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Emergency Department Management of Acute Asthma Exacerbation in Adults

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Why is this topic important? Asthma is a chronic obstructive airway disease with recurrent exacerbations. There are several areas of controversy regarding therapy for patients with asthma exacerbation, with recent studies evaluating different components of therapy.

How will this change my clinical practice? Initial treatment includes oxygen supplementation for hypoxia and administration of short-acting β2 agonists (SABAs), short-acting muscarinic antagonists (SAMAs), and systemic corticosteroids. Magnesium sulfate intravenous (IV) may be used as an adjunctive therapy in severe exacerbation. Airway management may be required; noninvasive positive airway pressure ventilation is recommended for those in respiratory distress. Endotracheal intubation does not address the underlying obstructive airway disease but is recommended in those with respiratory failure.

Synopsis Focus Points:

1. **Asthma is a chronic obstructive airway disease characterized by recurrent exacerbations ranging in severity. Diagnosis is based on history and examination.**
2. **Chest radiography or point-of-care ultrasound should be used in those with respiratory distress or those who fail to respond to standard therapies to evaluate for other conditions (e.g., pneumonia or pneumothorax).**
3. **Initial Emergency Department (ED) management includes supplemental oxygen if oxygen saturation is < 90%. Inhaled SABAs and SAMAs should be administered via nebulization or with a metered-dose inhaler (MDI) and spacer. In patients with moderate to severe exacerbation, continuous nebulization with SABAs and SAMAs for one hour is recommended.**
4. **Systemic steroids should be administered within one hour of presentation. Inhaled steroids are a component of outpatient management and may be prescribed at discharge for patients with poor asthma control.**
5. **Magnesium IV should be considered in those with severe exacerbation. Parenteral β2 agonists can be considered in patients who fail to respond to standard therapies.**

6. **Antibiotics such as azithromycin and inhaled magnesium do not improve patient outcomes during an acute asthma exacerbation.**
7. **Noninvasive positive pressure ventilation (NIPPV) can be used in those with significant respiratory distress.**
8. **Endotracheal intubation and mechanical ventilation should be reserved for those with respiratory failure.**

Background:

ED Evaluation
Initial assessment of the patient with suspected asthma exacerbation includes respiratory rate and heart rate, oxygenation, severity of dyspnea, wheezing, accessory muscle use, ability to speak, and mental status. The absence of wheezing in those with evidence of significant respiratory distress or altered mental status suggests impending respiratory failure.(1,2) The clinician should also consider mimics of asthma exacerbation, such as anaphylaxis, pneumonia, pulmonary embolism, heart failure, foreign bodies, and chronic obstructive pulmonary disease.

Chest radiograph is not necessary in all patients with asthma exacerbation, but may be helpful to evaluate for other conditions (e.g., pneumothorax or pneumonia) in those who do not respond to typical therapies.(1,2) Point-of-care ultrasound may be used in those with undifferentiated dyspnea. Routine laboratory analysis is unnecessary unless another condition is suspected (e.g., pulmonary embolism). Arterial blood gas is not recommended to evaluate for hypercarbia or acidosis. Venous blood gas is less painful and invasive and an adequate screen for hypercarbia and acidosis.(2) It may be obtained in those with severe exacerbation who do not improve with therapy. End tidal carbon dioxide monitoring has demonstrated promise in determining severity of airway obstruction and monitoring treatment response.(2)

Oxygen
In those with oxygen saturation < 90%, oxygen supplementation is recommended via nasal cannula or face mask, targeting a level between 93% and 95%.(1) Hyperoxia should be avoided.

Inhaled therapies
Inhaled SABAs (e.g., albuterol) are the first-line inhaled therapy for asthma exacerbation.(1) Levalbuterol does not demonstrate any advantages and costs more.(2) SABAs may be administered with a metered-dose inhaler (MDI) or nebulizer. There is no difference between MDI with spacer and nebulization in rates of hospital admission or ED length of stay in adult patients with mild to moderate exacerbation.(1,2) Dosing of albuterol MDI includes 4-10 puffs every 20 minutes up to four hours, followed by 4-10 puffs every one to four hours. Nebulized therapy is recommended in severe exacerbation.(3) Long-acting beta agonists are not recommended in the ED.

Nebulized therapy may be intermittent or continuous. However, continuous, compared to intermittent, SABA therapy is associated with improved pulmonary function and reduced hospitalization rates (number needed to treat [NNT] 10) in those with moderate to severe exacerbation.(3) Dosing of nebulized albuterol includes 5 mg every 20 minutes up to three doses or 10-20 mg continuous followed by 2.5-10 mg every one to four hours.

