Allergy to pine processionary caterpillar (*Thaumetopoea pityocampa*) in children

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ABSTRACT

Contact with pine processionary caterpillar (*Thaumetopoea pityocampa*) induces dermatitis usually located in exposed areas through a toxic-irritative mechanism. Over the last few years an immediate hypersensitivity mechanism have mainly been demonstrated in adult patients. However, there are few studies carried out in children.

Objective: To evaluate a group of 16 children who experienced allergic reactions after exposure to pine processionary caterpillar.

Patients and methods: All patients underwent allergy testing through skin prick test. Serum specific IgE determination was performed by EAST technique. The molecular mass of the IgE-binding bands was studied by SDS-PAGE Immunoblotting.

Results: Skin prick test with the caterpillar extract was positive in all patients. Specific IgE was positive (higher than 0.35 kU/L) in 15 patients’ sera. Western blotting showed several IgE-binding bands with molecular mass values ranging from 17.5 to 168 kDa. Electrophoretic mobility of some of the relevant allergens was related to the conditions of sample preparation (reduced or non-reduced).

Conclusions: The results of this study demonstrate the existence of an allergic IgE-mediated mechanism caused by pine processionary caterpillar proteins. Airborne urticating hairs of this animal should be considered as seasonal inhalant allergen, which is able to induce allergic pathologies in children who frequent pine areas.

Key words: Pine processionary caterpillar. Allergy. Children. Immunoblotting.

INTRODUCTION

Pine processionary caterpillar (*Thaumetopoea pityocampa*), belonging to the *Thaumetopoeidae* family, can induce skin eruptions, generally located in exposed areas, and less frequently ocular lesions. Usually these reactions are produced by a toxic-irritative mechanism1,2 motivated by airborne urticating hairs of the caterpillar3, which, upon entering and breaking inside the skin produce a basophil degranulation with histamine release4,5.

This caterpillar represents a real pest in Europe, mainly in the Mediterranean area4. The urticating capacity of its hairs is well known from antiquity, however the first descriptions were made by Reaumur in 1736 and by Fabre in 19002. Since then different studies have provided new advances on the etiopathogeny of these reactions, which involve mechanical and chemical factors6,7. Although this is the main pathogenic mechanism, they are more and more frequent bibliographical references of cases in those areas.
mechanism of immediate hypersensitivity is implied, generally due to an occupational exposition. This study emphasizes the appearance of IgE-mediated symptomatology produced by this Lepidoptera in children more frequently than previously observed.

**PATIENTS AND METHODS**

**Patients**

We evaluated sixteen children from 6 to 15 years old, who came to our clinical setting with different allergic symptoms probably related to pine processionary caterpillar exposure. Clinical and demographic data of patients are shown in table I.

**Complementary clinical tests**

All patients underwent a basic physical examination and a blood sample analysis which included hemogram with leukocyte formula, erythrocyte sedimentation rate (ESR) and biochemical blood analysis, as well as a fecal parasitologic examination when urticaria was the main clinical manifestation, and spirometry in presence of asthma.

**Skin test**

Skin prick tests (SPTs) were carried out with extracts of common aeroallergens (pollens, animal epithelia, moulds, mites and cockroaches), from *Anisakis simplex* and from caterpillars at the last larval stage (L5), provided by Laboratorios Bial-Arístegui. The caterpillar extract was also tested in 30 control subjects (atopic and non-atopic). Besides, SPT with mosquito (*Aedes* sp) extract was carried out in three patients with prurigo disease (patients n.º 2, 6 and 7) and in patient n.º 12.

Histamine phosphate (10 mg/ml) and sterile 0.9% saline were used as positive and negative controls, respectively. A mean wheal area of 3 mm² or greater compared with the negative control, measured 15 minutes after puncture, was considered a positive response.

