Occupational Lung Disease

Occupational Lung Disease
Robert J. McCunney, MD, MPH, MS
Mass General Brigham Hospital System
Pulmonary Division
Harvard Medical School
Boston

Robert J. McCunney, MD, MPH, MS

- MD @ Thomas Jefferson University Medical School
- Internal Medicine Residency @ Northwestern University Medical School
- MS Environmental Health @ University of Minnesota
- Occupational Medicine Fellowship @BWH and MPH @Harvard School of Public Health
- Past Director of Environmental Medicine @ MIT
- Instructor of Medicine@ HMS
  - Clinical focus: Occupational and Environmental Lung Disease
  - Research focus: Occupational and Environmental Lung Disease

Disclosures

- I have no financial disclosures or potential conflicts of interest in this presentation

Occupational Lung Disease: Outline

- Major Categories: Asthma, Parenchymal Disease, Cancer
- Clinical Evaluation of Occupational lung disease
- Determining Work Relatedness of lung disease
- Case Examples

Occupational and Environmental Medicine

Impact on Pulmonary Medicine

Role of prevention, diagnosis and treatment of occupational pulmonary illnesses

Importance of Exposure-disease relationships: "dose makes the poison." Exposure to sensitizers and low exposure

Occupational and Environmental Medicine: Pulmonary Medicine Implications:

Evaluating Occupational Pulmonary Disease

? Is the lung disease caused or aggravated by workplace or environmental activities

? Is the occupational or environmental exposure a hazard to the lungs

A clinical assessment with diagnostic studies can aid in (1) forming an accurate diagnosis and (2) in future preventive activities.

Occupational and Environmental Medicine

Context of occupational lung disease

- Workers Compensation-no fault: > 51 % likelihood of causality; is it more likely than not that exposure contributed to the disease?
- Regulatory: OSHA-workplace enforcement of regulations, EPA- e.g. asbestos, formaldehyde, silica, coal, lead
- Scientific: NIOSH (education and research) part of CDCP
- Legal: toxic torts
- Non Governmental Activities in exposure limits for hazards (ACGIH-TLV)

Occupational and Environmental Medicine

- Key Related fields: Epidemiology, toxicology and industrial hygiene

Epidemiology

- Evaluates potential links between **exposure** (agent, job, industry) and lung disease
- Various types with varying significance in evaluating causality

Occupational epidemiology studies

- Does exposure increase risk of **mortality** from certain diseases (i.e. lung cancer, pneumoconiosis etc)?-assessed via **mortality studies**
- What is the safe level of exposure?-assessed via **morbidity** studies that link exposure with a designated health effect (i.e. symptoms, lung function, imaging findings)
- Goal: Evaluate **exposure- disease** relationships
- Strengths: risks in humans –no need to extrapolate from animal studies: Evaluate consequences of exposure in which it actually occurs

Occupational and Environmental Medicine

Key Scientific fields (Cont'd)

- **Toxicology**-conducts controlled experiments to evaluate toxicity of substances
- **Industrial Hygiene-**assesses exposures to hazards in the workplace

Results from epidemiology, toxicology and industrial hygiene serve as the scientific basis of regulations, exposure limits and carcinogen classification

Sampling of Current Issues in Occ and Env Lung disease

- Air Pollution and effect on asthma and COPD exacerbations; risk factors; role of oxidative stress; prevention with anti-oxidants*
- “Old” occupational lung disease ?-coal, silica, asbestos
- New risks? Nano materials
- New Materials and asthma
- Screening for occupational lung cancer
- Role of animal studies in human risk assessment

**Asthma, Genes, and Air Pollution. (McCunney, RJ, J Occup Environ Med)*

Inhalation Toxicology (what gets inhaled and what is the effect ?)

Risk from inhalation of a substance is based on

- Size; < 7 microns inhalable
- Shape-asbestos
- Solubility-ammonia vs ozone; amorphous silica vs. crystalline silica
- Composition- Cr_{VI}
- Surface area (nano particles; < 100 nano meters)

Water Solubility	Examples	Site of Injury
High	Ammonia, formaldehyde	Upper airway
Moderate	Chlorine, sulfur dioxide	Lower airways
Low	Nitrogen oxides, phosgene	Lung parenchyma
Particle Size (Aerodynamic Diameter)		
>10 µm	Dust from Earth's crust	Upper airway
2.5–6 µm	Some fire smoke particles	Lower airways
<2.5 µm	Metal fumes, asbestos fibers	Lung parenchyma

Occupational Lung Disease

Major Types:

- Occupational asthma-causes: isocyanates, QACs, metal working fluids, etc.
- Pneumoconiosis-(restrictive lung disease) Causes asbestos, silica, and coal. “Benign” Pneumoconiosis of no apparent clinical consequence-chest film findings without functional effect (barium, tin, iron oxide)
- Occupational cancer-asbestos, beryllium, hexavalent chromium (IARC Classification)
- Hypersensitivity Pneumonitis

Occupational Asthma

- Numerous causes
- Pulmonary Function Testing
- FEV_1 post bronch > 12% improvement
- Methacholine Challenge Testing
- Evaluating equivocal cases of asthma
- PC_{20} associated with a 20% drop in FEV_1
- ATS Guidelines; Pelligrino et al, 2005

Occupational Lung Cancer

Role of exposure: “Dose makes the poison.”

Risk **dependent on the level and degree of exposure**

IARC of the WHO Classification scheme: Class 1 Human Lung Carcinogens; Examples: Asbestos, crystalline silica, hexavalent chromium, arsenic, diesel exhaust particles, cadmium

Occupational Lung Cancer: Issues of concern

??? Does early detection of occupational lung cancer with LDCT lead to improved outcome- Recall results of NLST for high risk smokers.

??? Should current workers or retirees be screened for current or past exposure to occupational lung carcinogens

Occupational Lung Cancer

Presents (i.e. symptoms and chest film abnormalities) like non occupational lung cancer

Therapeutic approach identical

5 year survival: stage dependent

Hypersensitivity Pneumonitis

- Relation to indoor environment
- Pigeon breeders
- Metal working Fluids
- Hot tubs
- Chest Film
- Serum precipitins

“Old” Major Occupational Lung Diseases

- Asbestos
- Coal
- Silica

Asbestos

Major Issues:

