OCCUPATIONAL ASTHMA DUE TO SPOT-WELDING

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ABSTRACT

A case of occupational asthma from fumes due to spot-welding is described. The hazards from resistance welding have been considered minimal as compared to other types of welding. This paper illustrates the possible hazards of occupational asthma among welders including those doing spot-welding. It also illustrates the difficulties encountered in identifying the specific causative agent in such cases.

Keywords : welder, resistance welding, asthma, occupational

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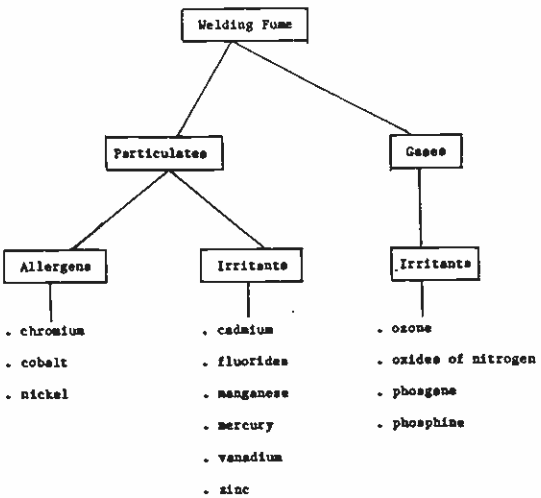
INTRODUCTION

Welding fume is a complex mixture of particulates and gases[1]. This is summarised in Table I. Ozone, oxides of nitrogen, cadmium, zinc and vanadium are known pulmonary irritants[2]. Chromium[3,4], nickel[5,6] and cobalt[7,8] may also be respiratory allergens. Occupational asthma due to ozone has been reported[9].

The extent of hazard varies with the different types of welding. This is summarised in Table II. From the Table, resistance welding appears to be among the least hazardous.

There have been few reports of asthma due to welding fumes[11-16]. And even fewer reports mention the specific causative agent or type of welding. These included a case due to chromium in manual metal arc welding[11], a case due to acetylene welding[13] and one where colophony (used in flux) was the agent[14]. As far as we know, there were no previous reports of asthma due to spot or resistance welding.

Table I
Possible Respiratory Irritants or Allergens in Welding Fumes



We describe a case of occupational asthma due to spot welding.

CASE REPORT

A 36-year old woman developed frequent episodes of cough, breathlessness, chest tightness and wheezing about two years after starting work as an operator of a spot-welding machine in a factory manufacturing steel wire mesh. The symptoms were associated with rhinitis

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Table II
Potential Hazards from Welding

Welding Process	SMA[a]	GTA[b]	GMA[c]	Submerged	Plasma	Resistance (Spot)	Gas
Metal fumes	M – H	M – H	M – H	L	H	L	L – M
Fluorides	L	L	L	M	L	L	L
Ozone	L	M	H	L	H	L	L
Nitrogen dioxide	L	M	M	L	H	L	H
Carbon monoxide	L	L	L H if Co_2	L	M	L	M – H
Decomposition of chlorinated HC	L	M	M – H	L	H	L	L

Hazard codes: L = low; M = medium; H = high
[b]GTA = gas tungsten arc
[c]GMA = gas metal arc
[a]SMA = shielded metal arc
Adapted from: Burgers WA(10)

and urticaria. Her asthmatic symptoms usually occured at night, after work. Symptoms improved when she was on leave.

She had no past history asthma. There was also no family history of asthma. She had never smoked.

OCCUPATIONAL EXPOSURE

Her job was to operate a spot-welding machine. Wires made of mild steel were fed into the machine and welded together to form a crossed linked wire-mesh. This steel wire mesh was used to reinforce concrete in the construction industry.

Spot-welding is a method of applying resistance welding. Basically, an electric current is passed through workpieces held together under pressure. There is localised heating at the contact surfaces due to the contact resistance, and the metal coalesces. No flux or filler metal is added to this process.

She was exposed to some fumes from the spot-welding process. Her workplace was well ventilated and there were no other processes nearby. Besides some lubricating oil for the machine there were no other chemicals in the vincinity.

The mild steel wires were essentially iron with small quantities of carbon, manganese, phosphorus and sulphur. The content of chromium, nickel and cobalt was about 0.2%. The steel wires were coated with a calcium soap fatty acid. The electrode was made of copper with about 0.4% chromium.

