

# Successful Non-Invasive Management of Near-Fatal Asthma with Severe Hypercapnic Respiratory Failure: A Case Report

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**Background:** Asthma exacerbations can be life-threatening if not promptly recognized and treated. Although necessary, intubation and mechanical ventilation can cause barotrauma, hemodynamic instability, and increased mortality. Documenting near-fatal asthma case with severe hypercapnia, recovering without intubation is uncommon and offers useful clinical insight.

**Case Presentation:** A 45-year-old Somali woman with poorly controlled bronchial asthma presented to the emergency department with acute severe dyspnea following a three-day prodrome of fever, cough, rhinorrhea, and sore throat. On arrival, she was semi-conscious, in respiratory distress, with a silent chest, hypoxemia (SpO<sub>2</sub> 47%), and hypercapnia (PaCO<sub>2</sub> 106.4 mmHg). She received immediate bag-valve-mask breathing, high-flow oxygen, intravenous corticosteroids, repeated nebulized bronchodilators, inhaled budesonide, and magnesium sulfate. The patient showed remarkable clinical improvement within an hour, including restored awareness, bilateral wheezing, SpO<sub>2</sub> at 99% on oxygen, and normalized arterial blood gases. After monitoring in the ICU, she switched to oral medication and returned home without endotracheal intubation on the fourth day.

**Discussion:** For life-threatening asthma, GINA, BTS/SIGN, and ERS/ATS recommend systemic corticosteroids, frequent bronchodilators, and intravenous magnesium sulfate as the main treatment, with intubation reserved for respiratory collapse. This case sheds light on how severe hypercapnic respiratory failure patients can recover without invasive airway procedures in resource-limited emergency settings with timely, guideline-adherent care.

**Conclusion:** Early non-invasive treatments for life-threatening asthma can provide positive outcomes, even in near-fatal asthma cases. Intubation and related risks were avoided through close supervision, timely corticosteroids, nebulized bronchodilators, and intravenous magnesium sulfate.

**Keywords:** life-threatening asthma, hypercapnic respiratory failure, magnesium sulfate, emergency management, non-invasive treatment

## Introduction

Asthma is a chronic inflammatory disorder of the airways characterized by recurrent episodes of wheezing, shortness of breath, chest tightness, and coughing due to variable airflow limitation and bronchial hyperresponsiveness.<sup>1</sup> Acute exacerbations, or asthma attacks, are medical emergencies that can be life-threatening if not promptly recognized and appropriately treated.<sup>2</sup>

According to international guidelines, the Global Initiative for Asthma (GINA, 2024), British Thoracic Society/Scottish Intercollegiate Guidelines Network (BTS/SIGN, 2019), and European Respiratory Society/American Thoracic Society (ERS/ATS, 2020), the standard management of severe asthma exacerbations includes high-flow oxygen, repeated short-acting  $\beta_2$ -agonists with anticholinergics, systemic corticosteroids, and intravenous magnesium sulfate.<sup>3-5</sup> Although

mechanical ventilation can be lifesaving in refractory cases, it carries significant risks and should be reserved for patients with impending respiratory failure.<sup>6,7</sup>

Recent evidence by Althoff et al demonstrated that noninvasive ventilation in critically ill asthma patients was associated with improved outcomes and may reduce the need for intubation.<sup>8</sup> In resource-limited settings such as Somalia, where intensive care capacity is constrained, severe asthma remains a major cause of morbidity and mortality.<sup>9</sup>

Here, we report a case of a 45-year-old woman with poorly controlled bronchial asthma who developed near-fatal hypercapnic respiratory failure but achieved full recovery following timely, aggressive medical management without endotracheal intubation or mechanical ventilation.