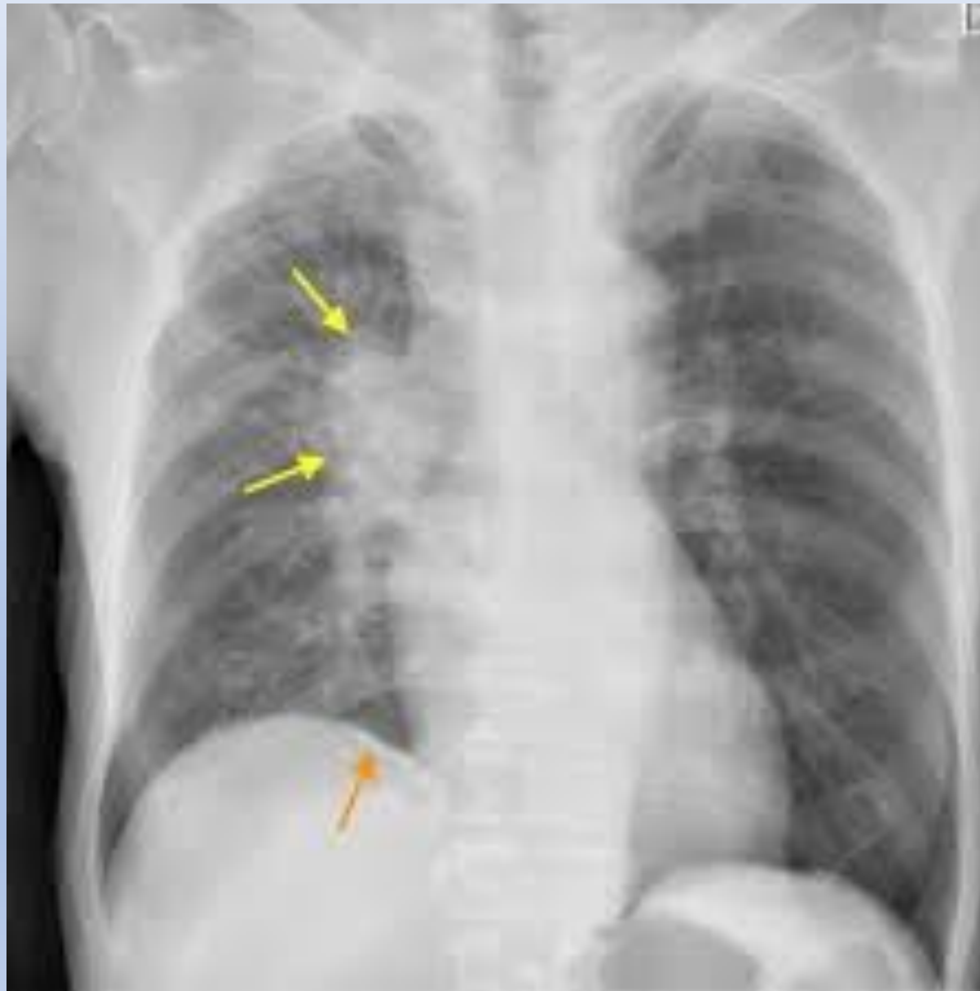
- Asbestosis, lung cancer, mesothelioma
- Radiographic findings-pleural plaques.
- Reduction in asbestosis due to dust control and banning of asbestos
- Latency for lung cancer and mesothelioma risk
- Smoking and lung cancer confounding

Asbestos: Contemporary Medical and Public Health Issues

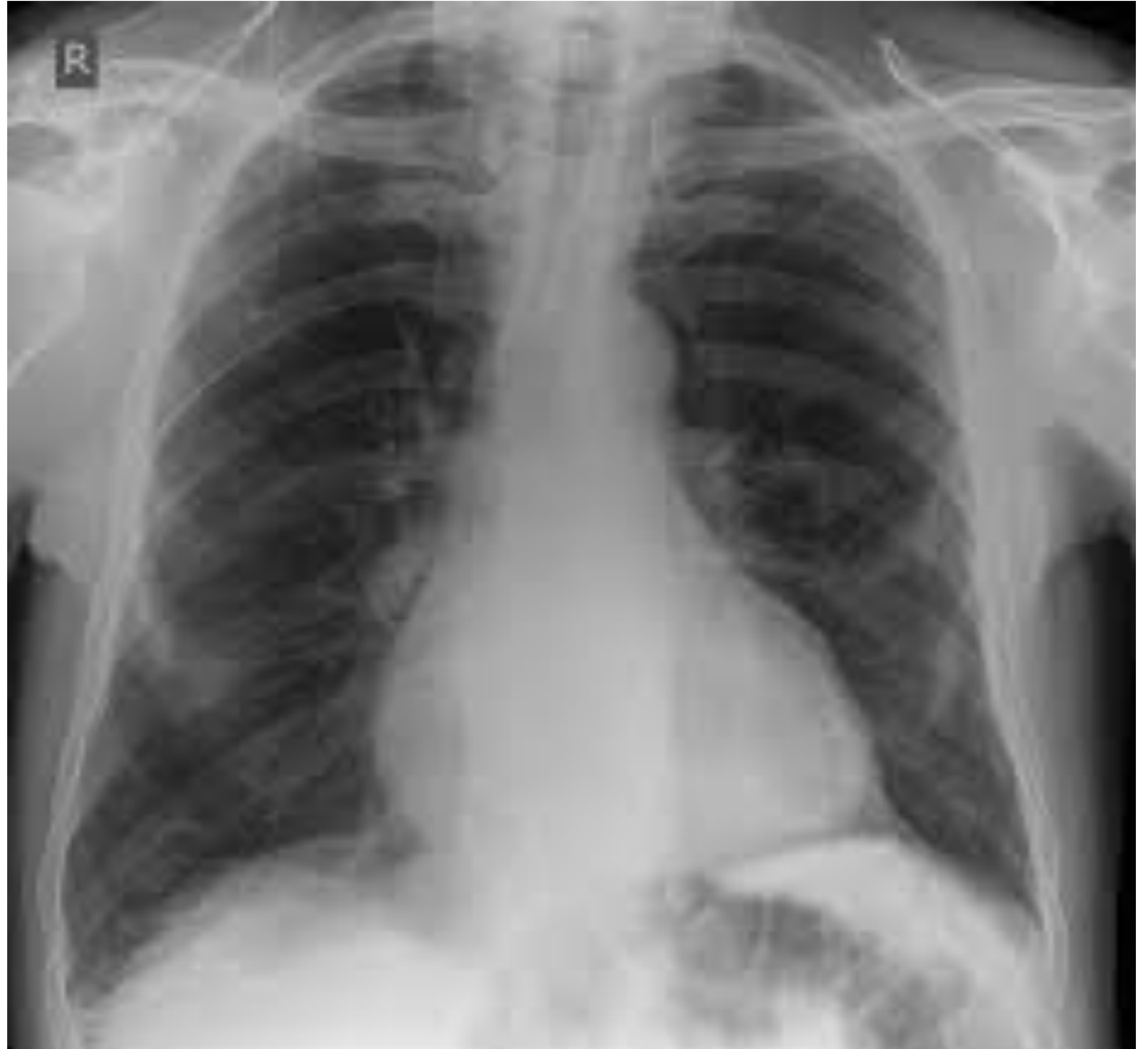
Current concerns

- Evaluating health risk from previous exposure
- Evaluating imaging findings; pleural thickening; pleural plaques
- Mesothelioma
- Asbestos in place
- Asbestos removal activities
- Recent (2022) EPA proposal to ban asbestos

Asbestos Induced lung cancer



Asbestos: Pleural Plaques- bilateral associated with asbestos exposure



Mesothelioma

- About 2500 cases per year in USA
- High fatality rate: 6-12 month survival
- Radical surgery helpful in some cases
- Biomarkers (mesothelin)

