



Life-Threatening Asthma Exacerbation

Key Article

Garner O, et al. *Management of Life-Threatening Asthma. Severe Asthma Series. Chest 2022; online ahead of print.*

Background

- Approx. 2 million patients present each year in the US to an ED for acute asthma exacerbation.
- Approximately 25,000-50,000 patients will require ICU admission for asthma.
- In one study of over 30,000 acute asthma exacerbations requiring admission, approximately 10% were admitted to the ICU and 2% required intubation and mechanical ventilation.
- The management of patients presenting with severe asthma is challenging and fraught with potential peril.

Triaging the Severity of Illness

- *Simplified Severity Score for Acute Asthma*
 - Mild
 - HR < 90
 - Wheezing absent
 - Rales absent
 - Prolonged expirations absent
 - SpO₂ 95-100%
 - No accessory muscle use
 - Moderate
 - HR 91-119 bpm
 - Wheezing present
 - Rales present
 - Prolonged expirations present
 - SpO₂ 90-94%
 - Accessory muscle use
 - Severe
 - HR > 120 bpm
 - Wheezing present
 - Rales present
 - Prolonged expirations
 - SpO₂ < 89%
 - Accessory muscle use
- Static Assessments
 - History
 - Outpatient treatment adherence?
 - Severity of current exacerbation compared with prior episodes?
 - Prior hospitalizations or need for mechanical ventilation?

- Exam
 - Tripoding?
 - Use of accessory muscles?
 - Absence of breath sounds?
 - Abdominal paradoxical breathing?
 - PEF or FEV1 < 50% of predicted?
- Dynamic Assessments
 - More helpful than static assessments because they gauge response to treatment
 - Lack of improvement in expiratory flow rates after bronchodilator therapy?
 - SpO2 < 92% despite supplemental O2?
 - Worsening hypercarbia / ETCO2?
 - Encephalopathy?
 - Presence of arrhythmia?
 - Need for HFNC, NIV, or MV?

Pharmacologic Management

- Inhaled Short-acting B2-agonists (SABA)
 - Albuterol the mainstay SABA and first-line treatment for acute asthma
 - Continuous nebulization of albuterol or intermittent dosing reasonable
 - High-dose strategy (7.5 mg) offers no benefit over low-dose (2.5 mg) of albuterol
 - Isoproterenol may have a theoretical advantage over albuterol when it does not yield a significant response. However, potential for systemic adverse effects is high.
- Inhaled Short-acting Muscarinic Antagonists
 - Ipratropium bromide relaxes bronchial smooth muscle by antagonizing muscarinic receptors on smooth muscle of airways.
 - Slower onset of action compared to SABA (60-90 min)
 - Should be used in combination with SABAs
 - Benefit likely limited to patients with severe disease
- Systemic Corticosteroids
 - Improve outcomes in patients with acute asthma.
 - Clinical effects may take 6-12 hours.
 - No difference in efficacy between PO and IV
 - Potential role of inhaled steroids has not been evaluated fully in large trials; some studies do suggest a benefit but no conclusive.
- Magnesium Sulfate
 - Acts as a bronchodilator by inhibiting calcium channels and blocking parasympathetic tone
 - IV magnesium has been studied as an adjunct to SABAs, ipratropium, and steroids
 - May reduce hospital admissions in severe disease and improve pulmonary function, but has not been found to reduce mortality or need for NIV.
- Systemic B2-Agonists
 - IV Epinephrine
 - Has bronchodilating effects
 - 0.1 mcg/kg/min
 - Terbutaline
 - Can be considered in those refractory to inhaled medications
 - Strong evidence to support superiority of its use is lacking

- Avoid in patients with hypokalemia and tachyarrhythmias
 - Side effects: tremors, tachycardia, hyperglycemia, elevated lactate, and hypokalemia
- Supplemental Oxygen
 - Acute asthma exacerbation associated with significant V/Q mismatch resulting in hypoxemia and hypercarbia
 - O₂ therapy should be given if SpO₂ < 90%
 - Target SpO₂ > 92%
- Heliox
 - Has a lower density and higher viscosity than regular air
 - Can improve airflow through narrow airways
 - FiO₂ requirements need to be 30% for its use
 - Comes in either 70:30 or 80:20 preparations
 - Associated with improvement in PEF; also associated with decreases in dynamic hyperinflation, work of breathing, and hypercarbia
 - Can be considered in severe bronchospasm that do not respond to conventional therapy to facilitate medication delivery

Noninvasive Ventilation

- HFNC
 - Role in acute asthma has not been well studied
 - One small study of 36 patients did not demonstrate a difference in clinical response, though there was a signal of improved HR and RR was found in the HFNC group
- NIV
 - A Cochrane Review demonstrated improvements in RR, PEF, FEV₁, hospital admissions, and LOS in the ICU; however, no clear mortality benefit or rate of intubation was shown
 - Can use either CPAP or BiPAP
 - Authors prefer the use of BiPAP
 - CPAP: 10 cm H₂O
 - BiPAP: IPAP 10 cm H₂O, EPAP 5 cm H₂O
 - Reassess after 30-60 minutes. If no improvement in work of breathing, PEF, FEV₁, or PCO₂ then move on to intubation.

Ventilation

- Intubate patients who present in frank distress, are encephalopathic, or are hemodynamically unstable
- RSI can be difficult and can lead to a poor outcome
 - Patients have poor reserve
 - BVM can worsen hyperinflation
 - Worsening acidosis can result in cardiac arrest
 - Consider ketamine as an induction agent and rocuronium as a paralytic
 - Use a large ETT if possible (> 8 mm)
- Mechanical Ventilation
 - Goals are to improve delivery of medications, improve work of breathing, reduce hyperinflation, and prevent volutrauma and barotrauma
 - Patients can be ventilated with either assisted or controlled VCV or PCV
 - Initially set a low RR (8-10 bpm)

- Initially set Vt to 6-8 ml/kg IBW
- Initially set PEEP to low level (< 5 cm H2O)
- Initially set FiO2 to 100% but then rapidly titrate down to SpO2 goal of > 92%
- Monitor Pplat to keep < 30 cm H2O
- Evaluate the flow-time scalar to ensure that the expiratory portion comes back to baseline before new breath is initiated
- If breath stacking continues, decrease the inspiratory time. Ideally, the I:E ratio should be set at 1:2 but can be changed to 1:3 to 1:4 if needed.
- If breath stacking still continues, disconnect from the ventilator and compress the chest for 30-60 seconds.
- Permissive hypercarbia usually well tolerated up to PaCO2 90-100 mm Hg and pH 7.20.

Non-Ventilation Strategies

- Sedation
 - Light sedation may be used to help patients tolerate NIV and deliver inhaled bronchodilators.
 - Use of sedatives should warrant ICU admission
- Opioids
 - May consider intermittent dosing of a short-acting opioid to decrease sensation of breathlessness
 - Consider fentanyl given rapid action and short half-life
- Dexmedetomidine
 - An alpha-2 agonist
 - Does not suppress respiratory drive and can result in anxiolysis
 - Effect can be seen in 5-15 min
- Ketamine
 - Does not cause respiratory depression and can have bronchodilatory effect
 - Infusions can be started at subanesthetic doses and titrated to effect
 - Onset usually within seconds