SHORT REPORT

Two patients with occupational asthma who returned to work with dust respirators

Yasushi Obase, Terufumi Shimoda, Kazuko Mitsuta, Hiroto Matsuse, Shigeru Kohno

Abstract

***Objectives*—To assess the efficacy of dust respirators in preventing asthma attacks in patients with occupational asthma (asthma induced by buckwheat flour or wheat flour).**

***Methods*—The effect of the work environment was examined in two patients with occupational asthma with and without the use of a commercially available mask or a dust respirator. Pulmonary function tests were performed immediately before and after work and at 1 hourly intervals for 14 hours after returning to the hospital.**

***Results*—In patient 1, environmental exposure resulted in no symptoms during and immediately after work, but coughing, wheezing, and dyspnoea developed after 6 hours. Peak expiratory flow rate (PEFR) decreased by 44% 7 hours after leaving the work environment, showing only a positive late asthmatic reaction (LAR). In patient 2, environmental exposure resulted in coughing and wheezing 10 minutes after initiation during bread making, and PEFR decreased by 39%. After 7 hours, PEFR decreased by 34%. The environmental provocation tests in both patients were repeated after wearing a commercial respirator. This resulted in a complete suppression of LAR in patient 1 and of immediate asthmatic reaction (IAR) and LAR in patient 2.**

***Conclusions*—Two patients with asthma induced by buckwheat flour or wheat flour in whom asthmatic attacks could be prevented with a dust respirator are reported. Dust respirators are effective in preventing asthma attacks induced by buckwheat flour and wheat flour.**

(*Occup Environ Med* 2000;**57**:62–64)

Keywords: asthma: buckwheat flour: wheat flour; environmental provocation test

The Second Department of Internal Medicine, Nagasaki University School of Medicine, Nagasaki, Japan
Y Obase
T Shimoda
K Mitsuta
H Matsuse
S Kohno

Correspondence to:
Dr Yasushi Obase, The Second Department of Internal Medicine, Nagasaki University School of Medicine, 1–7–1 Sakamoto-machi, Nagasaki 852–8501, Japan
email obadann-ngs@umin.u-tokyo.ac.jp

Accepted 15 September 1999

Among occupational diseases, the incidence of occupational asthma has been steadily increasing in recent years.[1] Early detection and avoidance of antigens can often achieve a complete cure of asthma.[2] As occupational asthma is caused by specific antigenic material present in the work environment, in some cases antigen avoidance is effective in preventing attacks, and a change of job results in overall improvement of symptoms or even remission. However, these methods in most circumstances are impractical as they lead to job loss. We report two patients with occupational asthma (to buckwheat flour and wheat flour) in whom the use of a dust respirator for ultrafine particles prevented attacks of asthma and allowed return to the workplace.

Case reports

PATIENT 1 (ASTHMA INDUCED BY BUCKWHEAT)

The patient was a 54 year old man working in a food factory for buckwheat noodles. Coughing appeared during the production of buckwheat noodles 2 years before presentation. Dyspnoea persisted during noodle production even with the use of a commercially available mask. Dry rales were heard over the entire lung fields during auscultation of the chest. Recording of peak expiratory flow rate (PEFR) over several days showed that it fluctuated between 230 and 340 l/min, with nocturnal and early morning dipping to 230–260 l/min.

PATIENT 2 (ASTHMA INDUCED BY WHEAT)

A 42 year old male patient had worked as a baker for 16 years since he was 26 years old. During the past 3 years, the patient required daily inhalation of a bronchodilator and developed mild to moderate attacks of wheezing once a week, and wheezing in the workplace became more frequent. One year before presentation, the patient was transported to a local hospital after developing a severe attack of asthma.

Methods

Skin prick tests, intradermal skin tests, Prausnitz-Küstner reaction, and specific bronchial provocation tests were performed with the method described by Cockcroft *et al*.[3] These tests were performed after confirming that the percentage of their forced expiratory volume in 1 second (FEV_1%) increased after admission to 80% of that predicted. In patient 1, commercially available extracts of buckwheat flour (1:10 weight/volume, Torii, Tokyo, Japan) was used. In patient 2, antigens at a final concentration of 1:10 weight/volume were prepared with six components (components A-F) of the wheat flour which were classified by the product's name usually used by the patient.

