Industrial Dust Diseases

The term ‘pneumoconiosis’ refers to a group of lung diseases caused by the inhalation and retention of dust in the lung. This causes a range of granulomatous and fibrotic changes.

In modern times, the most commonly occurring variant, apart from asbestosis, is coal worker's pneumoconiosis (CWP), arising from the inhalation of coal dust. There is generally a long time lag between exposure and onset of the disease - 10 years in the case of coal dust and 15-60 years with asbestos - hence, most new cases or deaths from pneumoconiosis reflect the working conditions of the past.

Pneumoconiosis is a notifiable industrial disease - where a patient develops the disease, their doctor must notify their employer in writing with the patient's consent. The employer then is duty-bound to inform the local Health and Safety Executive (HSE). Pneumoconiosis is also a prescribed industrial disease. Financial compensation may be available where an individual is able to show they worked in a job for which their disease is prescribed and that their illness is likely due to the occupational exposure.

Epidemiology

Greater understanding of the causes of industrial lung disease, as well as enforcement of legislation by the HSE, have reduced the risk of industrial dust disease. In the post-industrial UK, exposure is nowhere near the scale found in the 1950s and 1960s. Whilst mining has declined in Western Europe and many parts of the USA, elsewhere in the world, many still depend on it for their living and may have much less statutory protection. Interactions between industrial dust diseases and infection may also be significant, particularly in low-income countries with a high incidence of HIV.[1]

Industrial lung disease has a very marked male preponderance but this is most likely related to occupation rather than inherent susceptibility.

Remember, there may be a long latency between exposure and the presentation of an industrial lung disease - review past employment history as well as current employment.

The first deaths attributable to asbestos were described in 1907 and disease from asbestos exposure is now said to account for about 5,000 UK deaths each year.[2] It is the most common cause of death relating to work in the UK. Legislation has existed in the UK since 1931 and asbestos use is now banned but much of the material still exists, particularly in buildings. There is still the potential to kill those who are unknowingly exposed to the fibres in their work, or those who choose to ignore the controls that provide effective protection during work with asbestos.

- In 2011, asbestosis was cited as the underlying cause of death on 178 death certificates.[3]
- The annual number of mesothelioma deaths has increased from 153 in 1968 to 2,291 in 2011. This will probably continue to rise until 2015.[4]
- Asbestos-related lung cancer is underdiagnosed since it is indistinguishable from that caused by cigarette smoking. Current estimates (based on the number of excess lung cancer cases in high-risk occupations) ascribe about 2,000 deaths to asbestos-related lung cancer.[4]

Coal worker's pneumoconiosis:

- There were 265 new assessed cases of coal worker's pneumoconiosis and 40 cases of silicosis in the Industrial Injuries and Disablement Benefit (IDB) scheme in 2011.
- Chronic bronchitis - now chronic obstructive pulmonary disease (COPD) - and emphysema became prescribed diseases in September 1993 for coal miners with a specified level of lung function impairment and a minimum of 20 years of underground exposure to coal dust. The numbers have fluctuated considerably, based more on publicity and relaxation of criteria to be able to claim rather than upon incidence. Approximately 15% of COPD is likely to be work-related. This suggests there could be around 4,000 occupational COPD deaths currently each year in the UK.[5]

Asbestos-related diseases[6]

See separate article Asbestos-related Diseases.

Asbestosis

Asbestosis is a typical pneumoconiosis and tends to follow heavy exposure with a 5- to 10-year time interval. It usually presents with:

- Shortness of breath with a dry cough.
- Progressive dyspnoea.
- Repetitive inspiratory basal crackles, sometimes known as 'velcro crepitations'.
- Clubbing of the fingers (late feature).
The rate of progression depends upon the level of exposure and eventually results in increasing disability and death from cardiorespiratory failure.

**Investigations**

- CXR shows a ground-glass opacification, small nodular opacities, 'shaggy' cardiac silhouette and an ill-defined diaphragmatic contour.\(^7,8\)
- Spirometry - restrictive pattern of lung function with reduced volumes/transfer factor.
- Sputum microscopy may show asbestos bodies. These confirm exposure to asbestos but their significance in diagnosing asbestosis is uncertain.

**Asbestos-related lung cancer**

Lung cancer is a common disease amongst smokers but it has an increased incidence in those with asbestosis (40-50% risk of death from bronchial carcinoma in smokers with asbestosis). All types can cause the disease with some evidence of more danger from blue and brown. Asbestosis-related lung cancer may also occur in non-smokers. The presentation and investigation of lung cancer are discussed elsewhere.

