Inhalers
Asthma
Anatomy & Physiology
Cancer
All that wheezes is not... Treasure State

100  100  100  100  100  100
200  200  200  200  200  200
300  300  300  300  300  300
400  400  400  400  400  400
500  500  500  500  500  500

The technique for breathing in this type of inhaler is very rapid.
What is a dry powder inhaler (DPI)?

Mean inspiratory flow rate:
- Foradil aerolizer >60 L/min
- Spiriva Handihaler >60 L/min
- Pulmicort flexhaler >30 L/min
- Advair diskus >30 L/min

Every patient with asthma should have this type of inhaler.

What is a quick-relief short-acting beta₂-agonist rescue inhaler?

SABA
- albuterol (Proair, Ventolin, Proventil)
- or
- lev-albuterol (Xopenex)
These 2 inhaled corticosteroids have the smallest particle size and may result in better efficacy and less side effects.

What are Qvar and Alvesco?
Beclomethasone (Qvar) and Ciclesonide (Alvesco)
Small-particle ICS: 1.1 micron
• Reaches small airways (lung deposition 58%)
• Improved safety profile; less drug in oropharynx.
Low incidence of candida (<1%)

This combination inhaler for COPD containing a short-acting beta₂-agonist (SABA) and short-acting muscarinic antagonist (SAMA) was reformulated with a new delivery system.
What is Combivent Respimat?

Albuterol + ipratropium: 1 inhalation qid

This combination inhaler is approved for COPD but not asthma and does not contain an inhaled corticosteroid.

What is Anoro Elipta?

Combines LAMA Anticholinergic (umeclidinium) + LABA (vilanterol)

Dose: 1 puff daily
This controller class of drug is the preferred therapy for treating persistent asthma.

What are inhaled corticosteroids (ICS)?

This oral medication for asthma is also FDA approved for treating allergic rhinitis and would very helpful in aspirin-induced asthma.
What is Singulair (montelukast)?

Leukotriene receptor antagonist.
- Granules (4 mg)
- Chew tab (4 mg)
- Tabs (5 or 10 mg)

Once daily

This complication of acute asthma presents as neck or throat pain with dyspnea.

What is a pneumomediastinum?

Characteristic of high-risk asthmatic:
- Previous life-threatening attack
- Delay in seeking care
- Pulsus paradoxus
- PEF <100 L/s
- Poor response to beta agonist
- Diminishing consciousness
- $P_aCO_2$ normal or rising
This complication of severe asthma presents as hypoxemia and decreased breath sounds occurring after mechanical ventilation.

**Topic II 400 Question**

**What is pneumothorax?**


**Tx:** general anesthesia, heliox, ECMO, asthma meds, chest tube

**Topic II 400 Answer**

This monoclonal antibody is administered by injection for treatment of moderate to severe allergic asthma (and now FDA approved for chronic hives).
What is Omalizumab (Xolair) anti-IgE antibody?

- asthma symptom and attacks
- steroid use (po and ICS)
- urgent visits, ED, hospitalization
- No increase in FEV1 or improvement in BHR
- allergy sx; improve QOL

This organ of respiration has 3 lobes on the right and 2 lobes on the left.

What are the lungs?

Surface area: >1000 sq ft.
Half of tennis court
This lung disorder is defined by chronic inflammation, bronchoconstriction and bronchial hyper-reactivity.

What is Asthma?

COPD is made up of these 2 forms of lung disease.
What is chronic bronchitis and emphysema?

This microscopic part of the airway can be permanently thickened from uncontrolled airway inflammation due to asthma.

What is the basement membrane or airway smooth muscle?
These diagnoses (obesity, scoliosis, IPF, hypersensitivity pneumonitis, ALS, muscular dystrophy) can show this type of general abnormality on lung function testing.

What is **Restrictive Lung Disease**?

This single round or oval "spot" in the lungs measuring <3 cm as seen on chest x-ray or CT scan may be from many different causes.
What is a solitary pulmonary nodule?

