceptible to both penicillin and clindamycin. A nose swab for respiratory viruses was also collected and was positive for respiratory syncytial virus (RSV).

In the following days, cardiovascular, renal, and hepatic functions improved and inotropic and vasopressor support was withdrawn almost completely. However, respiratory functions deteriorated, with a substantial air leak in the chest tube, and the child was put on high-frequency ventilation and treatment with nitric oxide. Chest computed tomography revealed necrotizing pneumonia of the right upper lobe with multiple air spaces, a pneumatocele, and a bronchoalveolar fistula (–Fig. 1).

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Fig. 1 Chest CT demonstrating necrotizing pneumonia of the right upper lobe. CT, computed tomography.

On day 6 of his hospitalization, respiratory functions continued to deteriorate, with hypercapnia and oxygen desaturation reaching 50% despite maximal respiratory support. Arterial blood gases were pH 7.45, partial pressure of oxygen (pO_2) 34.2 mm Hg, partial pressure of carbon dioxide (pCO_2) 52 mm Hg, and bicarbonate 34 mmol/L, with a PaO_2 /fraction of inspired oxygen (FiO_2) ratio of 34 and an oxygenation index of 50. The oxygenation index was above 40 for approximately 2 hours before ECMO support could be initiated. The worsening respiratory failure was accompanied by hemodynamic instability, with falling blood pressures and bradycardia. Arteriovenous ECMO was initiated via the right carotid artery and right jugular vein. Subsequently, several attempts to wean him off ECMO support failed, as increasing ventilation pressures were insufficient for satisfactory oxygenation and ventilation. Due to the worsening of his clinical condition and the infiltrates on his chest radiographs, his antibiotic treatment was changed from ceftriaxone to piperacillin/tazobactam.

A right upper lobectomy was performed on day 8 of ECMO support (► **Fig. 2**). The resected lobe weighed 249 g, and its dimensions were 8 cm × 7 cm × 3.5 cm. Pathological examination of the resected lobe revealed suppurative necrotizing pneumonia with multiple abscesses and hemorrhages. Microbiological cultures taken from the resected lung yielded growth of *Candida albicans*. Immediately following surgery, the patient was successfully weaned off ECMO support. He recovered uneventfully and was discharged home after 2 weeks of rehabilitation, without pulmonary or neurological sequelae.

Discussion

Necrotizing pneumonia is a severe form of pneumonia with a high rate of mortality and morbidity and increasing incidence worldwide.¹ Management of the condition is mainly conservative. Intensive care admission and respiratory support are often necessary. Empirical antibiotic therapy represents the mainstay of treatment, aimed at covering the chief infective organisms, specifically *Streptococcus pneumoniae* and *Staphylococcus aureus*. Additional supportive care

Fig. 2 The right upper lobe after resection.

includes supplemental oxygen in case of hypoxia, analgesia, and fluid replacement. Cases of empyema generally require chest drainage.

Surgical intervention, such as lung decortications, wedge resection, or lobectomy, is not routine for necrotizing pneumonia. All the patients in a recent report on surgical procedures in pediatric cases of necrotizing pneumonia survived, and surgical resection was associated with little postoperative morbidity.² Surgical intervention was also found to be an effective option in adults after failed medical treatment.

A review of the Extracorporeal Life Support Organization database revealed that 10% of all pediatric cases treated by ECMO for respiratory support are due to bacterial pneumonia, with an average support time of 11.8 days and a survival rate of 60%.³ This indicates that ECMO support carries a high risk for mortality and complications, e.g., hemorrhage, thrombus formation, and neurological, cardiovascular, or renal sequelae. Several studies have also shown a strong association between the duration of ECMO support and the occurrence of complications.⁴

Experience with ECMO in necrotizing pneumonia is limited. The sparse reports, however, showed encouraging outcomes in both children⁵ and adults,⁶ with relatively high survival rates and satisfactory post-ECMO respiratory functions. Reported fatalities were few, and they were due to complications of ECMO rather than to the disease itself.

In cases requiring ECMO support, treatment options include watchful waiting for improvement of respiratory functions until eventual withdrawal, or surgical intervention to facilitate withdrawal. The former option represents a more conservative approach, but carries the risk of complications due to prolonged use of ECMO, whereas the latter option, while associated with the risks of surgery, would ideally shorten the

period of time on ECMO and thus reduce the risk for serious complications. Considering the complications of surgical procedures during ECMO support, a recent report showed them to be safe. Rates of blood loss and death did not differ in comparison with surgical intervention without ECMO.⁷ In the case we presented here, the inability to wean the patient off ECMO support for several days suggested surgical intervention to be unavoidable. Thus, our patient's necrotizing pneumonia was successfully treated by surgical lobectomy while he was on ECMO support. This case exemplifies surgical lobectomy as a viable option for the treatment of necrotizing pneumonia after conservative treatment failure.

Conflict of Interest

None.

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