

Case report

Clinical improvement after unusual avoidance measures in the home of an atopic dermatitis patient

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A 27-year-old female office clerk with widespread atopic dermatitis (AD) since infancy appeared to be highly sensitized and exposed to molds, storage mites, and chicken feathers and moderately sensitized to house-dust mites and grass and birch pollens. Hardly any textiles were present in her home; that is, only 28 m², which is less than 25% of the Dutch national average. The causal relationship between eczema and molds plus storage mites in this case of AD was strengthened by the positive effect of an unusual, multidisciplinary home-sanitation program involving cleaning of mineral surfaces and ventilation improvement. This home-sanitation program led to a gradual drop of total IgE and clinical symptom scores to 21% and 13%, respectively, of the original values.

Key words: atopic dermatitis; home sanitation; mites; molds.

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In the pathogenesis of atopic dermatitis (AD), genetic influences play a role together with environmental factors. The clinical effect of house-dust allergen avoidance by cleaning or removal of textiles from the home has been reported repeatedly since 1929 (2, 5, 6). As was stated recently, the numbers of viable fungi in floor coverings are weakly associated with allergic symptoms (9).

We report on an association between eczema symptoms and exposure to fungi and mold-devouring mites living on walls and room partitions in a chronic case of AD.

Material and methods

Patient

A 27-year-old woman office clerk with widespread AD since infancy had attended the outpatient clinic for over 1 year. Symptomatic therapy did not improve her dermatologic and respiratory symptoms. Since her symptoms became exacerbated, she was admitted to hospital from 7 February until 12 May

1989 (University Department of Dermatology and Allergy, Utrecht, the Netherlands).

The patient appeared to be highly sensitized to a mold mixture, storage mites (SM), and chicken feathers (skin test score > 2); moderately sensitized to house-dust mites (HDM) and grass and birch pollens (score 2); and slightly sensitized to several foods (score 1) (on the scale 0-4). Her total serum IgE concentration was 24000 kU/l before hospitalization. The intensity and the topography of the AD was scored at admission to the hospital and after 3.5 years, according to a simple scoring system (3). Specific IgE was measured by RAST and after 1989 by the Pharmacia Cap system RAST FEIA (Pharmacia, Uppsala, Sweden). Therefore, specific IgE results are given in RAST classes. Total serum IgE was measured by RAST, but after 1989 the Pharmacia CAP system IgE FEIA was used (Pharmacia, Uppsala, Sweden).

Eczema around the eyes, conjunctivitis, and respiratory symptoms prevented the patient from reading and performing other office functions. In addition,

tion, she felt chronically tired and had to give up her favorite sports. During hospitalization, an antieczema treatment (wood tars and local corticosteroids) was given together with a wheat-, egg-, nut-, and fruit-free diet. Topical therapy could gradually be diminished. Her diet included fruits and wheat again. During weekend leaves, symptoms became exacerbated, especially after the patient had been in the kitchen, although there were no textiles in that room.

The patient's home environment

The patient's home had been built around 1780 and was adapted to modern living without the massive introduction of textiles. There were only one couch, a double bed, one padded chair (in total 12 m² area), and 16 m² textile floor covering in the whole house. Average textile area per home in the Netherlands includes 63 m² surface of padded furniture and 52 m² textile floor covering (4).

Allergen exposure appeared mainly to originate from walls infested with mites and molds (total infested surface about 400 m²). On the mineral surfaces, molds were more widespread than domestic mites. Penetrating- and rising-damp areas were discovered, especially in the bedroom, as well as insufficient ventilation and a high level of relative humidity in the kitchen. In March 1992, relative humidity and temperature were measured for 1 week with a Vaisala reader (Helsinki, Finland) to establish the home's (Dutch) indoor climate class. By this method the humidity of dwellings may be evaluated (7).

Allergologic inventory

An allergologic survey of the patient's home was performed twice in April 1989. Airborne mold spores were collected in all rooms for 15 min by the open Petri dish method (Oxoid malt with a water activity of 0.99). Dishes of 69.4 cm² were incubated at room temperature for 2 weeks before analysis. Adhesive tape samples were taken from walls, floors, and textiles were vacuumed (1 min/m²), and the collected dust was analyzed for mites by a flotation method.

