

# Chapter 76

## Approach to Acute Exacerbation of Asthma in the ICU



### 76.1 Introduction

Acute exacerbations of asthma are life-threatening emergencies that necessitate prompt recognition and aggressive management in the intensive care unit (ICU). Patients often present with severe respiratory distress and are at significant risk of respiratory failure.

Acute severe asthma exacerbation can present with status asthmaticus (SA) and near-fatal asthma (NFA). SA is defined as exacerbation of asthma that doesn't respond readily to initial intensive bronchodilator therapy (15–30 minutes). NFA presents with acute respiratory failure (hypoxemia and/or hypercarbia, metabolic or respiratory acidosis), apnea, paradoxical breathing, and impaired level of consciousness. The primary objectives in managing these patients are to reverse airway obstruction, correct hypoxemia, address underlying inflammation, and prevent complications such as barotrauma and prolonged mechanical ventilation [1, 2] [Ref: Algorithm 76.1].

### 76.2 Initial Assessment

#### 76.2.1 Evaluate for Signs of Respiratory Distress

- Clinical Signs:
- Inability to Speak: Difficulty speaking complete sentences due to breathlessness.
- Use of Accessory Muscles such as sternocleidomastoid, scalene, abdominal muscles

- **Paradoxical Breathing:** Abnormal chest and abdominal movements during respiration.
- **Severe Wheezing or Silent Chest:** Diminished or absent breath sounds indicating minimal airflow.
- **Altered Mental Status:** Confusion or drowsiness suggesting hypoxia or hypercapnia.

### ***76.2.2 Vital Signs and Monitoring***

- **Continuous Monitoring:**
- Oxygen saturation ( $\text{SpO}_2$ ).
- Heart rate and rhythm.
- Respiratory rate and pattern.
- Blood pressure.
- **Peak Expiratory Flow Rate (PEFR):**
- Obtain baseline PEFR to quantify airway obstruction severity.
- Useful for assessing response to therapy.

## **76.3 Diagnostic Workup**

### ***76.3.1 Laboratory Tests***

- **Complete Blood Count (CBC):**
- Evaluate for infection (elevated WBC) or anemia.
- **Arterial Blood Gas (ABG) or Venous Blood Gas (VBG):**
- Assess acid-base status, oxygenation ( $\text{PaO}_2$ ), and ventilation ( $\text{PaCO}_2$ ).
- **Serum Electrolytes:**
- **Potassium and Magnesium Levels:**
- Monitor for hypokalemia and hypomagnesemia due to  $\beta_2$ -agonist therapy.
- **Sputum Culture:**
- If a bacterial infection is suspected.
- **Electrocardiogram (ECG):**
- Detect arrhythmias, ischemia, or effects of hypoxia and electrolyte imbalances.

### ***76.3.2 Imaging Studies***

- **Chest Radiograph (X-ray):**
- Rule out pneumothorax, pneumonia, atelectasis, or other complications.
- Especially important if chest pain, unilateral breath sounds, or fever is present.

### **76.3.3 Pulmonary Function Testing**

- Peak Expiratory Flow Rate (PEFR):
- Provides rapid, objective measurement of airway obstruction.
- Essential for initial assessment and ongoing monitoring.

### **76.3.4 Additional Investigations**

- D-dimer, echocardiography, and CT scan as appropriate.

## **76.4 Differential Diagnosis**

- Consider Alternative Diagnoses:
- Pneumothorax: Sudden chest pain, absent breath sounds on one side.
- Pulmonary Embolism: Sudden dyspnea, chest pain, hypoxia.
- Heart Failure: Edema, jugular venous distention, crackles on auscultation.
- Anaphylaxis: Hives, hypotension, airway swelling.
- Upper Airway Obstruction: Stridor, hoarseness.

## **76.5 Management of Acute Asthma Exacerbation**

### **76.5.1 Oxygen Therapy**

- Goal SpO<sub>2</sub>:
- Maintain  $\geq$  (94–98% BTS 2017)( $\geq$  95% in pregnant women and cardiovascular patients).
- Delivery Methods:
- Nasal cannula, face mask, or high-flow oxygen devices.
- Avoid Hyperoxia:
- Prevent worsening ventilation-perfusion mismatch.

### **76.5.2 Pharmacological Management**

#### **76.5.2.1 Short-Acting $\beta_2$ -Agonists (SABA)**

- Continuous Nebulization:

- Salbutamol (Albuterol):
- Concentration: 5 mg/mL solution.
- Dose: 10–15 mg/hour via continuous nebulization.
- Terbutaline:
- Dose: 2.5 mg/hour via continuous nebulization.
- Intermittent Nebulization:
- Salbutamol: 2.5–5 mg every 20 minutes for three doses, then 2.5–10 mg every 1–4 hours as needed.
- Monitoring:
- Watch for tachycardia, tremors, hypokalemia, and arrhythmias.

