**Asthma Basics**
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**Disclosures**
- I have no perceived conflicts of interest or commercial relationships to disclose.

**Objectives**
- Discuss the pathophysiology of asthma, including the role that mast cells and eosinophils play in the inflammatory process involved in this disease.
- Recognize the signs and symptoms associated with asthma.
- Discuss the options for diagnostic testing for the diagnosis and management of asthma.
- Formulate a treatment plan for the disease process using various medication and non medication therapies.
ETIOLOGY OF ASTHMA

INFLAMMATION IS KEY

- Asthma is a chronic inflammatory process
- Results of inflammation
  - Airway obstruction
  - Airway hyper-responsiveness
  - Limitation of airflow
- “Swelling and squeezing”
**AIRWAY REMODELING**

- Long-standing chronic inflammation can lead to permanent remodeling changes in the lungs
  - Sub-basement fibrosis
  - Mucous hypersecretion
  - Injury to epithelial cells
  - Smooth muscle hypertrophy
  - Angiogenesis

**WHAT CAUSES ASTHMA TO DEVELOP?**

- Likely a combination of genetic predisposition and environmental triggers
- Atopy (genetic predisposition for the development of an immunoglobulin E (IgE)-mediated response to common aeroallergens) is the strongest identifiable predisposing factor for developing asthma
- Viral infections can be both a trigger for onset and exacerbations of asthma

**WHICH VIRAL INFECTION IS MOST COMMONLY ASSOCIATED WITH THE DEVELOPMENT OF ASTHMA?**

- A. Metapneumovirus
- B. RSV
- C. Rhinovirus*
- D. Parainfluenza
** Signs & Symptoms of Asthma

- Wheezing
- Coughing
- Shortness of Breath
- Chest Tightness
- Difficulty with Exercise
- Nighttime Cough
- Throat Clearing
- Recurrent “bronchitis” or “pneumonia”
**Diagnosing Asthma**

**Spirometry**
- Gold standard for diagnosing asthma
- Usually obtainable in patients 6 years and older
- Measures airflow volumes and flow rates during a forced expiratory maneuver
- Typically done pre and post bronchodilator
- Improvement of 12% or 200 L in FEV1 is consistent with a diagnosis of asthma

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**National Jewish Health**

*Science Transforming Life*
**SPIROMETRY FINDINGS IN ASTHMA**

- Asthma is an obstructive pattern, not restrictive
- FVC usually normal
- FEV1 reduced
- Look at FEV1/FVC ratio
  - <20 years =>85%
  - 20-39 years =>80%
  - 40-59 years =>75%
  - 60-80 years =>70%
- Reversibility = 12% or 200 ml improvement in FEV1 after bronchodilator

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### Predicted vs. Pt Result

<table>
<thead>
<tr>
<th></th>
<th>Predicted</th>
<th>CI</th>
<th>Pt Result</th>
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<tbody>
<tr>
<td>FVC</td>
<td>3.16</td>
<td>0.6</td>
<td>3.10</td>
</tr>
<tr>
<td>FEV1</td>
<td>2.83</td>
<td>0.51</td>
<td>2.39</td>
</tr>
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**The Ratio**

15 year old Caucasian female, 60" tall

Acceptable FVC range = 2.56 – 3.66 L
Acceptable FEV1 range = 2.32 – 3.34 L

Interpreted as normal, but is it?
Interpretation of FEV1 without knowing FVC can be misleading

Patients who usually have results >100% of predicted (large lungs) can have obstruction even with “normal” results based on predicted values

The “Ratio” = FEV1/FVC gives a true representation of the degree of obstruction

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15 year old Caucasian female, 60” tall
FEV1/FVC = 77% which shows obstruction

Normal:
- <18 years = 85%
- 20-39 years = 80%
- 40-59 years = 75%
- 60-80 years = 70%
**What if Spirometry is Normal?**
- Normal spirometry does not rule out asthma
- Additional bronchoprovocation testing may be needed to confirm diagnosis
  - Methacholine challenge
  - Eucapnic voluntary hyperventilation (EVH)
  - Exercise challenge
- Many patients are treated clinically without confirmation of an asthma diagnosis

**So What About the Little Ones?**
- Asthma can be diagnosed in any age
- Diagnosis based on:
  - Symptom patterns
  - Response to medications
  - Ruling out other common causes
  - Risk factors
  - Modified Asthma Predictive Index