**Mesothelioma**

See separate article *Malignant Mesothelioma.*

**Coal mining\(^9,10\)**

Coal miners are exposed to a variety of dusts including silica. Tiny particles of coal dust, just 2-5 microns in diameter, are retained in the alveoli. They are engulfed by macrophages but, eventually, the system is overwhelmed and an immune response follows. This produces pulmonary fibrosis. If this is associated with rheumatoid arthritis, it is called Caplan's syndrome.\(^11\) Morbidity and mortality are related to the type of coal dust and the duration of exposure. Dust that is high in silica increases the risk of fibrosis but the rate of progression and severity of the diseases are also influenced by the presence of other minerals in the inhaled dust. A high percentage of free silica gives a high degree of pulmonary fibrosis.\(^12\) CWP is divided into:

- **Simple pneumoconiosis** - a nodular interstitial lung disease that is graded according to CXR appearance. Patients are often asymptomatic and the diagnosis is an incidental finding on CXR. There has been much debate as to the effect on lung function - but it does increase the risk of COPD, diminish forced expiratory volume in one second (FEV1) and have additive effects combined with smoking.\(^13\)
- **Progressive massive fibrosis** - symptoms progress from shortness of breath on exertion, cough and black sputum to respiratory failure. CXR reveals large nodular, fibrotic masses in the upper lobes. Respiratory function tests show a mixed obstructive and restrictive picture with decreased lung volumes and gas transfer.
Silicosis
This is also known as ‘potter’s rot’ and was recognised by Hippocrates and others in Ancient Greece. Silica exposure occurs beyond coal mining: high levels of exposure may also be found within the construction industry, tunnelling, cement industry, brick manufacturing, pottery and ceramic work, silica sand and granite extraction, gold mining and iron and steel foundry.

Prolonged exposure to high levels of silica causes silicosis and increases the risk of developing COPD. Silicosis and CWP are indistinguishable on CXR. Risk varies depending on the presence of other minerals in the dust, particularly clay minerals and the size of the particles and percentage of quartz. The effect of cumulative silica dust exposure on airflow obstruction is independent of silicosis.\[14\]

Pulmonary siderosis
Those who work with metallic grinding or welding have a risk of inhalation of metallic particles. Iron absorbs X-rays and produces very impressive shadows on CXR but it has little effect on pulmonary function and little long-term morbidity. Tin and barium produce similar clinical and radiological pictures (stannosis and baritosis respectively).

Berylliosis\[15\]
This is rare, affecting those working in the aerospace, nuclear, telecommunications, semi-conductor and electrical industries. It has been recognised as a cause of occupational lung disease since the 1940s and can cause an allergic immune response (beryllium sensitisation), acute beryllium disease (similar to acute pneumonitis) and chronic beryllium disease (a granulomatous lung disease with symptoms similar to sarcoidosis).\[16\]

Management of suspected industrial dust disease
- Take a good occupational history, going back over many years and looking also at hobbies and pastimes.
- CXR and lung function tests are required. Occupational lung disease cannot be diagnosed by radiology alone.\[17\] However, with the advent of high-resolution CT scans which are more sensitive and specific than X-ray, these are having an increasing role in diagnosis, assessment of disease activity and evaluation of response to therapy.\[18\]
- Refer to a chest physician for further diagnostic and management advice.
- There may be considerable financial implications and a tribunal may be required to make a decision, often requiring expert opinion. It used to be the case that a claim could not be based on the presence of pleural plaques, for asbestos-related lung damage. However, whilst this remains true for England and Wales, in Scotland and Northern Ireland the local parliaments passed legislation which reversed the decision of the House of Lords and provided that pleural plaques constitute actionable harm for the purposes of an action of damages for personal injuries.\[19\]
- None of these diseases is curable. Smoking cessation should be encouraged strongly. Treat/palliate symptoms. Support the patient and their family through the disease and its social/occupational/legal ramifications.

Prevention
Surveillance and monitoring play an important role. The HSE has a Working Group on the Assessment of Toxic Chemicals (WATCH) to consider the evidence on the occupational exposure and health effects of substances, including whether a maximum exposure limit (MEL) or occupational exposure standard (OES) would be appropriate and setting limits, where indicated.\[20\]

It is probably impossible to prevent all industrial dust diseases but they can certainly be reduced by following appropriate safety precautions, including:
- Adequate ventilation.
- Keeping down dust levels in the workplace.
- Wearing of facemasks.

Further reading & references
- Asbestos-Related Pleural Disease; Learningradiology.com, 2006

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5. Pneumoconiosis Statistics; Health and Safety Executive (HSE)
17. Martin L; Pitfalls in Diagnosing Occupational Lung Disease (OLD) for Purposes of Compensation, Occupational Safety and Health Administration.
19. Court awards damages for pleural plaques; Northern Ireland Courts and Tribunals Service, 2014
20. Advisory Committee on Toxic Substances (ACTS); Health and Safety Executive, 2014

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