Causes of solitary pulmonary nodules:
>50%: benign lung tumors or granulomas from previous infections (TB, Aspergillus, Coccidiomycosis, Histoplasmosis, cryptococcosis).
<50%: cancer

This is the most common group of lung cancer representing 85% of all lung cancers.

What is non-small cell lung cancer?

Types:
- Non-small cell carcinoma
- Small-cell carcinoma
- Other or unspecified

Diagram showing the distribution of the different types of non-small cell lung cancer.
10-15% of lung cancers are of this type, spread quickly and occur almost always in smokers.

What is small cell or oat cell cancer?

Risk Factors: smoking and radon

Smoking: >80% smoked

Survival rates:
- Stage I: 31%
- Stage II: 19%
- Stage III: 8%
- Stage IV: 2%

This rare lung tumor (also seen in the GI tract) grows slowly and releases active hormones leading to flushing, diarrhea and difficulty breathing.
What are Lung Carcinoid Tumors?

AKA: lung neuroendocrine tumors
Age >60 years old
Slow growing
Sx: bloody cough, wheezing, SOB, chest pain
Carcinoid Syndrome: Flushing, diarrhea
Diagnosis: 5-HIAA, Chromogranin-A

Lung tumors that occur in individuals <40 yrs old, who are nonsmokers and the nodule is small and has calcium in it are likely to have this type of tumor.

What is a Benign Lung Tumor?

Risk factors for lung cancer:
• Smoking, radon, asbestos exposure
• Arsenic, chromium, nickel exposure
• Older age
• Large size
• Non-calcified
• Family history of lung cancer
This genetic lung disease is due to a mutation in delta F508 gene that codes to transmembrane conductance regulator gene on chromosome 7 (CFTR gene).

What is Cystic Fibrosis?

Presentation: by 6-8 months

- Chronic/recurrent cough
- DOE, chest pain
- Prolonged bronchiolitis
- Recurrent wheezing
- Recurrent pneumonia
- Atypical asthma
- Pneumothorax
- Hemoptysis
- Clubbing

Other:
- Recurrent sinusitis
- Nasal polyps
- Chronic diarrhea
- FTT
- Meconium ilius

This rare lung disorder presents as dyspnea with emphysema in <50 year olds who don’t smoke.
What is α₁-antitrypsin deficiency?

- Emphysema in 20-50 y/o nonsmokers
- 1:1500 to 1:3500: Mutations in the SERPINA1 gene
- FHx: emphysema and/or liver disease
- High prevalence of asthma in ZZ AAT deficient pts
- Inhibits proteolytic enzyme elastase
- Dx: serum AAT level <50-80 mg/dL
- PFT: FEV1 43%; Bronchiectasis: 2-43%
- Tx: Lifelong weekly IV infusions pooled human AAT

A teenage over-achiever with difficulty breathing on inspiration, this spirometry and poor response to albuterol may have this condition.

What is vocal cord dysfunction?

- May coexist with asthma!
- Poor response to asthma medications
- High achievers, women, +/- GER
- Difficulty on "inspiration"
- Spiro: truncated inspiratory loop
- Laryngoscopy
- Tx: facilitated breathing exercises
An asthmatic who presents with worsening asthma, fever, “pneumonia” brown sputum and eosinophilia may have this.

What is ABPA (Allergic Bronchopulmonary Aspergillosis)?

In asthma (1-2%) and CF (1-15%)

- History of asthma
- Skin test positive to Aspergillus
- Precipitating serum antibodies to Aspergillus
- Serum IgE>1000 ng/mL
- Blood eosinophilia >500/mm³
- Lung infiltrates or bronchiectasis on CXR or HRCT
- Elevated Aspergillus serum IgE and IgG

A 12 yr old boy had a cold with cough. The nasal symptoms resolved, but the cough continues every day, but never at night. No treatment has helped. He may have this.
What is habit cough or factitious cough?

Difficult to diagnose
No response to appropriate therapy
Seal bark, coughing fits, harsh “annoying” cough
Many pts have medical knowledge
Symptoms do not occur during sleep
If distracted, sx can resolve temporarily
Psychiatric disease can be severe

This is the official state flower of Montana.