#### **76.5.2.2 Anticholinergics**

- Ipratropium Bromide:
- Dose: 0.5 mg every 6 hours via nebulization.
- Benefits:
- Enhances bronchodilation when combined with  $\beta_2$ -agonists.
- May improve outcomes in severe exacerbations.

#### **76.5.2.3 Systemic Corticosteroids**

- Administration:
- Methylprednisolone:
- Dose: 1–2 mg/kg/day IV, divided every 6–8 hours.
- Transition to Oral Therapy:
- Prednisone:
- Dose: 40–60 mg/day for prolonged therapy.
- Rationale:
- Reduces airway inflammation and mucus production.
- Potentiates  $\beta_2$ -agonist effects.
- Early initiation is crucial.

#### **76.5.2.4 Magnesium Sulfate**

- Indication:
- Severe exacerbations resistant to initial bronchodilator therapy.
- Administration:
- Dose: 2 g IV infusion over 20–30 minutes.
- Mechanism:
- Relaxes airway smooth muscle.

### 76.5.2.5 Subcutaneous $\beta_2$ -Agonists

- Terbutaline:
- Dose: 0.25 mg subcutaneously every 20 minutes for up to three doses.
- Indication:
- Rescue therapy when inhaled medications are ineffective or impractical.

## 76.5.3 Ventilatory Support

### 76.5.3.1 Non-Invasive Ventilation (NIV)

- Indications:
- Moderate to severe exacerbations not responding to medical therapy.
- Signs of increasing work of breathing or hypercapnia.
- BiPAP Settings:
- Inspiratory Positive Airway Pressure (IPAP): 10–15 cm H<sub>2</sub>O.
- Expiratory Positive Airway Pressure (EPAP): 4–5 cm H<sub>2</sub>O.
- Monitoring:
- Respiratory rate, SpO<sub>2</sub>, ABGs, and mental status.
- Contraindications:
- Altered mental status, inability to protect the airway, hemodynamic instability.

### 76.5.3.2 Mechanical Ventilation

- Indications:
- Severe respiratory acidosis (pH < 7.25).
- Altered consciousness.
- Respiratory arrest or exhaustion.
- Failure or contraindication of NIV.
- Airway Management:
- Endotracheal Tube Size:  $\geq 8.0$  mm for reduced resistance and easier suctioning.
- Ventilator Settings:
- Low Tidal Volumes: 6–8 mL/kg predicted body weight.
- Permissive Hypercapnia:
- Allow elevated PaCO<sub>2</sub> to maintain pH > 7.2.
- Reduces risk of barotrauma.
- Prolonged Expiratory Time:
- I:E ratio of 1:3 to 1:4 to minimize air trapping.
- Plateau Pressures:
- Keep <30 cm H<sub>2</sub>O to prevent lung injury.

- Sedation and Paralysis:
- May be necessary to synchronize the patient with the ventilator.
- Use cautiously and monitor for side effects.
- Monitoring:
- Frequent ABGs, ventilator parameters, and lung mechanics [3].

### **76.5.4 Adjunct Therapies**

#### **76.5.4.1 Ketamine**

- Indications:
- Refractory cases not responding to standard treatments
- Administration:
- Bolus: 1–2 mg/kg IV
- Infusion: 0.5–1 mg/kg/hour
- Benefits:
- Bronchodilation, sedation, analgesia
- Minimal respiratory depression

#### **76.5.4.2 Volatile Anesthetics**

- Agents:
- Isoflurane, sevoflurane.
- Indications:
- Life-threatening bronchoconstriction unresponsive to conventional therapy.
- Considerations:
- Requires specialized equipment.
- Monitor for hypotension and arrhythmias.

#### **76.5.4.3 Heliox Therapy**

- Composition:
- Helium-oxygen mixtures (70:30 or 80:20).
- Mechanism:
- Lower density reduces airway resistance and breathing work.
- Indications:
- Severe airflow obstruction.
- Limitations:
- Limited oxygen content; not for significant hypoxemia.

### ***76.5.5 Evaluate Blood Gas (pH) and Monitor Progress***

#### **76.5.5.1 Non-Severe Acidosis (pH $\geq$ 7.25)**

- Management:
- Continue aggressive medical therapy.
- Consider or continue NIV.
- Monitoring:
- Close observation for signs of deterioration.

#### **76.5.5.2 Severe Acidosis (pH 7.25)**

- Management:
- Proceed to mechanical ventilation.
- Rationale:
- Indicates respiratory failure requiring advanced support.