Short-term management

A causal, preventive therapy was tried as follows:

- 1) removal of the highly mold-infested couch and bedroom carpet (16 m²)
- 2) special cleaning twice a year with a) Apesin AP-100 (R) (Mg-monoperoxyphthalate-hexahydrate) (Werner & Mertz, Mainz, Germany) to kill fungi and remove mites on walls and ceilings; b) Aca-rozan (R) (benzylbenzoate) (Werner & Mertz,

Mainz, Germany) to kill mites and remove their allergens on the remaining padded chair

- 3) machine washing at 60°C or dry cleaning of clothing (once)
- 4) purchase of two washable mattresses (Lava-Dorm) (Waidner & Co., Freiburg, Germany) which were washed four times yearly together with pillows and quilt
- 5) mowing the lawn more frequently to prevent flowering of grass
- 6) removal of the henhouse in the garden (although the patient was hardly exposed to it).

At the patient's workplace, similar procedures were followed after November 1989. Textiles were first cleaned with acaricidal detergents, but were later replaced by furniture with nontextile covers.

Long-term management

For a long-lasting reduction of fungi and mites, moisture levels had to be diminished. A 24-h heating and ventilation scheme was prepared for the dwelling. Measures taken included the following:

- 1) The outside front wall was made hydrophobic.
- 2) Ventilation grilles were installed in the kitchen, the attached scullery and built-on shed were demolished, and an extra door was constructed.
- 3) Mechanical ventilation was installed in the bathroom.
- 4) Wall-lathing was removed in the bedroom to reduce empty spaces inhabitable by molds and mites.
- 5) The roof was paneled, and the attic floor and walls were covered with thermal insulation material.
- 6) Gutters were replaced and leaks repaired.
- 7) Acetate-containing sealant was avoided, since it is prone to fungal attack.
- 8) Finishing was renewed with nonhygroscopic materials.

During these alterations (November 1989 to March 1990), the patient lived in a trailer to avoid exposure to the dust of construction work.

All cleaning procedures were performed by the patient's husband and other relatives. This home-sanitation plan was supervised by a team of physicians, engineers, and biologists, who visited the home six times altogether.

Results

The allergologic survey of the dwelling revealed various mold and mite species and other arthropod species. Per gram mattress dust were found 150 tarsonemids and eight SM (both fungus-eating types of mites), 36 HDM, and six other acarids (6 m²; 0.25 g dust collected). Bedroom walls (160 m²; 1 g dust

collected/20 m²) were inhabited by molds (*Aspergillus*, *Penicillium*, *Cladosporium*; about 40 000 spores/cm²), HDM (mean 11.8/g dust), SM (mean 15.4/g), oribatids (mean 7.1/g), and dust lice (mean 16.9/g). SM species found belonged to the genera *Tyrophagus*, *Acarus*, and *Glycyphagus*. A mean of 21.3 mold-colony-forming units (cfu)/air-exposed dish was found. After the avoidance measures were taken, three HDM, three oribatids, 10 dust lice, and three plant lice were found per gram in dust from the washable mattresses, pillows, and bedding (21 m²; 1.2 g dust collected).

One week after the first cleaning, the number of viable diaspores had dropped to a mean of 6.5 cfu/dish. Six weeks after the first cleaning, this had again risen to a mean of 15.3 cfu/dish. Mold- and mite-infested textiles had just been removed. Fifteen weeks after the first allergologic cleaning, viable fungal spores had increased to a mean of 66.2 cfu/dish. By this time, construction work had started and caused an increase in airborne dust and molds. Five months after the fifth cleaning in November 1991, the mold spores had decreased to a mean of 8 cfu/dish.

After 3 years of humidity management, the house was classified as (Dutch) indoor climate class II, a normally dry home, while at the start of the study it was assigned to class IV because of surface condensation and mold growth on the inner walls.

Total serum IgE concentration was 24 000 kU/l before hospitalization, dropping to 15 000 kU/l during hospitalization (Table 1). In April 1989, the pa-

tient's total serum IgE concentration increased to 18 500 kU/l after weekend leaves. After the first allergologic cleaning in May 1989, it was 12 000 kU/l. Constructional improvements and residence in the trailer ended in March 1990. By this time a decrease to 9100 kU/l had taken place. After the fourth allergologic cleaning in February 1991, total serum IgE concentration dropped further to 6366 kU/l. A continued reduction in total IgE was seen until October 1992, when the concentration was 4407 kU/l. This was a reduction of 80% from the initial concentration (Table 1).

Scoring of the patient's AD in intensity and topography decreased from 78 (whole body and face affected) at admission to hospital to 10 (involvement of only the ventral site of the trunk and dorsal site of the upper arm) after 3.5 years of avoidance measures (maximum score = 100). Although no dramatic changes in specific IgE have been seen (Table 1), skin prick tests suggest a decreased sensitization to SM and an increased sensitization to HDM and pollen. No change in skin prick tests for molds has been seen (Table 2).

In November 1989, the patient resumed work. Nowadays she still follows a limited elimination diet, and her dermatologic medication has been reduced to an occasional use of wood tar on the face. Respiratory symptoms have disappeared. The patient cycles 30 km a day with pleasure.

