Asthma

RSPT 2310

Introduction

• The first evidence based asthma guidelines were published in 1991 by:
  – National Asthma Education and Prevention Program (NAEPP)—under the coordination of the:
    • National Heart, Lung, and Blood Institute (NHLBI) of the National Institutes of Health.

• Today, the NAEPP guidelines are structured around the following four components:
  1. Assessment and monitoring of asthma
  2. Patient education
  3. Control of factors contributing to the asthma severity
  4. The pharmacologic treatments

Anatomic Alterations of the Lungs

• Smooth muscle constriction of bronchial airways (bronchospasm)
• Bronchial wall inflammation
• Excessive production of thick, whitish, bronchial secretions
• Mucus plugging
• Hyperinflation of alveoli (air-trapping)
• In severe cases, atelectasis caused by mucus plugging
Epidemiology

- Asthma was first recognized by Hippocrates more than 2000 years ago
- It remains one of the most common diseases encountered in clinical medicine
- Over the past decade the incidence of asthma has increased dramatically
- It is estimated that more than 25 million Americans have asthma

Epidemiology

- About 500,000 Americans are hospitalized annually for severe asthma
- About 4000 die as a result of asthma annually
- According to the World Health Organization, about 180,000 people worldwide die from asthma
- Among young children, asthma is about two times more prevalent in boys than girls
- After puberty, however, asthma is more common in girls

Risk Factors

- Extrinsic asthma (Allergic or Atopic asthma)
  - Asthma episodes clearly linked to the exposure of a specific allergen (antigen):
    - House dust
    - Mites
    - Furred animal dander
    - Cockroach allergen
    - Fungi
    - molds
    - Yeast

Risk Factors

- Extrinsic asthma is an immediate (Type I) anaphylactic hypersensitivity reaction
- Extrinsic asthma is family related and usually appears in children and adults younger than 30 years old.
- It often disappears after puberty
- Because extrinsic asthma is associated with an antigen-antibody induced bronchospasm, an immunologic mechanism plays an important role.

Risk Factors

- Occupational sensitzizers (Occupational Asthma)
- Intrinsic asthma (Nonallergic or Nonatopic asthma)
  - Asthma episode cannot be directly linked to a specific antigen or extrinsic factor.
  - Onset usually occurs after the age of 40 years
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Asthma

Risk Factors
- Obesity
- Sex
  - The male sex is a risk factor for asthma in children
- Infections
- Exercise-induced asthma
- Outdoor/Indoor air pollution
- Drugs, food additives, and food preservatives

Risk Factors
- Gastroesophageal reflux
- Sleep (nocturnal asthma)
- Emotional stress
- Perimenstrual asthma (catamenial asthma)

Diagnosis
- The presence of any of these signs and symptoms should increase the suspicion of asthma:
  - Wheezing—history of any of the following:
    - Cough, worse particularly at night
    - Recurrent wheeze
    - Recurrent difficult breathing
    - Recurrent chest tightness

Diagnosis
- Symptoms occur or worsen at night, awakening the patient
- Symptoms occur or worsen in a seasonal pattern.
- The patient also has eczema, hay fever, or a family history of asthma or atopic diseases.

Diagnosis
- Symptoms occur or worsen in the presence of:
  - Animals with fur
  - Aerosol chemicals
  - Changes in temperature
  - Domestic dust mites
  - Drugs (aspirin, beta blockers)
  - Exercise
  - Pollens
  - Respiratory (viral) infections
  - Smoke
  - Strong emotional expression
Diagnosis

- Symptoms respond to appropriate anti-asthma therapy.
- Patient’s colds “go to the chest” or take more than 10 days to clear up.

Diagnostic Tests

- Spirometry
- Peak expiratory flow
- Responsiveness to metacholine, histamine, mannitol, or exercise challenge
- Positive skin tests with allergens or measurement of specific IgE in serum

Classification of Asthma Severity by Clinical Features Before Treatment

Moderate Persistent
- Symptoms daily
- Exacerbations may affect activity and sleep
- Nocturnal symptoms more than once a week
- Daily use of inhaled short-acting β₂-agonist
  * FEV₁ or PEF ≥ 80% predicted
  * PEF or FEV₁ variability < 20%

Severe Persistent
- Symptoms daily
- Frequent nocturnal asthma symptoms
- Limitation of physical activities
  * FEV₁ or PEF ≤ 60% predicted
  * PEF or FEV₁ variability > 30%

Mild Persistent
- Symptoms more than once a week but less than once a day
- Exacerbations may affect activity and sleep
- Nocturnal symptoms more than twice a month
  * FEV₁ or PEF ≥ 80% predicted
  * PEF or FEV₁ variability < 20 - 30%