## Case Presentation

A 45-year-old woman with a ten-year history of poorly controlled bronchial asthma, characterized by exclusive reliance on short-acting  $\beta_2$ -agonists and poor adherence to maintenance therapy, presented to the emergency department with a sudden onset of severe dyspnea. She had no known cardiovascular or metabolic comorbidities, and no prior allergologic evaluation or asthma phenotype assessment had been performed due to limited diagnostic resources. The episode was preceded by a three-day history of fever, cough, rhinorrhea, and sore throat. Her respiratory symptoms rapidly progressed, culminating in acute dyspnea and inability to speak. On arrival, her Glasgow coma scale was 9/15 and in severe respiratory distress. Physical examination revealed a silent chest on auscultation, prominent use of accessory muscles, and gasping respirations, while peripheral pulses remained palpable.

Upon admission, vital signs indicated an oxygen saturation ( $\text{SpO}_2$ ) of 47%, heart rate (HR): 130 beats per minute, blood pressure (BP): 95/60 millimeters of mercury, temperature: 36.8 degrees Celsius, and random blood glucose: 102 milligrams per deciliter.

The patient was promptly relocated to the resuscitation (red) zone and treated as outlined below:

Manual ventilation utilizing an oropharyngeal airway, Ambu bag with reservoir, and oxygen for five minutes until  $\text{SpO}_2$  attained 99%. Two large-bore intravenous cannulas were placed. Intravenous fluids, specifically Ringer's lactate, were commenced. Methylprednisolone 125 mg intravenously and pantoprazole 40 mg intravenously were provided.

Following five minutes of bag-valve-mask ventilation, the patient was transitioned to nebulized bronchodilators: albuterol 5 mg combined with ipratropium bromide 0.25 mg every 20 minutes for three doses, and budesonide 0.5 mg by inhalation. The head of the bed was raised to 45-degree angle.

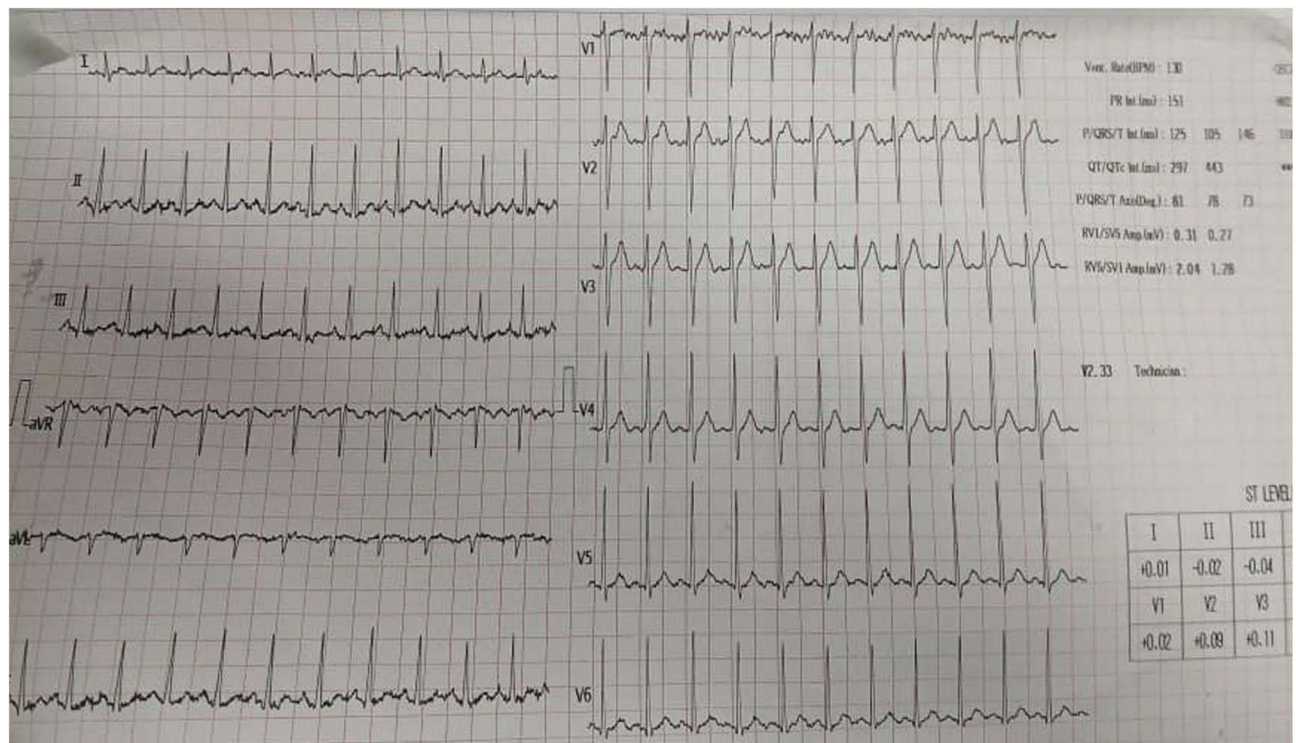
Arterial blood gas (ABG), complete blood count (CBC), liver and renal function tests, and serum electrolytes were obtained. The electrocardiogram (ECG) demonstrated sinus tachycardia (Figure 1), while the chest radiograph revealed hyperinflated lung fields consistent with acute asthma exacerbation, without evidence of pneumonia or structural abnormalities (Figure 2).

