# Metal Fume Fever: An Uncommon Consequence of Inhalation Injury

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**Abstract**

Metal fume fever (MFF) is caused by the inhalation of heavy metal oxide fumes. Although well recognized by occupational medicine physicians and clinical toxicologists, it is rarely seen in the emergency department. The diagnosis is based on clinical findings and confirmed by a history of exposure and rapid resolution of the symptoms. The resemblance of MFF to influenza often leads to its misdiagnosis. Management is mainly supportive.

We describe a patient who presented to the emergency department twice, at an interval of 3 months, with MFF. The natural history, pathogenesis, clinical presentation, and management/prevention of the disease are discussed.

**MeSH Words**: Metal fume fever, emergency medicine, toxicology, fever, differential diagnosis

## Introduction

Metal fume fever (MFF) is an acute, self-limited occupational disease caused by the inhalation of excessive concentrations of a variety of heavy metal oxide fumes during welding of galvanized metal or melting metal. The risk is increased when these activities are performed in confined and unventilated spaces. Although well recognized by occupational medicine physicians and clinical toxicologists, MFF is rarely encountered in the emergency department. The clinical presentation strongly resembles that of common viral respiratory diseases [1]. Therefore, awareness of the disease and knowledge of the patient's occupational history are crucial to its proper diagnosis.

We describe a patient who presented to our emergency medicine department on two different occasions with MFF. The natural history, pathogenesis, clinical presentation, and management of the disease are discussed.

## Case Report

A 20-year-old man presented to the department of emergency medicine in the evening with complaints of malaise, cough, fever, generalized myalgia, nausea, and dyspnea at rest. Anamnesis revealed that the symptoms had started about 3 hours after the patient welded a zinc-coated metal (galvanized steel) as part of his work at a nearby factory. Previous medical history was

noncontributory. On physical examination, the patient appeared alert, in good general condition, and in no evident distress. Respiratory rate was 20 breaths/min, with oxygen saturation 96% in room air. Pulse rate was 100/min, blood pressure 140/70 mmHg, and temperature 38°C p.o. Chest examination yielded normal breath sounds. The rest of the physical examination was unremarkable. Findings on blood gas analysis were as follows: partial pressure of oxygen ($PO_2$) 57mmHg, partial pressure of carbon dioxide ($PCO_2$) 39mmHg, pH 7.42, bicarbonate 26meq/l, and oxygen saturation 89%. Chest X-ray was normal. White blood count was 20.800/uL with 94% neutrophils (neutrophilic leukocytosis), with normal hemoglobin, platelet count, and erythrocyte sedimentation rate. Blood glucose level and kidney and liver function tests were within normal limits. The electrocardiogram and cardiac ultrasound study revealed no abnormalities.

The clinical diagnosis was MFF. The patient was admitted for observation and oxygen therapy. The following morning, he was completely asymptomatic. No additional tests were done, and the patient was discharged.

Three months later, the patient again presented to the emergency department in the evening with complaints of high fever, malaise, and generalized myalgia that had started 3 hours after he welded galvanized metal. This time there were no respiratory symptoms. On physical examination, his general condition was good. Rectal temperature measured 40°C, pulse 106/min, and blood pressure 144/62 mmHg. Respiratory rate was18 breaths/minute and oxygen saturation was 96% in room air. The lungs were clear. The rest of the physical examination was unremarkable. Chest X-ray and electrocardiogram were normal. The white blood cell count was 17.000/uL with 90% neutrophils. Findings for other blood tests and urinalysis were within normal range.

Given the clinical picture and the occupational history, the diagnosis was again MFF. The patient was hospitalized for observation overnight. By the following morning, all symptoms had resolved, and the patient was discharged. The patient was given a detailed explanation on how to avoid the disease and was referred to the occupational medicine clinic.

**Discussion**

Welding is an important part of many industries. The high temperatures cause the metals to liberate fumes that include components of the metal and other combustion products. Their excessive inhalation by the welder can induce MFF, especially in poorly ventilated areas. The metals usually involved are zinc-coated brass or steel; MFF is rarely caused by metal oxide fumes from magnesium, copper, manganese, cadmium, or cobalt. Symptoms usually appear 3 to 10 hours after exposure and include fever, chills, headache, myalgia, fatigue and dyspnea. Some subjects also present with cough, excessive thirst, metallic taste, and excessive salivation. Neuthrophilic leukocytosis may be found on laboratory tests. The chest roentgenogram is usually normal but may show bilateral pulmonary infiltrates [1]. Recovery is spontaneous, generally within 24 hours. There are no known late complications.

About 2000 cases of MFF are reported annually in the United States [2]. A study of welding apprentices reported possible MFF (at least one manifestation of fever, flu-like feeling, general malaise, chills, dry cough, metallic taste, or shortness of breath) in 39.2% of participants [3]. The pathophysiology of the disease is unclear, but it seems to be secondary to a direct toxic effect. There is evidence of an exposure-dependent neuthrophilic alveolitis induced by the increased release of tumor necrosis factor alpha and interleukins 6 and 8 from pulmonary cells [4]. Adaptation with repeated exposure has been documented, but it is usually transient and disappears rapidly after even a short (2-day) work hiatus ("Monday morning fever") [5].

The diagnosis is based on the clinical findings and is confirmed by the occupational history combined with the rapid resolution of the symptoms. The differential diagnosis includes common respiratory viral diseases, inhalation injury from polymer fumes or smoke [6], and true chemical pneumonitis following exposure to fumes from cadmium, manganese, mercury, or nickel. In the latter cases, the condition is progressive and sometimes complicated by noncardiogenic pulmonary edema [1].

Treatment is mainly supportive, consisting of analgesics, antipyretics, and rest. The mainstay

of management of MFF is prevention of subsequent exposure to harmful metals. Increasing public and physician awareness of MFF may help to reduce the occurrence of the disease.

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