Research Paper

Volume : 4 | Issue : 10 | October 2015 • ISSN No 2277 - 8179

METAL FUME FEVER: Engineering Control is necessary

Physics

KEYWORDS : Metal fume, Toxic substances, Symptoms etc.

Dr. Mahendra Kumar Assistant Professor, Deptt. of Physics, University of Lucknow.

ABSTRACT

Metal fume sever is an acute self limiting condition caused due to inhalation of metal oxide fumes. Symptomatology of metal fume fever can mimic other conditions that must be considered in the differential diagnosis. The abrupt onset of symptoms on the job or within 3 to 10 hours after work and history of welding or galvanization of steel should make the diagnosis. Treatment of metal fume fever is symptomatic and nonspecific. In this concept paper we conclude that prevention includes implementation of engineering controls like fume extractors built into welding equipment.

INTRODUCTION:

The specific community and the public have become increasingly aware of and justifiably concerned about the presence of toxic substances in their working and living environments and about the health impact of those substances. There is a consequent increasing demand to evaluate the potential health risk of those substances under the conditions in which they are used.

According to WHO they are at least four categories of occupational disease syndromes; diseases that are only occupational in origin eg. Pneumoconiosis, those in ehich occupation is one of the casual factors eg. Bronchogenic carcinoma, those in which occupation is contributing factor in complex situations eg. Chronic bronchitis and those in which occupation may aggravate pre-existing disease eg. Asthma. Acute metal fume fever is one of the few ancient occupational disease conditions encountered still in modern industrial practice in our country. Medical professionals who are in industrial sector may be aware of it but general practitioners and specialists are ignorant of this condition.

Metal fame fever is an acute self-limited syndrome caused due to inhalation of high concentrations of metal oxide fumes. The association of febrile illness with metal inhalation has been ascribed to Datissier in the early 1820's. Thackrah in 1832 wrote of disease realted exposure to yellow brass in brass melters and Greenhow in 1862 described Brass founders' ague in brass-casters. Other names that habve been used for metal fume fever include Monday fever, brass chill, zinc ague, welder's ague, spelter shakes, foundry fever, the smoothers, brass founder's ague and copper colic. Antimony, arsenic, beryllium, cadmium, aluminium, magnesium, nickel, selenium, cobalt, copper, manganese, chromium, lead, zinc and tin are the metals which causes for the Metal Fume Fever.

OCCUPATIONAL EXPOSURE:

ZINC:

Occupations where fumes are generated by cutting, welding, smelting or galvanising operations of metals. The most common metal associated with Metal Fume Fever is Zinc. Fumes of zinc occur as the result of volatilization of the metal in air. The volatilization of zinc occurs so rapidly (melting point =419°C, boiling point=907°C that zinc oxide is formed in the ambient air and constitute potential hazard for inhalation.

It is widely believed that only way that metal fume fever can occur is during exposure to freshly generated fumes. Blanc and Boushey reported that heavy exposure to 'mature' zinc oxide dust in the respirable range can cause fume fever. All the chemical substances are toxic at some concentration. A concentration exists for substances from which no injurious effect will result, no matter how often the exposure is repeated. This concentration has been termed as Threshold Limit value (TLV). In other words, TLV is a time weighted average concentration of hazardous agent in atmosphere. TLV means the maximum allowable concentration of contaiminants in the environment where worker can work 8 hours a day/ 5 days in a week without any adverse effects. Each (chemical) metal have a threshold limit value eg. TLV for zinc oxide is 5 mg/.

Exposure to zinc oxide fumes occurs mainly during welding or the galvanization of steel . Galvanization of steel may involve significant fume exposure during dipping, electrolysis or zinc spraying. Two compounds of zinc namely zinc oxide and zinc chloride produce adverse effects in humans. Zinc oxide is highly volatile i.e. has significant vapour pressure even at relatively low temperatures and so is evolved during any operations in which the molten metal's are used. Welding on galvanized metal can also produce dense clouds of white zinc oxide fumes. Fumes of other metals such as copper, magnesium, aluminium, antimony, cadmium, iron, manganese, nickel selenium, silver and tin can cause metal fume fever. However, most cases are caused by Zinc, copper or magnesium fumes.