Intermittent
- Symptoms less than once a week
- Brief exacerbations
- Nocturnal symptoms not more than twice a month
  * FEV₁ or PEF ≥ 80% predicted
  * PEF or FEV₁ variability < 20%
Overview of the Cardiopulmonary Clinical Manifestations Associated with Asthma

The following clinical manifestations result from the pathophysiologic mechanisms caused (or activated) by:
- Bronchospasm
- Excessive Bronchial Secretions

Clinical Data Obtained at the Patient’s Bedside

The Physical Examination

- Vital Signs
  - Increased
    - Respiratory rate (Tachypnea)
    - Heart rate (pulse)
    - Blood pressure

The Physical Examination (Cont’d)

- Use of accessory muscles of inspiration
- Use of accessory muscles of expiration
- Pursed-lip breathing
- Substernal intercostal retractions
The Physical Examination (Cont'd)

- Increased anteroposterior chest diameter
  - barrel chest
- Cyanosis
- Cough and sputum production

The Physical Examination (Cont'd)

- Pulsus paradoxus
  - Decreased blood pressure during inspiration
  - Increased blood pressure during expiration

The Physical Examination (Cont'd)

- Chest Assessment Findings
  - Expiratory prolongation (I:E ratio > 1:3)
  - Decreased tactile and vocal fremitus
  - Hyperresonant percussion not
  - Diminished breath sounds
  - Diminished heart sounds
  - Wheezing and rhonchi

Clinical Data Obtained from Laboratory Tests and Special Procedures

Pulmonary Function Test Findings

Moderate to Severe Asthmatic Episode
(Obstructive Lung Pathophysiology)

Forced Expiratory Flow Rate Findings

<table>
<thead>
<tr>
<th>FVC</th>
<th>FEV₁</th>
<th>FEV₁/FVC ratio</th>
<th>FEF₂₅%-₇₅</th>
</tr>
</thead>
<tbody>
<tr>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FEF₅₀%</th>
<th>FEF₂₀₀-₁₂₀₀</th>
<th>PEFR</th>
<th>MVV</th>
</tr>
</thead>
<tbody>
<tr>
<td>↓</td>
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<td>↓</td>
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</tbody>
</table>

Lung Volume & Capacity Findings

<table>
<thead>
<tr>
<th>VT</th>
<th>IRV</th>
<th>ERV</th>
<th>RV</th>
<th>VC</th>
</tr>
</thead>
<tbody>
<tr>
<td>N or ↑</td>
<td>N or ↓</td>
<td>N or ↓</td>
<td>↑</td>
<td>↓</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IC</th>
<th>FRC</th>
<th>TLC</th>
<th>RV/TLC ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>N or ↓</td>
<td>↑</td>
<td>N or ↑</td>
<td>N or ↑</td>
</tr>
</tbody>
</table>
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Asthma

### Arterial Blood Gases

#### Asthmatic Episode

**Mild to Moderate Stages**

Acute Alveolar Hyperventilation with Hypoxemia

(Acute Respiratory Alkalosis)

<table>
<thead>
<tr>
<th>pH</th>
<th>PaCO₂</th>
<th>HCO₃⁻</th>
<th>PaO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>↑</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
</tr>
</tbody>
</table>

**Severe Stage**

Acute Ventilatory Failure with Hypoxemia

(Acute Respiratory Acidosis)

<table>
<thead>
<tr>
<th>pH</th>
<th>PaCO₂</th>
<th>HCO₃⁻</th>
<th>PaO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>↓</td>
<td>↑</td>
<td>↑</td>
<td>↓</td>
</tr>
</tbody>
</table>

### Oxygenation Indices

**Moderate to Severe Stages**

<table>
<thead>
<tr>
<th>Qₛ/Qₜ</th>
<th>D0₂</th>
<th>V0₂</th>
<th>C(a-v)O₂</th>
<th>O₂ER</th>
<th>SvO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>↑</td>
<td>↓</td>
<td>N</td>
<td>N</td>
<td>↑</td>
<td>↓</td>
</tr>
</tbody>
</table>

### Abnormal Laboratory Tests and Procedures

- Sputum examination
  - Eosinophils
  - Charcot-Leyden crystals
  - Casts of mucus from small airways (Kirschman spirals)
- IgE level (elevated in extrinsic asthma)
Radiologic Findings

- Chest radiograph
  - Increased anteroposterior diameter (barrel chest)
  - Translucent (dark) lung fields
  - Depressed or flattened diaphragms