Table 1 Characteristics and laboratory examination of patients

	Patient 1 Asthma induced by buckwheat	*Patient 2 Asthma induced by wheat*
Age, sex	54, man	42, man
Occupation	Factory making buckwheat noodles	Baker
History of the work	36 y, since age 18	16 y, since age 26
Habits	Non-smoker and social drinker	Non-smoker and never drinker
Peripheral eosinophils (%)	23	0
Total IgE (IU/ml)	176	458
FEV_1 (% predicted)	1.31 (49%)	3.89 (69.5%)
$PaCO_2$, PaO_2 (mm Hg)	42, 60	40, 93
PC20* (mg/ml)	0.625	0.128
Chest *x* ray film	Normal	Normal
Prick test† (mm)	Buckwheat flour extract 10^{-3} g/ml: 4 × 4 / 28 × 25 10^{-4} g/ml : negative	Wheat flour extract (10^{-3} g/ml) A–F: all positive
Skin test (mm)	Buckwheat flour extract: 10^{-6} g/ml: 12 × 10 / 40 × 33 10^{-7} g/ml: negative	Wheat flour extract: (threshold) A: 10^{-6} g/ml, B: 10^{-5} g/ml, C–F: 10^{-4} g/ml
Prausnitz-Küstner reaction	Not done	Positive for wheat flour extracts A, B, C, D, E, F
IgE-RAST‡	Buckwheat flour: class 3 Other 30 antigens: all negative	Wheat flour : class 5 Other 18 antigens: all negative
Bronchoprovocation test§	Buckwheat flour extract (10^{-3} g/ml) IAR: negative LAR: 32% fall in FEV_1 7 h later	Wheat flour extract (A: 10^{-2} g/ml) IAR: 23% fall in FEV_1 LAR: 33% fall in FEV_1 7 h later
Environmental provocation test¶	Work for 30 minutes IAR: negative LAR: 44% fall in PEFR 9 h later	Work for 15 minutes IAR: 39% fall in PEFR LAR: 36% in PEFR 7 h later

*Non-specific methacholine bronchial provocation test.
†Results of the skin prick test were expressed as wheal / flare (mm). In Patient 2, antigens were prepared using six components (component A–F) of the wheat flour that were usually used by the patient (see text).
RAST: radioallergosorbent test; IAR=immediate asthmatic reaction; LAR=late asthmatic reaction; PEFR=peak expiratory flow rate.

EVALUATION OF THE EFFICACY OF DUST RESPIRATORS AGAINST ASTHMA ATTACKS

At each workplace, the patient performed his routine while wearing a commercially available nose mask equipped with thick gauze (Mascot, Nagasaki, Japan). One week later, a similar test was performed under the same working conditions wearing dust respirators (3M-disposable dust respirator No 9920, 3M Corporation or Shigematsu disposable dust respirator TS No DDR-11, Shigematsu, Tokyo).

Results

The characteristics and results of the allergy tests for patients 1 and 2 are shown in the table. In skin prick tests, all five normal people showed negative results. Methacholine challenge tests in patients 1 and 2 showed airway hyperresponsiveness. Inhalation induction tests showed a positive late asthmatic reaction (LAR) only in patient 1, but both immediate asthmatic reaction (IAR) and LAR were positive in patient 2.

EVALUATION OF THE EFFICACY OF DUST RESPIRATORS AGAINST ASTHMA ATTACKS

In patient 1, no symptoms were seen during and immediately after work, but coughing, wheezing, and dyspnoea developed after 6 hours. Seven hours after leaving the work environment, PEFR decreased by 44%, showing positive results only for LAR. In patient 2, coughing and wheezing developed 10 minutes after the start of work (bread making), and the PEFR decreased by 39%. After 7 hours, coughing, wheezing, and dyspnoea recurred, and the PEFR decreased by 34%. The environmental provocation tests were repeated again with the dust respirators. These resulted in a complete suppression of IAR (patient 2) and LAR (patients 1 and 2).

On admission, an obstructive pulmonary pattern was found in both patients with PEFR of 180–350 and 300–450 l/min in patients 1 and 2, respectively. At the time of discharge from the hospital, the values of PEFR had increased to 380–450 and 650–750 l/min without exposure to antigens. The variability in PEFR during the daytime had decreased from 49% ((350–180)/350) to 16% ((450–380)/450) in patient 1, and from 33% ((450–300)/450) to 13% ((750–650)/750) in patient 2, respectively.

After discharge from the hospital, both patients returned to work with the dust respirator. We followed up patients 1 and 2 in the outpatient department for 2 and 3 years, respectively. During these periods, both patients kept a diary of daily morning and evening PEFR values. These diaries and clinical examination indicated at each follow up visit that neither patient had had an attack of asthma.

Discussion

We discuss in this report two patients with occupational asthma who returned to work using dust respirators. The reported incidence of asthma induced by wheat flour is 6%–9% among people engaged in bread production.[4 5] There are a few cases reported of asthma induced by buckwheat flour in countries such as Japan and Korea, and France, Sweden, and other European countries.[6–8] In our study, symptoms developed in patient 1 at 34 years after the first exposure to buckwheat. Patient 2 developed dyspnea about 5 years after starting work in bread production.

Valdivieso *et al*[7] reported a case of asthma induced by buckwheat, and the patient developed both IAR and LAR in a bronchial provocation test with buckwheat flour extract 1:10 000 g/ml. Choudat *et al*[8] also reported a patient with asthma induced by buckwheat, who showed only an immediate response in bronchial provocation test with 10 μg buckwheat flour. In our study, patient 1 showed only

an LAR in bronchial provocation test with buckwheat flour extract at a concentration of 10^{-3} g/ml.

