

Basic Course in Occupational and Environmental Medicine, Part III

Orlando, Florida, October 30, 2011

Occupational Lung Disease

Basic Course in Occupational Medicine
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Objectives

1. Establish basic understanding of Occupational Lung Disease
2. Learn about the OSHA Respiratory Standard
3. Learn about spirometry in the occupational setting
4. Discuss the basic categories of Occupational Lung Disease

Occupational Pulmonary Disease

- Significantly under reported
- One of top ten causes of occupational disability and death
- Importance of Recognition and Diagnosis
 - Minimizes health effects and disability
 - Enables appropriate treatment and response (including compensation)
 - Identification to prevent future exposures

Respiratory Tract

- Frequent Site of Injury from Occupational Exposures
 - Responses of Respiratory Tract to Injury
 - Acute include; sinusitis, laryngitis, bronchitis, alveolitis, and pulmonary edema
 - Chronic include; asthma, bronchitis, bronchiolitis, parynchymal fibrosis, bronchiolitis obliterans, pleural fibrosis, and cancer

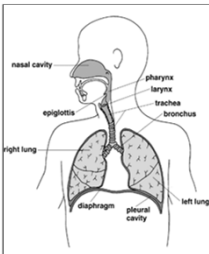
Respiratory Tract

- Size Matters

The smaller the particle the deeper it goes in the lung 5µm usually the cutoff between upper and lower airway (metal fumes and asbestos fibers)
- Solubility Matters

The less water soluble the further down in the lungs the substance goes (phosgene and nitrogen oxides)

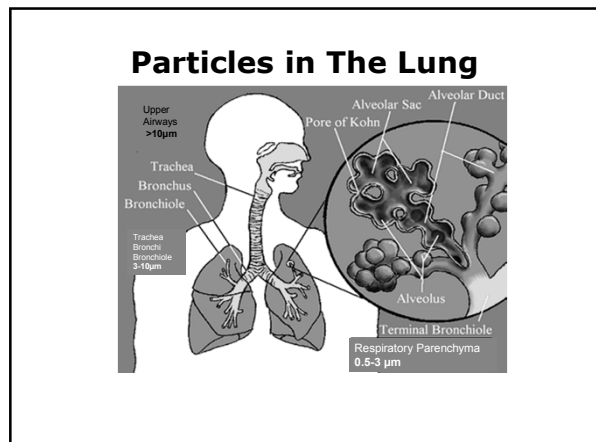
Respiratory Tract



<u>Water Solubility</u>	<u>Level of Impact</u>	<u>Compounds</u>
High	Eyes Nose Pharynx Larynx	Aldehydes Ammonia Chlorine Sulfur Dioxide
Medium	Trachea Bronchi	Ozone
Low	Bronchioles Alveoli	Nitrogen Phosgene

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Being a Good Occ Doc

- Industrial process (onsite visits)
- Job duties and tasks
- Protective equipment?
- Worksite evaluation (ventilation system, enclosed space?)
- Specific chemical exposure (MSDS)
- Physical form of exposure (dust vapor, etc)
- Understanding health effects of exposure
- History of plant compliance/ monitoring
- Employee relations and litigation

How do we measure risk?

- Risk is not = to Exposure alone
- Risk is not = to Toxicity alone
- Risk = Toxicity x Exposure

Exposure Dose vs. Response

- 1 Aspirin/Day \longrightarrow Protects CVD
- 5 Aspirin/Day \longrightarrow Cures Headache
- 20 Aspirins/Day \longrightarrow Relieves Arthritis
- 90 Aspirins/Day \longrightarrow Lethal

Exposures

- Timing of symptoms in relation to work
 - Worse at work or better at home
 - Coincide with introduction of new exposure or change in job description
 - Re-exposure relationship
- Evaluation of non-work exposures
- Home environment
- Recreational activities

Factors for host susceptibility

- Age
- Genetic make-up
- Co-morbid disease
- Nutrition
- Exposure Data
- Atopy
- Race
- Gender
- Cigarette Smoking
- Physical capacity
- Emotional factors

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Physician's Role in Diagnosis

Occupational History

- Include all work experiences
- Explore known and suspected exposures
- Hobbies
- Environmental exposures
- History of present illness (Symptoms)

Physician's Role in Diagnosis

Physical Examination

- Symptom overlap in lung disease
- Insensitive for mild respiratory disease
- Cyanosis, Clubbing
- Skin and Mucosal Irritation
- Lung examination
- Cor Pulmonale

