

## Asthma in the Pediatric Population: An Urgent Care Approach

**Urgent message:** Though sometimes viewed as an easily controlled disease, asthma can become a medical emergency quickly. It is important for the urgent care clinician to be able to recognize the signs of a potentially life-threatening asthma exacerbation—and know how to treat it accordingly.

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### Introduction

Asthma is an episodic and reversible airflow obstruction. It is the most common chronic disease in children, affecting millions every year; in 2002, up to 9 million children in the United States were affected by asthma.<sup>1</sup> Asthma is also one of the leading causes of mortality and morbidity, including hospitalizations, in pediatric patients.

The symptoms of acute exacerbation of asthma are some of the most common complaints of children presenting to urgent care centers. It is imperative that practitioners know how to quickly diagnose and treat patients with potentially life-threatening acute exacerbations. This includes recognizing the signs and managing and stabilizing the rapidly deteriorating asthmatic patient. If this is not done expeditiously, the patient may die or suffer considerable morbidity.

*Acute asthma* is defined as an exacerbation of underlying asthma requiring urgent or emergency treatment. It is characterized by an episode of increased breathless-



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ness, cough, wheezing, chest tightness or a combination of these symptoms.

The term *status asthmaticus* relates severity to outcome and has been used to define a severe asthmatic exacerbation that does not respond to standard treatment.<sup>2</sup>

The goals of asthma care are to:

1. treat airway inflammation and bronchoconstriction
2. control symptoms by adequately treating the above
3. prevent acute exacerbations and thereby
4. decrease the incidence of mortality and morbidity.

An exacerbation of asthma necessitating an emergency department or unscheduled visit or hospital admission can be construed as a failure of primary care.<sup>3</sup>

### Pathophysiology

Asthma is an inflammatory airway disease. Decrease in airway flow is related mainly to both airway inflammation and airway constriction.

| Table 1. Red Flags in Asthma Assessment   |        |                             |
|---|--------|-----------------------------|
| The findings below are indicative of severe asthma exacerbation or imminent respiratory arrest.   |        |                             |
| Symptoms and Signs  | Severe | Imminent respiratory arrest |
| Must sit upright  | ■      |                             |
| Talks in words only   | ■      |                             |
| Agitated mood   | ■      |                             |
| Drowsy or confused  |        | ■                           |
| Respiratory rate increased<br>Age Normal<br><2 months <60/minute<br>2-12 months <50/minute<br>1-5 years <40/minute<br>6-8 years <30/minute  | ■      |                             |
| Pulse increased<br>Age Normal<br>2-12 months <160/minute<br>1-2 years <120/minute<br>2-8 years <110/minute  | ■      |                             |
| Bradycardia   |        | ■                           |
| PEF <40%  | ■      |                             |
| PEF <25%  |        | ■                           |
| Adapted from: Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma. National Heart, Lung, and Blood Institute National Asthma Education and Prevention Program. U.S. Department of Health and Human Services National Institutes of Health. Available at: <a href="http://www.nhlbi.nih.gov/guidelines/asthma/index.htm">http://www.nhlbi.nih.gov/guidelines/asthma/index.htm</a> .<br>Strunk RC. Defining asthma in the preschool-aged child. <i>Pediatrics</i> . 2002;109(2 Suppl):357-361. |        |                             |

**Evaluating a Child with Acute Asthma**

When a patient presents with symptoms of acute asthma exacerbation, the clinician must perform a rapid—but thorough—clinical evaluation. Performing a physical examination expeditiously is necessary to allow the physician to recognize the severity of the asthma episode and to diagnose other conditions that can be confused with asthma.

In some cases, this must be done concurrently with the initiation of treatment with  $\beta_2$ -agonists.

This focused examination should also include:

- vital signs
- measurement of oxygen saturation
- assessment of
- level of consciousness
- wheezing
- air entry
- accessory muscle use
- retractions.

Treatment should not be delayed to obtain more history. Further history can be obtained *after* the patient has been stabilized. However, it must be noted that obtaining an appropriate history is an important component of determining the severity of the asthma, which will help to tailor the treatment, as suggested by the National Asthma Education and Prevention Program Expert Panel Report 3.

“Red flags” from the history and physical examination which are warning signs of impending respiratory failure that may lead to death are summarized in **Table 1**.