Table 1. Total IgE concentration and specific IgE values for HDM and SM during 4 years. Specific IgE is given in RAST classes; total IgE as kU/l

Date	HDM RAST class	SM RAST class	Total IgE in kU/l	Actions taken
7-87	nd	nd	27 000	
2-88	6	nd	23 500	
3-88	4	nd	24 000	
2-89	nd	nd	21 000	Hospitalization
3-89	nd	nd	15 000	Weekend leaves
4-89				Allergologic survey
5-89	6	2	18 500	Discharge from hospital and 1st allergologic cleaning
6-89	4	6	12 000	
2-90	5	nd	9300	2nd allergologic cleaning
5-90	5	nd	9100	3rd allergologic cleaning
2-91	5	2	6366	4th allergologic cleaning
11-91	5	nd (3)*	6204	5th allergologic cleaning
4-92				6th allergologic cleaning
10-92	5	1 (2)*	4407	

During construction work November 1989–March 1990, patient stayed in a tent trailer to avoid exposure.

HDM: *Dermatophagoides pteronyssinus*.

SM: *Tyrophagus putrescentiae*.

() * Another storage mite: *Glycyphagus domesticus*.

nd: not done.

Table 2. Results of skin prick tests expressed as wheal diameter before and during hospitalization, and after avoidance measures in the home

Antigen source	Before hospitalization	During hospitalization	After avoidance measures
<i>Dermatophagoides pteronyssinus</i>	2	nd	4
<i>Acarus siro</i>	nd	1 1/2	0
<i>Tyrophagus putrescentiae</i>	nd	2	1
<i>Lepidoglyphus destructor</i>	nd	2 1/2	0
<i>Aspergillus</i>	nd	1 1/2	2
<i>Penicillium</i>	nd	2	2
<i>Alternaria/Cladosporium</i>	nd	3	2
Mold mixture IV	nd	3 1/2	3
Mold mixture V	nd	3	2
Basidiomycetes	nd	1 1/2	1 1/2
Grass pollen	2	nd	3
Tree pollen	1 1/2	nd	3

Skin test: 1 = wheal of 5 mm in diameter with erythema (according to Voorhorst et al., 1989)†.

Skin tests done with *Dermatophagoides pteronyssinus*, mold allergens, and grass and tree pollens are from HAL allergen laboratory BV, Haarlem, the Netherlands. Skin tests done with SM allergens are from Diephuis, Groningen, the Netherlands.

Mold mixture IV = *Mucor mucedo*, *Rhizopus nigricans*, *Aureobasidium pullulans*, *Candida albicans*.

Mold mixture V = *Stemphylium botryosum*, *Botrytis cinerea*, *Fusarium culmorum*, *Trichoderma viride*, *Phoma betae*, *Helminthosporium halodes*.

nd: not done.

Discussion

AD is a multifactorial disease. Factors such as indoor climate and allergens have an effect on the skin (2). The patient's damp home harbored allergens originating from walls infested with molds and mold-devouring mites. The few mite-infested textiles in the home were removed at the beginning of the study.

The patient's total serum IgE concentration dropped after hospitalization, and a further decrease was seen after residence in the trailer. This agrees with other studies (5, 6) and could be expected, since in hospital and in the trailer no exposure to molds and mites occurred. Relocation to another environment was temporarily successful, because after the patient returned to the damp home for weekend leaves and was exposed to molds and mites living mainly on the inner walls, her symptoms worsened. A total relapse was prevented by the execution of a multidisciplinary home-sanitation program. Intensive fungicidal and acaricidal cleaning led to a decrease of mold diaspores in the air and mite numbers on the walls. However, when only cleaning was performed, mold exposure increased within 3 months. A long-term effect was achieved by humidity management. The decrease in total IgE continued, and the clinical symptom score diminished.

This case study shows that exposure to molds and mites living on home walls may play a role in atopic diseases such as AD. Previously, no relation was found between the amount of floor-dust-bound fungi and atopic diseases, probably because only textiles in the home were intensively cleaned while exposure to molds from walls remained (9). Recently, cat and mite allergens have also been isolated from home inner walls (10).

This is the first report of a successful, multidisciplinary home-sanitation program aimed mainly at the allergenicity of mineral surfaces. Other reports have dealt with avoidance of mite allergens from textiles (1, 5) or relocation of residents to "minirisk" houses (2).

We conclude that allergen avoidance in damp homes of AD patients may have to follow unusual paths to be successful. This type of allergen survey and planned home treatment should be repeated in other homes to achieve more generally applicable results.

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