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Asthma & COPD

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Asthma

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Asthma – Reactive Airways Disease

- **Chronic disorder** that affects 7.5% of the adults in the US and up to 300 million people worldwide
- Asthma is primarily an **inflammatory disease**
 - More severe the inflammation, the more hyper-responsive the airways
- Pathophysiology:
 - **Bronchial Hyper-responsiveness of airways** to various stimuli (no or minimal effect on non-asthmatics)
 - Bronchial hyper-responsiveness is not unique to asthma
 - Resultant airflow obstruction which is characteristically **waxing and waning**
- Airflow obstruction is due to a variety of mechanisms
 - **Spasm** of smooth muscle in airway
 - **Edema** of the airway wall
 - Increased secretion of **mucus**

Asthma Epidemiology

- May develop at any age but is more common in children and young adults
- Children fall into one of 2 groups
 - Group 1 – intermittent symptoms, often related to viral illnesses
 - Younger age of onset
 - Frequently outgrow condition as they get older
 - Group 2 – more regular symptoms
 - Onset at an older age
 - More likely to have multiple allergies and a maternal history of asthma
 - Symptoms more persistent over time
- Adult onset of disease is less likely to resolve with longer duration
 - More likely to occur in women, especially in the perimenopausal period
 - More severe the disease the greater the likelihood that it will persist over time

Asthma – Atopic (Allergic) or Nonatopic

- Atopic variety is more common in children
 - Caused by external allergens
 - Associated with allergic type symptoms
 - Allergic rhinitis
 - Conjunctivitis
 - Atopic dermatitis
 - Urticaria
 - Food allergies
- Nonatopic type is more common in adults
 - Triggered by non-immune causes
 - Aspirin
 - Respiratory tract infections
 - Inhaled irritants
 - Stress
 - Exercise
 - Cold temperatures

