

Occupational Lung Disease

Jeffrey P. Kanne, M.D.

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Jeffrey P. Kanne, M.D.
Sections of Cardiac and
Thoracic Imaging
Cleveland Clinic
Cleveland OH

Introduction

- Occupational lung disease remains the most common work-related illness in the US
- 22,000 newly reported cases in 2002
- Cost of these injuries exceeds \$170 billion per year

TUESDAY

Introduction

- Diagnosis
 - Requires detailed occupational history
 - Supportive laboratory and diagnostic imaging tests
- Imaging
 - Can confirm presence of occupational lung disease
 - Assess severity and response to therapy

Introduction

- Difficulties in establishing relationship between inhaled dust and lung disease
 - Particular job associated with multiple exposures
 - Exposure to a particular dust can occur in various occupations
 - Some dusts can cause more than one disease (e.g. asbestos)
 - Paraoccupational exposures
 - Latency from introduction of substance and recognition of lung disease

Objectives

- Review various organic and inorganic substances that induce lung disease in the workplace
- Understand various types of injuries that can occur in the lungs from occupational exposures
- Recognize the radiographic and HRCT findings of common occupational lung diseases

Occupational Lung Disease

- Occupational asthma
- Lung carcinoma
- Pneumoconiosis
 - Silicosis
 - Coal workers' pneumoconiosis
 - Asbestos-related lung disease
 - Hard metal pneumoconiosis
 - Berylliosis
- Hypersensitivity pneumonitis
- Obliterative bronchiolitis

Occupational Asthma

- Most common occupational-related lung disease
- Incidence increasing
 - >250 chemical implicated in development of occupational asthma
 - Up to 20% of asthma cases may be occupationally related
- High-molecular-weight proteins, polysaccharides, and glycoproteins derived from plants or animals

Occupational Asthma

- Animal workers - fur and urine of rats, mice, guinea pigs, rabbits
- Seafood exposure – fishers, processing plant workers, cooks
- Grain workers – mites, weevils, and grains themselves
- Latex workers – manufacturers, inspectors, healthcare workers, and patients

Lung Carcinoma

- ~5% of lung carcinomas are estimated to result from occupational exposure
- Asbestos-related exposure comprises the largest fraction of these cases
- Cigarette smoking greatly increases the risk of lung carcinoma in exposed individuals particularly those with interstitial fibrosis from asbestos
- Incidence of asbestos-related lung carcinoma is thought to have peaked in the early 1990s

Lung Carcinoma

- At least 12 substances classified as human lung carcinogens
 - Asbestos
 - Nickel
 - Cadmium
 - Beryllium
 - Chromium
 - Polycyclic aromatic hydrocarbons
 - Crystalline silica

Pneumoconiosis

- Condition characterized by
 - Permanent deposition of substantial amounts of particulate matter in the lungs
 - Usually of occupational or environmental origin
 - Tissue reaction to its presence

Pneumoconiosis

- Fibrotic reaction
 - Focal and nodular (silicosis)
 - Diffuse (asbestosis)
 - Usually associated with radiographic abnormalities and functional respiratory impairment
- Aggregates of particle-filled macrophages
 - Minimal or no fibrosis (iron, tin, barium)
 - May have radiographic abnormalities
 - Little or no functional impairment

Silicosis

- Free silica (SiO_2) exposure
 - Mining
 - Quarrying
 - Construction
 - Manufacturing (foundry and concrete)
 - Ceramics
- Acute high-level exposure can lead to silicoproteinosis

Silicosis

- Chest radiograph - simple silicosis
 - Multiple nodules 1-10 mm
 - Well circumscribed
 - Upper lobe predominance
 - 10-20% calcified
 - Calcified lymph nodes (5%) “egg-shell”

Silicosis

- Chest radiograph – complicated silicosis/progressive massive fibrosis (PMF)
 - Large opacities (>10 mm), usually in upper lobes
 - Paracatricial emphysema
 - Decreased profusion of small nodules as large opacities increase

Silicosis

- HRCT - Similar to chest radiography
 - Nodules upper zone and posterior predominance
 - 40% hilar or mediastinal lymphadenopathy
 - Pseudoplaques from conglomeration of subpleural nodules

Silicosis

- Carcinoma
- Infection
 - *M. tuberculosis*
 - Non-tuberculous mycobacteria
- COPD
- Connective tissue disease
 - Scleroderma
 - Rheumatoid arthritis (?), SLE (?)

