Short Communication

The Beneficial Effect of Gauze Mask on Methyltetrahydrophthalic Anhydride-Induced Allergic Rhinitis

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Methyltetrahydrophthalic anhydride (MTHPA) is a dicarboxylic anhydride used as a hardener for epoxy resins, typically requires a high curing temperature (50–200°C) which facilitates the escape of MTHPA vapours, and has been reported to cause type I allergy [1-4]. We have previously reported on a cross-sectional survey of 73 employees currently exposed to MTHPA in a condenser plant [5]. In spite of relatively low current exposures to MTHPA a high proportion (63%) of those surveyed had detectable levels of specific IgE antibodies, a finding attributable perhaps to higher exposures in the past. Sensitization was more common among those with work-related rhinitis, and no cases of occupational asthma were identified. When workers with symptomatic rhinitis were asked about factors that improve symptoms, their answers were taking medicine, washing their face, taking a bath, or wearing a gauze mask. We felt a great interest in the gauze mask, since personal protective equipment such as a gas mask considerably limits the worker’s activity during work but the gauze mask does not. The purpose of this study was therefore to clarify why the gauze mask improves rhinitis symptoms.

Subjects and Methods

Forty-five (62%) subjects of a previous study [5] were engaged in monitoring work in the various work zones and had been continuously exposed to MTHPA during an 8 h work shift. The subjects consisted of 2 male and 3 female workers with severe rhinitis, ranging in age from 22 to 43 years (mean ± SD = 36.8 ± 8.5 yr). The workshop, exposure and details of work-related symptoms were described in detail in a previous paper [6].

Air samples were collected on silica gel tubes equipped with cellulose filters by personal sampling in the breathing zone of the workers with battery-operated pumps. It is hypothesized that gauze masks adsorb MTHPA in air. Therefore, with informed consent, parallel samples were taken on silica gel tubes and gauze masks for the duration of a full work shift. A part (0.6–1 g) of the gauze mask (8 g) was extracted with 50 ml of distilled water, 5 ml of concentrated sulfuric acid, and 100 ml of ether. The extract was dried with anhydrous sodium sulphate. After evaporation, the residue was analyzed. The anhydride analysis followed, with slight modifications, the procedure of Pfaffli et al. [6].

Results and Discussion

Samples collected in silica gel tubes in the air stream after passing cellulose filters indicated a penetration through the filter of >94%. These results suggest that MTHPA mainly exists as vapours in the work environment. The results obtained with gauze masks and silica gel tubes are summarized in Table 1. The concentrations found by the gauze masks were 48–113% of those found by the silica gel tubes. Because high humidity is present on the inside of the gauze masks, it is thought that methyltetrahydrophthalic acid is adsorbed on the gauze masks, since the reaction of MTHPA with water results in the formation of the free acid. The marked variation in efficiency can be partially explained by analysis of only a part of the gauze mask or differences in ventilation or work intensity.

As described above, improvements in nasal symptoms may be due to exposure reductions caused by gauze masks. Relative humidity (RH) in the workplace in summer was higher than that in winter (50% and 20%, respectively), and workers with rhinitis had higher frequencies of nasal symptoms in winter than in summer. These results invite the speculation that high RH may lead to decreased responsiveness of the upper airways to MTHPA. Another explanation is that it may be the result of superior humidification and warming of inspired air.

The gauze mask has been shown to be effective in reducing the consequences of exposure in symptomatic subjects. Even if allergic rhinitis is not considered to be as serious as asthma, it can be troublesome for many symptomatic workers. Allergic rhinitis may precede occupationally incurred asthma [5]. Although control of exposure to below 15–20 µg MTHPA/m³ is the most direct way of reducing the number of incident cases, it raises the possibility that the gauze mask may play a role in easing the clinical manifestations of MTHPA-induced rhinitis. Some symptomatic workers used gauze masks for that reason because of individual preference.

In conclusion, our results show the possibility that the gauze mask is efficient respiratory protective equipment for preventing the induction of allergic rhinitis due to MTHPA.
Table 1. Comparison of amounts of MTHPA collected simultaneously by gauze masks and silica gel tubes

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Amount adsorbed on gauze masks (µg)</th>
<th>Estimated amount of exposure (µg)</th>
<th>Efficiency † (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>88</td>
<td>183</td>
<td>48</td>
</tr>
<tr>
<td>2</td>
<td>229</td>
<td>234</td>
<td>98</td>
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<td>3</td>
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<td>4</td>
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<td>207</td>
<td>63</td>
</tr>
<tr>
<td>5</td>
<td>227</td>
<td>366</td>
<td>62</td>
</tr>
</tbody>
</table>

*The individual ventilation was uniformly regarded as 15 l/min. The estimated amount of exposure was calculated as the concentration in the breathing zone of the subjects multiplied by individual ventilation.

†Percentage of MTHPA on gauze masks compared with estimated amount of exposure.

References