Physician's Role in Diagnosis

Imaging Studies

- CXR routine part of workup, normal CXR does not rule out disease and findings do not necessarily correlate with degree of injury
- Insensitive for mild respiratory disease
- ILO classification for Pneumoconioses B reader
- CT more sensitive than CXR, HRCT even more sensitive

Physician's Role in Diagnosis

Pulmonary Function Testing

- Detect and quantitate abnormal lung function
- Spirometry needs to be done properly, ATS 2010 statement, NIOSH training for technicians
- Predicted values for Spirometry based on age and height with race correction
- PEFr Testing
- Inert gas dilution or body plethysmography, DLCO

Physician's Role in Diagnosis

Other Tests

- Bronchoprovocation
- Immunologic
- Bronchoscopy
- Lung Biopsy

Prevention of Occupational Lung Diseases

- OSHA 29 CFR 1910.134
- OSHA standard for workers required to wear respirators

Questionnaire: Appendix C

http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9783

- Remember PPD is the final step in your hierarchy of controls

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Evaluation for Respirator Use

- Must provide a medical evaluation to determine employee's ability to use a respirator
 - **before fit testing and use**
- Must identify a **physician or other licensed health care professional (PLHCP)** to perform medical evaluations using a medical questionnaire or an initial medical examination that obtains the same information as the medical questionnaire (information required is contained in mandatory Appendix C).
- Annual review of medical status is not required unless there is a change in job status or respirator type.

The Most Important Questions

- Have you worn a respirator before?
- Have you had any problems with respirator use in the past?
- Are you able to perform the function of your job while wearing a respirator?
- What is your job and what type of respirator are you wearing? (very important)

Medical Exam

- Must obtain a **written recommendation** regarding the employee's ability to use the respirator from the PLHCP.
- Additional medical evaluations are required when:
 - employee reports medical signs or symptoms related to ability to use respirator;
 - PLHCP, program administrator, or supervisor recommends reevaluation;
 - information from the respirator program, including observations made during fit testing and program evaluation, indicates a need;
 - change occurs in workplace conditions that may substantially increase the physiological burden on an employee.

Medical Exam For Respirator Use

- May be questionnaire only
- May be hands on exam
- May be Pulmonary Function Testing
- May be imaging studies
- May be referral to a specialist
- May be all of the above!!
- You are the Occ Doc and you decide, remember this is your opportunity to detect and prevent disease, use it wisely, counsel on other health issues, hypertension, obesity, smoking, exercise, vaccinations, etc.

SPIROMETRY in the Occupational Setting



Reasons for Spirometry

- Diagnostic
- Monitoring
- Occupational Reasons



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Reasons for Spirometry

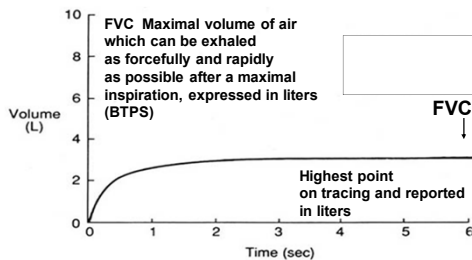
Occupational Reasons

- meet OSHA, Governmental requirements - cotton dust, asbestos
- obtain baseline
- susceptible person - high risk
- surveillance and looking for change due to exposure
- assess changes from removal from exposure
- Respirator Clearance
- Disability and Impairment

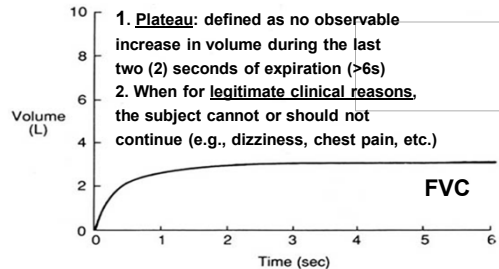
Spirometry the Basics

- Essential test for the Occ Doc
- Lots of variation in test quality
- You need to know if a test is valid in order to make medical decisions based on that test
- Efforts have been made in standardization of testing but...