**Making the Diagnosis**

The first step in the management of acute asthma, of course, is to make the correct diagnosis.

Diagnosis of asthma is clinical and can be made essentially by searching for the five key symptoms that indicate asthma. They are:

- cough
- wheeze
- dyspnea
- chest tightness
- increased respiratory secretions.<sup>6</sup>

(It is important to note, however, that cough may

Evidence shows that various early life exposures, such as high exposure to house dust mites and early antibiotic use, may predispose susceptible individuals to the development of asthma.<sup>4</sup>

Factors reported to be associated with asthma persistence and relapse include:

- sensitization to house dust mites
- airway hyper-responsiveness
- female gender
- smoking
- early age of onset of asthma.<sup>5</sup>

It is important to keep these in mind when evaluating the child with an asthma exacerbation, as avoidance of any of these factors may decrease the likelihood of future episodes. Such awareness also encourages effective patient education that diminishes the risk for future exacerbations.

be the only presenting symptom in patients with asthma.<sup>7)</sup>

Typically, the diagnosis of asthma is made if episodic symptoms of airflow obstruction or airway hyper-responsiveness are present, airflow obstruction is at least partially reversible, and alternative diagnoses are excluded.<sup>8</sup>

It is also important to determine the severity of asthma that the child has (Table 2). The disease process is dynamic and its severity can change over time. The child may get better or worse. Out-patient medication should be based on the degree of severity in order to adequately control the symptoms and prevent acute exacerbations.<sup>9</sup>

**Differential Diagnosis**

Although most children with recurrent wheezing have asthma, other conditions should be considered in the differential diagnosis.

A thorough patient history is important when excluding other causes. Armed with a proper physical examination and history, the physician can determine whether or not the patient has asthma exacerbation.

However, one must be cautious of other pathologies that may present with similar symptoms. The differential diagnosis of asthma is broad and may include some potentially life-threatening conditions, as well as others that are less severe.

Specifically, allergies, gastroesophageal reflux disease, pneumonia, cystic fibrosis and bronchopulmonary dysplasia, and foreign body aspiration should be considered. If cough occurs after eating, gastroesophageal reflux disease, in particular, should be strongly suspected.<sup>10</sup>

**Management**

Management of asthma is now being directed to early recognition and early intervention. Considerations in the treatment of asthma include not only pharmacologic agents but also recognition and modification of potential triggers such as environmental tobacco smoke, air pollution (both indoor and outdoor), and allergens.

The treatment of acute asthma is directed to the underlying pathophysiology, with the intent of reversing bronchoconstriction, controlling airway inflammation, and decreasing mucus production.

Exacerbations of acute asthma call for early recog-

**Table 2. Classifying Asthma in Children Based on Symptom Severity and Lung Lunction<sup>9</sup>**

| Class                      | Symptoms                            | Nocturnal symptoms | Lung function   |
|----------------------------|-------------------------------------|--------------------|---|
| <i>Mild-intermittent</i>   | ≤2 times per week                   | ≤2 times/month     | FEV <sub>1</sub> ≥80% predicted                         |
| <i>Mild-persistent</i>     | >2 times per week, <1 per day       | >2 times/month     | FEV <sub>1</sub> ≥80% predicted, variability 20% to 30% |
| <i>Moderate-persistent</i> | Daily symptoms, use of SABA         | >1 time/week       | FEV <sub>1</sub> 60% to 80% predicted, variability <30% |
| <i>Severe-persistent</i>   | Daily symptoms which limit activity | Frequently         | FEV <sub>1</sub> <60 predicted, variability >30%        |

FEV<sub>1</sub>, forced expiratory volume in 1 second; SABA, short-acting beta agonist.

niton and initiation of therapy with bronchodilators and anti-inflammatory corticosteroids. As stated previously, management and use of specific inpatient and outpatient pharmacotherapy depends on the severity of the disease and the exacerbation.

*Oxygen*

Hypoxemia present during asthma exacerbation is caused by the presence of ventilation-perfusion (V/Q) mismatch. If a child is in acute distress, humidified oxygen should be provided to maintain oxygen saturations ≥92%.<sup>11</sup>

Caution should be exercised when administering 100% oxygen in severe asthma, due to concerns of respiratory depression followed by carbon dioxide retention.