CWP

- Prevalence of CWP declining
 - Less dust
 - Fewer miners
 - Removal of affected miner from workplace
- Miners often exposed to other dusts
 - Especially silica

CWP

- Radiograph
 - Small (1 – 5 mm nodules)
 - Less well defined than silicosis
 - 10% to 20% calcified (particularly anthracite workers)
 - Large opacities (PMF)
 - In practice, cannot be distinguished from silicosis

CWP

- HRCT
 - Small centrilobular and subpleural nodules
 - Pseudoplaques
 - 30% hilar or mediastinal lymphadenopathy (usually calcified)
 - Large opacities
 - Paracatricial emphysema

Asbestos

- Fibrous minerals
 - Silicic acid with magnesium, calcium, sodium, and iron
- Two groups
 - Serpentine (*chrysotile*)
 - Amphibole (*amosite*, *crocidolite*, *anthophyllite*, *tremolite*, *actinolite*)

Asbestos

- Serpentine
 - Curved
 - Deposition in central airways
 - Transported out of lung via mucociliary clearance and lymphatics
- Amphiboles
 - Straight
 - Transported to periphery of lung
 - Are not cleared by the body

Asbestos

- Asbestos-related pleural disease
 - Pleural effusion
 - Parietal pleural plaques
 - Diffuse pleural thickening
 - Mesothelioma
- Asbestosis

Asbestos-Related Pleural Disease

- Pleural effusion
 - Usually small
 - Latency <20 years after exposure
- Pleural plaques
 - Dense fibrous tissue on parietal pleura
- Diffuse pleural fibrosis
 - Usually bilateral
 - Spares mediastinal pleura

Asbestos-Related Pleural Disease

- Mesothelioma
 - 50-90% patients exposed to asbestos
 - Exposure to crocidolite and amosite (amphiboles) provides greatest risk
 - Risk from exposure to chrysotile smaller

Asbestosis

- HRCT
 - Intralobular linear opacities
 - Irregular septal interlobular septal thickening
 - Subpleural curvilinear opacities
 - Small peripheral centrilobular nodules (earliest)
 - Parenchymal bands
 - 95%-100% have evidence of asbestos-related pleural disease on HRCT

Hard Metal Pneumoconiosis

- Formerly termed giant cell interstitial pneumonitis (GIP)
- Exposure to cobalt and tungsten carbide
- Pathogenesis unclear
- Histopathology
 - Interstitial pneumonitis
 - Variable fibrosis

Hard Metal Pneumoconiosis

- Radiograph
 - Diffuse nodules and reticulation
 - Lymphadenopathy
- HRCT
 - Ground-glass opacity
 - Consolidation
 - Reticular opacities
 - Traction bronchiectasis

Berylliosis

- Beryllium used in aerospace, automotive, energy, nuclear, medical, and electronic industries
- Acute disease virtually non-existent
- Chronic disease
 - >2 year exposure
 - Symptoms usually occur 6-10 after exposure has ceased
 - Delayed-type hypersensitivity reaction

Berylliosis

- HRCT
 - Interlobular septal thickening
 - Nodules (perilymphatic)
 - Peribronchovascular
 - Interlobular septal
 - Lymphadenopathy usually only present with lung abnormalities

Hypersensitivity Pneumonitis

- Incidence of HP from workplace exposure is increasing
- Newly recognized antigens and newly introduced substances
- Agriculture and bird exposures remain the most common

Hypersensitivity Pneumonitis

- Organic antigens
 - Bacteria
 - Fungi
 - Plant
 - Animal antigens
- Low molecular weight inorganic compounds
 - Isocyanates

Hypersensitivity Pneumonitis

- Acute
 - Uncommon presentation
- Subacute
- Chronic

Hypersensitivity Pneumonitis

- HRCT – Subacute
 - Bilateral ground-glass opacity
 - Poorly-defined centrilobular nodules
 - Middle and lower lung zone predominance
 - Lobular air trapping

Hypersensitivity Pneumonitis

- HRCT – Chronic
 - Irregular linear opacities
 - Honeycombing
 - Features of subacute disease
 - Poorly-defined centrilobular nodules
 - Ground-glass opacity
 - Lobular air trapping

Obliterative Bronchiolitis

- Usually occurs in those working with noxious gases
 - Nitrogen dioxide (NO₂)
 - Sulfur dioxide (SO₂)
 - Phosgene (CClO₂)
 - Ammonia (NH₃)
 - Chlorine (Cl₂)
- Most exposures occur through spills or accidental exposures and not during routine work
- Flavor workers' lung

Flavor Workers' Lung

- 8 cases reported to Missouri Department of Health in 2000
- Young patients working at the same Missouri popcorn flavoring plant
 - Four worked in flavor mixing room
 - Four worked in microwave popcorn packing room

Flavor Workers' Lung

- >100 volatile organic compounds in mixing rooms
- Diacetyl (2,3-butanedione) predominant
 - Ketone with butter flavor
- Mixers - 800 fold greater mean exposure to diacetyl than outside, warehouse, and office workers
- Packers – 15 fold greater mean exposure

Flavor Workers' Lung

- Other reported cases
 - Additional microwave popcorn plant
 - Snack food manufacturing workers
 - Flavoring manufacturing plants

Summary

- Despite improved safety implementations, workers continue to be exposed to potentially dangerous dusts and fumes
- Occupational lung disease remains the most common work-related illness in the US

Summary

- New compounds are being introduced into the workplace each year
- The latency between exposure and clinical disease can be quite long
- Many workers exposed to multiple compounds
- Many compounds are used across different industries

Conclusion

- Imaging, particularly HRCT, is central to the diagnosis of occupational lung disease
- Imaging may confirm the presence of an occupational lung disease
- Imaging can assess severity and progression of disease