



Pulmonary Medicine

ASTHMA UNLEASHED: OVERCOMING A LIFE-THREATENING EXACERBATION IN A YOUNG ADOLESCENT- A CASE REPORT

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ABSTRACT A 14-year-old male with a history of severe asthma presented with a severe exacerbation triggered by rhinovirus infection. Despite maximal medical therapy, including high-dose corticosteroids and bronchodilators, he developed Type 2 respiratory failure requiring endotracheal intubation and mechanical ventilation. Refractory hypoxemia and hypercapnia, complicated by persistent severe bronchospasm and impending acute respiratory distress syndrome (ARDS), necessitated veno-venous extracorporeal membrane oxygenation (ECMO) support as a rescue therapy. With aggressive and multidisciplinary management, including ECMO, targeted antiviral therapy, broad-spectrum antibiotic therapy for secondary infections, and meticulous ventilatory support, the patient was successfully weaned off mechanical ventilation and ECMO. He achieved a full recovery and was discharged home with an optimized long-term asthma management plan. This case highlights the potential for rhinovirus-induced asthma exacerbations to rapidly escalate to life-threatening respiratory failure, even in young adolescents, and underscores the critical role of ECMO as a life-saving intervention when conventional therapies prove insufficient. It emphasizes the need for early recognition of treatment failure and prompt escalation to advanced support modalities.

KEYWORDS : Asthma, Life-threatening exacerbation, Adolescent, Intensive care, ECMO, Mechanical ventilation.

INTRODUCTION

Asthma, a chronic inflammatory airway disease, is characterized by airway inflammation, reversible airflow obstruction, and bronchial hyperresponsiveness.¹ It remains a significant global health burden, affecting millions worldwide, with a considerable prevalence in children and adolescents.² While typically manageable with appropriate pharmacotherapy, including inhaled corticosteroids and bronchodilators, severe exacerbations can pose a substantial threat to life. These acute episodes, often characterized by progressive increases in dyspnoea, cough, wheezing, and chest tightness, can rapidly escalate to acute respiratory failure.

Viral respiratory infections are widely recognized as the most common trigger for asthma exacerbations, particularly in pediatric and adolescent populations.³ Among these, rhinoviruses are the predominant culprits, accounting for a significant proportion of acute asthma attacks.⁴ Rhinovirus infections can induce profound airway inflammation and bronchoconstriction, leading to severe airflow limitation and compromised gas exchange.⁵ In susceptible individuals, especially those with poorly controlled underlying asthma, such infections can precipitate a rapid and severe deterioration, necessitating intensive care admission.

In severe cases, where conventional medical therapies fail to restore adequate ventilation and oxygenation, patients may progress to acute respiratory failure requiring invasive mechanical ventilation. However, even with optimal ventilatory strategies, a subset of patients with refractory hypoxemia and hypercapnia due to severe bronchospasm and air trapping may remain critically ill. In such life-threatening scenarios, extracorporeal membrane oxygenation (ECMO) has emerged as a crucial rescue therapy. ECMO provides temporary cardiorespiratory support, allowing the lungs to rest and recover from severe injury or intractable bronchospasm.⁶

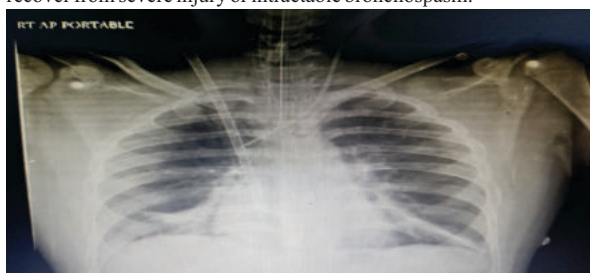


Figure 1: Chest X-ray of patient with ARDS on VV ECMO.

This case report aims to detail the complex management of a 14-year-old boy with severe asthma who developed a life-threatening rhinovirus-induced exacerbation, ultimately necessitating ECMO support, and highlights the successful application of advanced critical care interventions in achieving a positive outcome.

Case Report

A 14-year-old male, with a known history of bronchial asthma, presented to the emergency department of our tertiary care hospital with acute respiratory distress. His symptoms had been progressively worsening over the previous week, characterized by an escalation in cough, increasingly severe wheezing, and profound shortness of breath. Notably, his asthma control had been suboptimal for several months prior to this admission, as he was not consistently adhering to any regular medications. The patient had history of multiple previous hospitalizations for asthma exacerbations, but had never before necessitated mechanical ventilation.

