

## Cadmium or compounds thereof

### Definition of causal agent

Cadmium is a silver-white, malleable metal which is highly resistant to corrosion.

Its compounds include: cadmium acetate, cadmium sulphide, cadmium sulpho-selenide, cadmium stearate, cadmium oxide, cadmium carbonate, cadmium sulphate, cadmium chloride

### *Main occupational uses and sources of exposure:*

Used for manufacture of Nickel-Cadmium (Ni-Cd) batteries; electroplating other metals, mainly iron and steel; in alloys; as pigments in paints and as stabilizers in plastics. It is also encountered in the recovery of other metals.

### Toxic effects

#### *1. Acute effects*

##### 'Metal fume fever'

Pseudo-influenza type syndrome usually occurring shortly after acute exposure to Cadmium Oxide (CdO) fumes and causing irritation and dryness of the nose and throat, coughing, headache, weakness, shivering, fever, etc. Metal fume fever usually resolves spontaneously.

##### Acute broncho-pneumonia (chemical pneumonitis)

The first stage is very similar to (and often confounded with) the typical "metal fume fever". After some hours, development of symptoms suggesting the onset of an acute upper respiratory tract infection: irritation and dryness of nose and throat, cough, headache, dizziness, weakness, chills, fever, chest pain and breathlessness which may progress to serious consequences such as pulmonary oedema or respiratory failure. Death occurring several days after acute exposure to cadmium is usually due to pulmonary oedema.

#### *Exposure criteria:*

*Minimum intensity of exposure:* Occupational exposure confirmed, if possible assessed, by history and study of working conditions providing evidence of intense inhalation of cadmium oxide fumes (CdO fumes are formed readily when the metal is heated in air).

It has been estimated that an 8-hour exposure to 5 mg/m<sup>3</sup> may be lethal and an 8-hour exposure of 1 mg/m<sup>3</sup> is considered as immediately dangerous for life.

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*Minimum duration of exposure:* From a few minutes to a few hours depending on the intensity of exposure.

*Maximum latent period:* The first symptoms usually appear within 48 hours following exposure.

## 2. Chronic effects

### ☐ Nephropathy

Nephrotoxicity in occupationally exposed subjects is usually a tubular dysfunction associated with an increased urinary excretion of Low Molecular Weight (LMW) proteins such as  $\beta$ -2 microglobulins ( $\beta$ 2M) and retinol binding protein (RBP). An effect on the glomerulus may also be observed in cadmium-exposed workers, as indicated by increased urinary excretion of HMW proteins including albumin, immunoglobulin G (IgG) or transferrin. Overt clinical disease is rare.

#### ***Exposure criteria:***

*Minimum intensity of exposure:* Occupational exposure confirmed, if possible assessed, by:

- history and study of working conditions providing evidence of repeated or prolonged exposure to cadmium;
- and, if available:
  - biological monitoring (levels below which nephropathy is unlikely to be due to occupational exposure to cadmium)  
guide values (depending on the duration of exposure):  
CdU > 5-10  $\mu$ g/g creatinine
  - workplace air monitoring  
guide values: atmospheric concentration > 2  $\mu$ g/m<sup>3</sup>.

The critical concentration of cadmium in the renal cortex associated with increased incidence of renal dysfunction in an occupational setting (mainly low molecular weight proteinuria) is estimated to be about 200 ppm, equivalent to an urinary Cd excretion of about 5-10  $\mu$ g Cd/g creatinine. This threshold is considered as clinically relevant because several studies have indicated that when CdU > 10  $\mu$ g/g creatinine renal changes are irreversible and may lead to an exacerbation of the age related decline in the glomerular filtration rate. Changes in renal biomarkers of unknown health significance and predictive value can occur at lower levels.

*Minimum duration of exposure:* Several years depending on the level of exposure

*Maximum latent period:* Cd is a highly cumulative agent. The first signs of renal damage may develop several years after documented exposure.

### ☐ Pulmonary lesions

Long-term inhalation exposure to cadmium can lead to decreased lung function (obstructive syndrome) and emphysema.

#### ***Exposure criteria:***

*Minimum intensity of exposure:* Occupational exposure confirmed, if possible assessed, by:

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- history and study of working conditions providing evidence of repeated or prolonged exposure to cadmium ;
  - and, if available :
    - biological monitoring (levels below which a pulmonary lesion is unlikely to be due to occupational exposure to cadmium)
    - guide values: CdU > 5-10 µg/g creatinine  
CdB > 5-10 µg/L
    - workplace air monitoring
    - guide values: atmospheric concentration > 2 µg/m<sup>3</sup>.

*Minimum duration of exposure: about 10 years.*

*Maximum latent period: Five years.*

### □ Lung cancer

An increased risk of lung cancer has been found among workers in foundries and battery manufacturing plants where exposure to cadmium has been confirmed. However, the causal relationship between lung cancer and prolonged exposure to cadmium or cadmium compounds has not been firmly established.

See also section on *Occupational cancers* in the **Preface**.

### □ Bone

Cadmium has been known to cause bone demineralisation with accompanying severe bone pain (well described in 'Itai Itai' disease in Japan). However this resulted from environmental contamination (particularly in elderly women) and not from occupational overexposure.

Individual case reports of bone effects following heavy occupational Cadmium exposure have occurred in specific groups of individuals especially post-menopausal women with vitamin D deficiency.