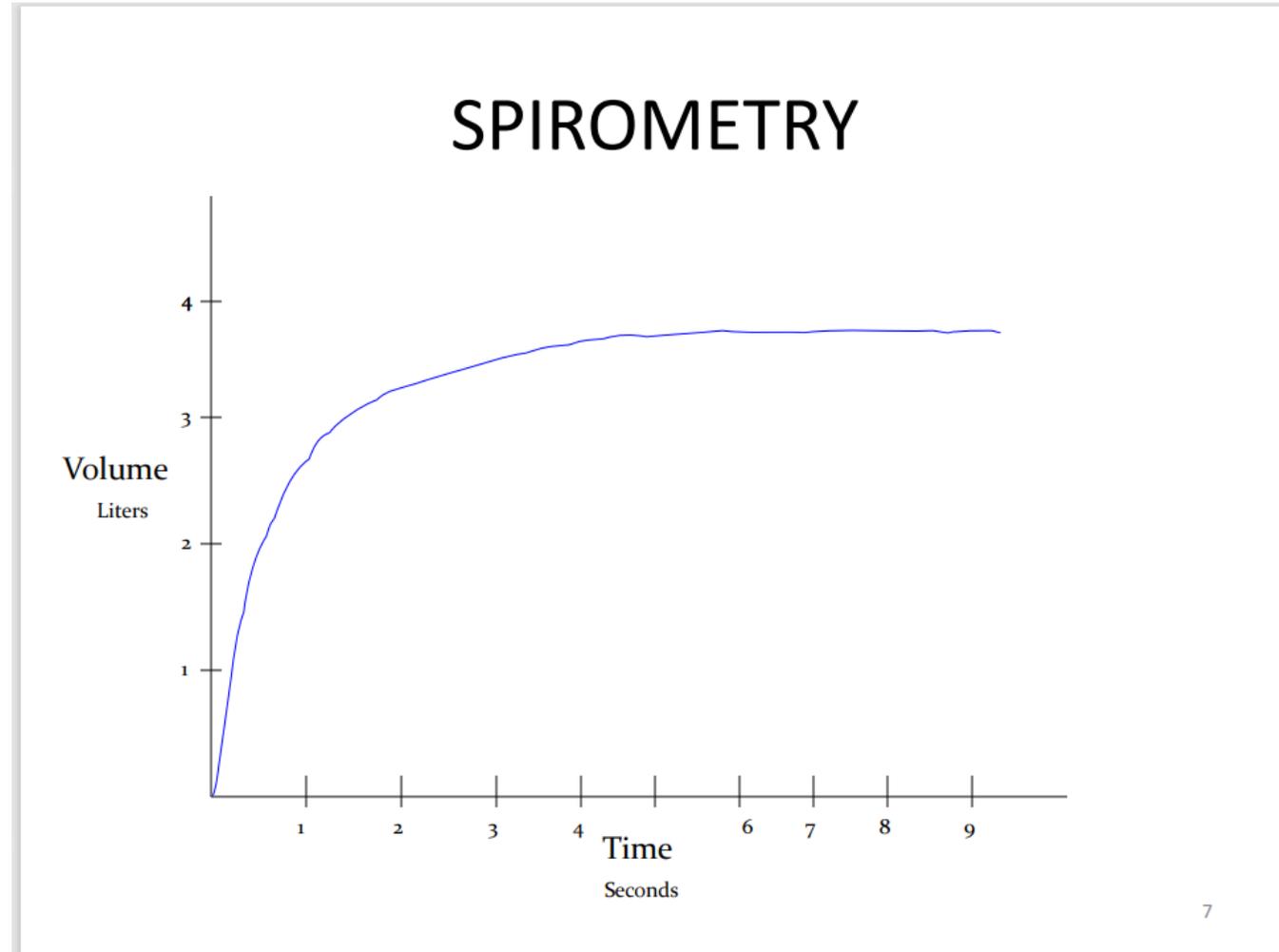
Asthma - Diagnosis

- Clinical signs and symptoms
 - intermittent shortness of breath
 - cough
 - wheezing
- Clinical Suspicion of Asthma → Spirometry
- Spirometry before and after bronchodilator administration should be performed for **all patients** with a history of dyspnea, chronic cough, reduced exercise tolerance, or asthma-like symptoms
- Spirometry - most commonly used pulmonary function test used to measure forced expiratory flow rates and volumes
 - Office spirometry
- Flow Volume Loops → plot of inspiratory and expiratory flow (on the Y-axis) against volume (on the X-axis) during the performance of maximally forced inspiratory and expiratory maneuvers

Office Spirometry

- Procedure
 - Patient is seated
 - With or without nasal occlusion (nose clip or manual occlusion)
 - Deep breath in before inserting the mouthpiece
 - Tight lip seal around the mouthpiece to prevent air leakage
 - Exhale for at least 6 seconds
 - Usually repeated 3 times (adequate rest in between)
 - Reproducibility is very important
 - Forced Vital Capacity (FVC) – 2 highest values must be within 0.15 L of each other
 - Forced expiratory volume in 1st second (FEV₁) – 2 highest values must be within 0.15 L of each other
 - Misclassification rates due to suboptimal spirometry performance or interpretation are relatively high in the office setting
 - Results should be verified by repeat testing in a Pulmonary Function Test (PFT) laboratory when important clinical decisions will be made based on the results

Spirometry Graph



Spirometry Interpretation

- FEV₁ versus FEV₁/FVC
- FEV₁/FVC
 - Most important parameter to make the diagnosis
 - Not to be used for monitoring
- FEV₁
 - Most important parameter to determine severity of airway obstruction
 - Used for serial monitoring in asthma & COPD

Spirometry Interpretation - <https://www.aafp.org/afp/2004/0301/p1107.html>

Spirometry Interpretation – Normal FEV₁/FVC (UpToDate.com)

Normal FEV₁/FVC:

- 8 to 19 years 85 percent
- 20 to 39 years 80 percent
- 40 to 59 years 75 percent
- 60 to 80 years 70 percent

Asthma – Reversibility

- Reversible obstruction is characteristic of asthma
 - Pulmonary function returns to normal or near normal status between attacks
 - Reversibility of airway obstruction can be detected on spirometry
 - Defined as a 200 ml or 12% or greater increase in FEV1 following 2 puffs of a bronchodilator

Asthma Severity

- **Defined by a combination of factors** (National Heart, Blood, and Lung Institute Expert Panel 2007)
 - Frequency of daytime symptoms
 - Nighttime awakenings
 - Frequency of use of short acting beta-agonist bronchodilators (rescue inhalers)
 - Degree of interference with normal activities
 - Measure of lung function (FEV1, FEV1/FVC ratio)
 - Number of exacerbations requiring use of oral systemic steroids
- **These factors define 4 major categories of severity**
 - Intermittent
 - Mild Persistent
 - Moderate Persistent
 - Severe
- **Status Asthmaticus is the most severe form of asthma**
 - Acute attack persists for days to weeks
 - May require hospitalization, often with mechanical ventilation
- **Asthma with persistent abnormalities of the FEV1 and ratio indicates permanent damage of the lungs**
 - It represents a **variant of COPD**

Asthma Severity by Criteria

Criteria	Intermittent	Mild Persistent	Moderate Persistent	Severe
Symptoms	2 days or less/ week	3 days or more per week, not daily	Daily	Multiple times per day
Night-time Awakenings	2 or less per month	3 or 4 per month	> 1 per week, not daily	Multiple times per week to daily
Rescue Inhaler Use	2 days per week or less	3 or more days per week, not daily	Daily	Several times per day
Interference with Normal Activity	None	Minor limitation	Moderate limitation	Extremely limited
FEV1	> 80%	≥ 80%	60-79%	< 60%
FEV1/FVC	Normal	Normal	Reduced ≤ 5%	Reduced > 5%
Exacerbations Requiring Oral Steroids	0 to 1 per year	≥ 2 per year	≥ 2 per year	≥ 2 per year

Asthma Therapy

- Basic treatments
 - Avoidance of known allergens or irritants
 - Allergy desensitization shots
 - Routine influenza and pneumonia vaccinations
 - Routine monitoring with a peak flow meter to detect the first sign of an exacerbation
 - A personalized action plan that addresses what to do in the event of an attack (time is critical)
 - Goal is to initiate treatment ASAP
- Medication treatment occurs in a stepwise fashion depending on the severity of the disease (GINA)
 - Intermittent
 - Mild Persistent
 - Moderate Persistent
 - Severe

Asthma Therapy

- Intermittent asthma
 - Short acting beta adrenergic drugs agonist
 - These drugs may be used as “rescue inhalers” for acute episodes in other categories of severity
- Mild persistent asthma
 - Requires drugs designed for long-term control
 - Mainstay is low dose inhaled steroids
 - Other drugs include leukotriene receptor antagonists (LTRA), cromolyn or theophylline
- Moderate persistent asthma
 - Moderate dose inhaled steroids or
 - Low dose inhaled steroids plus a long acting beta agonist inhaler (LABA) or
 - Low dose inhaled steroids plus LTRA or theophylline or leukotriene production inhibitor (Zyflo)
- Severe asthma
 - Minimum high dose inhaled steroids plus LABA
 - Other medications or procedures in addition to above that would suggest severe disease and include:
 - Chronic oral steroids
 - Biologic agents (Xolair, Nucala, Cinqair, Fasenra)
 - Therapeutic bronchial thermoplasty

Asthma Prognosis

- Most individuals with asthma are well controlled with basic therapy and appropriate medications
- Great majority with not require emergency room treatment or hospitalization
- In particular, the use of inhaled steroids has decreased the frequency of severe exacerbations and death rates
- Oral steroids in short bursts (5-10 day course) are particularly effective in terminating acute episodes
- Nevertheless, asthma may be associated with an increase in mortality in some individuals