Mesothelioma

From Edinburgh College of Surgeons Museum

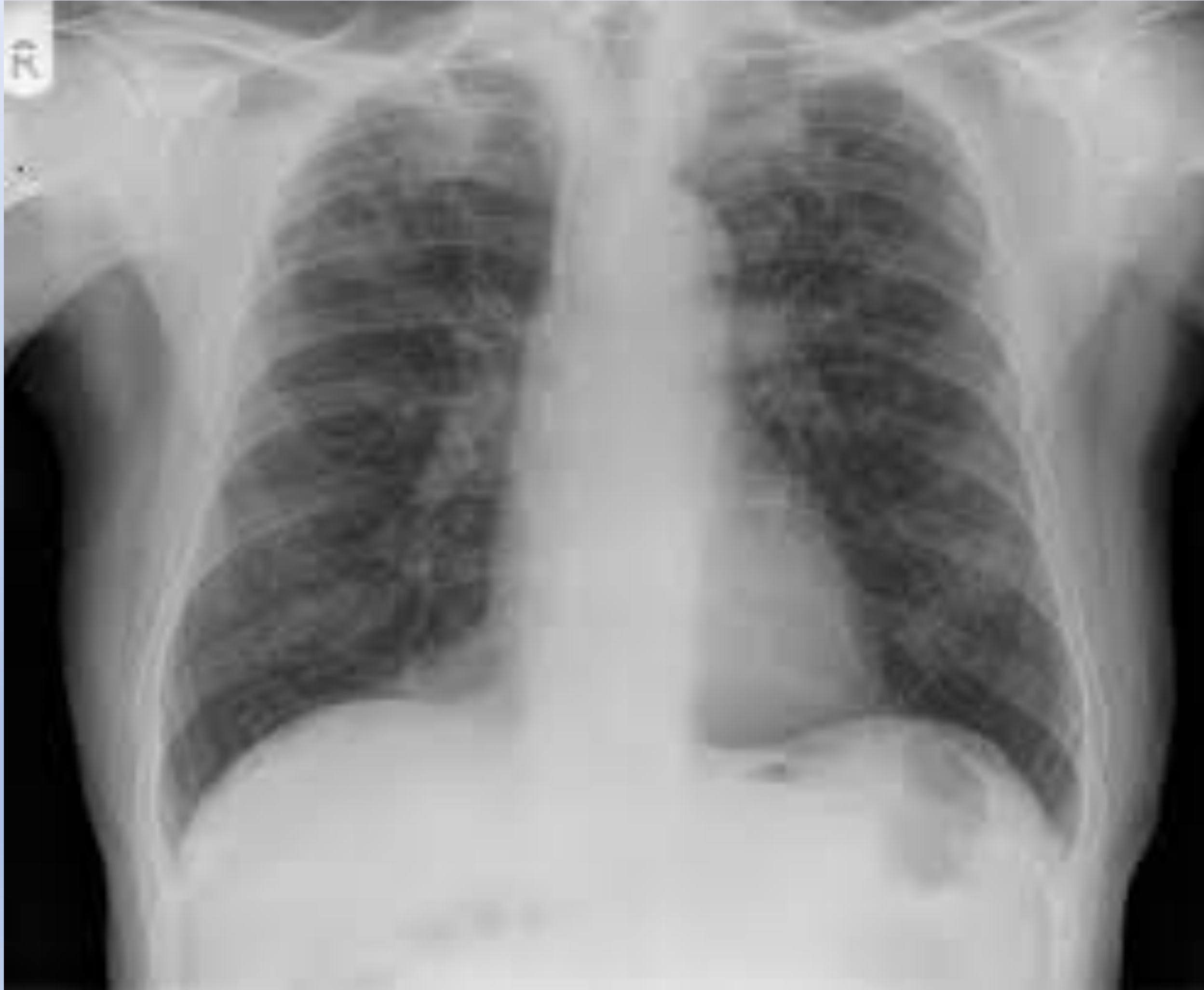
Coal

- Risk of CWP based on level and degree of Exposure
- No apparent increase in lung cancer risk
- What component of coal causes coal workers' pneumoconiosis?

"The active agent within coal appears to be iron, not quartz. By identifying components of coal before mining activities, the risk of developing CWP may be reduced." (McCunney RJ, J Occup Environ Med)

Coal Workers Pneumoconiosis (From Edinburgh College of Surgeons Museum)

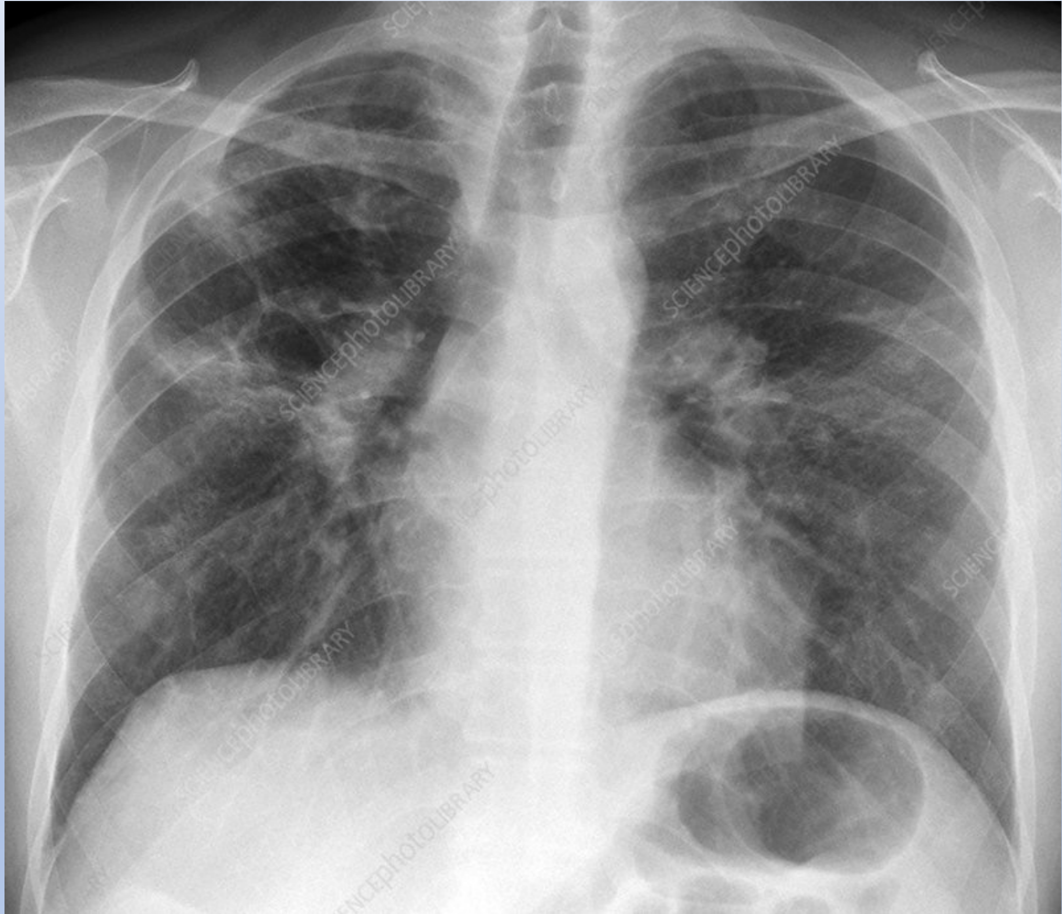
Crystalline Silica: Risk of fibrosis and lung cancer