**Preparation of pine processionary caterpillar extract**

Some specimens of *Thaumetopoea pityocampa* in L5 larvae stage were ground in a pool of liquid nitrogen into a course “powder” of frozen fragments in a mortar and extracted by magnetic stirring in agita-

**Table I**

Clinical and demographic data of the patients included in the study

<table>
<thead>
<tr>
<th>Patient n.º</th>
<th>Age</th>
<th>Sex</th>
<th>Atopy</th>
<th>Symptomatology</th>
<th>Specific IgE (kU/L)</th>
<th>Class</th>
<th>Prick wheal (mm)</th>
<th>Month of symptoms</th>
<th>Localization of skin lesions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>14</td>
<td>Female</td>
<td>Yes</td>
<td>Urticaria</td>
<td>0.9</td>
<td>2</td>
<td>3 × 3</td>
<td>March-June</td>
<td>IIIEE/SSEE*</td>
</tr>
<tr>
<td>2</td>
<td>11</td>
<td>Male</td>
<td>Non</td>
<td>Prurigo</td>
<td>2.3</td>
<td>2</td>
<td>4 × 4</td>
<td>June</td>
<td>IIIEE/SSEE</td>
</tr>
<tr>
<td>3</td>
<td>9</td>
<td>Female</td>
<td>Non</td>
<td>Anafilaxis</td>
<td>1.3</td>
<td>2</td>
<td>6 × 5</td>
<td>February-Springtime</td>
<td>Face/hands</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>Male</td>
<td>Non</td>
<td>Urticaria-asthma</td>
<td>4.3</td>
<td>3</td>
<td>7 × 5</td>
<td>March-April</td>
<td>SSEE/IEE</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>Female</td>
<td>Non</td>
<td>Rhinitis-asthma</td>
<td>0.4</td>
<td>1</td>
<td>3 × 3</td>
<td>Springtime</td>
<td>NON</td>
</tr>
<tr>
<td>6</td>
<td>15</td>
<td>Female</td>
<td>Yes</td>
<td>Prurigo-angioedema palpebral</td>
<td>6.3</td>
<td>3</td>
<td>5 × 4</td>
<td>Springtime</td>
<td>Eyelid/SSEE/IEE</td>
</tr>
<tr>
<td>7</td>
<td>15</td>
<td>Male</td>
<td>Yes</td>
<td>Prurigo</td>
<td>2.8</td>
<td>2</td>
<td>7 × 9</td>
<td>Springtime</td>
<td>SSEE/IEE</td>
</tr>
<tr>
<td>8</td>
<td>12</td>
<td>Male</td>
<td>Yes</td>
<td>Urticaria-asthma</td>
<td>3.2</td>
<td>2</td>
<td>4 × 5</td>
<td>Springtime</td>
<td>Generalised</td>
</tr>
<tr>
<td>9</td>
<td>7</td>
<td>Male</td>
<td>Yes</td>
<td>Urticaria-asthma</td>
<td>3.3</td>
<td>2</td>
<td>5 × 4</td>
<td>Springtime</td>
<td>Generalised</td>
</tr>
<tr>
<td>10</td>
<td>11</td>
<td>Male</td>
<td>Yes</td>
<td>Urticaria-angioedema</td>
<td>1.2</td>
<td>2</td>
<td>3 × 3</td>
<td>Springtime</td>
<td>Generalised</td>
</tr>
<tr>
<td>11</td>
<td>9</td>
<td>Male</td>
<td>Yes</td>
<td>Urticaria</td>
<td>1.1</td>
<td>2</td>
<td>6 × 5</td>
<td>Springtime</td>
<td>Generalised</td>
</tr>
<tr>
<td>12</td>
<td>12</td>
<td>Female</td>
<td>Yes</td>
<td>Urticaria</td>
<td>4.6</td>
<td>4</td>
<td>5 × 10</td>
<td>March-April</td>
<td>Generalised</td>
</tr>
<tr>
<td>13</td>
<td>10</td>
<td>Male</td>
<td>Yes</td>
<td>Urticaria-asthma</td>
<td>2.7</td>
<td>2</td>
<td>9 × 8</td>
<td>March-April</td>
<td>Generalised</td>
</tr>
<tr>
<td>14</td>
<td>14</td>
<td>Male</td>
<td>Yes</td>
<td>Angioedema</td>
<td>0.66</td>
<td>1</td>
<td>7 × 4</td>
<td>October</td>
<td>NON</td>
</tr>
<tr>
<td>15</td>
<td>10</td>
<td>Female</td>
<td>Yes</td>
<td>Exanthem-conjunctivitis</td>
<td>4.9</td>
<td>3</td>
<td>4 × 3</td>
<td>March-April</td>
<td>Face/hands/SSEE/IEE</td>
</tr>
<tr>
<td>16</td>
<td>7</td>
<td>Female</td>
<td>Non</td>
<td>Rhinoconjunctivitis-asthma</td>
<td>&lt; 0.35</td>
<td>0-1</td>
<td>4 × 4</td>
<td>May-June</td>
<td>NON</td>
</tr>
</tbody>
</table>