Asthma Mortality

- Individuals who die from asthma have one of two patterns
- Pattern 1
 - Extended period of deterioration with an exacerbation of symptoms that fails to clear
 - Represents the majority of fatal episodes
 - Often associated with poor compliance with management
- Pattern 2
 - Affected individual has sudden deterioration of their clinical condition
 - Less common than pattern 1
 - Many in this group have a poor ability to recognize a worsening of their condition
 - Go rapidly from normal to very ill
 - Death may occur before they can reach medical help

Asthma – Factors Associated with Fatal and Near Fatal Episodes

- Past history of sudden severe asthmatic episodes (pattern 2)
- History of prior intensive care unit admission for asthma
- Prior history of endotracheal intubation for an asthma exacerbation
- Two or more hospitalizations for asthma in the past year
- Three or more ER visits for asthma in the past year
- A hospitalization or ER visit for asthma in the past month
- Reduced awareness of airflow obstruction and its severity
- Presence of significant cardiovascular disease or COPD
- Poor compliance with treatment for moderate to severe disease
- Frequent use (more than 2 canisters per month) of short acting beta adrenergic inhalers
- Current use of chronic oral steroids
- Recent withdrawal from oral steroids
- History of drug abuse
- Serious psychiatric illness which may affect asthma in several ways

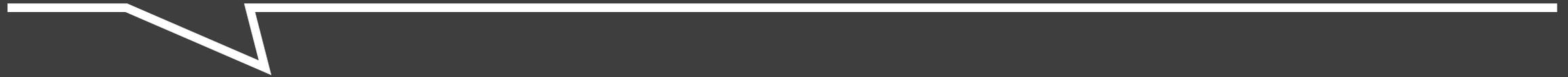
Asthma and Mental Illness

- Asthmatics are more likely to have mental illness
 - Especially anxiety and depression
- Severe mental illness is associated with worsened outcomes – particularly fatal and near fatal episodes
- Several factors associated with psychiatric illness are thought to lead to these worsened outcomes
 - Precipitation of acute attacks by psychological distress
 - Altered perception of the severity of the disease or attack
 - Direct physiological effects of anxiety and depression
 - Increased inflammation
 - Autonomic nervous system dysfunction
 - Poor compliance is more common in the presence of mental disorders

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COPD



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Chronic Obstructive Pulmonary Disease (COPD)

- COPD is the 4th leading cause of death in the US – kills 120 000 Americans every year
 - Affects 5% of the population
- Associated with a mixture of airway disease and anatomic destruction of lung tissue
- 3 Subtypes:
 - **Chronic bronchitis** = chronic productive cough
 - Present for 3 months in 2 consecutive years
 - Increased inflammation in airways and increased mucin production
 - **Emphysema** characterized by anatomic changes in lung
 - Destruction of the walls of alveoli (air exchange spaces in lung)
 - Results in enlargement of airspaces beyond the terminal bronchioles
 - **Chronic Obstructive Asthma** associated with inflammation and hyper-responsive airways
 - Asthma leads to transient obstruction of airways
 - If obstruction persists between attacks – constitutes a variant of COPD

COPD Risk Factors

- Cigarette smoking
 - Most important risk factor
 - Critical threshold is a 10 pack-year history of smoking
- Occupational exposure (dusts, chemicals, fumes etc.)
- History of chronic asthma
- Genetic factors (alpha-1-antitrypsin deficiency)
- Factors that influence lung development in childhood (low birth weight, severe infections, etc.)