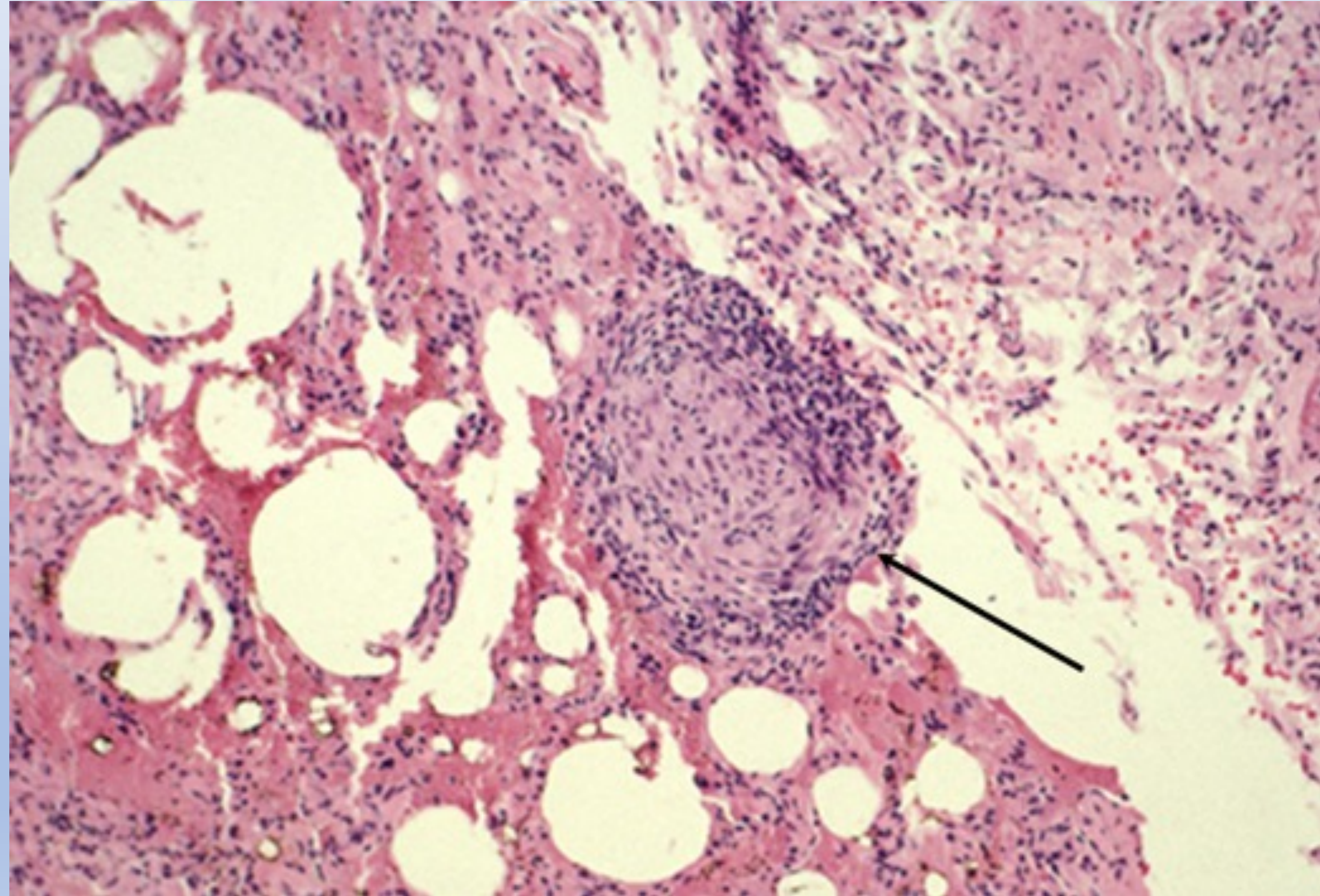
Berylliosis

- Risk based almost exclusively on genetics: presence of HLAB27 antigen
- Granulomas
- Need to differentiate from sarcoidosis

Chronic Berylliosis



Beryllium Nodule



Clinical Evaluation of Occupational Pulmonary Disease

Patients tend to present concerned about:

- Is my lung disease caused by exposure to an occupational or environmental hazard?
- Has my exposure to a hazard affected or will it affect my lungs?

Clinical Evaluation of Occupational and Environmental Lung disease

Work Related Information patients can bring to an evaluation

- SDS (Safety Data Sheets)
- Exposure information-i.e. air sampling results
- Job description

Evaluating Occupational Lung Disease

History: key: symptoms in relation to exposure; acute, delayed (Latency)

- ? Introduction of new materials
- ? Exposure-related symptoms
- ? Has exposure monitoring been performed
- Exposure assessment: Review of SDSs and exposure data, if available; respirator use

Physical Exam: auscultation etc.

Safety Data Sheet (SDS)

- Required for all materials used in commerce
- Contains basic health-related information about the substance
- Further review of literature may be necessary
- Discuss with company representative, per patient approval

Evaluating Occupational Lung Disease

Exposure assessment via history

- key: symptoms in relation to exposure; acute, delayed (Latency);
- Assess length of exposure, controls, personal protective equipment use

? Relief when away from exposure

- Review SDSs, exposure data if available-Industrial hygiene assessment

Evaluating Occupational Lung Disease

Diagnostic Studies

- Veni puncture-IgE antibodies, RAST, HP panel
- Pulmonary function-key measure
- Methacholine Challenge
- Imaging

Chest Film-ILO criteria for evaluating pneumoconiosis, based primarily of size and shape of lesions

Computed tomography (CT) -high resolution (HRCT)/ low dose (LDCT)-many findings non specific

- Biopsy/BAL

Evaluating Occupational Lung Disease: Asthma

Pulmonary Function Testing

- Evaluating asthma (NHLBI Guidelines) FEV_1 > 12% post bronchodilators
- Use in screening for respirator use: i.e. FEV_1 < 70 % may require pulmonary evaluation; role of respirators in increasing airway resistance
- Following trends in FEV_1 over time (? Accelerated decline in lung function)

Methacholine Challenge Testing

- Evaluating equivocal cases of asthma
- ATS Guidelines (Pelligrino et al, 2005)

Evaluating Occupational Lung Disease: Major Diagnostic Studies

<u>Imaging</u>

- Chest films- ILO criteria define size, shape, location-designed to reduce inter-observer variability (NIOSH certifies “B” readers in USA)
- Computed tomography- HRCT (diagnostic) and Low Dose (screening)

<u>BAL</u>

<u>Biopsy</u>

Occupational Lung Cancer

- Should we screen with low dose CT for historical Exposures to carcinogens such as asbestos, hexavalent chromium and crystalline silica?

Reduced Lung-Cancer Mortality with Low-Dose Computed Tomographic Screening

The National Lung Screening Trial Research Team*

N Engl J Med 2011;365:395-409.

NLST Results

- Reduction of 20% in lung cancer mortality with LDCT screening.(95% CI, 6.8 to 26.7; P=0.004).
- Reduction of 6.7% in overall mortality in the LDCT group, compared with the chest film group. (95% CI, 1.2 to 13.6; P=0.02).

DISCUSSION re: NLST

- Will populations with risk profiles that are different from those of the NLST participants-(ie, asbestos, silica, hexavalent chromium, et al.) benefit from screening?
- Are less frequent screening regimens equally effective?
- How long should screening continue?
- Would different criteria for a positive screening result, such as a larger nodule diameter, still result in reduction in mortality?

Interpreting Pulmonary Function in the Occupational Setting

PFTs in the Occupational Setting

PFTs play role in primary, secondary and tertiary prevention of occupational lung diseases.

- Prevention: assessment of respirator fitness
- Monitoring: evaluate lung function over time due to exposures
- Diagnosis: evaluate workplace symptoms and exposures
- Research: Epidemiology: Evaluating effects of exposure

Recommendations for a standard Pulmonary Function Report: Official ATS Statement; Am J Respir Crit Care Med 2017: 196: 1463-1472

- Regression equations based on **age, <u>height</u> and gender**
- NHANES III-no need for separate ref equations for Hispanic populations
- Grading A-F; A- 3 acceptable tests within 150 ml.
- Recommends use of LLN to define abnormality; not percent predicted
- Key parameters:
  Only FEV_1;FVC; FEV_1/FVC (reported as decimal fraction) need to be reported

Critical Elements of Occupational Spirometry

Technicians and Clinical Healthcare Professionals

- Technicians- successfully complete a NIOSH approved course
- Program supervised by a healthcare professional knowledgeable about spirometry.

Spirometry Equipment

- A letter from the spirometer manufacturer indicating successful validation testing, following ATS / ERS standards.
- Check spirometer's calibration daily. Records of calibration checks maintained and available for review.