On examination, the patient was tachypneic with a respiratory rate of 38 breaths per minute, using accessory muscles for breathing. His oxygen saturation was 85% on room air and improved to 92% with supplemental oxygen. Auscultation revealed diffuse wheezing and decreased breath sounds bilaterally. Arterial blood gas analysis indicated hypoxemia (PaO₂ 60 mmHg) and hypercapnia (PaCO₂ 70 mmHg), necessitating immediate intervention. Patient was initially started on NIV support and shifted to MDICU for further management. Initial laboratory tests were conducted, including complete blood count (CBC), inflammatory markers and serum electrolytes were within normal limits. Chest X-ray showed no signs of pneumonia or other complications. Given the severity of his respiratory distress and failure to respond to standard treatment measures (including nebulized bronchodilators and systemic corticosteroids), the decision was made to initiate mechanical ventilation. Hypoxemia, hypercapnia and severe bronchospasm persisted in spite of mechanical ventilation. His condition worsened, in view of impending ARDS, prone ventilation was initiated, but patient failed to respond. Hence ECMO was initiated.

The patient was placed on ECMO for a total of 6 days. Bronchoscopy was done and BAL was sent for Film Array – Pneumonia Plus Panel which showed Rhinovirus and secondary bacterial infections. During this time, he received ongoing sedation, antivirals, antibiotic therapy for secondary infections, and bronchodilator therapy via nebulization. Regular arterial blood gas analyses were performed to monitor his respiratory status.

Over the first 72 hours on ECMO, there was significant improvement in his gas exchange parameters. Arterial blood gases showed progressive normalization of pH and CO₂ levels. The ventilator settings were gradually weaned as lung mechanics improved. By day 4, the patient demonstrated adequate spontaneous breathing efforts while on minimal ventilatory support.

On day six, the ECMO support was successfully discontinued without complications. The patient was extubated on Day 7, thereafter and transferred from the intensive care unit to the ward for further recovery on Day 8.

The patient continued to improve in the ward setting, with resolution of respiratory distress and normalization of oxygen saturation levels on room air. He was discharged with a tailored asthma management plans that included inhaled corticosteroids, long-acting beta 2 agonists, leukotriene receptor antagonists and education on recognizing early signs of exacerbation

He is currently on follow-up in the Pulmonary OPD and is having adequate asthma control.

DISCUSSION

This case highlights the complexities involved in managing severe asthma exacerbations in children, particularly those triggered by viral infections like rhinovirus. The use of ECMO in this context illustrates its potential role as a life-saving intervention when conventional therapies fail.

Asthma exacerbations triggered by viral infections, especially rhinoviruses, are a well-recognized phenomenon.⁷ Rhinoviruses can induce intense airway inflammation, leading to profound bronchoconstriction, increased mucus production, and airway remodeling.⁷ In individuals with underlying severe asthma, this inflammatory cascade can be exaggerated, resulting in severe airflow limitation and ventilation-perfusion mismatch. Our patient's presentation with severe hypoxemia and hypercapnia, rapidly progressing to respiratory failure, is characteristic of a severe viral-induced asthma attack. The identification of rhinovirus in the BAL confirmed the etiological trigger, providing crucial insight into the pathogenesis of his life-threatening condition. The presence of a secondary bacterial infection underscores the vulnerability of critically ill patients, especially those with prolonged mechanical ventilation, to nosocomial infections, necessitating vigilant monitoring and appropriate antibiotic therapy.

Literature suggests that ECMO can provide adequate gas exchange while allowing time for lung recovery in patients with near-fatal asthma exacerbations.⁵ Severe asthma in children is often characterized by heterogeneous phenotypes that may require individualized treatment approaches. This case shows the importance of recognizing, inadequacy of standard therapies and considering advanced interventions such as ECMO early in the course of treatment. The application of ECMO in severe, refractory asthma exacerbations has gained increasing recognition as a life-saving bridge to recovery. Literature supports its use in cases of near-fatal asthma where conventional mechanical ventilation fails to provide adequate gas exchange without incurring further lung injury.¹⁰ ECMO provides temporary total respiratory support, allowing the inflamed and hyper-reactive airways to rest, enabling time for systemic corticosteroids and bronchodilators to take effect without the added stress of high-pressure ventilation. In our patient's case, VV-ECMO effectively managed the severe hypoxemia and hypercapnia, facilitating immediate improvement in gas exchange and systemic pH. This allowed the medical team to drastically reduce ventilator settings, thereby mitigating the risk of ventilator-induced lung injury, which is a major concern in severe asthma. The significant improvement in gas exchange parameters and lung mechanics within 72 hours of ECMO initiation, followed by successful decannulation and extubation, highlights the efficacy of this rescue therapy.

CONCLUSIONS:

The successful management of this 14-year-old boy with severe asthma through mechanical ventilation and ECMO demonstrates the importance of a multidisciplinary approach in critical care settings. Ongoing research into the mechanisms underlying severe asthma exacerbations will be essential for developing more effective treatment strategies tailored to pediatric and young adolescent patients.

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