**Introduction**

Asthma exacerbations are acute or subacute episodes of progressively worsening shortness of breath, cough, wheezing, and chest tightness due to airflow obstruction and bronchial hyperresponsiveness. They are a major cause of morbidity, lost productivity, and health care utilization. Pharmacists play a pivotal role in the management of asthma exacerbations in the emergency department by ensuring appropriate pharmacotherapy, monitoring response, providing patient education, and facilitating follow-up care. Key aspects in management include rapid administration of inhaled bronchodilators, systemic corticosteroids, assessment of severity, identification of high-risk patients, and preventing hospital admissions. Recent advancements include the use of biomarker monitoring, magnesium infusions, and noninvasive ventilation in select patients. This section will cover the clinical features, pathophysiology, diagnostic approach, pharmacotherapy, and evidence-based management of asthma exacerbations.

**Clinical Presentation**

Patients with an asthma exacerbation typically experience acute worsening of respiratory symptoms such as shortness of breath, cough, chest tightness, and wheezing. On physical exam, signs of bronchospasm include prolonged expiratory wheezing, accessory muscle use, and intercostal retractions. Patients may appear anxious or agitated and prefer to sit upright. Vital signs show tachypnea, tachycardia, and hypoxemia. Speech becomes limited to phrases and single words in more severe exacerbations.

Risk factors for asthma exacerbations include:

* Viral respiratory infections
* Allergen exposure
* Air pollution
* Nonadherence to controller medications
* Comorbid COPD

High risk features include:

* Prior intubation or ICU admission for asthma
* Multiple ED visits or hospitalizations for asthma in the past year
* Current use of oral corticosteroids
* Inability to perceive symptoms of worsening airflow obstruction

Consider alternative diagnoses like:

* Congestive heart failure
* COPD exacerbation
* Pneumonia
* Foreign body aspiration

**Pathophysiology**

Asthma exacerbations represent an acute worsening due to uncontrolled airway inflammation involving:

* Mast cells
* Eosinophils
* T lymphocytes

Mediators released include:

* Histamine
* Leukotrienes
* Cytokines

Key effects include:

* Bronchial hyperresponsiveness
* Bronchospasm
* Mucus plugging
* Airway edema

This results in variable airflow limitation and bronchial obstruction. Airway remodeling from chronic inflammation also contributes.

Two main phenotypes exist:

* Slow onset (gradual deterioration over days)
* Primarily underlying inflammation
* Slower response to treatment

* Rapid onset (abrupt deterioration in under 6 hours)
* Primarily bronchospasm
* Faster response to treatment

**Diagnostic Approach**

The initial focus is a thorough history and physical exam assessing the patient's respiratory status. Vital signs provide the following key information which indicate more severe airflow limitation:

* Tachycardia
* Tachypnea
* Hypoxemia

Lung auscultation may reveal diffuse wheezing and prolonged expiratory phase, but decreased breath sounds in severe exacerbations.

Speech assessment gives insight into severity, with progressive limitation to phrases and single words as obstruction worsens.

Peak flow meters permit quantification of expiratory airflow limitation, with values less than 40% of predicted or personal best indicating severe exacerbations.

Pulse oximetry allows noninvasive tracking of arterial oxygen saturation. A chest x-ray is obtained if complications like pneumonia or pneumothorax are suspected.

ABG or VBG permit assessment of hypoxemia and hypercapnia, the latter indicating respiratory failure.

An ECG helps identify cardiac strain, ischemia, or arrhythmias that may accompany severe exacerbations.

Checking a CBC is considered if concomitant bacterial pneumonia is suspected. Spirometry, however, is not useful during an acute presentation.

**Management - Overview**

The key principles in managing acute asthma exacerbations are:

1. Prompt initiation of bronchodilators and corticosteroids
2. Frequent reassessment of severity and response to guide adjustments in therapy
3. Utilization of adjunctive therapies like heliox or BiPAP for severe refractory exacerbations
4. Identification of high risk patients requiring close monitoring for respiratory failure
5. Preventing unnecessary hospital admissions
6. Arranging post-discharge follow-up and controller medication adjustments
   * Titrate oxygen to keep saturations 88-92%

Initial management centers on rapid administration of inhaled short-acting beta-2 agonists (SABA) like albuterol and systemic corticosteroids. Oxygen is titrated to target saturations of 88-92%. Response to treatment determines the need for hospitalization versus discharge from the emergency department. Preventing future exacerbations involves optimization of controller medications like inhaled corticosteroids and patient education.