COPD Diagnosis

- History & Examination
 - Symptoms: 3 cardinal symptoms are dyspnea, chronic cough, and sputum production
 - Exposure to cigarette smoke, other noxious gas exposure, occupational dust, family history of emphysema (Alpha-1 Antitrypsin Deficiency)
- Spirometry
 - Performed pre and post bronchodilator administration
 - Post bronchodilator FEV1:FVC < 70%
 - Partial or no reversibility post bronchodilator
- Pulse oximetry
 - Low oxygen saturation: < 92%
- GOLD system for classifying severity – uses 3 factors
 - Baseline Symptoms, Annual Exacerbations, Spirometry Results

COPD Assessment of Severity

- GOLD system:

1. Symptoms

- Breathless only with strenuous exercise
- Shortness of breath only with hurrying on level ground or walking up a slight hill
- Walk slower than people of the same age on a level surface because of breathlessness or has to stop for breathe when walking at own pace on a level surface
- Have to stop for breath when walking about 100 yards or a few minutes on level surface
- Too breathless to leave the house or breathless when dressing

2. Exacerbations in the last year

- 0 exacerbations
- 1 exacerbation without a hospital admission
- 2 or more exacerbations without a hospital admission
- 1 or more exacerbations with a hospital admission

COPD Assessment of Severity

3. Spirometry results for FEV1% - (FEV1/FVC must be < 0.7)

- FEV1 - $\geq 80\%$
- FEV1 - 50-79%
- FEV1 - 30-49%
- FEV1 - $< 30\%$

COPD Adverse Prognostic Factors

- Continued cigarette smoking
- Body mass index (BMI) < 21
- Decreasing exercise capacity
- Airway hyper-responsiveness
- CT evidence of emphysema
- Elevated C-reactive protein

COPD Assessment of Severity

- Based on symptoms and exacerbations individuals are placed in one of 4 GOLD classes - labeled A to D
 - GOLD A – low symptoms, low exacerbations
 - GOLD B – high symptoms, low exacerbations
 - GOLD C – low symptoms, high exacerbations
 - GOLD D – high symptoms, high exacerbations
- Combining these GOLD classes with spirometry results further subdivides the groups
 - Four subclasses of each GOLD grouping
 - A1, A2, A3D2, D3, D4
- Mortality correlates with each of these subclasses
 - Lowest at A1, highest at D4

COPD Mortality by Symptoms, Exacerbations and Spirometry (GOLD Subclass)

GOLD A	HR	GOLD B	HR	GOLD C	HR	GOLD D	HR
A1	1.00	B1	2.35	C1	1.53	D1	3.23
A2	1.26	B2	2.07	C2	1.86	D2	3.23
A3	1.91	B3	3.03	C3	2.63	D3	4.04
A4	3.06	B4	4.32	C4	3.63	D4	5.90

COPD Therapy – Varies with GOLD Class

- Discontinuation of cigarette smoking for all individuals
- GOLD A – low symptoms, low exacerbations
 - Short acting bronchodilators and/or short acting anticholinergic drugs
- GOLD B – high symptoms, low exacerbations
 - Long acting inhaled bronchodilators or long acting anticholinergic drugs
- GOLD C – low symptoms, high exacerbations
 - Long acting inhaled bronchodilators and/or long acting anticholinergic drugs
 - Inhaled corticosteroids in some cases
- GOLD D – high symptoms, high exacerbations
 - Triple therapy – long acting inhaled bronchodilators, long acting anticholinergics, inhaled corticosteroids

COPD Therapy – Additional Considerations

- Oral steroids generally used for acute exacerbations
 - Chronic use of steroids suggests very severe disease
- Antibiotics are used only for acute exacerbations
 - Generally not used chronically
- Several treatments are used only for severe or refractory disease
 - Oral phosphodiesterase-4 inhibitor – roflumilast (Dalisresp)
 - Oral theophylline
 - Home oxygen therapy
 - Lung reduction therapy
 - Lung transplantation

COPD Other Factors that Suggest Increased Severity

- Oxygen saturation less than 90%
- Polycythemia
- Evidence of right heart failure (cor pulmonale)

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