### ***76.5.6 Prevention and Post-Discharge Planning***

#### **76.5.6.1 Personalised Asthma Action Plans**

- Components:
- Daily management instructions.
- Symptom monitoring guidelines.
- Step-by-step actions for exacerbations.
- Emergency contact information.

#### **76.5.6.2 Patient and Family Education**

- Topics:
- Proper inhaler and spacer technique.
- Medication adherence is important.
- Trigger identification and avoidance.
- Recognition of early exacerbation signs.

#### **76.5.6.3 Maintenance Therapy**

- Inhaled corticosteroids.
- Long-acting  $\beta_2$ -agonists.

- Leukotriene modifiers.
- Adherence:
- Emphasize consistent use to prevent exacerbations.

#### **76.5.6.4 Follow-Up Care**

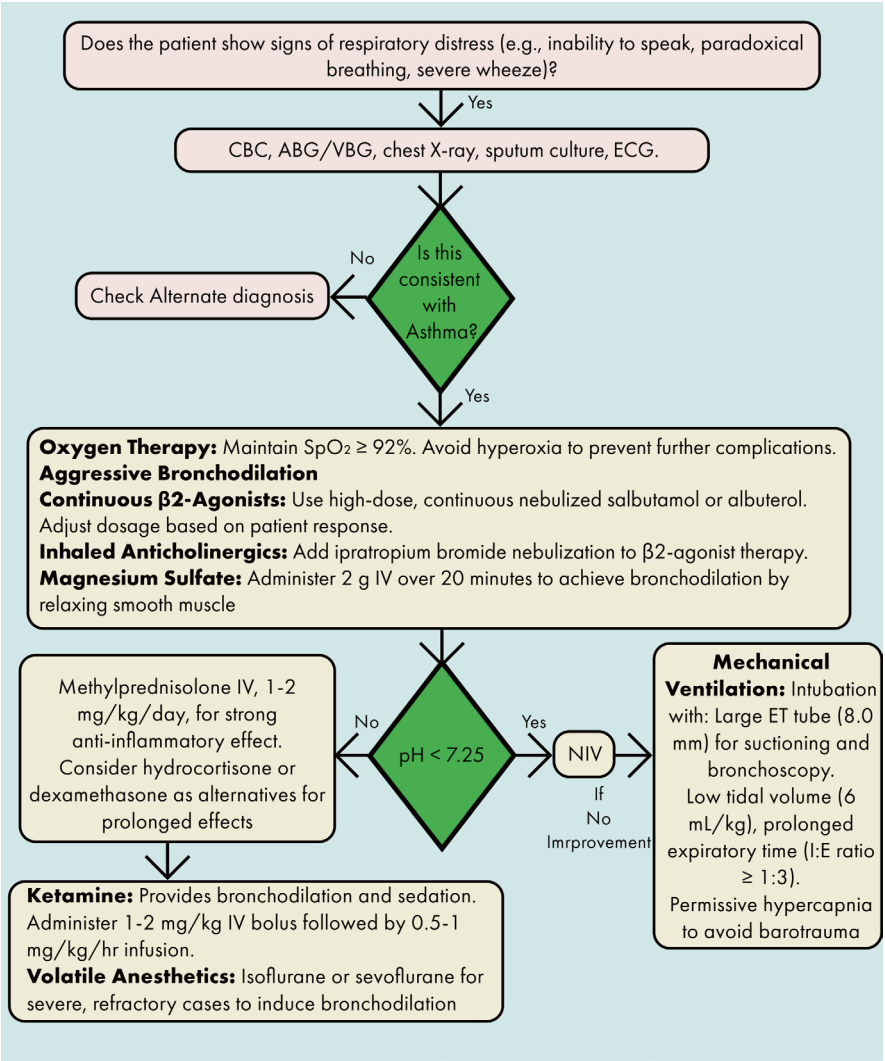
- Appointments:
- Schedule regular visits with healthcare providers.
- Assessment:
- Monitor asthma control.
- Adjust treatment plans as needed.
- Referrals:
- Consider pulmonology or allergy specialists for uncontrolled asthma [4].

### **76.6 Conclusion**

Managing acute asthma exacerbations in the ICU demands a comprehensive and systematic approach. Early recognition and prompt initiation of aggressive bronchodilator therapy, oxygen supplementation, and anti-inflammatory treatment are vital. Careful monitoring and appropriate ventilatory support are essential to prevent respiratory failure and minimize complications like barotrauma. Adjunct therapies such as ketamine, volatile anesthetics, and heliox may be beneficial in refractory cases. Post-discharge planning, including personalized asthma action plans and patient education, is crucial to reduce future exacerbations and hospital readmissions. A multidisciplinary team approach enhances patient outcomes and promotes long-term asthma control.



Algorithm 76.1: Approach to acute exacerbation of asthma in the ICU



## Bibliography

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