GINA

- The Global Initiative for Asthma (GINA) was launched in 1993 in collaboration with the following organizations:
  - National Heart, Lung, and Blood Institute (NHLBI) of the National Institutes of Health, and the
  - World Health Organization (WHO)

GINA's specific goals are the following:
- Increase awareness of asthma and its public health consequences
- Promote identification of reasons for the increased prevalence of asthma
- Promote study of the association between asthma and the environment
- Reduce asthma morbidity and mortality
- Improve management of asthma
- Improve availability and accessibility of effective asthma therapy

GINA

- Provides a user friendly, evidence-based program for the management of asthma
  - Use of the evidence-based guidelines provided by NAEPP
  - Resources gathered worldwide from asthma experts and researchers
GINA’s Five Components of Asthma Care

Component 1: Develop Patient/Doctor Partnership
- Avoid risk factors
- Take medications correctly
- Understand the difference between “controller medications” and “reliever” medications (also called rescue medications)
- Monitor the status using symptoms and, if relevant, PEFR
- Recognize signs that asthma is worsening and take action
- Seek medical help as appropriate

Component 2: Identify and Reduce Exposure to Risk Factors
- Strategies for avoiding common allergens and pollutants
- Avoid:
  - Tobacco smoke
  - Drugs, foods, and additives
  - Occupational sensitizers

Component 3: Assess, Treat, and Monitor Asthma
- Assessing Asthma Control
- Treating to Achieve Control
- Monitoring to Maintain Control

Component 4: Manage Asthma Exacerbations

Component 5: Special Considerations in Managing Asthma

Table 12-1 Controller Medications Commonly Used to Treat Asthma Excerpts

<table>
<thead>
<tr>
<th>Generic Name</th>
<th>Brand Name</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inhaled Corticosteroids</strong></td>
<td></td>
</tr>
<tr>
<td>Beclomethasone dipropionate</td>
<td>QVAR</td>
</tr>
<tr>
<td>Triamcinolone acetonide</td>
<td>Azmacort</td>
</tr>
<tr>
<td>Flunisolide</td>
<td>Aerobid, AeroBid-M</td>
</tr>
<tr>
<td>Flunisolide hemihydrate</td>
<td>Aerospan</td>
</tr>
<tr>
<td>Fluticasone propionate</td>
<td>Flovent HFA, Flovent Diskus</td>
</tr>
<tr>
<td>Ciclesonide</td>
<td>Alvesco</td>
</tr>
<tr>
<td>Budesonide</td>
<td>Pulmicort Turbuhaler</td>
</tr>
<tr>
<td>Mometasone Furate</td>
<td>Asmanex Twishalter</td>
</tr>
</tbody>
</table>

Table 12-1 Controller Medications (Cont’d)

<table>
<thead>
<tr>
<th>Generic Name</th>
<th>Brand Name</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Systemic Corticosteroids</strong></td>
<td></td>
</tr>
<tr>
<td>Prednisone</td>
<td>Deltasone</td>
</tr>
<tr>
<td>Methylprednisolone</td>
<td>Medrol, Solu-Medrol</td>
</tr>
<tr>
<td>Hydrocortisone</td>
<td>Solu-Cortef</td>
</tr>
<tr>
<td>Prednisolone</td>
<td>Opapred</td>
</tr>
</tbody>
</table>
### Table 12-1: Controller Medications Commonly Used to Treat Asthma Excerpts (Cont’d)

<table>
<thead>
<tr>
<th>Generic Name</th>
<th>Brand Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salmeterol</td>
<td>Serevent</td>
</tr>
<tr>
<td>Formoterol</td>
<td>Foradil</td>
</tr>
<tr>
<td>Arformoterol</td>
<td>Brivana</td>
</tr>
<tr>
<td>Long-Acting β₂-Agents (LABA)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Generic Name</th>
<th>Brand Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluticasone/sameterol</td>
<td>Advair Diskus</td>
</tr>
<tr>
<td>Budesonide/formoterol</td>
<td>Symbicort</td>
</tr>
<tr>
<td>Inhaled Corticosteroids &amp; Long-Acting β₂-Agents</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Generic Name</th>
<th>Brand Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cromolyn sodium</td>
<td>Intal</td>
</tr>
<tr>
<td>Nedocromil</td>
<td>Tilde</td>
</tr>
<tr>
<td>Mast-cell-Stabilizing Agents</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Generic Name</th>
<th>Brand Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zafirlukast</td>
<td>Accolate</td>
</tr>
<tr>
<td>Montelukast</td>
<td>Singular</td>
</tr>
<tr>
<td>Zileuton</td>
<td>Zyflo</td>
</tr>
<tr>
<td>Leukotriene Inhibitors (antileukotrienes)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Generic Name</th>
<th>Brand Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Omalizumab</td>
<td>Xolair</td>
</tr>
<tr>
<td>Monoclonal Antibody</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Generic Name</th>
<th>Brand Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxtriphylline</td>
<td>Choledyl SA</td>
</tr>
<tr>
<td>Aminophylline</td>
<td>Aminophylline</td>
</tr>
<tr>
<td>Dyphylline</td>
<td>Dylix, Lufyllin</td>
</tr>
<tr>
<td>Xanthine Derivatives</td>
<td></td>
</tr>
</tbody>
</table>
### Table 12-2  
Reliever Medications (Rescue Medications)  
Commonly Used to Treat Asthma Excerpts (Cont’d)