The initial arterial blood gas analysis revealed severe respiratory acidosis with a pH of 6.75, marked hypercapnia ( $\text{PaCO}_2$  106.4 mmHg), and hypoxemia ( $\text{PaO}_2$  67 mmHg). On repeat analysis, both pH and  $\text{PaCO}_2$  improved significantly (7.26 and 50.8 mmHg, respectively) and normalized within 24 hours (7.35 and 40.8 mmHg), consistent with rapid clinical recovery. Leukocytosis ( $\text{WBC } 17.8 \times 10^3/\text{mm}^3$ ) with neutrophilia ( $8.19 \times 10^3/\text{mm}^3$ ) indicated an acute inflammatory response, while mild anemia developed during hospitalization (hemoglobin 11.6  $\rightarrow$  9.3 g/dL). Liver and renal function tests, electrolytes, and C-reactive protein remained within normal limits, confirming preserved systemic function throughout treatment.

Following one hour of vigorous resuscitation and meticulous monitoring, the patient exhibited significant improvement: she was completely alert, conversing in complete phrases, and auscultation indicated bilateral wheeze rather than a silent chest. Oxygen saturation increased to 99% with supplementary oxygen.

Ceftriaxone 1 g IV was subsequently delivered as empiric antibiotic coverage, along with magnesium sulfate 2g IV over 20 minutes, and dexamethasone 8 mg IV. The patient was admitted to the intensive care unit (ICU) for 24 hours of observation before being transferred to the pulmonology department.

After two days, she was discharged home on an oral regimen that included methylprednisolone 16 mg twice daily for five days, a fixed-dose inhaler containing formoterol fumarate 12 mcg and budesonide 400 mcg twice daily, pantoprazole 40 mg once daily, and a Ventolin (salbutamol) inhaler as needed.



**Figure 1** Electrocardiography showing sinus tachycardia.



**Figure 2** AP chest X-ray showing hyperinflation, consistent with acute asthma exacerbation with no pneumonia or structural abnormality.

## Result

Notwithstanding the occurrence of life-threatening asthma and severe hypercapnic respiratory failure, the patient exhibited a swift recovery by rigorous medical intervention, avoiding the necessity for endotracheal intubation or mechanical ventilation.

