

SHORT REPORT

Two cases of paraoccupational asthma due to toluene diisocyanate (TDI)

R De Zotti, A Muran, F Zambon

Abstract

Two cases of paraoccupational asthma caused by toluene diisocyanate (TDI) are reported. The first patient was a metal worker in a machine shop situated near a factory producing polyurethane foam. Symptoms at work were not explainable by any specific exposure to irritants or allergens in the work site. As the patient recalled previous occasional work in the adjacent polyurethane factory with accompanying worsening of respiratory symptoms, a specific inhalation (SIC) test was performed with TDI, which confirmed the diagnosis of TDI asthma. The second case was a woman working part time as a secretary in the offices of her son's factory for varnishing wooden chairs. TDI was present in the products used in the varnishing shed. The SIC test confirmed the diagnosis of TDI asthma, despite the fact that the patient's job did not present risk of exposure to the substance. In both patients, symptoms disappeared when further exposure was avoided. These two cases confirm that paraoccupational exposure to TDI must be considered when evaluating patients with asthma not mediated by immunoglobulin E. They also suggest the need for more prospective studies evaluating the health risk for the general population living near polyurethane factories or other firms that use TDI.

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Occupational exposure to diisocyanate varnishes or to polyurethane foam are the main causes of TDI asthma, that affects 5%–10% of workers exposed to diisocyanate.^{1,2} Paraoccupational exposure to TDI has seldom been reported, but this possibility must be considered when evaluating patients with asthma not mediated by immunoglobulin E (IgE).^{3,4} Identifying the aetiology of the symptoms means improving the prognosis of the disease by avoiding further exposure. The patient, however, may be hampered by the difficulties involved in having the exposure to TDI recog-

nised as an occupational hazard. We report two recent cases.

CASE 1

A man aged 60 had no personal or family history of atopy or pre-existing asthma, and had been an ex-smoker for 21 years (previously 15 cigarettes/day for 20 years). He was employed as a bricklayer for 38 years and then for 9 years as a metal worker in a machine shop near a factory producing polyurethane foam. In 1990, after a few weeks' work in the machine shop, he began to complain of upper respiratory irritation with a dry and then productive cough, and self limiting episodes of wheezing and shortness of breath. Symptoms progressively worsened, both at work and during the night. In September 1998, he went sick because of these respiratory symptoms. At that point his symptoms improved, but he still took short and long β_2 agonists, mucolytics, and antihistamines. A chest x ray film and spirometric evaluation during this period were within normal limits. He resumed work, but soon after re-exposure in the workplace he complained again of the same respiratory symptoms.

The patient was admitted to our department 4 months later, once again off work sick. He had stopped taking antihistamines and β_2 agonists as required 3 weeks earlier. On admission, his general condition was good and the physical examination was normal. Baseline spirometry was normal. The log cumulative dose of methacholine producing a 20% fall in forced expired volume in 1 second (FEV₁) was low (methacholine PD₂₀FEV₁=570.6 μ g), suggesting airway hyperresponsiveness. Skin prick test was positive to *Dermatophagoides* species. Total IgE antibodies (PRIST) were 78.8 U/ml. Blood tests were normal. Ear, nose, and throat (ENT) examination was normal. During the history taking, the patient recalled that in the past he had occasionally performed maintenance work in the adjacent polyurethane factory and that, in these occasions, his dyspnoea and wheezing had worsened. Inside or outside the machine shop the respiratory symptoms were less severe, and not related to any specific job or exposure. The patient confirmed our suggestion that the proximity of the polyurethane foam factory might be a factor in causing his illness. We then decided to perform a specific inhalation challenge (SIC) test with TDI. In

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line with SIC test standards, the test was preceded by a control test, which ensured a stable FEV₁ over an 8 hour period.⁵ Exposure to TDI was generated in the chamber by blowing air over the surface of TDI (20 ml) in a 200 ml glass bottle. The airflow rate was controlled by a rotameter, calibrated at 2 l/min. The concentration of atmospheric TDI was measured with isocyanate detection equipment in the same room (MDA Model 7100 GETEC MDA Scientific, Glenview, IL, USA). Exposure was stopped after 5 minutes because of dyspnoea and cough. The median TDI concentration was 5.5 ppb. The FEV₁ was monitored at 5, 15, 30, and 60 minute intervals after the end of exposure, and then hourly for 8 hours. The SIC test was positive for early asthma (fig 1). At a subsequent examination, 3 months later, the patient was still free from respiratory symptoms but off work.