Inhaled SAMAs (e.g., ipratropium bromide) should be administered in those with acute asthma exacerbation, as they reduce the need for hospitalization (NNT 11).(4,5) Ipratropium MDI dosing includes eight puffs every 20 minutes as needed. Nebulized therapy includes 0.5 mg every 20 minutes

for three doses, or 1-2 mg over the first hour. This should be combined with the SABA in those with moderate to severe exacerbation, as the combination reduces the need for hospitalization (NNT 16) and risk of relapse (NNT 20) compared to using either agent alone.(6)

Steroids
Systemic steroids should be administered within one hour of presentation to the ED. Current evidence suggests that the intravenous (IV) and oral routes have equivalent bioavailability and efficacy in the majority of exacerbations.(1,2) If possible, oral administration is recommended (prednisone 40-50 mg or dexamethasone 12-16 mg), although IV administration is typically necessary in severe exacerbation (methylprednisolone one mg/kg IV or dexamethasone 12-16 mg IV). Early steroid administration reduces the need for hospitalization in those with severe exacerbation (NNT 8) and can prevent relapse (NNT 10).(7) Patients who are discharged should be prescribed oral steroids after their ED visit. A five-day regimen of prednisone (40-50 mg daily) or equivalent (dexamethasone 12-16 mg on day one and day three) may be used.(1,2)

Inhaled steroids are an integral component of the outpatient management of chronic asthma and should be considered upon discharge for use as a controller medication.(1) The combination of inhaled steroid with an inhaled β2 agonist (budesonide 200 micrograms plus formoterol 6 micrograms) is associated with reduced exacerbations, hospital admission, and need for unscheduled healthcare visit.(8)

Magnesium
Magnesium as an adjunctive therapy has been controversial. However, data suggest magnesium sulfate IV may reduce hospital admissions compared to placebo in those with severe exacerbation, as an adjunct to other therapies, or in those who do not improve with standard therapies (NNT 14).(9,10) Thus, it should be considered in those with severe exacerbations. Dosing includes 2 g IV over 20 minutes. A clear improvement in patient outcomes has not been demonstrated with the use of Inhaled magnesium sulfate.(10,11)

Parenteral Beta Agonists
Parenteral beta agonists (e.g., epinephrine and terbutaline) are potent bronchodilators. However, there are no high-quality prospective data supporting their use in severe exacerbation.(1,2,12) Epinephrine is not recommended for routine use as a first-line therapy but should be considered in doses of 0.3-0.5 mg intramuscular (IM) every 20 minutes for three doses in those with severe exacerbation who fail other therapies.(1,2) The intramuscular (IM) route in the anterolateral thigh is recommended over the subcutaneous route for epinephrine, as patients with cardiorespiratory distress and fatigue have reduced skin and subcutaneous circulation. If patients with severe hypotension or refractory to IM administration, epinephrine IV 5-20 micrograms every two to five minutes should be considered.(2)

Terbutaline is a β2 agonist. It may be administered via inhalation or the subcutaneous or IV route. However, literature does not demonstrate improved patient outcomes when terbutaline is compared to standard inhaled SABAs.(12)

Ketamine
Ketamine is a dissociative analgesic that can be considered in patients refractory to other treatments. It may reduce bronchoconstriction and airway hyperreactivity while improving pulmonary function. However, literature is controversial regarding improvement in patient outcomes.(2)

Antibiotics
Data do not suggest antibiotics improve patient outcomes or reduce symptoms compared to placebo.(13) Antibiotics should be reserved for those with evidence of bacterial pneumonia or other

infection (i.e., systemic symptoms, including fever, or consolidation on chest x-ray) and are not recommended for those with asthma exacerbation.

