Asthma

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Asthma

- Common chronic inflammatory disease of the airways.

- It is characterized by:
  - Variable, recurring and reversible symptoms
  - Bronchospasm
  - Underlying inflammation or swelling
  - Increased mucous production

![Diagram of normal and asthmatic bronchioles]
Incidence and Prevalence

- Most common diagnosis among hospitalized children
- Accounts for 15% of hospital admissions
- Most common chronic lung disease in children. Affects 5-15%
- Incidence
  - Pre pubertal: M>F
  - Post pubertal: F>M
- Prevalence and M&M:  
  - Puerto Rican and Non-Hispanic black children > Non-Hispanic white children
- All wheeze is not Asthma
  - In early infancy → asymptomatic by 6 years of age

Asthma Pathophysiology

2 main processes that occur in Asthma:

1) Contraction (spasm) of bronchial smooth muscle
2) Inflammation of airway, leading to increased mucous

This occurs in the lower airways (bronchi and bronchioles)

Both of these processes result in decreased diameter of airway lumen.

Imagine “breathing through a straw”
Asthma Pathology

- Inflammatory cell infiltration
- Thickened basement membrane
- Focal epithelial loss
- Smooth muscle hypertrophy

Who is at risk of developing asthma?

Asthma is a condition that results from multiple factors:

- Genetics
- Environment
Increased risk of developing asthma

- **Genetics**
  - Complex genetics
  - 25+ specific genes have been identified as increasing asthma risk
    - Genes associated with modulating the immune system
    - Many more likely to be discovered
  - **Family history of atopy** (Predilection to produce specific IgE following exposure to allergen) is STRONGLY ASSOCIATED
  - **African-American Ancestry**

Increased risk of developing asthma

- **Environment**
  - Increase in symptoms when exposed to:
    - Exposure to allergens (major trigger)
    - Tobacco Smoke
    - Pollution
  - Some viruses acquired at young age can increase risk later in childhood:
    - RSV
    - Rhinovirus
Increased risk of developing asthma: Viruses

Patterns of Pediatric Asthma

- There are 2 main patterns commonly seen in pediatric asthma:

1) Intermittent
2) Persistent
Intermittent Asthma

- Onset is common in infants and toddlers
- Viral illness = commonly cause of exacerbation
- Symptoms are absent between exacerbations
  - Weeks, months, or years symptom-free between episodes of asthma
- May become less frequent as child grows older
  - Often less frequent exacerbations
    due to less frequent viral infections

Persistent Asthma

- Onset is later
  - Common around the time children enter school
- Symptoms are persistent
  - No periods of time without symptoms present
  - Cough (particularly at night) is common
- Asthma type associated with “Atopic Triad"
- Associated with positive allergy testing (allergic rhinitis) and atopic dermatitis (eczema)
Classification of Asthma

### Diagnosing asthma

- Patients under 5 years old:
  - Diagnosis is made by observation
  - By definition, asthma is reversible with the appropriate treatment
  - Some places will trial a few days of oral steroid or beta agonists (albuterol)
  - Parents monitor for improvement in symptoms
    - To count as successful treatment, the improvement must be obvious
    - Often occurs within the first 48 hours of treatment
  - Clear improvement with steroid = Asthma
Diagnosing asthma

For patients 5 years old and up:
- Diagnosis is made by observation, in addition to pulmonary function testing (PFTs)

Pulmonary function tests are a helpful tool for diagnosing asthma:
- FEV1/FVC more sensitive estimate of airflow limitation compared to FEV1 alone.

Disadvantages:
- Relies on correct technique

Asthma Triggers

Allergens:
- Animal dander from feathered or furry pets
- Cockroach droppings
- Dust mites
- Molds
- Pollen

Other:
- Chemicals and strong smells
- Environmental tobacco smoke or second hand smoke
- Air pollution
- Weather changes
- Upper respiratory infections
- Cold air
- Strong emotions
- Exercise
- Certain medicines: Beta Blocker, Aspirin
- GERD
BOTH intermittent and persistent asthma can:

- Be serious and life-threatening
- Result in hospitalization and need for ICU care
- Require an asthma plan of action

Symptoms of Asthma

- Asthma is characterized by recurrent episodes of:
  - Wheezing
    - Widespread high pitched musical wheezes-
    - Characteristic but not specific. Mostly expiratory.
    - Polyphasic vs monophasic (local bronchial narrowing).
  - Coughing
  - Shortness of breath
  - Chest tightness

- Asthma can be present without having all of the above symptoms.
- Clubbing not present unless secondary issue (CF, ILD etc)
- Allergic rhinitis + Asthma: Pale, boggy nasal mucosa
- Atopic dermatitis+ asthma: Lichenified plaques on flexural distribution
Symptoms of Severe Asthma Exacerbation

- Tachypnea, Tachycardia, Hypoxia
- Prolonged expiratory phase of respiration (decreased I:E ratio)
- Tripod Position: Seated position with use of extended arms to support the upper chest.
- Use of the accessory muscles of breathing (e.g., sternocleidomastoid)
- Pulsus paradoxus (greater than 12 mmHg fall in systolic blood pressure during inspiration).