MAIN SOURCES:

The following operations involve zinc chloride fume and lead workers to exposures to this substance:

- Etching of metals and copper plating of iron,
- Soldering with zinc-chloride-containing fluxes,
- Browning steel and galvanizing iron,
- Arc welding of galvanized iron and steel pipes,
- Use in vulcanizing and reclaiming processes in rubber manufacture,
- Generation of smokescreens for military use

LEAD: Examples of lead-risk occupations are:

- Abrassive blasters and coasters
- Cable layers
- Demolition workers
- Electricians
- Plumbers
- Metal workers

Sources of lead (TLV-Time Weighted Average (TWA) of 0.05 mg/) (Boiling point: 1740°C, Melting point: 327.5°C)

Lead is describing as a 'multi-source toxin'. Workers are particularly at risk as they are often exposed to many sources of lead over long periods of time. Main sources of lead at work are:

- Lead Paint consists of following point:

- Domestic paint used in many houses built before 1970,
- Protective coatings used on industrial buildings, plant and equipment,
- Marine, automotive and vehicle paints,
- Specialised paints, such as road marking and sign writing applications.

- Building products which can contain lead including flashing, sheet lead, PVC products, lead solder and plumbing fittings.

- Petrol and lubricants including leaded petrol, some types of oil and grease and waste oil.
- Hazards lead dust which can accumulate on old buildings or workplaces which are not cleaned properly. Many work practices commonly used in industry, such as burning, sanding and grinding, can disturb or create hazardous lead fumes and dust which workers can take onto their bodies.

There are many other materials and products, often inadequately labelled, which are commonly used in industry and contains lead:

There are some ways from where lead enters human body:

- Breathing in dust and fumes is the main way by which lead enters a worker's body. Fine particles of lead can penetrate deep into the lungs and rapidly pass into the blood.
- Eating contaminated food and drink can occur if workers don't wash their hands before meals and eat in workplaces where lead dust is present. Smokers can accidently take in lead dust on their hands or cigarettes.
- Absorption through the skin can occur where leaded petrol or lubricants are handled without gloves or barrier cream. Recent research suggests that fine particles of lead may be able to enter the body through sweat pores in the skin.

CHROMIUM:

As we know that Threshold Limit Value Chromium is 0.5 mg/ and Melting point and boiling point are respectively 1860°C and 267°C. It is a hard, corrosion resistant grey metal that exists in several oxidative states. The heaxavalent compounds are much more chemically aggressive than the trivalent compounds. Hexavalent chromium (chromate) is used in pigments and for chromium plating, stainless steel contains nickel and chromium is oxidized to hexavalent chromium. Some types of cement and treated wood products contain hexavalent chromium. As hexavalent chromium compounds are more chemically aggressive they cause more irritative symptoms when inhaled. Inhalation of hexavalent chromium particles may cause sneezing, rhinorrhoea, lesion of the nasal septum, metal fume fever and occupational asthma. In general, hexavalent compounds pass through biological membranes while trivalent chromium compounds do not. Exposure to hexavalent chromium compounds are associated with an increased risk of lung cancer.

MAGNESIUM:

Magnesium found in the form of its compound as magnesium chloride, magnesium oxide etc. it having melting point 650°C and boiling point 1107°C. Magnesium chloride is used for a variety of other applications besides the production of magnesium: the manufacture of textiles, paper, fireproofing agents, cements and refrigeration brine, dust and erosion control. Mixed with hydrated magnesium oxide, magnesium chloride forms a hard material called Sorel cement. Prolonged inhalation of magnesium chloride fumes may cause metal fume fever.

WAY FOR ENTRY:

Welding is an occupation associated with respiratory symptoms and bronchial obstruction. Metal Fume Fever and Acute Bronchitis seem to be quite common. The route of entry is mostly inhalation only.