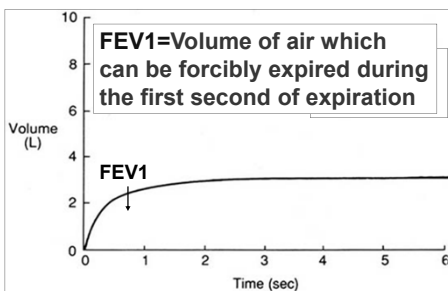
Forced Vital Capacity



End of Test Criteria (ATS-1987)



FEV1

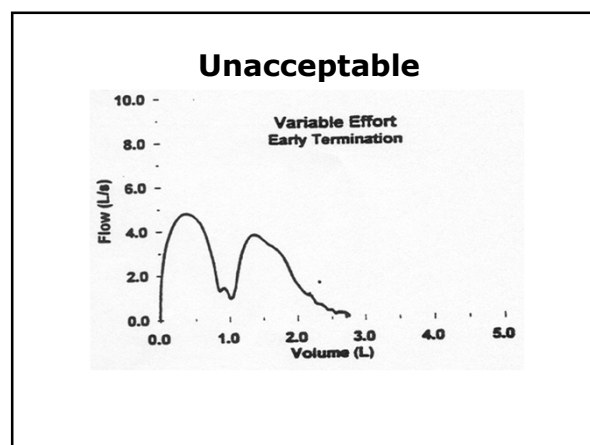
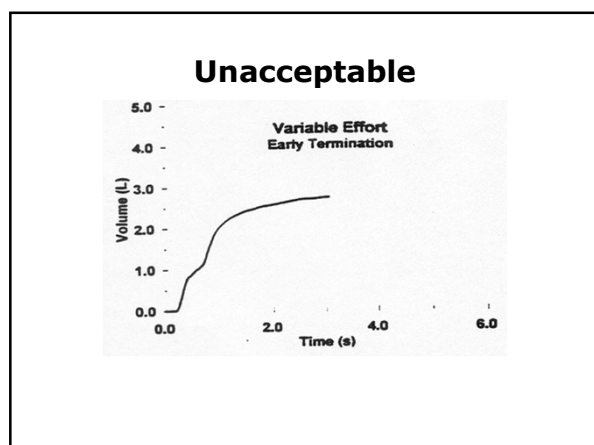
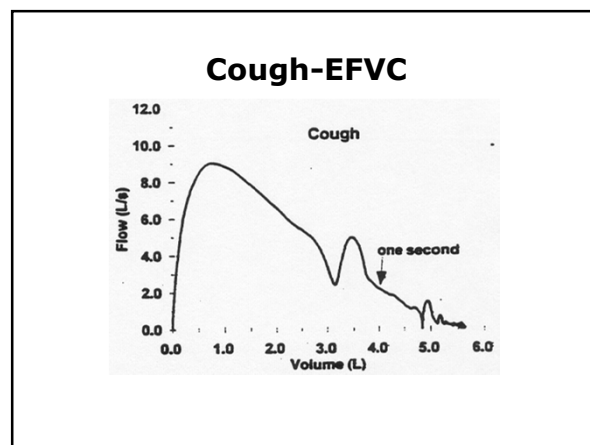
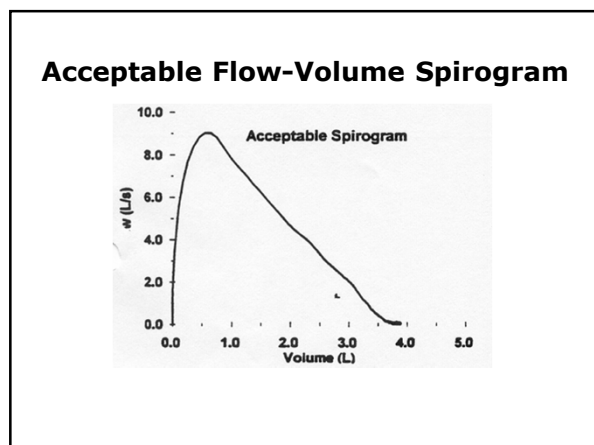
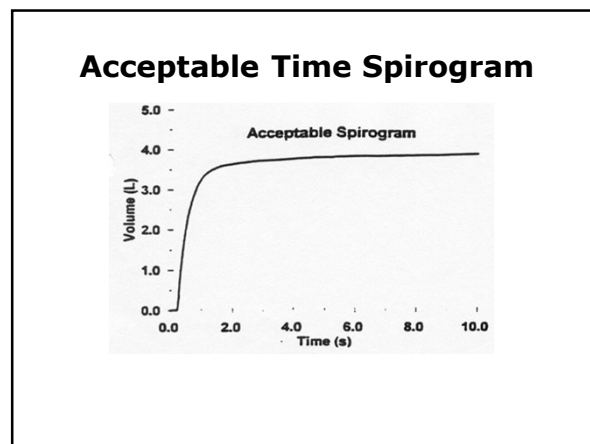
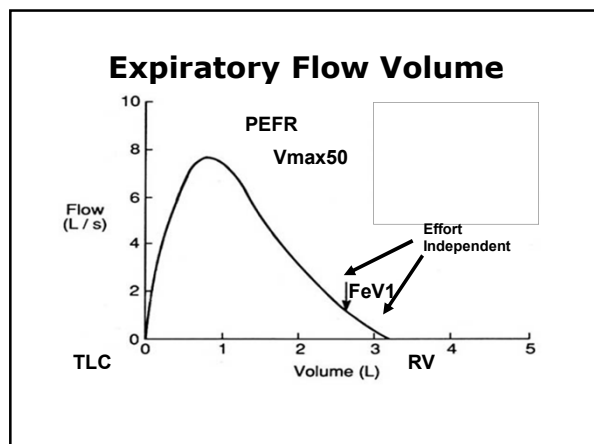