- These signs are insensitive manifestations of severe airflow obstruction; their absence does not exclude the possibility of a severe asthmatic attack.
- Absence of wheeze with above signs: Impending respiratory failure

Assessing a patient with respiratory distress

- Providing prompt treatment to a patient in respiratory distress is critical.

- Asthma can progress rapidly
  - Resulting in quick deterioration of the patient’s clinical status
Assessing a patient with respiratory distress

Physical examination begins when you look at the patient:

- **Work of breathing**
  - ... Does the patient appear distressed?
  - ... Can the patient comfortably speak, drink, or eat?

- **Retractions**
  - ... Does the patient appear to be “sucking in” around their chest, or “belly-breathing”?

- **Late findings: cyanosis, altered mental status, unresponsive**
  - These findings are serious and require immediate action

Retractions are seen with increased work of breathing.

- They are present due to the use of accessory muscles of respiration
  - **Suprasternal:** Tugging inward at base of neck above clavicles
  - **Subcostal:** Movement in anterior inferior chest, around the epigastric area
    - Can look like “belly-breathing”
  - **Intercostal:** Sucking in of the skin between each of the ribs
    - Can be seen on sides of chest at the rib angle
Retractions: Suprasternal and Subcostal

Assessing a patient with respiratory distress

Physical exam: Listening

- Audible breathing without the stethoscope
  - Is it inspiratory or expiratory?
    - This can help localize the area of the airway responsible for distress

- Auscultation with stethoscope:
  - Wheezing
    - Monophonic vs. polyphonic
  - Stridor
  - Crackles (Rales)
    - Fine vs. Coarse
General rules for noisy breathing:

INSPIRATORY noise (when breathing IN):
- Obstruction is occurring in LARGE AIRWAY(S)
- Pharynx, larynx, supraglottis/proximal trachea
- Inspiratory noises are associated with stridor or stertor
  - Stridor: High-pitched sound produced by turbulent airflow through a partially obstructed airway
    - Croup is the leading cause of stridor in children
  - Stertor: Heavy snoring inspiratory sound that can occur with obstruction of the larynx or upper airways

EXPIRATORY noise (when breathing OUT):
- Obstruction is occurring in SMALL AIRWAY(S)
- Middle to distal trachea, bronchi to terminal bronchioles
- Expiratory noises are associated with wheeze
  - Monophonic
  - Polyphonic: “musical” sound, varied pitch
    - Polyphonic wheeze is associated with asthma

Assessing a patient with respiratory distress

- Important vital signs:
  - Respiratory rate
  - Oxygen saturation (SpO2)
  - Heart rate
  - Temperature

- Key lab results:
  - Capillary blood gas
  - CBC
  - CRP

- Other diagnostics:
  - Chest x-ray
    - AP and lateral
Blood Gas

- Blood gasses:
  - Hypoxemia and hypocarbia – early
  - Hypoxemia and hypercarbia – impending respiratory failure

- Initially, a patient with asthma may have a gas consistent with hyperventilation when experiencing an exacerbation.
  - Low pCO2 and respiratory alkalosis is common finding early on.
  - Example: pH 7.45  pCO2 30

- An elevated CO2 in a patient presenting with asthma exacerbation is an ominous sign.
  - Example: pH: 7.25  pCO2 60
  - The patient is likely “tiring out” and can not maintain appropriate ventilation
  - These patients should be monitored closely
    - May require observation or care in ICU

Chest X-ray in Asthma

- Indicated in new onset asthma symptoms, difficult to control asthma with co-morbid conditions, or worsening symptoms (cough, hypoxia, fever etc)
- Helps rule out other causes of increased work of breathing
  - Eg. pneumonia, pneumothorax, foreign body
- Typical findings with asthma:
- Findings:
  - B/L thickened bronchovascular markings
  - Hyperinflation
    - Flatting of the diaphragms
    - Increased AP diameter
    - Count the ribs
  - Sub-segmental atelectasis may be seen
    - Sometimes this can be mistaken for infiltrate
      (Right Middle Lobe Syndrome)
Managing Asthma

Treatment of asthma: Acute exacerbation

Recall the two main causes of asthma:

1) Bronchospasm
2) Inflammation
Treatment of asthma: Acute exacerbation

- Bronchospasm = Treated with β2-adrenergic agonists
  - Short acting, eg. Albuterol, Terbutaline, Xopenex, others
    - Commonly used
  - Long acting, eg. Salmeterol,
    - Not used as often due to black box warnings
    - Still used for difficult-to-control asthma