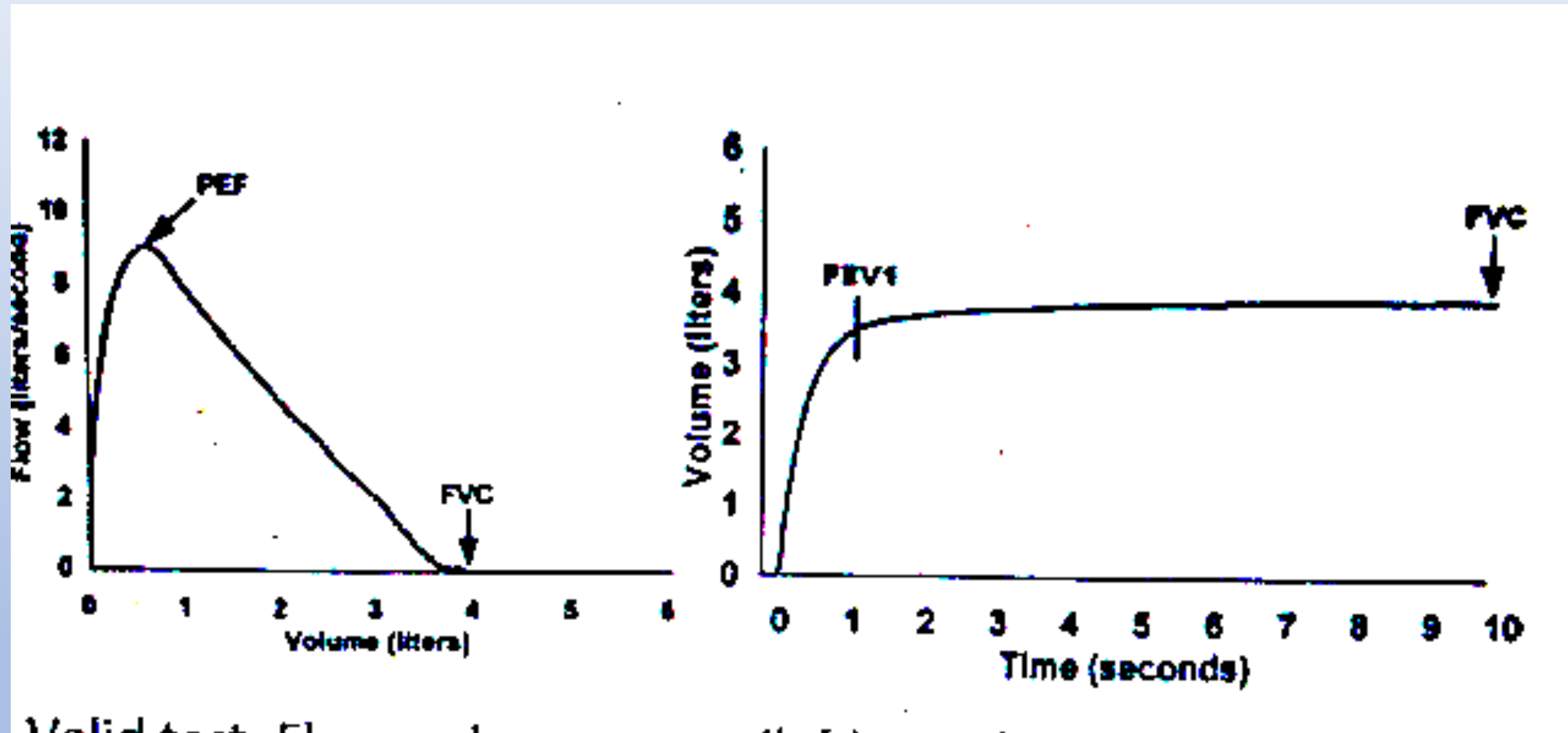
Critical Elements of Occupational Spirometry

Interpretation of Results

- Worker's results compared to normal values and to baseline values- the preferred method of evaluating change over time.

Reporting of Results to worker

Acceptable Test



Interpreting PFTs

- ATS/GOLD criteria
- Assessing validity
- Grading system: based on acceptability and repeatability: 3 acceptable maneuvers and repeatable (FEV_1 and FVC measurements within 150 ml)
- Lower limit of normal (LLN): FEV1 $< 80\%$; $FEV_1/FVC < 70\%$
- FEF $_{25\text{-}75\,:}$ “Has not demonstrated added value for identifying obstruction in adults or children and is not recommended for routine use. (ATS, 2017)

Interpreting PFTs

- FEV_1/FVC post bronchodilator < 0.70 confirms diagnosis of persistent airflow limitation. GOLD Criteria (2017)
- "Most common reason for low FVC and FEV_1 is incomplete inhalation. " (Official ATS Statement; Am J Respir Crit Care Med 2017: 196: 1463-1472)
- Obstruction: $FEV_1/FVC < LLN$
- Restriction: FVC < LLN (need TLC)

PFTs in the Occupational Setting: Evaluate Respirator Fitness

- Respirators used by ~ 3.3 million US Workers
- Mining, construction, hazardous waste and fire fighting primarily
- OSHA Standard Requires: health questionnaire and medical clearance
- Lack of consensus on components of medical evaluation to evaluate a person's suitability to wear a respirator
- PFTs and other diagnostics used: Decision based on physician's judgment; i.e.: is $FEV_1 < 70$ % predicted suitable ?
- Role for occupational medicine and pulmonary physicians to collaborate

Respirator Medical Clearance

Most workers denied medical clearance for respirator due to:

- Pulmonary (69%) and Cardiac issues (57%); (Desautels et al, J Occup Environ Med 2016: 58: 982)
- Determination of “medical fitness” left to physician judgement based on job duties, work environment and need to wear respirator. (i.e. continuously periodically, emergencies)

Use of PFTs in Occupational Settings: Evaluate Lung Function over time

Monitor Worker Exposures

- OSHA Standards: e.g.; asbestos removal operations; formaldehyde, coal, beryllium; etc.
- Good Practices: e.g.: crystalline silica; titanium dioxide; iron oxide, poorly soluble low toxicity particles, etc.
- Caution: Variation in technical quality, testing protocol, different vendors and equipment

Assessing Accelerated Decline in lung function

ATS (2014) and ACOEM (2011) guidance documents

- FEV_1: key parameter to assess: least affected by technical issues and patient effort
- Need to address Age Related decline: ~ 30 ml annually and variability (15%) of PFTs
- Usually need about 6 years to reliably assess abnormal decline to account for variability
- Consider asthma, smoking, obesity et al as factors affecting decline in lung function in addition to occupational exposures

Case Examples

Evaluating Causality

1. Establish a diagnosis

2. Assess exposure

3. Review the literature

4. Are the circumstances of patient exposure consistent with appropriate scientific literature?

Determining work relatedness of lung disease

Workers compensation: "No fault" state based system

- Implications-income replacement and illness care reimbursement.
- OSHA reporting requirements; need for further preventive activities.
- Is it more likely than not that illness is related to work?