What is the bitterroot?

• Seldom eaten raw, for its bitter taste and resultant swelling caused great discomfort!
• American natives boiled the root, then mixed it with meat or berries.
At this resort there are 2 oversized swimming pools and 2 soaking pools. They are fed by a virtually unlimited supply of 155° natural hot springs water, cooled to various temperatures.

What is **Fairmont Hot Springs Resort**?

This road in Glacier National Park is considered one of the most scenic drives in America.
What is the Going to the Sun Road?

What is the only North American gem to be included in the Crown Jewels of England?

What is the Montana Yogo Sapphire?
Also known as Ursus Arctos Horribilis, this is the official animal of the state of Montana.

What is the Grizzly Bear?

Lung Infections  ZZZZs  Medicine  Cough  More Asthma  Lung Immunology  PFTs
200  200  200  200  200  200  200
400  400  400  400  400  400  400
600  600  600  600  600  600  600
800  800  800  800  800  800  800
1000 1000 1000 1000 1000 1000 1000
This common winter virus causes bronchiolitis in infants and may be a risk factor for developing asthma.

What is RSV (respiratory syncytial virus)?
- Most infected by age 2 years
- Bronchiolitis
- Pneumonia
- Apnea

In 2014, the U.S. experienced an outbreak of this virus that was responsible for triggering severe asthma and paralysis in children.
**What is a **Enterovirus D68**?**

- Most common in summer and fall
- One of more than 100 non-polio enteroviruses
- 10 cases in Montana

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**Lung infection with pneumatoceles by this bacteria is common in patients with Job’s Syndrome (Hyper-IgE Syndrome).**

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**What is Staphylococcus?**

Hyper-IgE Syndrome: primary immune deficiency
Mutations in transcription factor STAT3
Staph abscesses: lung and skin
Severe eczema in newborns
Typical facial appearance
Joint hyper-extensibility
Retained primary teeth
Recurrent bone fractures from minimal trauma
Very high IgE levels >100x normal and eosinophilia
Infection with this organism is responsible for “Walking Pneumonia” and exacerbating asthma.

What is Mycoplasma pneumonia?

- Community-Acquired Pneumonia (CAP): most common cause in young adults and milder than bacterial infections.
- Precede the development of asthma
- Acute asthma attack: 3.3 to 50% of attacks (PCR)
- Chronic asthma: 45% of adults + PCR

After weeks of recurrent soaks in a hot tub, a person develops “interstitial pneumonia” with this organism.
What is **Mycobacterium Avium Complex**?

"Hot Tub Lung" Hypersensitivity Pneumonitis  
CXR: interstitial pattern  
PFT: obstruction or restriction with low DLCO  
Flu-like symptoms with cough/dyspnea  
Bronch: lymphocytes  
Bx: granulomas  
Tx: avoidance and oral steroids

Major symptoms of this disorder are loud snoring, daytime sleepiness, pauses in breathing while asleep, and episodes of waking at night feeling short of breath or gasping for air.

What is **sleep apnea**?

Excessive and inappropriate daytime sleepiness  
Loud snoring virtually every night  
Apneas witnessed by bed partner  
Episodes of waking feeling short of breath or gasping for air  
Insomnia  
Problems with memory and/or concentration  
Impotence  
Changes in mood, particularly depression  
Fatigue
This treatment of sleep apnea is designed to deliver a continuous level of air pressure to keep the airway open.

What is CPAP (Continuous Positive Airway Pressure)?

This scale is used to determine how sleepy a person is during the day.
What is the Epworth Sleepiness Scale?