As an attack of buckwheat asthma is often very severe, in this study, we limited the concentration of antigen in the specific inhalation test to 10^{-3} g/ml. This concentration induced only LAR; probably reflecting increased nocturnal symptoms reported by the patient after work. The importance of LAR was further shown by a positive late response in the environment test. We think that the inhalation test with less than 10^{-3} g/ml was useful and safe; the test did not result in the appearance of any abnormal shadows suggestive of pneumonitis, as confirmed clinically and through a series of chest *x* ray films before and after the challenge tests. Patient 2 showed both IAR and LAR in the environment test as well as in the laboratory inhalation test. These results also necessitated the use of a limited concentration of the antigen.

Buckwheat and wheat allergens belong botanically to the group of high molecular antigens, and occupational asthma induced by these antigens tends to develop in atopic people. However, the two patients in this report showed no atopy. We think that their asthma was due to type 1 allergy because the intradermal test, immunoglobulin E radio allergosorbent test (IgE-RAST), and specific inhalation test were all positive. Unfortunately, immunological cross reaction tests were not performed with the six wheat flour extracts. However, skin tests with these extracts showed positive results in patient 2.

To avoid an antigen, a change of workplace or job, or wearing appropriate protective clothes are necessary. In practice, a change of job is difficult for economic reasons, and protective clothes are cumbersome and may reduce work efficiency. Taivainen *et al*[9] had recently reported the efficacy of powered dust respirator helmets in the prevention of occupational asthma among farmers. They reported that, in particular, dairy farmers with occupational asthma benefited from the use of a powered dust respirator helmet. The dust respirators that prevented worsening of asthma in our patients have a dust capture efficiency of >99.5%. These respirators are light and easy to wear, weighing 25 g and about 17 g, for the 3M and Shigematsu masks, respectively. Each filter can be used continuously for 11–16 hours and costs about 3–8 US $. The efficacy of these respirators may be based on static electric and mechanical filtration, with filters of pore size <0.3 μm. Of course, the efficacy of a filter for particles is much more complex than only mechanical filtration and electric characteristics. They may prevent asthma attacks caused by inhalation of antigenic particles >0.3 μm such as western red cedar. However, in asthma induced by isocyanates, a different mechanical respirator may be more effective, as humidity is known to reduce the efficacy of static electric filtration.

Relief of symptoms related to asthma is occasionally reported in patients with occupational asthma in whom antigen avoidance is possible soon after onset by changing workplace or job—for example, asthma induced at a pulpmill, or by tetrachlorophthalic anhydride and snowcrab. However, in such patients, antigen sensitisation and airway hyperresponsiveness do not decrease even several years after avoidance of the antigen.[9 10] The two patients reported here were followed up for only 2–3 years. Therefore, it is not clear at this stage whether airway hyperresponsiveness would change with time. Furthermore evaluation after longer periods of follow up is planned. Personal protective equipment can reduce exposure to antigens. However, other measures that improve work practices and ventilation should provide a better working environment.

1 Venables KM, Chan-Yeung M. Occupational asthma. *Lancet* 1997;**349**:1465–9.
2 Chan-Yeung M. A clinician's approach to determine the diagnosis, prognosis, and therapy of occupational asthma. *Med Clin North Am* 1990;**74**:811–22.
3 Cockcroft DW, Killian DN, Mellon JJ, *et al*. Bronchial reactivity to inhaled histamine: a method and clinical survey. *Clin Allergy* 1977;**7**:235–43.
4 De Zotti R, Molinari S, Larese F, *et al*. Pre-employment screening among trainee bakers. *Occup Environ Med* 1995; **52**:279–83.
5 Nieuwenhuijsen MJ, Sandiford CP, Lowson D, *et al*. Dust and flour aeroallergen exposure in flour mills and bakeries. *Occup Environ Med* 1994;**51**:584–8.
6 Nakamura S. An occupational allergic asthma of different kinds newly found in our allergy clinic. *J Asthma Res* 1972; **10**:37–47.
7 Valdivieso R, Moneo I, Pola J, *et al*. Occupational asthma and contact urticaria caused by buckwheat flour. *Ann Allergy* 1989;**63**:149–52.
8 Choudat D, Villette C, Dessanges JF, *et al*. Occupational asthma caused by buckwheat flour. *Rev Mal Respir* 1997;**14**:319–21.
9 Taivainen A I, Tukiainen H O, Terho E O, *et al*. Powered dust respirator helmets in the prevention of occupational asthma among farmers. *Scand J Work Environ Health* 1998; **24**:503–7.
10 Bherer L, Cushman R, Courteau JP, *et al*. Survey of construction workers repeatedly exposed to chlorine over a 3–6 month period in a pulpmill: II follow up of affected workers by questionnaire, spirometry, and assessment of bronchial responsiveness 18 to 24 months after exposure ended. *Occup Environ Med* 1994;**51**:225–8.