Quick Relief Medications

- Albuterol for Nebulizer
- Ventolin
- Maxair Autohaler
- Proventil
- Generic Albuterol
Treatment of asthma: Acute exacerbation

- $\beta$ 2-adrenergic agonists work by relaxing smooth muscle in airways.
  - Best for symptomatic relief of asthma symptoms
  - Side effects are similar to adrenalin
    - Rapid heart rate, tremors

Inflammation = Treated with Corticosteroids

- IV (Methylprednisolone, others)
  - Use IV if patient in severe distress
- PO (Prednisolone, Prednisone, Dexamethasone, others)
  - Can be an option if patient can comfortably speak, drink, and eat
Treatment of asthma: Acute exacerbation

- Corticosteroids work by modulating immune system to decrease inflammation in airways.
  - More critical to treating asthma exacerbation effectively
  - Can take 12-24 hours before steroids take full effect

Treatment of asthma: Acute exacerbation

- Most important: Give corticosteroid early!

- $\beta$-adrenergic agonists will help with symptoms
  - Will NOT treat underlying inflammation that is causing asthma to progress

Steroids are the key to preventing asthma exacerbations from evolving further.
Steroid dosing

- Important to give adequate steroid doses in order to see clinical improvement.
- Prednisone (Prednisolone): 2 mg/kg per day, max 60 mg/day, once or twice a day divided dosing.
- Dexamethasone (less side effects): 0.6 mg/kg daily (maximum 16 mg) is as effective as a five-day course of oral prednisone.
- Methylprednisolone: 2 mg/kg per day, max 60 mg/day, once or twice a day divided dosing.

- Duration: Anywhere from 1-10 days.
- Tapering not needed unless patient on chronic steroids or needed steroids >10 days.
  - Decreasing the dose by 50 percent every two to three day.

Other Treatments for acute exacerbations:

- Systemic epinephrine, terbutaline (beta agonists), Theophylline, Magnesium Sulphate, Ipratropium bromide, Heliox
- Lobar Collapse in asthma: Chest Physiotherapy
- Antibiotic therapy: If concern of superimposed bacterial infection
- Pneumothorax: general management
- Oxygen:
  - To keep sats >92-94% and continuous pulse oximetry
  - All nebulized meds should be delivered with oxygen generally at a flow rate of 6-8 l/min.
- Mechanical ventilation
Asthma management:
Outpatient Setting

Asthma management in the outpatient setting is focused on:

- Management of daily symptoms
  - Can be a problem for patient with chronic asthma

- Prevention of future asthma exacerbations
  - Asthma plan of action
  - Education of plan, inhaler technique
Long-Term, Control Medications

Decrease the inflammation/swelling

Spacers
Asthma management: Outpatient Setting

For a child with intermittent asthma:

- Most important is what to do during an exacerbation
- Start oral steroid early to prevent progression of symptoms
  - At UIHC, we give steroid-on-hand for parents to have at home
  - Parents start steroid if using albuterol:
    - 4+ times in an hour
    - >4 times per day
    - No obvious improvement with albuterol
- Albuterol should be used to manage symptoms until steroid begins working
- Goal: Prevention Hospitalization

Asthma management: Outpatient Setting

- Sometimes, intermittent asthma can progress to persistent asthma.

- Is Asthma under good control (RULES OF 2’s)
  - Does the child need a “quick-relief inhaler” more than TWO TIMES A WEEK?
  - Does the child wake up at night with asthma more than TWO TIMES A MONTH?
  - Does the family refill the “quick-relief inhaler” more than TWO TIMES A YEAR?

- If patient shows persistent, daily symptoms, they require daily maintenance medications.
Asthma management: 
Outpatient Setting

- Asthma plan for managing future asthma exacerbations is key to preventing hospitalization, morbidity, and mortality.
- Reviewing steroid doses and at what point to use them.
- Length of steroid course, when to call if no improvement.
- Educating on proper inhaler technique.

Risk of Death

- Sudden, severe exacerbations
- Intubation
- Admission to ICU
- ≥ 2 hospitalizations in the past year
- 3 or more ED visits in the last year
- Hosp/ED visit in the last month
- Oral corticosteroids
- > 2 canisters per month of quick relief
- Poor perception of asthma symptoms
- Psychiatric/psychosocial problems
- Low socioeconomic status/urban living
- Alternaria (mold) sensitivity
- Illicit drug use
Mucus Plug

Asthma Care Plans

- Care plans can be used to determine how to help a child with asthma based on symptoms and/or peak flow meter readings.

- **List asthma medications, when to take them, and how much to take.**

- **Share copies with childcare providers, school teachers and administration, coaches, babysitters, and anyone else caring for the child.**
Asthma Action Plans

Diaries help track
- Asthma symptoms
- Use of medicines
- Peak flow numbers
- Triggers you’ve been in contact with

Diaries improve communication with your doctor
Summary

Questions?

Thank You

That was so funny I almost had an asthma attack!