<table>
<thead>
<tr>
<th>Situation</th>
<th>Chance of Dozing or Sleeping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitting and reading</td>
<td>0 = would never doze</td>
</tr>
<tr>
<td>Watching TV</td>
<td>1 = slight chance of dozing</td>
</tr>
<tr>
<td>Sitting inactive in a public place</td>
<td>2 = moderate chance of dozing</td>
</tr>
<tr>
<td>Being a passenger in a car for an hour or more</td>
<td>3 = high chance of dozing</td>
</tr>
<tr>
<td>Lying down in the afternoon</td>
<td></td>
</tr>
<tr>
<td>Sitting and talking to someone</td>
<td></td>
</tr>
<tr>
<td>Sitting quietly after lunch (no alcohol)</td>
<td></td>
</tr>
<tr>
<td>Stopped for a few minutes in traffic while driving</td>
<td>0 = sleepy</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Total score (This is your Epworth score)</td>
<td></td>
</tr>
</tbody>
</table>

0 = would never doze
1 = slight chance of dozing
2 = moderate chance of dozing
3 = high chance of dozing

This “index” in a sleep study is key in diagnosing sleep apnea when combined with pulse oximetry.

What is the Apnea Hypopnea Index (AHI)?

AHI: number of apneas or hypopneas recorded during the study per hour of sleep.

Based on AHI, severity of OSA is classified as:
- None/Minimal: < 5 per hour
- Mild: 5 to < 15 per hour
- Moderate: 15 to < 30 per hour
- Severe: ≥ 30 per hour
This surgical procedure for sleep apnea removes the bell-shaped organ that hangs from the top of the throat.

What is a uvullectomy?

This bacterial infection, if not promptly treated, is responsible for the 100 day cough. The vaccine requires boosters.
What is **Bordetella Pertussis**?

“Whooping cough”  Whoop on inspiration.
Teens and adults don’t whoop!
Initial: cold-like symptoms 1-2 weeks.
Cough: violent, rapid
Highly contagious
Treatment (before cough starts): macrolide
Vaccine: DTaP

This disorder of the GI tract causing chronic cough can be a primary problem or be a comorbid condition with asthma.

What is **GE reflux**?

Understanding the Relationship Between Asthma and GERD
- Does GERD cause asthma symptoms?
  - Indirect cause (reflux theory)
  - Direct cause (reflux theory)
- Does asthma cause GERD?
  - Asthma leads to weakening of lower esophageal sphincter
  - Coughing increases the abdominal pressure
  - Increased risk of GERD
- Certain anti-reflux medications may increase risk of asthma
  - H2 blockers
  - Calcium-containing compounds
This cause of chronic cough is more common in young children, elderly, intoxicated, and those with poor dentition.

What is aspiration or inhaled foreign body?

Presentation:
Cyanosis
Cough or wheeze
Incompletely resolved pneumonia
Localized bronchiectasis

This blood pressure medication is a frequent cause of chronic cough.
What is an ACE inhibitor?
Angiotensin-converting enzyme (ACE) inhibitors
Affects 20% or more of pts who receive ACEi
Dry cough
Class effect (may occur with all ACEi).
Resolution of cough: within days to weeks.
May be associated with URI symptoms.
Higher risk: Women, ACE genotype II, black or Asian ethnicity

A patient presents with chronic nasal congestion, post nasal drip, halitosis and chronic cough. He likely has this condition.

What is chronic sinusitis?
When the nose/sinuses produce extra mucus, it can drip down back of the throat triggering cough reflex. This is Upper Airway Cough Syndrome.
This common perennial allergen, mite lead to allergies and asthma with symptoms worse upon awakening.

What is **house dust mite**?

Indoor asthma triggers:

**Allergens:**
Dust mite, animal dander, feathers, cockroach, mold

**Irritants:**
Smoke, cleaning chemicals, fragrance, fireplace

An adult with daytime asthma symptoms 3 days/week, nighttime symptoms 2 x/week and FEV1 55% has this severity of asthma.
What is severe persistent asthma?

This type of asthma results from a high dose exposure from a noxious substance in a person without a history of asthma.

What is RADS (Reactive Airways Dysfunction Syndrome)?