*Bronchodilator*

Inhaled bronchodilators are a cornerstone of treatment for asthma exacerbations. These agents are the drugs of choice for relief of bronchospasm during an acute exacerbation of bronchial asthma.

All nebulized treatments should be administered with oxygen at a flow rate of 6 L/minute to 8 L/minute.

Usual doses of nebulized albuterol are 2.5 mg (<30 kg) and 5 mg (>30 kg).

Spacer devices for delivering inhaled medications from pressurized metered dose inhalers in acute asthma are equally effective as nebulizers.<sup>12</sup>

*Corticosteroids*

Corticosteroids are effective in the treatment of inflam-

mation in children with asthma. Early use of systemic corticosteroids may reduce the hospitalization rate.<sup>13</sup>

Oral preparations have been shown to be more effective than inhaled or nebulized steroids.<sup>14</sup> Generally, 1 mg/kg/day to 2 mg/kg/day of prednisone for three to 10 days (to a maximum of 60 mg) is provided.

Contrary to a commonly held perception, no dose tapering is required unless the patient has been on steroid therapy continuously for more than two weeks, in which case adrenal suppression may occur. However, there is no evidence that tapering the dose following improvement in symptom control and pulmonary function prevents relapse.

For long-term treatment of severe persistent asthma, administer a single dose in the morning, either daily or on alternate days (alternate-day therapy may produce less adrenal suppression).<sup>15</sup>

*Inhaled glucocorticoids*

The preferred long-term controller agents for initiating treatment for persistent asthma in children are

inhaled glucocorticoids.<sup>16</sup> These agents provide improved asthma control and fewer exacerbations in high-risk children.<sup>17</sup>

Although acute exacerbations of asthma in the urgent care center or ED should be treated with oral steroids or, in special situations, parenteral steroids, patients with significant asthma should usually be discharged on a steroid inhaler, as well as an albuterol inhaler and a short course of prednisone. This aggressive, pro-active approach is recommended to encourage physicians to identify patients at risk for developing persistent asthma and to intervene earlier with long-term control therapy.

As noted above, management with both rescue medications, such as albuterol inhalers, and controller medications, such as steroid inhalers, will decrease mortality and morbidity and allow the asthmatic child to live a better and longer life.

*Montelukast*

Montelukast, a leukotriene receptor antagonist, is



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considered an alternative to inhaled corticosteroids (ICS) in mild-persistent asthma, and a supplementary therapy to ICS for moderate persistent asthma. Studies have shown favorable effects with long-term improvement of symptoms and reduction in the number of exacerbations.<sup>18,19</sup> It has not yet been proven to acutely help in the treatment of acute asthma exacerbations.

Leukotriene receptors have the following actions:

- stimulation of bronchoconstriction
- mucus hypersecretion
- microvascular leakage with edema formation
- eosinophil chemo-attraction

Montelukast will prevent the above pathophysiology. The dose for adolescents is 10 mg once daily.

*Magnesium sulfate*

Magnesium has potential as a therapeutic agent in asthma because of its bronchodilating effect on smooth muscle cells.<sup>20</sup> Magnesium should be used for patients with severe asthma exacerbations or with moderate asthma exacerbations with clinical deterioration despite standard treatment. It is an adjunctive therapy in very sick asthmatics that may buy precious time for other therapeutic modalities, such as steroid therapy, to work.

Magnesium sulfate is usually administered at a dose of 75 mg/kg (to a maximum of 2 g) intravenously.<sup>21</sup>

*Monitoring*

Peak expiratory flow (PEF) monitoring is a mainstay of asthma management. It is a reproducible, objective measurement of airway obstruction. It is recommended, if possible, to obtain a PEF measurement initially and, subsequently, 15 to 20 minutes after the bronchodilator therapy is initiated to monitor the severity of the disease and the response to treatment.

It has been shown that the physical examination alone is often not adequate for this purpose. For example, decreased wheezing may not always be a sign that the patient is improving; in fact, it occasionally may indicate that the patient has become “tighter” and is not able to move enough air to wheeze.

PEF, when combined with the clinical findings, provides the practitioner with a better understanding as to when therapy needs to be increased or when the acute patient can be safely discharged from the urgent care center or ED.