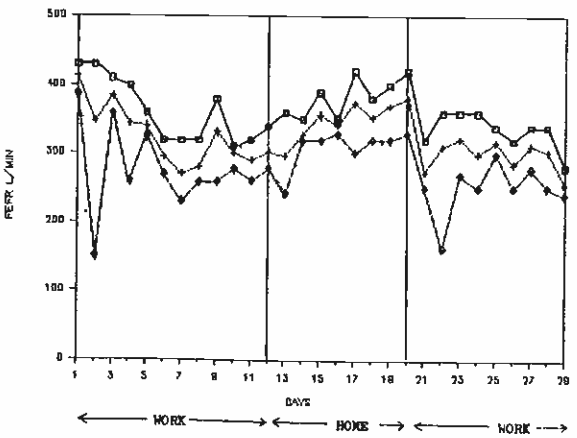
Environmental measurements made during the spot welding process failed to detect any nickel, chromium, cobalt or cadmium. (The detection limit was 0.006 mg/m^3 for nickel, 0.002 mg/m^3 for cobalt, 0.001 mg/m^3 for cadmium and 0.008mg/m^3 for chromium).

She would operate the spot-welding machine for 8 hours a day. No other work was done by her.

SERIAL MEASUREMENTS OF PEAK FLOW

Peak expiratory flow rate was measured every three hours from waking to sleeping for about a month. This included a continuous period of about 8 days at home in between the two periods of about 10 days each at work. The peak flow rate improved at home and deteriorated during the working period (Fig 1).

Fig 1
Daily maximum (□), mean (+) and minimum ( ) peak expiratory flow rates

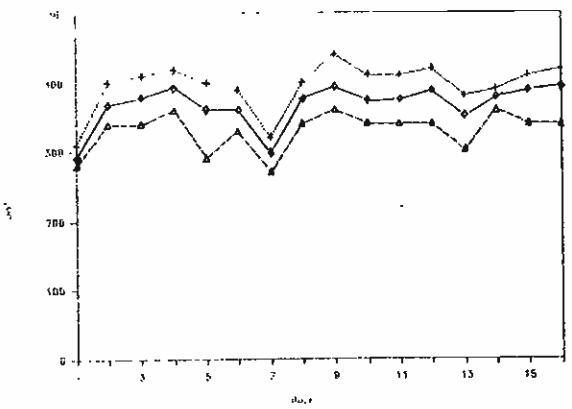


Peak expiratory flow rate was measured three hourly for a period of two weeks after she was transferred to the job of a forklift driver in the same factory. An improvement is seen compared to when she was doing spot-welding (Fig 2).

OTHER INVESTIGATIONS

The patient had non-specific bronchial hyperreactivity as assessed by histamine inhalation challenge, the PD_{20} was at 0.31 umol/L. Skin prick testing to common environmental allergens was positive to housedust. Patch testing to nickel, cobalt and chromium was negative. No

Fig 2
Daily maximum (+), mean ( ) and minimum (Δ) peak expiratory flow rates during period of transfer to a non-welding job in the same factory.



prick testing to these metals was carried out. Chest X-ray examination was normal.

DISCUSSION

The peak flow recordings and history support the diagnosis of occupational asthma. Although she has no previous history of asthma or family history of asthma, she is likely to be atopic based on the skin prick test result. It is also noteworthy that her asthma was associated with rhinitis and urticaria. The cause of her asthma is most likely some constituent in the welding fume. As it was not practical to carry out bronchial provocation testing to the individual constituents of the welding fume, we could not identify the exact causative agent. This may explain the lack of literature on welding fume and asthma especially with regard to specific causative agent.

The possible causative agent could be very low levels of metals such as chromium, nickel or cobalt or low levels of ozone or nitrogen oxides. The causative agent could also be the thermal degradation products from any residual surface oil or lubricant on the steel wires[10].

This case illustrates that spot-welding (resistance welding) which has been classified as the least hazardous of the various types of welding can be a cause of occupational asthma particularly in atopic individuals. Our environmental assessments are in agreement with this observation as the levels of the potentially allergenic metals were below the detection limit. Although no measurements of ozone or nitrogen dioxide was made in this case, the concentrations were also expected to be very low, if at all detectable.

Another reason for the low levels of metals such as chromium and nickel could be because mild steel rather than stainless steel was welded. In a study of manual metal arc welders in shipyards in Singapore, environmental assessments showed that chromium and nickel were rarely detected and this was attributed to the fact that mild steel was commonly used in shipyards[17].

Welding is a common industrial process. This paper serves to remind us of the possible hazard of occupational asthma among welders.

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