Case: 1 Abnormal PFTs in asbestos worker

Asbestos Fibers-mesothelioma risk; OSHA Standard: 0.1 fibers/cc; 8 hour time weighted average

Case 1: Respirator Clearance

- Asbestos Removal operator for 12 years referred for evaluation due to abnormal annual PFTs
- Daily potential exposure to asbestos
- 55 yo WM ex-smoker
- FEV_1: 2.6 (43%); FVC: 3.2 (54%); ratio: 80; no PB response

PFTs @ Hospital Pulmonary Division: Normal

- Diagnosis: invalid screening test due to lack of full exhalation

Case 2: Restriction noted on PFTs

- 52 yo factory worker (non smoker) referred for abnormal PFTs
- Are the PFTs reflective of restrictive lung disease ?
- 5’7; 275 #; BMI: 42.5 (Morbid obesity)
- PMH: obstructive sleep apnea; fatty liver
- Occupational History: 20 years of solvent exposure
- ? Cause

Restriction on PFTs

Date	FEV1	FVC	Ratio	TLC	DLCO	Post BD
11/14/95	3.04 (73%)	3.51 (67%)	87			
9/16/14	1.55 (40%)	1.93 (39%)	**78**	**3.13 (46%)**	17.5 (61%)	22% increase
3/2/15	1.32 (34%)	1.68 (34%)	**101**	**3.04 (45%)**	17.9 (62%)	no data
3/10/15	1.45 (40%)	1.77 (38%)	**82**	**3.49 (54%)**	21.1 (70%)	no data
1/25/16	1.64 (49%)	2.11 (51%)	**78**	**3.09 (51%)**	13 (43%)	no sig change
10/10/16	1.58 (47%)	1.95 (48%)	**81**	**2.98 (49%)**	18.1 (61%)	no data
10/31/16	1.63 (43%)	1.74 (36%)	**94**	**3.28 (47%)**	9.70 (27%)	no data
4/17/18	2.11 (64%)	2.50 (59%)	**78**			13% increase
5/22/18	**1.72 (47%)**	**2.17 (48%)**	**79**	**4.0 (62%)**		**No increase**

Restriction on PFTs in Occupational Setting

Chest CT Scan: Post operative changes (likely lung biopsy related); No interstitial fibrosis; calcified granulomas

Bronchoscopy: *"unremarkable*". No endo -bronchial lesions observed.

Lung biopsy: *"minimal focal bronchiolar fibrosis,*

- lower lobe atelectasis and obstructive changes (foamy alveolar macrophages, chronic inflammation).

Industrial Hygiene Sampling of Solvents

- Benzene
- Ethylbenzene
- Naphthalene
- Toluene
- Xylene

- Isophorone
- Formaldehyde
- Butyl cellusolve acetate
- Diethylene glycol monobutyl ether
- Cumene
- MIBK

- **In none of the air monitoring samples on 10 separate days over a period of years was the 8-hour time weighted average above recommended limits of OSHA or ACGIH**.

Respiratory Spirometric Pattern

- Diagnosis: Patient had (RSP) on 10 occasions on PFTs.
- Exposure: Work place exposure assessments: no elevations in any of the solvents used.
- Literature search: No studies indicate pulmonary fibrosis among workers exposed to the type of solvents used.

Diagnosis: Restrictive Spirometric Pattern (RSP)

- Defined as FVC < 80% of predicted and FEV_1/FVC > 0.7. (Backman et al, 2016)

Can be associated with

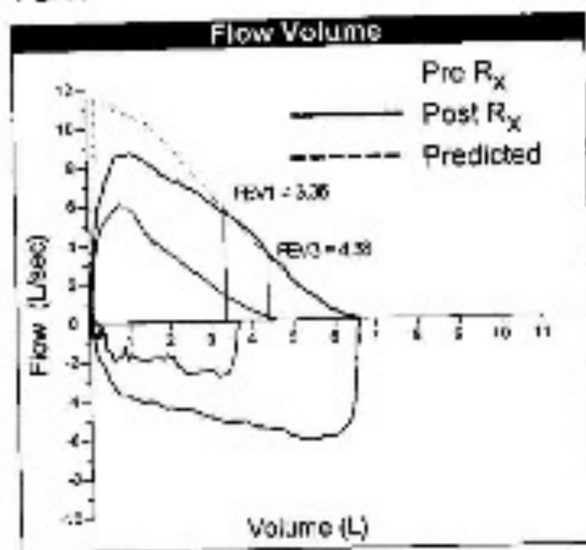
- Restrictive (interstitial) lung *disease*,
- **No pulmonary disease-the pattern is up to 100 times more common than interstitial lung disease**. (Godfrey et al, 2016)
- Prevalence of RSP ranges from 8-12%, based on NHANES surveys, yet prevalence of interstitial lung disease is < 0.1% in general population. (Demedts, 2001; Backman, 2016; Godfrey et al, 2016)
- A moderate to severe RSP -over two- three times more common in obese individuals. (OR: 3.20: 95% CI: 1.80-5.69) (Kurth et al, 2015; and Blackman et al, 2016)

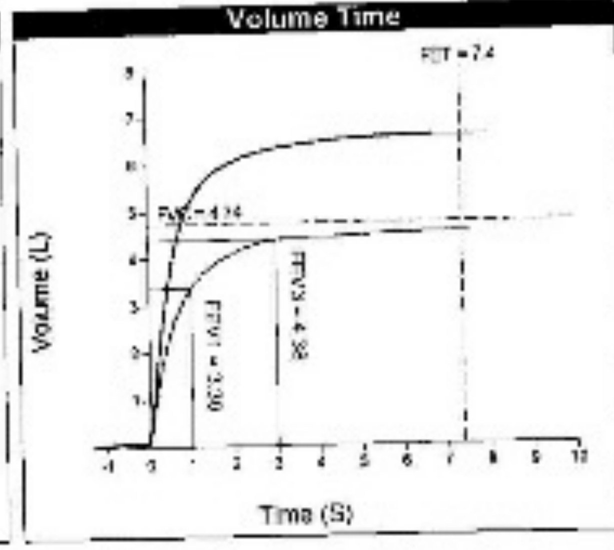
Case 3: Shortness of breath

- 28 year old warehouse worker referred to Pulmonary for SOB and wheezing intermittently for a year.
- Episodes accompanied by chest tightness- happens almost exclusively at work-rarely outside of work

ATS compliant tests are indicated by a ...

Spirometry		Predicted Range Mean	Predicted Range 95%	Pre Bronchodilator Actual	Pre Bronchodilator % Pred	Post Bronchodilator Actual	Post Bronchodilator % Pred	Percent Change
FVC Effort Time		----	----	14:06	----	14:33	----	--
FEV_1	L	4.99	4.15	3.36	67	5.20	104	55
FVC	L	6.16	5.04	4.74	77	6.58	107	39
FEV_1 / FVC	%	81	73	71	88	79	98	11
FEV_6	L	6.31	5.27	4.57	72	6.58	104	44
FEV_1 / FEV_6	%	83	74	74	89	79	95	7
FEF_{25-75}	L/s	4.92	3.25	0.58	12	4.91	100	747
PEFR	L/s	11.46	8.79	7.40	65	8.72	76	18