Respiratory sx: minutes or hours after a single accidental inhalation of a high concentration of irritant gas, aerosol, or smoke. Followed by asthma-like symptoms and persistent airway hyper-responsiveness. Example: World Trade Center 9/11.
Deficiency of this vitamin is associated with decreased responsiveness to inhaled steroids and difficult-to-control asthma.

What is Vitamin D?
In children and adults with asthma
Low Vitamin D levels have been associated with:
Abnormal lung function.
Increase in asthma flare-ups.
Lower response to treatment (inhaled steroids).

This new asthma treatment uses heat delivered through a bronchoscope to treat refractory asthma.
What is Bronchial Thermoplasty?
Outpatient procedure
3 sessions
Reduce asthma attacks by 32%
for at least 5 years
84% reduction in ER visits

This white blood cell is the primary cell involved in allergic asthma.

What are eosinophils?
This white blood cell (WBC) has been associated with severe asthma and asthma deaths.

What is a neutrophil?

Neutrophils:
- Most abundant (40% to 75%) type of WBC
- An essential part of innate immune system.
- Short-lived and highly mobile.
- Controlled by T_h17 cells

This antibody is involved in 50% of adults with asthma and most children with asthma.
What is IgE (immunoglobulin E)?

The lowest concentration of all immunoglobulins
Binds to allergens and triggers release of substances from mast cells and basophils causing inflammation.

This family of eicosanoid inflammatory mediators produced in leukocytes by the oxidation of arachidonic acid by the enzyme arachidonate 5-lipoxygenase plays a role in asthma and allergies.

What are Leukotrienes?

Name leukotriene:
Introduced in 1979
Comes from words leukocyte and triene (indicating the compound's 3 conjugated double bonds).
Biological targets for treating the immune response in asthma is directed at these 3 Interleukins.

What are IL-4, IL-5, IL-13??

- **Interleukin 4 (IL-4):** a cytokine that induces differentiation of naive helper T cells to TH2 cells
- **Interleukin 5 (IL-5):** stimulates B cell growth and is a key mediator in eosinophil activation.
- **Interleukin 13 (IL-13):** effects like IL-4

This breathing test should be performed on all patients over 5 years old who need an asthma evaluation.
What is spirometry?

This breath analysis test can measure airway inflammation “directly.”

What is FeNO (exhaled nitric oxide)?
This “light test” estimates the amount of oxygen in a person’s blood and “normal” results can be found in carbon monoxide poisoning.

What is pulse oximetry?
Normal Oxygen saturation level 95-100%
Factors affecting pulse ox:
• Hypothermia/shivering
• Vasoconstriction
• Hypotension
• Smokers/CO poison: falsely normal
• Methemoglobinemia: falsely low

This test when positive is a classic hallmark of symptomatic asthma
What is Methacholine challenge?
Bronchoprovocation: Bronchial hyperresponsiveness
0.05 to 25 mg/ml, Measure FEV1 at 1, 3, 5, 10 min
Positive test=PC20 Provocative concentration necessary to cause a 20% fall in FEV1

<table>
<thead>
<tr>
<th>PC20 mg/ml</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;16</td>
<td>Normal bronchial responsiveness</td>
</tr>
<tr>
<td>4.0 - 16</td>
<td>Borderline BHR</td>
</tr>
<tr>
<td>1.0 - 4.0</td>
<td>MMB BHR (positive test)</td>
</tr>
<tr>
<td>&lt;1.0</td>
<td>Moderate to severe BHR</td>
</tr>
</tbody>
</table>

This measure of lung function on spirometry estimates the “small airways” by calculating the velocity of flow.

What is the FEF25-75?
Forced expiratory flow rate between 25th and 75th%.
Normal >65-70% of predicted.
Lower in asthmatics
A more sensitive way to assess: early detection, severity and progression of asthma.
This woman was married to a Frenchman, Toussaint Charbonneau, a member of the Lewis and Clark Expedition.

Who is Sacajawea?
Credits

Produced by Oregon Health Sciences University
Department of Internal Medicine

Software Template Design by David L. Shenson

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Comments and suggestions can be made by e-mail to dshenson@concentric.net