FEV1/FVC%

FEV1 expressed as a % of FVC

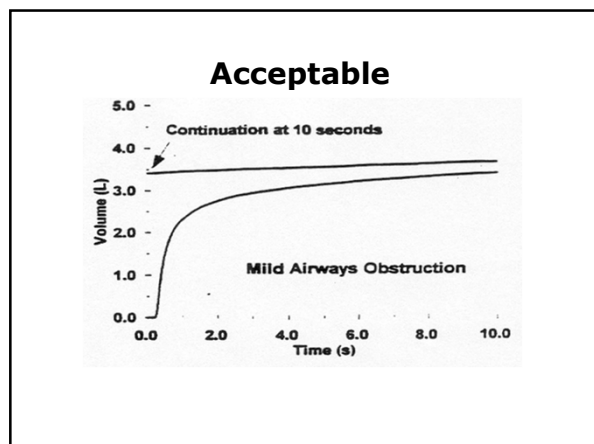
- expresses the volume of air the patient exhales in one (1) second as a % of the total volume of air that he/she exhales
- FEV1/FVC ratio is calculated by using the largest valid FEV1 and the largest valid FVC even if the FEV1 and FVC are not from the same tracing

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Criteria for a Valid Test

- Three Acceptable Tracings not just accepted
- Two matches, FEV1 and FVC within 150 ml of each other

Restrictive vs. Obstructive Lung Disease

- Restrictive Disease - Lungs stiff can't take in full deep breath. Low FVC, normal FEV1, increased or normal ratio.
- Obstructive Disease - Lungs lose natural spring back, FEV1 is decreased, FVC normal, low ratio
- Mixed, low FEV1, Low FVC
- ACOEM Position Statement, Spirometry in the Occupational Health Setting 2010 Update

Categories of Occupational Lung Disease

1. Toxic Inhalation Injury
2. Occupational Asthma
3. Hypersensitivity Pneumonitis
4. Inhalation Fevers
5. Metal Induced Lung Disease
6. Pneumoconioses

Clinical Outcomes of Occupational Lung Disease

1. Asthma
2. COPD
3. Bronchiectasis
4. Bronchiolitis Obliterans
5. Pulmonary Fibrosis
6. Cancer
7. Pleural Disorders

Toxic Inhalation Injury

Short Term Exposures to High Concentrations of noxious gases, fumes or mists

- Think: Firefighting, Spills, Accidents
- Site of injury depends on physical and chemical properties of inhaled agent, size and solubility
- Degree of injury also depends on time of exposure and minute ventilation

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Toxic Inhalation Injury

Effects

- Vary depending on agent, concentration exposure time
 - Transient mild irritation of mucous membranes to ARDS
- Long term sequelae may include bronchiectasis, bronchiolitis obliterans and persistent asthma

Toxic Inhalation Injury Evaluation and Management

- What is the causative chemical?
- Physical Findings
 - Look for burning of the nose or throat
 - Hoarseness, Stridor, Wheezing
 - CXR may be normal initially, chemical pneumonitis and ARDS findings 4-8 hour delay
 - ABGs likely to show hypoxemia prior to radiographic findings
 - Observation for at least 24 hours

Toxic Inhalation Injury Evaluation and Management

- Irrigation of exposed cutaneous and conjunctival areas with water
- Laryngoscopy, Bronchoscopy, Spirometry
- Consider intubation if laryngeal edema
- Oxygen, Bronchodilators, ABGS
- Aggressive Bronchial Hygiene
- Steroids, ABX maybe
- Essentially supportive care
- Consider long term follow up of exposed individuals

Train Derailment Kills 9 in 2005



Occupational Asthma

- Is "Asthma caused by exposure to agents encountered primarily (and usually exclusively) in the working environment?"