CASE 2

A woman aged 42 had no personal history of allergic disease. She had smoked one pack of cigarettes a day for 15 years, and for the past 7 years had had chronic rhinitis with sporadic but not seasonal relapses. She had been employed as a cotton spinner for 2 years and then as a packer in a confectionery factory for 17 years. In 1993, she began to work 2–3 days a week as a secretary in the offices of her son's factory, where wooden chairs were varnished. The office was on the same floor as the varnishing sheds, but not next to them. After 6 months, the woman began to complain of cough, wheezing, and shortness of breath, and to use β_2 agonists and a corticosteroid inhalant. The symptoms started just a few minutes after arriving in the office and improved only after long periods away from work. A chest x ray film ordered by the family doctor at the time was negative. On admission to our department, she had been off work for a month and had stopped taking drugs a week earlier, but still complained of sporadic fits of dry coughing. Baseline spirometry was normal, metacholine PD₂₀ FEV₁ was 473 μ g. Skin prick test with common allergens was negative; IgE antibodies were 66.9 U/ml; blood tests were normal and ENT examination showed evidence of vasomotor rhinitis. After the presence of TDI had been ascertained in the varnishes used in the factory where she worked, we suggested an SIC test

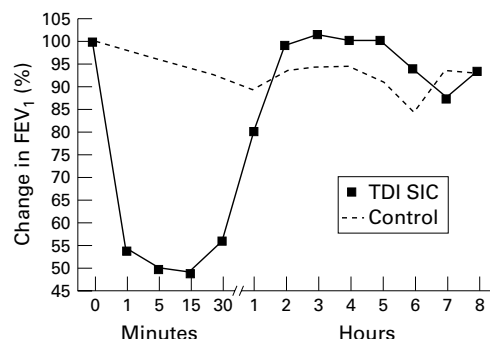


Figure 1 Case 1: man 60 years, ex-smoker, metal worker for 9 years. Specific inhalation test: TDI 5.5 ppb for 5 minutes.

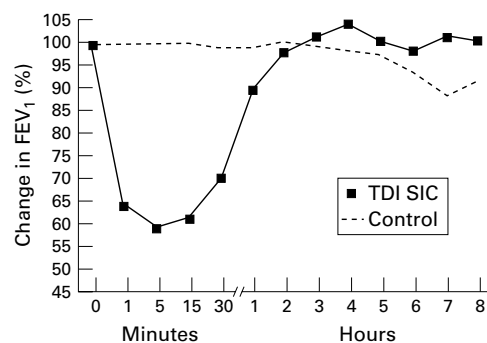


Figure 2 Case 2: woman 42 years, smoker, secretary for <1 year. Specific inhalation test: TDI 12 ppb for 5 minutes.

with TDI, which the patient accepted solely for diagnostic purposes. Exposure was stopped after 5 minutes because of dyspnoea and cough. The median TDI concentration was 12 ppb. The SIC test was positive for early asthma (fig 2) and the patient decided to stop working in her son's factory.

Discussion

A non-occupational TDI asthma may be caused by hobbies involving the use of varnishes, concrete sealers, glue, and other sources of diisocyanates. As well as these exposures, there are some paraoccupational situations, where the TDI does not come from the actual indoor occupation, but from other sources. Some of these cases have been ascribed to emissions from neighbouring factories where TDI is used.^{3,6} Moreover, other studies have shown that TDI concentrations in the residential ambient air in the vicinity of a factory producing polyurethane foam were alarmingly high. These findings arouse concern about the health risks for the general population living near this kind of establishment.^{7,8}

In the first case described, a paraoccupational exposure to TDI coming from a nearby factory producing polyurethane foam can be considered the cause of the patient's persistent respiratory symptoms. However, the first sensitisation to TDI probably occurred during the short periods when he did maintenance work on the machines in this factory.⁹ The symptoms were not immediately correlated with TDI; only after an accurate clinical history did the patient recall his previous sporadic direct exposure to TDI. Two considerations led us to suspect a causative role of the TDI used in the nearby factory in the symptoms of this patient. The first was the earlier relation between the worsening of symptoms and direct exposure to TDI, and the second was the positive stop-start relation between symptoms and his worksite, where there was no significant exposure to irritants or allergens. Unfortunately, data about TDI concentrations in the ambient air were not available. Nevertheless, diagnosis was confirmed by the outcome of SIC test and the remission of symptoms after he stopped working near the polyurethane foam factory.

In the patient who worked as a secretary, the absence of a work related hazard for exposure to TDI is even more evident. However, low

TDI concentrations in the ambient air could have come from the shed where the substance was used. The diagnosis of paraoccupational TDI was based on the fact that even very low TDI concentrations may cause asthma in sensitised subjects¹⁻⁶ on the result of the SIC test and on the remission of respiratory symptoms when the patient stayed away from work. For both subjects, stopping exposure restored good health, but unfortunately lost them their jobs. For the first patient, compensation was claimed, and he is waiting for an answer. For understandable reasons, the second patient refused to make a claim for compensation.

The cases described suggest that there may be cases of non-occupational exposure to TDI that cause asthma. As it can be difficult to identify the source of exposure, there is a need for careful evaluation of possible sources of indirect exposure both inside and outside the workplace. Moreover, it is important to identify the stop-start relation between symptoms and hobbies, between symptoms and temporary jobs done in other factories, and between symptoms and being in places near factories where the substance is used. Confirmation of diagnosis based on the specific inhalation test improves the prognosis for the patient, who

would otherwise be diagnosed as having intrinsic asthma. Paraoccupational TDI asthma also suggests the need for better assessment of health risks of the general population through more prospective studies evaluating the residential populations living around polyurethane factories or other firms that use TDI.

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