

CASES REPORT

An unusual form of formaldehyde induced lung disease

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ABSTRACT

A case report of an unusual formaldehyde exposure that had happened accidentally is described. A 54-year-old male ingested 10 % formaldehyde and inhaled while vomiting and he developed cough, dyspnea and wheezing with prevalent ronci and bilateral infiltrates on chest x-ray (cxr). His pulmonary symptoms and FEV₁ responded well to systemic corticosteroids and nebulised salbutamol given for the possible diagnosis of hypersensitivity and/or chemical pneumonitis, and infiltrates were cleared. Two weeks after the incident, he had massive haemoptysis, fever, leucocytes, prevalent crackles, bronchospasm, and new infiltrates on CXR. After an antibiotic and steroid therapy, his symptoms and crackles relieved, radiographic infiltrates were regressed. Delayed type hypersensitivity to formaldehyde patch test was appropriate with late-onset symptoms. This is a first case of pneumonitis as well as asthma different from the occupational exposure to formaldehyde. This data suggests direct and indirect effects of formaldehyde in healthy human airways.

Key words: Allergens. Asthma. Environment. Formaldehyde. Pneumonitis.

INTRODUCTION

Formaldehyde (HCHO) is a low molecular weight organic chemical. It has industrial applications in the manufacturing of plastics, rubber, resins, plywood, fabric coatings and adhesives. It is also used as a disinfecting, preserving, and embalming agent¹.

Formaldehyde has been reported to cause acute and chronic health problems¹. When formaldehyde is inhaled most of it is absorbed in the upper respiratory tract and relatively small amount reach the alveolar membranes of the lung². Formaldehyde acts as a sensitizer at low concentrations and as a potent asthmagenic agent. Because of its' widespread use in industrial processes, it causes occupational asthma³. Here, we report a case due to accidental formaldehyde exposure with various effects on bronchial tree.

CASE REPORT

A 54-year-old male admitted to the department of internal medicine of university hospital. He was hospitalized with graves disease with no history of asthma/atopy. His initial pulmonary examination was normal, as well as normal spirometric test. He was an exsmoker with a 20 pack/year history of smoking. After ingestion of ~200 cc formaldehyde 10 % accidentally, he developed nausea, vomiting, and sore

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throat. Two days after the incident, he began complaining of cough, shortness of breath, wheezing and hemoptysis (10 cc/day). He was referred to the pulmonary department for the assessment of his chest symptoms. He had bronchospasm and bilateral infiltrates on CXR (fig. 1). Endoscopic examination revealed low grade oesophagitis/gastritis which was treated symptomatically with proton pump inhibitors and parenteral hydration as well. On the following day, he underwent a spirometric examination which showed a decreased FEV₁ of 2.10L (69 %). Because he might have inhaled or asphyxiated formaldehyde while vomiting, a possible diagnosis of hypersensitivity and/or chemical pneumonitis was made with severe dyspnea, prevalent ronci, low FEV₁ and bilateral infiltrates on CXR. After a week of treatment with systemic glucocorticosteroid and nebulised salbutamol, his symptoms disappeared, ronci relieved, FEV₁ increased to 2.36L (77 %) and infiltrates were cleared. On the fourth day of prophylactic low MW heparin which was given for thrombus prophylaxis, he developed massive hemoptysis ~500 cc, 38.4 °C fever, leucocytes of 23600/mm³, prevalent crackles, severe bronchospasm, and new infiltrates on CXR. He had mild hypoxemia (PaO₂:59 mmHg) and low carbon monoxide diffusion capacity (DL_{CO}: 5.6L, 63 %). After bronchoscopic examination revealed intensive hemorrhagic mucosa predominantly at the right middle lobe and left lower lobe, heparin was sustained, antibiotic and combination therapy with inhaled steroid and salbutamol were started. Thoracic CT (fig. 2) demonstrated bilateral heterogeneous infiltrates which were consistent with the bronchoscopic findings. A week later, his symptoms and crackles were cleared, leukocyte count returned to normal values, re-bronchoscopic examination was normal, radiographic infiltrates were totally regressed, and FEV₁ and DL_{CO} were found to be within normal limits (3.09L, 100 % and 6.3L, 71 %, respectively). Allergologic investigations provided as follows: total and formaldehyde specific immunoglobulin E (IgE) were normal, skin prick tests to common aeroallergens were negative, patch tests with the Standard European Panel were positive to formaldehyde.

