SHORT REPORT

Occupational asthma caused by bacillary amylase used in the detergent industry

A M Hole, A Draper, G Jolliiffe, P Cullinan, M Jones, A J Newman Taylor

Abstract
Four cases are reported of occupational asthma due to amylase derived from Bacillus licheniformis, used in detergent washing powders. It is thought that these are the first reported cases of asthma due to this enzyme in the detergent industry. All four employees (men) were from the same factory and none had a history of asthma or atopy. All developed symptoms of wheeze at work after an initial symptom free period. Symptoms improved during periods away from work. All undertook serial peak flow recordings (not diagnostic) and underwent skin prick tests, radio allergosorbent test (RAST) measurement, and specific bronchial provocation testing. The bronchial provocation testing was performed by a dust tipping method in a single blind manner, with lactose as an inert control and powdered amylase, provided by the employer, as an active agent. Serial measurements of forced expiratory volume in 1 second (FEV1) were recorded and histamine provocative concentration causing a 20% fall in FEV1 (PC20) tests were determined before and 24 hours after each challenge. Patient 1 developed an isolated early reaction, patient 2 an isolated late reaction, and patients 3 and 4 developed dual reactions. All showed an increased non-specific bronchial reactivity after active challenge. The introduction of encapsulated enzymes in the detergent industry was followed by a reduction in the incidence of respiratory sensitisation. These patients developed occupational asthma despite working only with encapsulated enzymes. This highlights the importance of careful surveillance after the introduction of new agents in the workplace.

Keywords: occupational asthma; detergent enzyme; amylase

IMMUNOLOGICAL TESTING
None had immediate skin prick test reactions elicited by common Aeroallergens (cat dander, grass pollen, and Dermatophagoides pteronyssinus; Allergopharma, Reinbeck, Germany). All had immediate responses (>3 mm) to one or more enzyme solutions (1 mg/ml). Amylase provoked a response in all four, three patients...
(1, 3, and 4) had responses to protease, and three (1, 2, and 3) to cellulase.

With RAST and the same enzymes, we found high concentrations of circulating IgE antibodies to amylase and protease in all four men, and to cellulase in three.

BRONCHIAL PROVOCATION TESTING (figure)
Serial peak flow measurements were either not feasible or were not diagnostic in any case. We therefore undertook specific inhalation testing to make a diagnosis. Before admission the patients stopped all anti-inflammatory asthmatic treatment. Inhalation testing was carried out within 12 weeks of occupational exposure to detergent enzymes. A dust tipping method was used, with granulated enzymes (provided by the factory) crushed by hand with a pestle and mortar. With lactose as an inert control, we conducted the tests in a single blind manner.

Forced expiratory volume in 1 second (FEV₁) was measured every 5–10 minutes for 1 hour after the test and subsequently for 24 hours at hourly intervals while the patient was awake. The FEV₁ response to inhaled histamine was measured before and 24 hours after each test with the Cockroft method. Results were expressed as histamine PC₂₀.

None of the men reacted to the inert control but in each case the first exposure to amylase reproduced nasal symptoms similar to those experienced at work, which in the case of patient 2 was severe and occurred within 5 minutes of the test exposure. Amylase provoked an asthmatic response in all four: patients 1, 3, and 4 had a dual response; patient 2 developed an isolated late reaction, which began 6 hours after exposure. In all cases the asthmatic responses were associated with a fall in histamine PC₂₀.

Table 1 Patients: atopy, first exposure to enzymes, initiation of symptoms, and immunological findings

<table>
<thead>
<tr>
<th>Patient No</th>
<th>Age</th>
<th>Atopic</th>
<th>First exposure to detergent enzymes</th>
<th>Symptoms began</th>
<th>Enzyme</th>
<th>Skin prick test (size, mm)</th>
<th>RAST % binding</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>48</td>
<td>No</td>
<td>1985</td>
<td>1990–1</td>
<td>Amylase</td>
<td>14</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Protease</td>
<td>8</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cellulase</td>
<td>7.5</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>42</td>
<td>No</td>
<td>1995</td>
<td>1996</td>
<td>Amylase</td>
<td>6</td>
<td>77</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Protease</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cellulase</td>
<td>7</td>
<td>28</td>
</tr>
<tr>
<td>3</td>
<td>27</td>
<td>No</td>
<td>1993</td>
<td>1995</td>
<td>Amylase</td>
<td>7.5</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Protease</td>
<td>4</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cellulase</td>
<td>4.5</td>
<td>50</td>
</tr>
<tr>
<td>4</td>
<td>28</td>
<td>No</td>
<td>1992</td>
<td>1993</td>
<td>Amylase</td>
<td>6.5</td>
<td>74</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Protease</td>
<td>7</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cellulase</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

RAST = radioallergosorbent test.

(continued)

Changes in baseline FEV₁ in the four patients.

www.occenvmed.com
Patient 1 was also tested with protease which provoked a dual asthmatic response and associated fall in his PC20. Cellulase provoked an immediate nasal and mild asthmatic response but no reduction in histamine PC20.

**Discussion**

We think that these are the first reported cases of occupational asthma in detergent manufacturers caused by allergy to bacterial amylase, demonstrated by specific inhalation testing. The cases reported are four of a large outbreak of asthma in a modern detergent factory incorporating encapsulated protease, amylase, and cellulase into detergents.

Fungal amylase, well recognised as a cause of asthma in bakers, is used as a dough improver in powdered form. Bacterial amylase derived from *Bacillus Licheniformis* which is immunologically distinct from fungal amylase, was used in the factory in which these men worked, encapsulated in granules.

Animal studies have suggested that bacterial amylase is a more potent allergen than protease, its allergenicity potentiated by concurrent inhalation of protease. Modern enzyme detergents often contain a mixture of enzymes, which usually include a protease and bacterial amylase. Exposure to both enzymes is likely to become increasingly common among those working in the detergent industry, increasing the risk of allergy to amylase and associated asthma in the absence of appropriate preventive measures.

Occupational asthma caused by bacillary amylase used in the detergent industry

A M Hole, A Draper, G Jolliffe, P Cullinan, M Jones and A J Newman Taylor

*Occup Environ Med* 2000 57: 840-842
doi: 10.1136/oem.57.12.840

Updated information and services can be found at:
http://oem.bmj.com/content/57/12/840

These include:

**References**
This article cites 7 articles, 0 of which you can access for free at:
http://oem.bmj.com/content/57/12/840#BIBL

**Email alerting service**
Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

**Topic Collections**
Articles on similar topics can be found in the following collections

- Allergy, asthma (82)
- Respiratory (203)

Notes

To request permissions go to:
http://group.bmj.com/group/rights-licensing/permissions

To order reprints go to:
http://journals.bmj.com/cgi/reprintform

To subscribe to BMJ go to:
http://group.bmj.com/subscribe/