**Modified Asthma Predictive Index**
- Used to predict asthma in patients <3 years with at least 4 episodes of wheezing in the past year
- Major predictors (one or more = positive):
  - Parent with asthma
  - Child with eczema
  - Child with environmental allergies (skin test/Immunocap)
- Minor predictors (two or more = positive)
  - Food allergies
  - Eosinophilia >4%
  - Wheezing outside of colds
- About 75% accurate in predicting which children will have developed asthma in 5 years
DIFFERENTIAL DIAGNOSIS WHEN CONSIDERING ASTHMA

IF NOT ASTHMA, THEN WHAT IS IT?
- Vocal cord dysfunction (will revisit later)
- Airway lesions or congenital malformations
- Foreign body aspiration
- Chronic aspiration
- CHF
- COPD
- Reflux
- Allergies/chronic sinusitis
- Cystic fibrosis

ASTHMA TREATMENT GUIDELINES
EPR-3 Asthma Guidelines


- 74 page summary report vs 440 page full report

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EPR-3 Asthma Guidelines

- Four Components of Asthma Care
  - Assessing Severity, Monitoring Control
  - Education
  - Control of Triggers
  - Medications

- All four are equally important in treating asthma!
**Poll - Which would you rather have?**

A. Severe persistent asthma that is controlled*
B. Mild persistent asthma that is difficult to control

**Asthma Severity**

- Based on level of:
  - Impairment
  - Risk
- Assessed at the initial visit
  - Mild intermittent
  - Mild persistent
  - Moderate persistent
  - Severe persistent

**Assessing Severity**

[Table or diagram suggesting assessment criteria for asthma severity]
ASSESSING SEVERITY

- Therapy initiated based on level of severity

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**STEPWISE APPROACH FOR MANAGING ASTHMA LONG-TERM**

The stepwise approach follows the selection of medication to the level of asthma severity and stage of the disease control as per the guidelines. This approach is meant to tailor the medication to the patient's needs.

<table>
<thead>
<tr>
<th>Step</th>
<th>Medication Options</th>
<th>Dose Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>Inhaled Corticosteroids (ICS)</td>
<td>Low dose</td>
</tr>
<tr>
<td>Step 2</td>
<td>Long-Acting β-agonists (LABA)</td>
<td>Add-on to ICS</td>
</tr>
<tr>
<td>Step 3</td>
<td>Oral Steroids</td>
<td>Add-on to LABA</td>
</tr>
<tr>
<td>Step 4</td>
<td>Inhaled Anticholinergics</td>
<td>Add-on to LABA and ICS</td>
</tr>
<tr>
<td>Step 5</td>
<td>Combination Therapy</td>
<td>Add-on to LABA and ICS</td>
</tr>
</tbody>
</table>

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**ESTIMATED COMPARATIVE DOSE CHARTS**

- Dose selected based on step and age

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**ASSESSING SEVERITY**

- Dose selected based on step and age

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**ASSESSING SEVERITY**

- Therapy initiated based on level of severity
## Asthma Control

Control is assessed at all subsequent visits
- Well controlled
- Not well controlled
- Very poorly controlled

### Assessing Control

<table>
<thead>
<tr>
<th>Component of Control</th>
<th>Well Controlled</th>
<th>Not Well Controlled</th>
<th>Very Poorly Controlled</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>&lt; 2</td>
<td>2-3</td>
<td>&lt; 2</td>
</tr>
<tr>
<td></td>
<td>&lt; 4</td>
<td>4-6</td>
<td>&lt; 4</td>
</tr>
</tbody>
</table>

### Assessing Control - Asthma Control Test

1. In the past 4 weeks, how often did your asthma keep you from getting as much done at work, school, or at home?
   - Never
   - Rarely
   - Sometimes
   - Most of the time
   - All of the time

2. During the past 4 weeks, how often have you had shortness of breath?
   - Never
   - Rarely
   - Sometimes
   - Most of the time
   - All of the time

3. During the past 4 weeks, how often did your asthma prevent you from engaging in your normal activities (such as chores, work, or school) or did you miss time away from work or school because of your asthma?
   - Never
   - Rarely
   - Sometimes
   - Most of the time
   - All of the time

4. During the past 4 weeks, how often have you used your rescue inhaler or other medication (such as corticosteroids)?
   - Never
   - Rarely
   - Sometimes
   - Most of the time
   - All of the time

5. How would you rate your asthma control during the past 4 weeks?
   - Poor
   - Fair
   - Good
   - Very good
   - Excellent
**ASSESSING CONTROL**

Therapy adjusted based on level of control

**ASSESSING CONTROL**

Determine current step and adjust per recommendations

**STEPWISE APPROACH FOR MANAGING ASTHMA LONG TERM**

The stepwise approach takes the section of medication to the level of control needed over time to be at a step below the new level of control. This chart provides an outline of medication adjustments and recommendations. The therapy should be adjusted based on the level of control and age. The current level of control is determined by the physician and assessed at each visit.