MODE OF ACTION:

The mechanism of caustion of metal fume fever has endangered controversy and is not well understood. An immune reaction was hypothesized in reports by Lehman and Mc Cords. This hypothesis suggested modified lung proteins and the metal oxide itself elicit an antibody reaction. There is little support for this hypothesis. Blanc and colleagues have associated this with the release of cytokines which are known to have effects on thermoregulation. Two particular cytokines are important as pyrogenes; tumor necrosis factors released from macrophages, lymphocytes and other cell types. These cytokines are important in causing systemic symptoms, fever and neutrophil attraction and may have a role in tachyphylaxis.

SIGNS AND SYMPTOMS:

The diagnosis of metal fume fever is usually made when the clinical picture is combined with the history of metal fume exposure. The disorder is usually of short duratuion lasting not more than 24 to 48 hours the chief complaints will be metallic taste in the mouth, fever, chills, malaise, fatigue, headache, myalgias and chest tightness, dyspnoea and cough usually occur with 2 to 10 hours after exposure. The work relatedness of this condition may be missed because the symptoms may start when the employee is at home.

PHYSICAL FINDINGS:

These are like physical condition from effect of the metal. These are vary from person to person. Fever, sweating, tachycardia, chills, pleural, friction rub and pulmonary rales will be present.

DIFFERETIAL DIAGNOSIS:

The Symptomatology of metal fume fever can mimic other conditions that must be considered in the differential diagnosis. Influenza can present for medical evaluation with symptoms of chills, myalgia, sore throat, fatigue, fever and listlessness. The abrupt onset of symptoms on the job or within 3 to 10 hours after work, and a history of welding or galvanization of steel should make the diagnosis. Other common fever conditions for differential diagnosis are malaria, urinary tract infection and acute upper respiratory tract infection.

LABORATORY FINDINGS:

Laboratory studies include leukocytosis (15000 to 20000 cells/ml) with excess of polymorphonuclear cells. Lactate dehydrohenase may be elevated with the pulmonary fraction showing the greatest increase. Zinc levels may be elevated in the serum and urine but the absence of zinc does not rule out exposure or the diagnosis. Pulmonary function study results may be normal or may be show acute changes consistent with reduced lung volumes (forced vital capacity and forced expiratory volume in 1 second) and decreased carbon monoxide diffusing capacity. Over a time the pulmonary function abnormalities revert to normal.

TREATMENT:

The treatment of metal fume fever is symptomatic and nonspecific. Pulmonary sequels are not present and hospitalization is unnecessary for uncomplicated cases. Milk has been described as a folk remedy but no clinical studies have been established. Since it is a self limiting syndrome, Broad spectrum antibiotics and unwarranted radiological exposures usage may be avoided.

PREVENTIVE MEASURES:

Preventation of metal fume fever includes implementation of engineering controls, general room ventilation, local exhaust ventilation, process enclosure, down draft or cross draft tables, and use of fume extractors built into welding equipment. When local exhaust ventilation is not available or not feasible, personal respiratory protection should be used under the workers face shield. It should be noted that the user acceptability is limited because of the discomfort and elevated temperature noted beneath the breathing device.

CONCLUSION:

Globally every year over two million people suffer from various occupational related disabilities. To minimise this thorough study of the causes and preventive measures in occupational related problems in industrial set up is essential. Knowledge of metal fume fever by the medical Practitioners in Industries helps them to minimise the use and abuse of drugs. This also helps them in recommending various preventive measures to the managements of the various industries where such incidents are reported. A proper history from patients also avoids unwanted use of drugs and unwarranted radiological exposures by the general practitioners. It may be noted that no Indian data is available because metal fume fever usually occurs between 8-12 hours after exposure to metal; fumes when employee is at home and also it is not properly reported in our country.

REFERENCE

1. KB Lehman, Arch Hyg, 72, 358-381, 1910. 2. S Barnhart, L. Rosenstock, Chest, 86, 789-791, 1984 3. P. Blanc, HA Boushey, Semin Respir Med., 14, 212-225, 1993. 4. T. Gordan, JM Fine, Occuup Med: state Art Review, 8, 505-517, 1993. 5. Guy F. Perry Tr, MD Jown, Occupational Medicine Forum, 36, 1061-1062, 1994