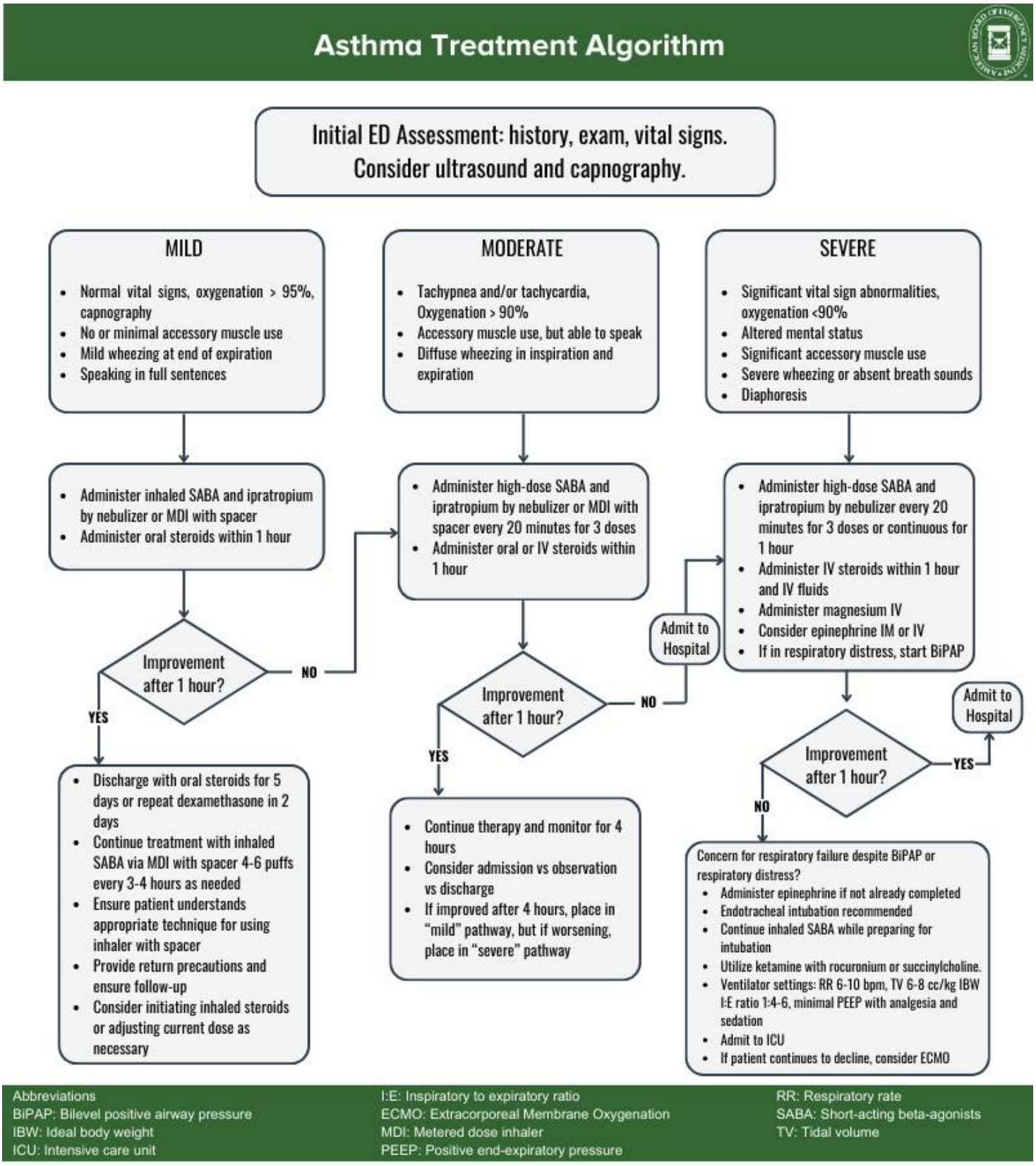
Airway support
There are limited prospective data demonstrating benefit with noninvasive positive pressure ventilation (NIPPV), although a large retrospective study of patients admitted to the critical care setting found NIPPV reduced intubation and mortality.(14) NIPPV should be considered in those with severe respiratory distress who do not respond to other therapies, as NIPPV can improve ventilation and reduce the work of breathing, and there is little harm. Bilevel positive airway pressure as opposed to continuous positive airway pressure is recommended in obstructive lung disease to improve ventilation.(2) Close monitoring of the patient is necessary to ensure improvement.

Intubation and mechanical ventilation
Intubation and mechanical ventilation should be avoided if possible, but are necessary for those with respiratory failure. Patients requiring intubation have a mortality rate up to 20% due to a variety of complications (e.g., aspiration, hyperinflation with barotrauma, and cardiorespiratory compromise).(2) Incomplete exhalation may result in breath-stacking. A plateau pressure < 30 cm H_2O is recommended, with initial ventilator settings using reduced respiratory rates (e.g., 6-10 breaths per minute) and tidal volumes (6-8 cc/kg ideal body weight) with volume cycled assist-control ventilation. An inspiratory to expiratory ratio of from 1:4 to 1:6 is recommended. Positive end-expiratory pressure (PEEP) should be minimal (0-5 cm H_2O). Adequate sedation and analgesia are necessary.(2) Ketamine should be used for induction and sedation if possible. These recommendations are based primarily on expert consensus and not prospective data.