**ASSESSING CONTROL**

Dose selected based on step and age

**ESTABLISHED CONSERVATIVE DAILY DOSES FOR CONTINUOUS MEDICATIONS FOR LONG TERM ASTHMA CONTROL**

<table>
<thead>
<tr>
<th>Drug Name</th>
<th>≤ 1 year of age</th>
<th>1 to 2 years of age</th>
<th>3 to 5 years of age</th>
<th>6 to 11 years of age</th>
<th>≥ 12 years of age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Levalbuterol</td>
<td>0.6 to 1.2 mg</td>
<td>1.2 to 2.4 mg</td>
<td>2.4 to 4.8 mg</td>
<td>4.8 to 9.6 mg</td>
<td>9.6 to 18 mg</td>
</tr>
<tr>
<td>Albuterol</td>
<td>0.5 to 1 mg</td>
<td>1 to 2 mg</td>
<td>2 to 4 mg</td>
<td>4 to 8 mg</td>
<td>8 to 16 mg</td>
</tr>
<tr>
<td>Tiotropium</td>
<td>2.5 to 5 mg</td>
<td>5 to 10 mg</td>
<td>10 to 20 mg</td>
<td>20 to 40 mg</td>
<td>40 to 80 mg</td>
</tr>
</tbody>
</table>

Note: The dosages are based on the age of the patient and should be adjusted based on the level of control and any side effects. The therapy should be reviewed and adjusted at each visit.
**ASSESSING SEVERITY & CONTROL**
- General rule of treatment: step up when you need to, step down when you can
- Maintain the patient on the lowest dose of medication that effectively controls symptoms
- Treatment plan should be individualized based on the patient's triggers and patterns
  - Seasonal patterns due to allergies
  - Viral infections during winter

**ASTHMA EDUCATION**

**ASTHMA EDUCATION IS KEY!**
- Disease Process
  - Inflammation
  - Bronchospasm
- Triggers and how to avoid
  - Viral infections
  - Allergens
  - Irritants, especially cigarette smoke!!!
  - Exercise
  - Emotions
  - Cold air
**Asthma Education is Key!**

- **Role of medications**
  - Controller medications vs rescue medications
  - Safety of inhaled steroids vs oral steroids

  **Responding to Patient Questions about Inhaled Corticosteroids**

  - Questions and worries about inhaled corticosteroids (ICS) are common and may affect adherence to treatment. It is important to discuss the role of ICS at regular follow-ups. In share with patients and families.
  - "ICS are the most effective medications for long-term control of asthma attacks. Since ICS are strong, they are often taken to prevent symptoms and reduce the need for rescue medication. ICS should be taken every day to prevent asthma symptoms and exacerbations."
  - "The potential risks of ICS are well balanced by their benefits. It is important to discuss the side effects of ICS and to work with their doctors to find the lowest dosage that maintains asthma control, and to consider the patient's response to ICS." It is important to discuss the risks and benefits of ICS and to work with patients to find the lowest dosage that maintains asthma control.
  - "Asthma inhalers with higher inhaled dose, should be avoided in children and patients with asthma exacerbations or symptoms more sensitive to inhaled doses.

- **Safety concerns regarding LABA's**
  - "I heard on TV this could kill me...."

  **Responding to Patient Questions about Long-Acting Beta2-Agonists**

  - "The administration of LABA for maintenance control of asthma in patients with asthma exacerbations or symptoms more sensitive to inhaled doses."
  - "A large clinical trial found that slightly more deaths occurred in patients taking a combination of LABA and ICS compared to patients taking ICS alone (3.5 per 1000 patients treated with LABA and ICS vs 2.7 per 1000 patients treated with ICS alone)."
  - "LABA should not be used as monotherapy for asthma control."
  - "It is recommended that patients are monitored closely for any signs of severe exacerbations, although the risk of severe exacerbations is low." It is recommended that patients are monitored closely for any signs of severe exacerbations.