*EEII/EESS: superior and inferior extremities.
†This value was less than 0.35 kU/L but greater than the value obtained with the negative control serum (pool from nonatopic subjects’ sera).
75 during 4 h at room temperature. After centrifuga-
tion, supernatant was dialyzed against water. The di-
alyzed extract was filtered through a 0.22 µm-pore di-
ameter membrane and freeze-dried.

Determination of specific IgE

The level of serum specific IgE to common aeroall-
ergens and Anisakis simplex was measured by CAP (Pharmacia Diagnostics, Uppsala, Sweden). Mea-
urement of specific IgE to pine processionary cater-
pillar was performed by EAST method using Bial-Aris-
tegui discs with the allergen coupled (10 mg/ml). Cellulose discs were activated with BrCN following
the method of Ceska et al.9 and measure was carried
out with the HY-TEC EIA Kit for specific IgE (HYCOR Biomedical Ltd. UK) following the manufacturer in-
structions.

SDS-PAGE Immunoblotting

SDS-PAGE was carried out according to the method of Laemmli10, 12.5 % and 4 % of acrylamide
were used for separating and stacking gel respective-
ly. Samples were studied in two conditions: reduced (with β-mercaptoethanol) and non-reduced condi-
tions (without β-mercaptoethanol). Separated proteins
bands were electrophoretically transferred to polyvinyl difluoride (PVDF) essentially described
by Towbin et al.11 and after incubation with patients’
sera detection was performed by a chemilumines-
cence method as recommended by the manufacturer
(ECL-Plus; Amersham Pharmacia Biotech).

RESULTS

Complementary clinical tests

Physical examination and complementary analy-
ses performed were normal.

Skin test

Skin tests against pine processionary caterpillar extract were positive in all patients and negative in
controls. SPT against common aeroallergens was positive to pollens in 68.75 % of patients, to mites in 6.25 %,
to moulds in 6.25 % and to epithelia in 25 %.

SPT to mosquito extract was negative in patients n° 2, 6 and 7, and positive in patient n° 12 who suffers

from allergy to shellfish and showed skin sensitiza-
tion to Anisakis simplex. His positive reactivity could be related to a crossed reactivity. Also, positive SPT
to A. simplex extract was also observed in patient
n° 6.

Measurement of specific IgE

Results of specific IgE determination are shown in
table I. Serum specific IgE against pine processionary
caterpillar was positive in all cases, except in patient
n° 16. Significant high levels of specific IgE (class = 2)
were detected in 81 % of the sera (13/16).