DISCUSSION

Although there is an increasing interest to formaldehyde exposure because of its' high levels in occupational settings, occupational asthma occurs in sporadic cases. There is a latent period, which extends from weeks to years before symptoms begin. Reactions are then provoked by concentrations that



Figure 1.—Bilateral reticular infiltrates at the lower zones on CXR.

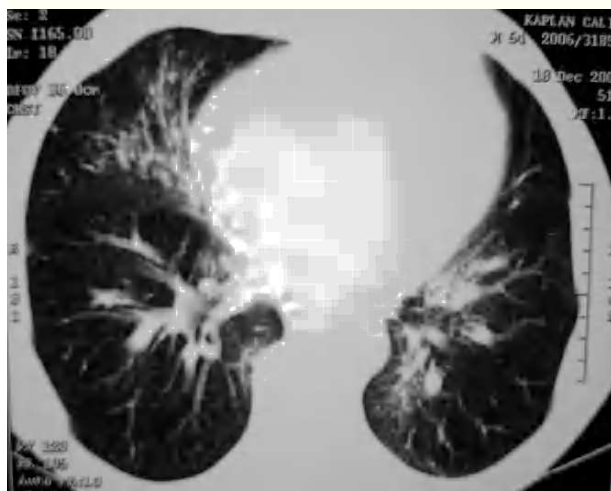


Figure 2.—Bilateral heterogeneous infiltrates on the thoracic CT.

were previously well tolerated and that have little effect on the majority of fellow workers.

Asthma induced by formaldehyde can be diagnosed by non-specific or specific bronchial provocation challenge⁴, but it was found to be difficult to maintain a constant concentration or to determine the atmospheric end-target concentration of formaldehyde inhalation. A closed-circuit apparatus to generate formaldehyde as a vapour was introduced by Lemiére et al⁵. Non-irritant concentrations of formaldehyde can be obtained by these apparatus but they are not standardised and therefore not useful for the clinical practice. Kim et al showed that environmental assessment as the mean level of formaldehyde was 0.06 ppm in the working area, but it was considered that the mean exposure level had been much higher when their patient suffered asthmatic

attacks in workplace³. There was some discrepancy between the formaldehyde concentrations which induced asthmatic reactions in the workplace challenge and in the specific challenge tests. A lower concentration of formaldehyde was enough to induce asthma in the work place. Our patient demonstrated asthmatic attack as well as alveolitis and pneumonitis with direct bronchial contact to high concentration of formaldehyde for a short duration of exposure. However, in this case there was no need for a provocation test, because our patient had the specific inhalation challenge accidentally. It is expected to see either a neutrophilic response or an exacerbation of pre-existent eosinophilic airways inflammation⁴. A neutrophilic response in bronchial secretions in this case was consistent with the literature.

The mechanism of formaldehyde induced asthma is not clear. Bronchoconstriction and airway symptoms can be explained by magnified acute airway inflammatory responses with its irritant effect on the upper airways. Immunological hypersensitivity and development of IgE to formaldehyde was proved in some studies⁴. Casset et al showed that low levels of formaldehyde significantly enhanced bronchial responsiveness to mite allergen in sensitized subjects with asthma⁶. In this case; IgE mediated hypersensitivity was ruled out with negative skin prick tests and specific IgE. A weak reaction to formaldehyde in the patch test was found to be related with delayed hypersensitivity to formaldehyde and which be an explanation of the chest symptoms occurred 48 hours after the incident.

In conclusion this is the first case of formaldehyde induced asthma different from the occupational exposure. It is most probable that the patient had inhaled formaldehyde 10 % while vomiting and specific bronchial hyperresponsiveness occurred, as well as focal alveolitis and bronchiolitis. Asthmatic findings found after three days of exposure was a typical of formaldehyde induced late reaction and responded well to glucocorticosteroids. It is known

that more than 95 % of inhaled formaldehyde is absorbed in the upper respiratory tract and comparatively small amount reach the alveolar membranes². Pneumonitis in this case may also be explained by the asphyxia of formaldehyde and haemoptysis was seen as a result of alveolitis and tracheobronchitis.

Outcome of the formaldehyde-induced asthma is often poor, and duration of exposure, severity of asthma and the pulmonary functions before the exposure are the prognostic determinants³. Two months after the accident, our patient still had expectoration of mucus.

This data suggests that the direct and indirect effects of formaldehyde may occur in healthy human airways, whereas mild asthmatic response and pneumonitis can be seen simultaneously in the same patient due to accidental exposure. Therefore, pulmonologists should be aware of the possibility of the reactions to formaldehyde not only in occupational settings, but also in many other fields.

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