It should be noted that PEF monitoring is not suitable for use in young children (under the age of 5 years), as

**Table 3. Criteria for Hospital Admission or Discharge of Children with Asthma**

|  |
|--|
| <p><i>Admit</i></p> <ul style="list-style-type: none"> <li>• Incomplete or poor response to treatment</li> <li>• Signs or symptoms of impending respiratory failure or drowsiness</li> <li>• PEF or FEV<sub>1</sub> &lt;40% and no improvement after initial treatment:                         <ul style="list-style-type: none"> <li>– oxygen</li> <li>– nebulized short-acting beta agonist + ipratropium, hourly or continuous</li> <li>– oral systemic corticosteroids</li> <li>– consideration of adjunct therapies</li> </ul> </li> </ul> |
| <p><i>Discharge</i></p> <ul style="list-style-type: none"> <li>• PEF or FEV<sub>1</sub> ≥70% of predicted</li> <li>• Improvement persists 60 minutes after completion of treatment</li> <li>• Normal physical examination</li> </ul>   |
| <p><small>Adapted from: Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma. National Heart, Lung, and Blood Institute National Asthma Education and Prevention Program. U.S. Department of Health and Human Services National Institutes of Health. Available at: <a href="http://www.nhlbi.nih.gov/guidelines/asthma/index.htm">http://www.nhlbi.nih.gov/guidelines/asthma/index.htm</a>.</small></p> <p><small>PEF, peak expiratory flow; FEV<sub>1</sub>, forced expiratory volume in 1 second.</small></p>         |

it is both effort- and technique-dependent.<sup>22</sup> Oxygen saturation should be monitored with pulse oximetry.

**Chest Radiographs**

Not every child with an asthma exacerbation requires a chest radiograph. However, children with their first episode of wheezing or an episode of unexplained severe wheezing that is not responding to bronchodilators to therapy should undergo chest radiography.<sup>23</sup>

X-rays should also be obtained if there is a clinical suspicion of pneumonia or pneumothorax, or if congestive heart failure is present. Presence of fever, chest pain, and subcutaneous emphysema are important clinical findings.

Most pediatric patients with acute asthma exacerbations have normal chest radiographs or just show hyperventilation. In most cases, the results of the chest x-rays rarely alter the management of the patient.

Predictors for clinically relevant chest x-ray in asthma exacerbation include:

- rapid respiratory rate
- fever
- low oxygen saturation or hypoxia
- physical findings on examination that suggest collapse, consolidation, CHF, or pneumothorax.

### Hospitalization or Discharge?

The decision to admit or discharge home should be guided by both clinical improvement and evaluation of the child's social situation.

Clinical factors which require hospitalization include worsening bronchospasm, hypoxia, and features of respiratory failure. As noted above, in older children serial measurement of the PEF can assist in making these decisions.

Other factors that require inpatient treatment are non-compliance with an outpatient treatment plan and inadequate access to medical care.

Patients who have shown marked improvement during the first hour can usually be discharged home.

Criteria for hospitalizing or discharging patients with acute asthma exacerbations are summarized in **Table 3**.

### Written Action Plans

Parental education is an essential component of asthma management. A visit to the ED or urgent care facility is an excellent opportunity to discuss the asthma action plan.

Parents must have a thorough understanding of the treatment offered and of the asthma action plan. This will increase the compliance with treatment and reduce unscheduled visits to the urgent care facility.

National and international asthma guidelines universally endorse written self-management plans for every asthmatic patient.

Typically, these represent just one facet of asthma education. Other facets include:

- medical review
- identification and avoidance of triggers
- explanation of medications and delivery systems
- early recognition of signs of deterioration
- instructions for the prevention and management of exacerbations.<sup>24</sup>

### Summary

Early recognition of symptoms facilitates early treatment and is the key to controlling asthma. Urgent care practitioners must know how to rapidly recognize and manage children with acute exacerbations of asthma in order to prevent significant mortality and morbidity.

Attention should also be paid to the maintenance regime of long-term control medications to prevent exacerbations.

Comprehensive asthma management should also include asthma education, with an emphasis on:

- avoidance of triggers
- appropriate and correct use of the inhaler
- reasons to return for care.

Urgent care physicians play an important role in the management of acute asthma in children and, therefore, have a unique opportunity to improve both the short- and long-term outcome and control of this very common, but potentially life-threatening illness. ■

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