<table>
<thead>
<tr>
<th>Generic Name</th>
<th>Brand Name</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ultra Short-Acting Bronchodilator Agents</strong></td>
<td></td>
</tr>
<tr>
<td>Epinephrine</td>
<td>Adrenaline CL Epinephrine Mist Primatene Mist</td>
</tr>
<tr>
<td>Racemic epinephrine</td>
<td>MicroNefrin</td>
</tr>
<tr>
<td>Isoetharine</td>
<td>Isoetharine</td>
</tr>
<tr>
<td><strong>Short-Acting Adrenergic Bronchodilator Agents (SABA)</strong></td>
<td>(β₂-Agents)</td>
</tr>
<tr>
<td>Metaproterol</td>
<td>Alupent</td>
</tr>
<tr>
<td>Albuterol</td>
<td>Proventil, Ventolin, AccuNeb, Proair</td>
</tr>
<tr>
<td>Pributerol</td>
<td>Maxair Autohaler</td>
</tr>
<tr>
<td>Levalbuterol</td>
<td>Xopenex</td>
</tr>
<tr>
<td><strong>Anticholinergic (COPD)</strong></td>
<td></td>
</tr>
<tr>
<td>Ipratropin Bromide</td>
<td>Atrovent</td>
</tr>
<tr>
<td>Tiotropium</td>
<td>Spiriva</td>
</tr>
</tbody>
</table>

| **β₂-Agents & Anticholinergic Agents** | |
| Ipratropium and albuterol | Combivent, DuoNeb |

### Component 4: Manage Asthma Exacerbations

- Asthma exacerbation is defined as a progressive increase in shortness of breath, cough, wheezing, or chest tightness, or a combination of these symptoms.

### Table 12-3  
Classification of Severity of Asthma Exacerbations Excerpts

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Mid</th>
<th>Moderate</th>
<th>Severe</th>
<th>Respiratory arrest imminent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breathless</td>
<td>Walking Can lie down</td>
<td>Talking Prefers sitting</td>
<td>At rest Hunched forward</td>
<td>Erratic resp. or apnea</td>
</tr>
<tr>
<td>Talk in</td>
<td>Sentences Phrases Words Silent</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 12-3: Classification of Severity of Asthma Exacerbations

<table>
<thead>
<tr>
<th>Signs</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
<th>Respiratory arrest imminent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory rate</td>
<td>Increased</td>
<td>Increased</td>
<td>Often &gt; 30/ min</td>
<td>Erratic resp. or apneic</td>
</tr>
<tr>
<td>Use of accessory muscles</td>
<td>Usually not</td>
<td>Usually</td>
<td>Usually</td>
<td>Paradoxical thoraco-abdominal movement</td>
</tr>
</tbody>
</table>

### Table 12-3: Classification of Severity of Asthma Exacerbations

<table>
<thead>
<tr>
<th>Signs</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
<th>Respiratory arrest imminent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheeze</td>
<td>Moderate, often only end expiration</td>
<td>Loud</td>
<td>Usually loud</td>
<td>Absence of wheeze</td>
</tr>
<tr>
<td>Pulse/min</td>
<td>&lt; 100</td>
<td>100-120</td>
<td>&gt;120 (adult)</td>
<td>Bradycardia</td>
</tr>
</tbody>
</table>

### Component 5: Special Considerations in Managing Asthma—Excerpts

- Pregnancy
- Surgery
- Rhinitis, Sinusitis, and Nasal Polyps
- Occupational Asthma
- Respiratory Infection
- Gastroesophageal reflux
- Aspirin-induced asthma
- Anaphylaxis

### Respiratory Care Treatment Protocols

- Oxygen Therapy Protocol
- Bronchopulmonary Hygiene Therapy Protocol
- Aerosolized Medication Protocol
- Mechanical Ventilation Protocol