Spirometer Calibration to ATS

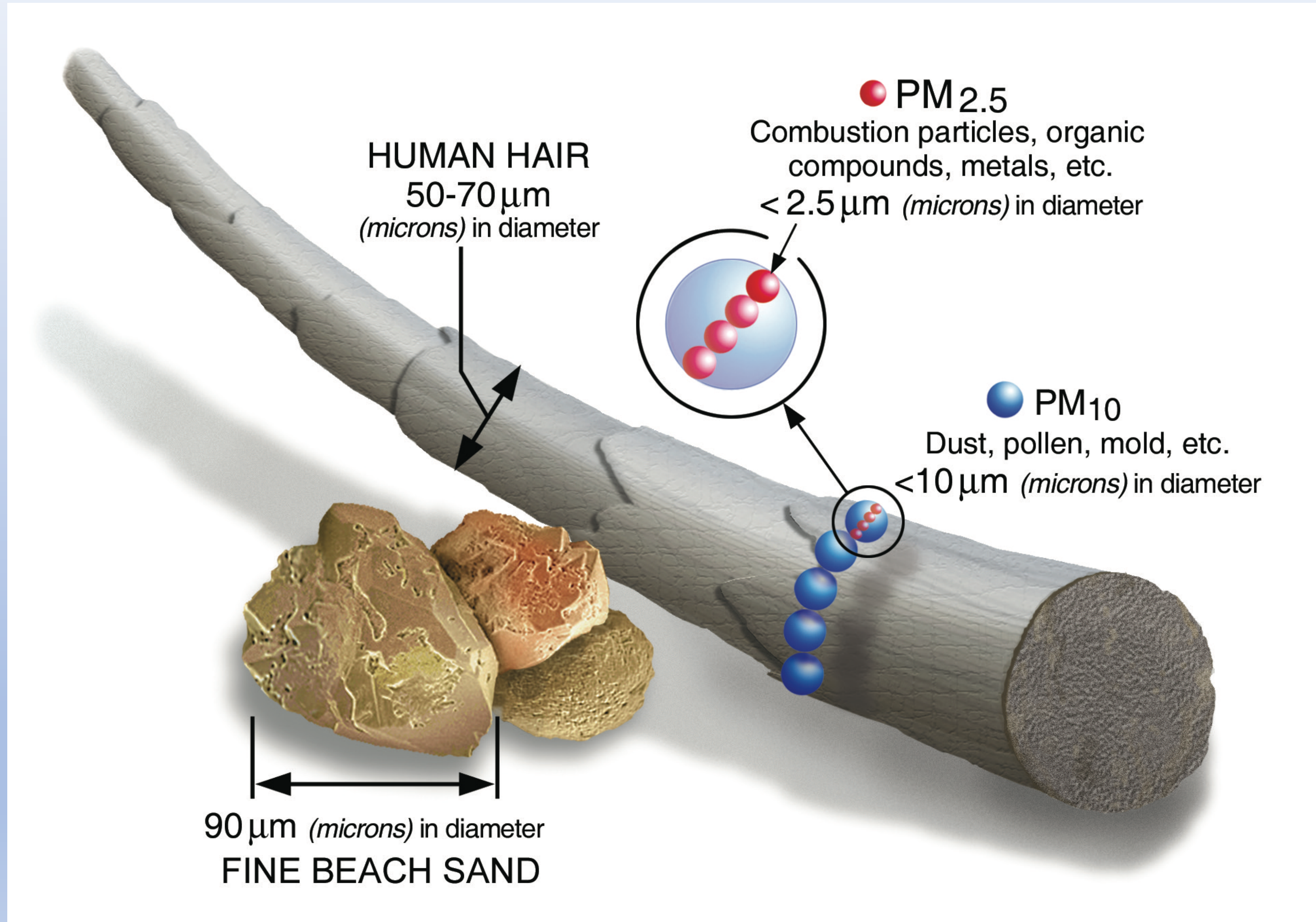
By: Kevin Farley

Same Day - 08:04 AM

Exposure Monitoring @ warehouse

- High particulates: ~ 900 mcg/m ^{3} EPA Ambient guideline for particulates: 35 mcg/m ^{3}
- CO_2 levels: > 800 ppm (ambient: ~ 400 PPM)-suggest inadequate ventilation

Particulates



इंडिया गेट
India Gate

Diagnosis: Occupational Asthma

Case 4: Evaluate Accelerated loss in lung function

- 58 yo WM worker non-smoker referred for accelerated loss in lung function
- PMH: BMI: 38; hx of asthma and allergies; high IgE (240; nl: < 80)
- Is it work related?
- **Initial Step: Review Technical Quality of PFTs (Guidelines of ATS);**

PFTs over time

Year	FEV_1	FVC	Ratio	
2005	3.78 (104%)	4.08 (104%)	92	
2012 (Feb)	3.22 (93%)	3.81 (84%)	85	
2012 (April)-left work June 2012	2.99 (86%)	3.72 (82%)	80	
2013 (Dec)	2.81 (83%)	3.48 (80%)	80	

Causes of accelerated decline in FEV_1

- Smoking-upwards of 90 ml/year
- Asthma
- Obesity
- Occupational exposures

Ensuring reliability of PFT results

- Should we measure height before performing PFTs or accept self report?

Height and % Predictive Values- * Knudson; ** NHANES III

FEV_1	Height	Caucasians *		Caucasian **	
3.14 liters	71	**69**		**66**	
	70	71		68	
	69	73		70	
	68	**75**		72	

4. Research: Role of different teams and devices: 5 plant cross sectional study

ORIGINAL ARTICLE

Cross-Sectional Study on Nonmalignant Respiratory Morbidity due to Exposure to Synthetic Amorphous Silica

Dirk Taeger, PhD, Robert McCunney, PhD, Ursula Bailer, MD, Kai Barthel, MD, Ulrich Küpper, MD, Thomas Brüning, MD, Peter Morfeld, PhD, and Rolf Merget, MD

Key Points

- In screening settings, lack of repeatability of PFTs often due to incomplete inhalation
- Largest FEV_1 and FVC values should be used, even if from different curves
- Obesity, especially morbid obesity (BMI> 40) plays a major role in lung health

Summary of PFTs in Occupational Settings

Pitfalls:

- What looks like restriction may not be: Note importance of RSP
- What looks like an abnormal PFT may not be: A valid test is critical for proper interpretation.
- What looks work related may not be: Numerous non occupational factors can affect lung function over time
- The use of different reference equations can affect % predicted values:
- Use FEV_1- not % predicted to monitor trends over time-least affected parameter by technical and performance reasons
- Need to measure height

Evaluating Occupational Disease

Role of Industrial Hygiene:

Recognition, evaluation and control of occupational and environmental hazards

Conduct a site visit and determine need for air sampling

The pulmonologist and the occupational medicine specialist

- Clinical and research collaboration
- Core competencies of board certified occupational physicians in occupational pulmonary disorders follow.
- Prepared by the American College of Occupational and Environmental medicine (ACOEM)

ACOEM: Core Competencies: Pulmonary

1. Prevent, diagnose, treat and/or **refer** occupational/environmental lung disorders, including:

- Occupational asthma and bronchoreactivity (e.g., reactive airways dysfunction syndrome [RADS
- Pneumoconioses (e.g., silicosis, coal workers' pneumoconiosis, asbestosis, hard-metal disease, benign pneumoconiosis, chronic beryllium disease).
- Irritant inhalations (e.g., acids, alkalis, oxides of nitrogen, phosgene, phosphine).
- Chronic obstructive pulmonary disease (COPD).
- Hypersensitivity pneumonitis.

ACOEM: Core Competencies: Pulmonary

2. Manage work restrictions for both occupational and non-occupational lung diseases.
3. Perform and interpret PFTs according to American Thoracic Society/European Respiratory Society standards.

Questions

1. What are the most common findings on chest CT in hypersensitivity pneumonitis?

What are the most common findings on chest CT in hypersensitivity pneumonitis?

A. Bronchiolitis

B. **Centri lobular nodules**

C. Fibrosis

D. Pleural Thickening

What are the most common findings on chest CT in hypersensitivity pneumonitis?

- Although chest imaging in HP can be essentially normal, the most common finding is centri lobular nodules.

2. What is the most effective screening method for early diagnosis of mesothelioma that leads to reduced mortality?

What is the most effective screening method for early diagnosis of mesothelioma that leads to reduced mortality?

A. Periodic Chest Films
B. Periodic low dose chest CT
C. Periodic BAL in heavily exposed workers
D. Mesothelin levels
E. None of the above

What is the most effective screening method for early diagnosis of mesothelioma that leads to reduced mortality?

- Mesothelioma, despite causing about 2500 deaths per year, is relatively rare in light of the extensive amount of people who have been exposed to asbestos. As a result of its low incidence, the development of an effective screening method to reduce mortality from this disease has been elusive.

3. Which of the following has not been recognized as a cause of hypersensitivity pneumonitis?

Which of the following has not been recognized as a cause of hypersensitivity pneumonitis?