## Discussion

Severe and life-threatening asthma exacerbations constitute genuine medical emergencies for prompt, evidence based treatments. The Global Initiative for Asthma (GINA 2024), British Thoracic Society/Scottish Intercollegiate Guidelines Network (BTS/SIGN 2019), and European Respiratory Society/American Thoracic Society (ERS/ATS 2020) recommend that the initial management of acute asthma exacerbation comprises high-flow oxygen, repeated high-dose inhaled short-acting  $\beta_2$ -agonists (SABA), anticholinergics, systemic corticosteroids, and adjunctive therapies like intravenous magnesium sulfate in cases of inadequate response to initial bronchodilators.<sup>3–5,10</sup> Intubation and mechanical ventilation are warranted in instances of respiratory arrest, declining mental status, fatigue, or exacerbating acidosis and hypercapnia despite optimal treatment.<sup>2,11,12</sup>

The patient exhibited near-fatal asthma, characterized by a quiet chest, disturbed mental status, severe hypoxemia (SpO<sub>2</sub> 47%), and significant hypercapnia (PaCO<sub>2</sub> 106.4 mmHg). These findings generally necessitate immediate airway management. Nonetheless, various circumstances facilitated her positive result without intubation. Initially, vigorous resuscitation utilizing high-concentration oxygen through bag-valve-mask breathing swiftly restored sufficient oxygenation. Secondly, the immediate administration of systemic corticosteroids (methylprednisolone), frequent nebulized bronchodilators albuterol and ipratropium, and inhaled budesonide yielded synergistic bronchodilation and early anti-inflammatory effects. Third, intravenous magnesium sulfate, per guideline recommendations for severe asthma, may have significantly contributed to alleviating bronchospasm by promoting smooth muscle relaxation and improving bronchodilator efficacy.<sup>13</sup>

The avoidance of intubation in this case was significant. Mechanical ventilation, although potentially lifesaving, is linked to problems in severe asthma, such as dynamic hyperinflation, barotrauma, and hypotension resulting from elevated intrathoracic pressures.<sup>7</sup> Current guidelines stipulate that intubation should be limited to patients experiencing imminent respiratory arrest or failure of optimal medical intervention.<sup>2–5,11</sup> In our patient, vigilant observation in the resuscitation bay, prompt intensification of pharmacological treatment, and physiological enhancement within the initial hour facilitated stabilization without the need for invasive airway management.

This case highlighted the significance of early, aggressive, guideline based treatment and thorough monitoring in the emergency department. It also reinforces the importance of intravenous magnesium sulfate as a crucial adjuvant in life-threatening asthma. Moreover, it emphasizes that specific patients experiencing acute hypercapnia and acidosis might swiftly recuperate without intubation when treated promptly and comprehensively.

The limitations of this report include its single-case nature, which restricts generalizability, absence of long-term follow-up, and lack of advanced diagnostic testing due to resource constraints.

## Conclusion

The case underscores, that early, aggressive, guideline-based therapy can sometimes prevent intubation in life threatening asthma. Clinicians, especially in resource limited setting, should recognize that timely non-invasive management (systemic corticosteroids, frequent bronchodilators and IV magnesium sulfate) can yield favorable outcomes and reduce complications from mechanical ventilation.

## Recommendations

Enhance Emergency Department protocols by standardizing severe asthma management in Somali hospitals under GINA and BTS/SIGN guidelines, emphasizing the prompt administration of systemic corticosteroids, frequent use of bronchodilators, and magnesium sulfate.

Verify that all emergency facilities, particularly district and regional hospitals, are equipped with inhaled bronchodilators, nebulization apparatus, systemic corticosteroids, and magnesium sulfate.

Training and education for emergency and general physicians to recognize and manage life-threatening asthma without intubation, given the limitations of ICU and ventilator resources in Somalia.

Enhance long term management by decreasing emergency visits and preventing uncontrolled asthma issues.

Document asthma outcomes and case series from Somali hospitals to establish context specific evidence for national guidelines and budget allocation.

## Ethical Consent

Written informed consent for publication of this case was obtained from the patient, and our institutional policy doesn't require additional ethical approval for case reports.

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## Disclosure

We declare that we have no competing interests.

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