Immunoblotting

Results of SDS-PAGE Immunoblotting with caterpil-
lar extract were different depending on the conditions
in which the sample was prepared: in non-reduced
condition (without β-mercaptoethanol), IgE-binding
bands of 168, 70, 60, 64, 57, 44, 37 and 17.5 kDa
were detected whereas in reduced ones (with
β-mercaptoethanol) the molecular mass of the bands
were 70, 55, 50, 40, 33, 21, 18 and 17/15 kDa (fig. 1).
It is highlighted the presence of a band of approxi-
mately 37 kDa which was only detected in absence
of β-mercaptoethanol, in with 80 % of the studied pa-
tients’ sera detection was performed by a chemilumines-
cence method as recommended by the manufacturer
(ECLPlus; Amersham Pharmacia Biotech).

DISCUSSION

Pine processionary is one of the main European
forest pests.1,12 Approximately 150 species of lepi-
doptera have been described which are able to be
harmful on human skin.2,3 Several species of cater-
pillars in larvae phase are equipped with an urticat-
ing mechanism provided with chitinous spines able
to penetrate the dermis and to induce contact der-
matitis.4 The effects of these urticating hairs in peo-
ple are mainly skin injuries (dermatitis and contact ur-
ticaria), conjunctivitis, and, occasionally, bronchial
effects and anaphylactic shock.1,2,13-15 These spicules
are detectable in air by aerobiological methods and
because of its size, (approximate length of
150-200 µm and diameter of 5 µm), its may pen-
etrate in the human respiratory systems as far as the
trachea and zones of the primary bronchi, inducing
respiratory pathology.4,16

Over the last years and generally in adult popula-
tion, several studies reported1,2,8,13,17,18 the existence
of a hypersensitivity by an IgE-mediated mechanisms in a high percentage of the reactions to this caterpillar.

Lamy et al in 1986 and Werno et al in 1993 described a specific IgE-binding band of 28 kDa by western blot composed by two polypeptides of 13 and 15 kDa, and they identified it as Thaumetopoea. More recently, Moneo et al described an IgE-binding protein of 15 kDa as the major allergen of pine processionary (Tha p 1). This latter author underlined that this protein showed the same molecular mass regardless of the electrophoretic conditions (reduced or non-reduced) and demonstrated the monomeric nature of the Tha p 1 protein.

In geographical areas with plenty of pine trees, outpatient pediatric consultations for symptoms related to pine processionary are frequent. Nevertheless, studies carried out in children are scarce and epidemiological studies have not been undergone. As far as we know only in three previous studies an IgE-mediated mechanism has been pointed out as the cause of hypersensitivity to this caterpillar during the childhood. One of them, which included 653 patients aged from 3 to 17 years, demonstrated that reactions to pine processionary affects 9.2% of children and teenagers who frequent pine areas. Our study results agree with Vega et al findings, demonstrating that the most common clinical manifestations were the dermatological ones, with lesions generally located in exposed areas. This latter author also described some severe symptomatology like asthma and anaphylactic reactions, in patients exposed to high levels of allergen due to occupational exposure. In our study, in despite the absence of occupationally exposure, six patients showed associated respiratory pathology, one of them reported asthma as the only clinical manifestation symptoms, and another one suffered an anaphylactic reaction.

In all of the cases here described symptoms appeared mainly between February and April (larvae phase L5), period of the year with the highest presence of caterpillar hairs in the air. Symptoms always appeared several hours after patients have been in pines areas infected with pine processionary caterpillar. Only in one case (patient n° 14) symptomatology occurs in autumn, period of the year when pine processionary is in larvae phase L3-L4, an urticating but
not procession state, and period when anaphylactic reactions are more frequent. Vega et al. noted that 37% of the occupationally exposed patients present symptomatology from October to December, whereas in non-occupationally exposed patients symptoms generally appeared in springtime. Finally, the atopic status of the patients here studied is in accordance with the high percentage of atopic patients found by other authors among non-occupationally exposed.

Therefore, the airborne urticating hairs of *T. pityocampa* should be considered, also in children, as seasonal inhalant allergens. In areas where the presence of this caterpillar is endemic, reactions to pine processionary caterpillar proteins should be taken into account in the diagnosis of urticaria, dermatitis and other allergic pathologies in children.

REFERENCES