A. Hot tubs

B. Isocyanates

C. **Crystalline Silica**

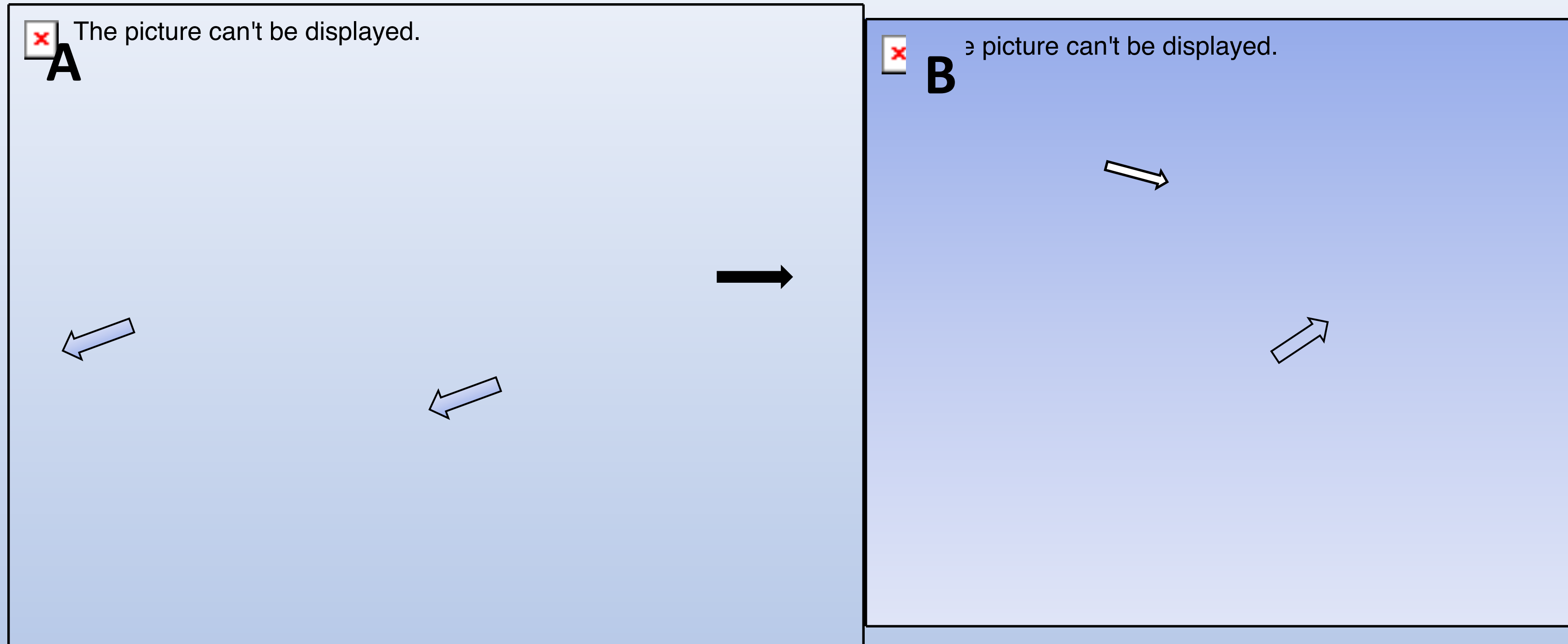
D. Metal Working fluids

Which of the following has not been recognized as a cause of hypersensitivity pneumonitis (HP)?

- Crystalline Silica, although a Type I IARC pulmonary carcinogen, has not been recognized as a cause of HP.
- The most common agent associated with HP is metal working fluids.

Sample Board Question

A 45 year old man presents to pulmonary clinic with one year history of cough, shortness breath, and fatigue. He teaches machining of various metals at a local technical high school. Pulmonary function testing (PFT) showed normal spirometry and lung volumes, but an impaired diffusion capacity (DL_{CO}, 57% predicted). Bronchoalveolar lavage revealed 58% lymphocytes and 3% eosinophils. Cultures for bacteria, fungi and mycobacteria were negative. Video-assisted thoracoscopic biopsies showed airway-centered lymphocytic infiltrate with patchy interstitial and airspace-containing poorly formed granulomas. A photo of the lung biopsy is noted below



On low-power view (Panel A) a peribronchiolar granuloma is observed (black arrow), associated with non-specific chronic interstitial inflammation and small foci of organizing pneumonia (grey arrows). The inflammatory infiltrate is mixed and comprised of lymphocytes, plasma cells and scattered eosinophils. Some granulomas (Panel B) have multinucleated giant cells (black arrow) and the inflammatory infiltrate also contains occasional eosinophils (grey arrow).

Which of the following is the most likely diagnosis?

A. Silicosis
B. Berylliosis
C. Hypersensitivity Pneumonitis
D. Idiopathic pulmonary fibrosis

Answer c. Hypersensitivity Pneumonitis

- Hypersensitivity pneumonitis (HP) is an inflammatory lung disease mediated by an immunological response to an inhaled antigen. Outbreaks of HP have been reported in industrial settings where manufacturing workers are exposed to water-based metalworking fluids (MWFs). Water-based MWFs promote growth of microorganisms and can be easily aerosolized and are thus potential etiological agents of HP. Culture of MWF used at the school grew *Pseudomonas Aeruginosa.* This is the first known report of MWF-induced HP outside an industrial setting. The growth of Pseudomonas in this case recalls the earliest reports of the microbiology of MWF-induced HP and suggests that routine bacterial culture may be useful in the diagnosis of HP in workplaces without standard cleaning and biocide regulations.

Occupational Medicine

Reference

Moniodis A, Cockrill B, Hamilton T, McCunney RJ. Case Report: Hypersensitivity Pneumonitis with Exposure to Metal Working Fluids in a Vocational School Teacher. Occup Med (London) 2015 July

Key words: hypersensitivity pneumonitis. Metal working fluids, lung biopsy, pulmonary function testing, culture of metal working fluids

.

Summary

- Occupational and environmental lung diseases are ideally preventable
- Suspect an occupational/environmental role in adult new onset asthma
- Conduct thorough occupational/environmental history in potential lung disease

References

- Perlman D et al. Occupational Lung Disease Med Clin North Am. 2019; 103(3):535-548.
- Backman H et al. Restrictive spirometric pattern in the general adult population: methods of defining the condition and consequences on prevalence. Respiratory Medicine 2016; 120: 116-123.
- Markowitz S et al. Screening for Occupational Lung Cancer: An Unprecedented Opportunity Clin Chest Med. 2020 41(4):723-737.
- Cox C. et al. *State of the Art: Imaging of Occupational Lung Disease*. Radiology: 2014: 270 (3): 681-696.
- ATS Ad Hoc Committee on Work-Exacerbated Asthma. OFFICIAL AMERICAN THORACIC SOCIETY (ATS) STATEMENT APPROVED BY THE ATS BOARD OF DIRECTORS, Am J Respir Crit Care Med Vol 184. pp 368–378, 2011
- ATS. Recommendations for a Standard Pulmonary Function Report: Official ATS Statement; Am J Respir Crit Care Med 2017: 196: 1463-1472.

Appendix

- Bradford Hill Criteria

PRINCIPLES IN EVALUATING WHETHER A DISEASE IS WORK RELATED: Bradford Hill, 1965

- Biological gradient: does a dose- response relationship exist?
- Plausibility: Does the association make sense biologically?
- Coherence: Is the association consistent with the natural history and biology of the disease?
- Experimental Evidence: Does experimental evidence support the hypothesis of an association?
- Analogy: Are there other examples with similar risk factors and outcome?

PRINCIPLES IN EVALUATING WHETHER A DISEASE IS WORK RELATED*

- Strength of association
- Consistency of results; does the association hold in different settings and among different study groups?
- Specificity: How closely are the exposure factors and health outcome associated?
- Temporality: Does exposure precede disease outcome. Is latency involved?

* From Hill AB. The environment and disease: association or causation? *Proc R Soc Med 1965: 58: 295-300*