Extracorporeal membrane oxygenation
Extracorporeal membrane oxygenation (ECMO) is a last-line modality in treatment-refractory patients and should be considered in mechanically ventilated patients with hypoxic respiratory failure or persistent hypercapnea with acidosis, in conjunction with a specialist.(2)

Disposition
Disposition should be based on treatment response, clinical course, and ability to follow-up. Patients who improve, are not in respiratory distress, and have follow-up can be discharged with oral steroids, along with SABA MDI with spacer (four puffs every three to four hours).(2) Inhaled steroids should be considered as a daily therapy for patients with asthma, which is associated with greater symptom control and reduced asthma exacerbations, ED visits, and need for hospitalization.(1) Patients with continued symptoms or cardiorespiratory distress should be admitted. Asthma care plans can improve outcomes and medication adherence, while reducing exacerbation recurrence.(1)

Figure 1. Asthma Treatment Pathway



References:

1. Global Initiative for Asthma (GINA). 2023 GINA Report, Global Strategy for Asthma Management and Prevention. 2023. Available at: https://ginasthma.org/wp-content/uploads/2023/07/GINA-2023-Full-report-23_07_06-WMS.pdf. Accessed June 12, 2023.
2. Long B, Lentz S, Koyfman A, Gottlieb M. Evaluation and management of the critically ill adult asthmatic in the emergency department setting. *Am J Emerg Med.* 2021;44:441-451.
3. Rowe BH. Continuous versus intermittent beta-agonists for acute asthma. *Cochrane Database Syst Rev.* 2011;(4):CD001115.
4. Stoodley RG, Aaron SD, Dales RE. The role of ipratropium bromide in the emergency management of acute asthma exacerbation: a metaanalysis of randomized clinical trials. *Ann Emerg Med.* 1999;34(1):8-18.
5. Rodrigo G, Rodrigo C, Burschtin O. A meta-analysis of the effects of ipratropium bromide in adults with acute asthma. *Am J Med.* 1999;107(4):363-370.
6. Kirkland SW, Vandenberghe C, Voaklander B, et al. Combined inhaled beta-agonist and anticholinergic agents for emergency management in adults with asthma. *Cochrane Database Syst Rev.* 2017;1(1):CD001284.
7. Rowe BH, Spooner C, Ducharme FM, et al. Early emergency department treatment of acute asthma with systemic corticosteroids. *Cochrane Database Syst Rev.* 2001;(1):CD002178.
8. Crossingham I, Turner S, Ramakrishnan S, et al. Combination fixed-dose beta agonist and steroid inhaler as required for adults or children with mild asthma. *Cochrane Database Syst Rev.* 2021;5(5):CD013518.
9. Kew KM, Kirtchuk L, Michell CI. Intravenous magnesium sulfate for treating adults with acute asthma in the emergency department. *Cochrane Database Syst Rev.* 2014;(5):CD010909.
10. Goodacre S, Cohen J, Bradburn M, et al; 3Mg Research Team. Intravenous or nebulised magnesium sulphate versus standard therapy for severe acute asthma (3Mg trial). *Lancet Respir Med.* 2013;1(4):293-300.
11. Knightly R, Milan SJ, Hughes R, et al. Inhaled magnesium sulfate in the treatment of acute asthma. *Cochrane Database Syst Rev.* 2017;11:CD003898.
12. Travers AH, Milan SJ, Jones AP, et al. Addition of intravenous beta(2)-agonists to inhaled beta(2)-agonists for acute asthma. *Cochrane Database Syst Rev.* 2012;12:CD010179.
13. Johnston SL, Szigeti M, Cross M, et al; AZALEA Trial Team. Azithromycin for acute exacerbations of asthma: the AZALEA randomized clinical trial. *JAMA Intern Med.* 2016;176(11):1630-1637.
14. Althoff MD, Holguin F, Yang F, et al. Noninvasive ventilation use in critically ill patients with acute asthma exacerbations. *Am J Respir Crit Care Med.* 2020;202(11):1520-1530.

Notes: Practice Advance synopses should be built from a strong body of evidence, that likely includes a systematic review. The synopsis will include a recommendation that should be similar in wording to how GRADE recommendations are given. These should not be controversial recommendations and essentially all emergency physicians should be adopting them. The impact or “effect size” should be substantial and no significant harm should be associated with this gain.

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