Hendrick, D, Burge, S, Beckett, W, Churg, A. Occupational Disorders of the Lung: Recognition, Management, and Prevention. WB Saunders 2002

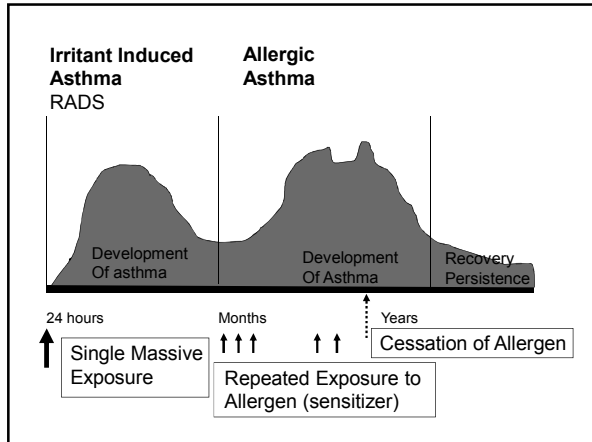
Types of Occupational Asthma

- Occupational Asthma with a latency period encompasses asthma of immunologic mechanism
- Occupational Asthma without a latency period
Immunologic Mechanism is not operative
Irritant Induced Asthma (RADS)



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Cause and risky jobs for allergic asthma (IgE positive) with latency period

- Bakery workers
- Animal handling
- Metal working operations
- Dusts from flours, grains, gluten, alpha-amylase, mites, molds
- Mouse, rat, guinea pig urine and serum proteins on bedding
- Dusts from tungsten carbide containing cobalt, nickel, platinum, chromium, metal working, fluid aerosols

Cause and risky jobs for allergic asthma (IgE positive) with latency period

- Working in health care facility
- House keeping work
- Food, fish, processing
- Latex gloves, biocides
- Dust from mites, animal dander, molds
- Aerosol/dust of clam, shrimp, lobster, various fish, food additives, spices

Culprits in Occupational Asthma

- Diisocyanates - polyurethane, insulation, upholstery
- Vegetable dusts, Cotton, Hemp Flax and Jute
Byssinosis Specific Cotton Dust Standard
- Metal Salts - platinum refining, jewelry making, fluorescent manufacture
- Acid Anhydrides - epoxy resins
- Wood Dusts- woodworkers,

Host Determinants

- Atopy
Associated with sensitization to high molecular weight agents
- Histocompatibility genotype
HLA class II antigens
Genetic polymorphism
- Cigarette smoking
Sensitization to high molecular weight agents that produce IgE Synergistic effect with Atopy



Diagnosis

- Suspected in new onset asthma
 - ▶ Obtain good occupational history
- Pulmonary Function Testing
 - ▶ Airway hyperreactivity
 - ▶ Methacholine challenge
 - ▶ Exaggerated PEF
- Peak expiratory Flow Rate
 - ▶ May help identify agents
- Skin Testing
 - ▶ High molecular weight compounds
 - ▶ Vegetables, dusts, grains, Animal proteins, Metals; Chemicals, TDI
 - ▶ Not available for low molecular weight
- Inhaled preparations
 - ▶ Suspected antigen
 - ▶ In the workplace



Management

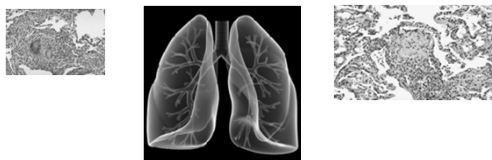
- A favorable prognosis is dependent upon:
 - ▶ Rapid diagnosis
 - ▶ Early removal
 - ▶ Improvement plateaus two years after cessation of exposure

Remember Hierarchy of Controls

- Drug treatment does not differ from that for non-occupational asthma

Hypersensitivity Pneumonitis

Extrinsic Allergic Alveolitis



Hypersensitivity Pneumonitis

- Immunologically mediated inflammatory disease of the lung parenchyma
- Many antigenic culprits, basic clinical and pathologic findings are similar

Hypersensitivity Pneumonitis

- Lymphocytic alveolitis and granulomatous pneumonitis with resolution if antigen exposure is terminated early
- Continued antigenic exposure can lead to progressive interstitial fibrosis

Hypersensitivity Pneumonitis

- Relatively small number of exposed persons develop HP
- TYPE III and TYPE IV Hypersensitivity Reactions

Farming, Vegetable and Dairy Cattle Workers

- Inhaled Bacteria; Thermophilic bacteria (*T. faeni*, *T. vulcaris*)
- Inhaled Mold; Fungi *Aspergillus umbrosus*, *A. clavatus*
- Inhaled Mold Dusts (ODTS)