- **Metered Dose Inhalers Should be Used Without a Spacer by Patients Over the Age of 18**

  A. True
  B. False*
**Asthma Education is Key!**

- Technique for inhaling medications
  - EVERY PATIENT SHOULD BE USING A SPACER WITH ALL MDI’S!!!!!!!
  - Only 5-20% of dose delivered without spacer
  - Most common mistake—inhaling too fast
  - Issues with dry powder inhaler technique

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**Inspiratory Flow Influences Drug Deposition**

<table>
<thead>
<tr>
<th>Inspiratory Flow</th>
<th>Drug Deposition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Too Slow</td>
<td>Mouth</td>
</tr>
<tr>
<td>Too Fast</td>
<td>Throat</td>
</tr>
<tr>
<td>Correct Speed</td>
<td>Lungs</td>
</tr>
</tbody>
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**Spacers**

- Any device that captures the spray of an inhaler and separates the actuation and the breath into two separate steps
- Valved-holding chamber (VHC) – a special spacer with a one-way valve
- Send to pharmacy not DME company; may be e-prescribed
- Low budget spacer options
- Spacers can allow use of MDI’s with any age
**SPACERS**

**LOW BUDGET SPACER OPTIONS**

**INHALER TECHNIQUE—INFANTS/YOUNG TODDLERS**

1. Shake the inhaler several times (unless QVar)
2. Remove the plastic cap from the inhaler
3. Insert the inhaler into the rubber ring in the back of the chamber
4. Check the mask to make sure there is nothing in it
5. Place the mask over the nose and mouth with enough pressure to get a good seal
6. Spray one puff of medication into the chamber
7. Observe the child taking 5-6 breaths (may count also)
8. Remove the mask, allow the child to rest for at least a minute
9. Repeat steps 5 through 9 if a second puff is prescribed
INHALER TECHNIQUE—PRESCHOOLERS

1. Shake the inhaler several times (unless QVar)
2. Remove the plastic cap from the inhaler
3. Insert the inhaler into the rubber ring in the back of the chamber
4. Check the mask to make sure there is nothing in it
5. Place the mask over the nose and mouth with enough pressure to get a good seal
6. With the mask in place, ask the child to blow out to empty the lungs
7. Spray one puff of medication into the chamber
8. Coach the child to take a SLOW DEEP breath in for the count of 4
9. Count while the child holds their breath (10 seconds is optimal)
10. Remove the mask, allow the child to exhale and rest for at least a minute
11. Repeat steps 5 through 10 if a second puff is prescribed

INHALER TECHNIQUE—SCHOOL AGE & UP

1. Shake the inhaler several times (unless QVar)
2. Remove the plastic cap from the inhaler
3. Insert the inhaler into the rubber ring in the back of the chamber
4. Check the mouthpiece of the chamber to make sure there is nothing in it
5. Exhale fully
6. Place the mouthpiece of the chamber in your mouth
7. Spray one puff of medication into the chamber
8. Take a SLOW DEEP breath in, taking XX seconds to fill your lungs completely (determined by formula below from FEV1)
9. Hold your breath for 10 seconds
10. Exhale and relax for at least a minute
11. Repeat steps 5 through 10 if a second puff is prescribed

TREATING CO-MORBIDITIES
CO-MORBIDITIES

- Co-morbidities can worsen asthma control if left untreated
- Most common
  - Allergic rhinitis
  - Chronic sinusitis
  - Gastroesophageal reflux
  - Obesity

CLINICAL PEARLS – ALLERGIC RHINITIS

- Hypertonic saline (3%) saline nasal rinses
- Dust mite covers
- Proper technique for nasal steroids
- Avoidance of triggers (pets, etc)

CLINICAL PEARLS – CHRONIC SINUSITIS

- Hypertonic saline (3%) saline nasal rinses
- Treat empirically with broad spectrum antibiotic for 14-21 days
CLINICAL PEARLS – REFLUX
○ H2 blocker therapy to start with in a THERAPEUTIC DOSE
○ Consider adding Atrovent for asthma symptom flares
○ Non-pharmacologic interventions
  ● Elevate head of bed
  ● No food or drink 2 hours prior to bed
  ● Small frequent meals, avoid overeating
  ● Avoid trigger foods

CLINICAL PEARLS – OBESITY
○ Pretreating with SABA prior to activity to encourage regular exercise
○ Food diaries
○ Other appropriate interventions

VOCAL CORD DYSFUNCTION
The Great Asthma Imitator
Vocal Cord Dysfunction

- Condition where vocal folds are “twitchy” or adduct during breathing
- Causes acute shortness of breath, especially with exercise
- Can cause stridor
- Often misdiagnosed as exercise-induced asthma
- Not responsive to asthma meds

Treated with breathing exercises
- Sometimes complicated by reflux
- Referral to speech therapy may be indicated