

PEM GUIDE - ASTHMA

INTRODUCTION

An acute asthma exacerbation is characterized by a precipitous narrowing of the airways as a result of airway inflammation and bronchoconstriction. Despite remarkable medical advances and public health efforts in the treatment of asthma, the overall morbidity and mortality from acute asthma exacerbations continues to climb. If untreated or under-treated, acute airway narrowing from asthma may deteriorate to complete airway obstruction and death. Early diagnosis and management is key to reversing the pathogenesis of airway hyper-responsiveness and bronchoconstriction.

CLINICAL FINDINGS

The history should focus on the duration of symptoms and precipitating factors for the current exacerbation (i.e. environmental exposures, URI symptoms, or medication non-compliance). Particular attention should be focused on the child's asthma severity by eliciting a history of ED visits, hospitalizations, ICU admissions, and number of intubations. Determine what asthma medications have been used both acutely (e.g. beta agonists) as well as for maintenance (e.g. inhaled steroids).

Assessment of the child should begin with an overall appraisal of respiratory distress. Respiratory rate, bilateral breath sounds, inspiratory-expiratory ratio, and the presence of wheezing should be noted. In more severe exacerbations, the older child may assume a "tripod" position (sitting forward and leaning on both arms) to help optimize ventilation. Central cyanosis, inability to speak in complete sentences, altered mental status, diaphoresis, severe retractions & accessory muscle use, stridor, and nasal flaring are all worrisome predictors of impending respiratory failure.

Pulse oximetry provides a quick, objective, and continuous measure of arterial hemoglobin oxygen saturation (SaO₂). An SaO₂ can be used to help grade the severity of airway obstruction; values less than 92% indicates inadequate oxygenation. The peak expiratory flow rate (PEFR) can be useful in the older child by providing serial measurements of airway obstruction that can be compared to the child's personal best (if known) or to reference ranges (based on age and height). A PEFR less than 50% of predicted indicates a moderate to severe airway obstruction. The child in impending respiratory failure should also have an arterial blood gas (ABG) obtained to provide an objective measure of hypoxemia. Hypercarbia, or even a normal PaCO₂, may reflect inadequate ventilation and impending respiratory failure. Chest x-rays are typically unnecessary in a known asthmatic and rarely demonstrate anything other than hyperinflation or atelectasis. Children complaining of pleuritic chest pain however, require a CXR to exclude a pneumothorax, and any child with fever should have a pneumonia ruled-out.

MANAGEMENT

The initial approach to treating an acute asthma exacerbation is dependant on the use of inhaled beta-agonists to rapidly reverse airway obstruction. Supplemental oxygen should be provided to achieve an SaO₂'s > 90% and early corticosteroids should be administered as indicated.

MILD TO MODERATE EXACERBATIONS

In children, the standard route of delivery for repetitive, inhaled beta-agonists is via nebulization. Keep in mind that the SaO₂ may initially decline following beta-agonist therapy because of an increase in V/Q mismatch. Repetitive treatments with nebulized Albuterol (0.5%) at a dose of 0.15 mg/kg (or 2.5 mg for children < 30 kg and 5 mg for children > 30 kg) are effective in rapidly reversing airway obstruction. In general nebulizer treatments are delivered every twenty minutes but may be delivered more frequently and at higher concentrations in more severe exacerbations. An equivalent mode of delivery via a metered-dose inhaler (MDI) and chamber (90 mcg per inhalation) can be just as effective for older children.

In the event of an inadequate or delayed response to inhaled beta-agonists, parenteral injections of either Epinephrine or Terbutaline can be considered simultaneously or in place of inhaled Albuterol. Both Epinephrine (1:1000) and Terbutaline (0.1%) may be given subcutaneously or IM at a dose of 0.01 cc/kg every 15 minutes for three doses (Epi max 0.3 cc, Terbutaline max 0.25 cc). Studies comparing intravenous to inhaled beta-agonists, however, have not demonstrated any advantage to the parenteral route of delivery.

Ipratropium may be given via nebulization every 20-30 minutes with the first 3 Albuterol treatments at a dose of 0.25 mg for children and 0.5 mg for adolescents.

Systemic corticosteroids should be given to any child with a moderate to severe exacerbation, and may even be necessary for those with mild exacerbations. All children who receive more than one treatment with inhaled beta-agonists, who have an SaO₂ < 95%, a PEF < 50% predicted, frequent/multiple ED visits, or a history of severe acute asthma, will require 1-2 mg/kg of either oral Prednisone - or if tolerance is a potential problem - then parenteral Methylprednisolone.

Intravenous magnesium may be considered at a dose of 25 – 75 mg/kg (max 2 gm) for moderate to severe exacerbations, and requires careful monitoring for hypotension.

SEVERE EXACERBATIONS

Continuous Albuterol nebulization may be superior to an MDI in children with severe exacerbations and may be administered at a dose of 0.5 mg/kg/hr (max 15 mg/hr). Continuous intravenous beta-agonist therapy with Terbutaline may be initiated with a 10 mcg/kg loading dose over 10 minutes, followed by a maintenance infusion at 0.4 mcg/kg/min. This infusion may be titrated to effect in increments of 0.2 mcg/kg, and requires continuous cardiac monitoring for arrhythmias.

If impending respiratory failure is a concern despite optimal therapy with either continuous inhaled or intravenous beta-agonist therapy, then preparations should be made for endotracheal intubation. Rapid sequence induction should proceed with intravenous Ketamine (1-2 mg/kg) because of its bronchodilating properties. Mechanical ventilation in an asthmatic requires careful attention to ventilation because of the high pressures generated by auto-PEEP that may lead to barotrauma or a pneumothorax.

DISPOSITION

Monitoring of the child in the ED for up to 2-4 hours of bronchodilator therapy may be needed to determine a decision for disposition. Admission should be considered for any child in persistent respiratory distress, an SaO₂ <92% on room air, a PEF_R < 50%, intolerance for oral medications, any underlying cardiopulmonary disease, or a pneumothorax. Admission may also be considered for children in whom medication non-compliance may be an issue or for whom significant socioeconomic factors may aggravate their condition.

Any child whose condition has improved enough for discharge should continue all their maintenance asthma medications. Children younger than 5 years should be given an MDI with a spacer or a nebulizer if needed. In this sub-acute phase following discharge, the use of inhaled Albuterol should be continued every 4 to 6 hours as needed until symptoms resolve. Children who require oral corticosteroids should be prescribed an additional 4 day course of Prednisone (2 mg/kg). Follow-up care should be arranged for all asthmatics.