**Pharmacotherapy**

Initial management:

**Oxygen**

* High concentrations may worsen hypercapnia in severe exacerbations
* Use nasal cannula or mask with reservoir bag to provide controlled low-flow delivery

**Inhaled short-acting beta-2 agonist (SABA)**

* Albuterol is the preferred SABA
* Given by nebulizer or MDI with spacer
* Nebulized dose: 2.5-5 mg every 20 minutes for 3 doses
* MDI dose: 4-8 puffs every 20 minutes for 3 doses
* Levalbuterol (Xopenex) is an alternative to albuterol
* Assess response and continue if severe exacerbation

**Ipratropium bromide**

* Anticholinergic bronchodilator with slower onset than SABA
* Nebulized dose: 0.5 mg every 20 minutes for 3 doses
* Add to SABA for severe exacerbations

**Systemic corticosteroids**

* First-line oral corticosteroid is prednisone 40-60 mg daily
* IV methylprednisolone 60-125 mg daily is alternative if unable to take oral
* Improve outcomes and reduce hospitalizations
* PO and IV efficacy are equal

Second-line therapies:

* Terbutaline – selective beta-2 agonist given 0.25 mg SQ
* Epinephrine – given IM for severe exacerbations unresponsive to SABA
* IV magnesium sulfate – 2 g IV over 60 minutes for severe refractory exacerbations
* Heliox – inhaled 70% helium/30% oxygen to reduce work of breathing
* BiPAP – noninvasive ventilation for hypercapnic respiratory failure
* Intubation – for respiratory failure unresponsive to above measures
* Ketamine – IV anesthetic with bronchodilator properties (limited evidence)
* Antibiotics – reserve for probable bacterial pneumonia, not routinely indicated

**Key Guidelines and Evidence**

Guideline Recommendations for Pharmacy-Related Care in Asthma Exacerbations

**Recommendation Level of Evidence Strength of Recommendation**

|  |  |
| --- | --- |
| Short-acting beta-2 agonists (SABA) are first-line therapies | A Strong |
| Inhaled route is preferred for SABA | A Strong |
| Systemic corticosteroids should be initiated | A Strong |
| Oral and IV steroids have equal efficacy | A Strong |
| Titrate oxygen to target saturations of 88-92% | B Moderate |
| Consider magnesium sulfate for severe exacerbations | B Moderate |
| BiPAP may help avoid intubation in select patients | C Weak |

**Summary**

Asthma exacerbations are episodes of acute worsening of symptoms due to bronchial inflammation and bronchoconstriction. Red flags for severe exacerbations include prior intubation, tachypnea, hypoxemia, and inability to speak in full sentences. Treatment centers on inhaled SABA, systemic steroids, and titrated oxygen. Magnesium sulfate, heliox, and BiPAP may help avoid intubation in severe cases. However, respiratory failure mandating intubation can occur and requires mechanical ventilation with permissive hypercapnia. Key points are distinguishing severity level based on clinical features, tailoring pharmacotherapy accordingly, and monitoring response. Prevention of future exacerbations involves optimizing controller medications and patient education.

**Clinical Scenarios**

**Scenario 1:**

A 35-year-old woman with a history of asthma presents with an exacerbation. She receives three doses of inhaled albuterol and 125 mg of IV methylprednisolone. After 45 minutes, she is less short of breath but still speaking in phrases. Her oxygen saturation is 90% on 4 L/min via nasal cannula. What is the most appropriate next step in management?

A. Discharge home with 5 day course of prednisone

B. Initiate BiPAP

C. Increase albuterol frequency

D. Intubate for respiratory failure

Answer: C

Explanation: The patient has received appropriate initial therapy but still has moderate persistent symptoms based on her limited speech. Her oxygenation is also suboptimal. She likely needs further albuterol treatments before considering discharge versus hospital admission. Increasing the frequency of albuterol would be the next appropriate step.

**Scenario 2:**

A 27-year-old man with a history of intubated asthma presents in severe distress. He is started on continuous albuterol nebulization. After 30 minutes, he appears fatigued with oxygen saturation 86% on 15 L/min oxygen by mask. His tidal volumes on observation are very small. What is the best next step?

A. Continue current therapy

B. Initiate BiPAP

C. Administer IV magnesium

D. Intubate

Answer: D

Explanation: The patient has high-risk features and his respiratory status is worsening despite aggressive standard therapy. Small tidal volumes indicate severe bronchoconstriction and fatigue. This patient has impending respiratory failure and likely needs intubation. Continuing current management risks respiratory arrest.

**Tips for Board Exam Questions**

* Know the clinical features and risk factors for severe or life-threatening asthma exacerbations.
* Be familiar with the step-wise pharmacotherapy approach, starting with oxygen, SABA, and steroids.
* Understand the indications and administration of magnesium, heliox, and BiPAP for severe refractory exacerbations.
* Recognize when respiratory failure requires intubation and mechanical ventilation.
* The goal oxygen saturation is 88-92% in acute asthma exacerbations.

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