Respiratory manifestations due to nickel

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Summary

Nickel sulphate more frequently determines allergic dermatitis due to contact (contact eczema); less known are nasal inflammation (rhinitis) and bronchial asthma caused by nickel sulphate. Sporadic cases, often related to patients’ work have been reported in the literature. The research described herein refers to 20 patients presenting clear nickel allergy with rhinitis (associated in 11 cases with asthma). The patients, all females, revealed positivity to this kind of allergy: patch test, prick tests with nickel sulphate, nasal provocation test by nickel sulphate, computed tomography of paranasal sinuses, spirometry and bronchial provocation test with metacholine, oral provocation test with nickel sulphate were employed. A strict long-term diet with food with low nickel content (2-4 months at least) led to a progressive reduction of nasal symptoms (rhinorrea, sneezing, nasal obstruction) and an improvement in bronchial symptoms and functional parameters.

Introduction

Nickel is the allergen that most frequently produces professional contact eczema in females 1-4. Albeit other pathological localizations of allergy to nickel are steadily increasing: mucositis, oculo-rhinitis, asthma, urticaria 5-15.

There are several groups of workers at professional risk (galvanic, metallurgical and mechanic industry workmen, hairdressers, cooks, tailors, goldsmiths, medical doctors, nurses), but the extra-professional hazard is also very important.

Nickel is present in many manufactured articles: costume jewelry, keys, pottery, furniture, clothes accessories; in soaps, in some natural foods (Table I) and in food cooked or packed in stainless steel food containers.

Females are more frequently affected than males (female: male ratio 14:1) and the allergy usually occurs in the third decade of life. Rhinitis caused by allergy to nickel, combined or not with asthma has been described in patients submitted to nickel exposure during their working activity 5 11-15. Nickel may be absorbed by skin, lungs and the digestive system.

The present reports refers to 20 patients with rhinitis, associated in 11 cases with bronchial asthma, due to

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<tr>
<th>Key words</th>
<th>Parole chiave</th>
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<td>Rhinitis • Allergy • Nickel sulphate</td>
<td>Riniti • Allergia • Nickel solfato</td>
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Table I. Food containing nickel (modified from Venuti et al. 1).

<table>
<thead>
<tr>
<th>Herring</th>
<th>Corn and buckwheat flour</th>
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<tbody>
<tr>
<td>Asparagus</td>
<td>Hazel-nut</td>
</tr>
<tr>
<td>Bean</td>
<td>Mushroom</td>
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<tr>
<td>Onion</td>
<td>Fresh and cooked pear</td>
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<tr>
<td>Tomato</td>
<td>Rhubarb</td>
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<tr>
<td>Pea</td>
<td>Tea</td>
</tr>
<tr>
<td>Lettuce</td>
<td>Cocoa and chocolate</td>
</tr>
<tr>
<td>Cabbage</td>
<td>Beer</td>
</tr>
<tr>
<td>Raisin</td>
<td>Raising agents</td>
</tr>
<tr>
<td>Margarine</td>
<td>Wine</td>
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All foods canned or cooked in inox steel
allergy to nickel in females who had not experienced nickel exposure as a working risk.

**Materials and methods**

**Description of cases**

A series of 20 patients, all female, aged between 24 and 48 years (mean 33.7 ± 2) with chronic rhinitis were examined between January 1996 and June 2004 (asthma was present in 11 cases).

No respiratory allergy was revealed in the case history, but all patients had contact eczema, probably due to nickel sulphate.

Blood tests, spirometry, bronchoconstriction test with metacholine, total and specific dosage of IgE were all in the normal range.

**Methods**

The following diagnostic procedures were carried out:

- patch test for metals (chrome, cobalt, nickel);
- prick tests for most common respiratory allergens (graminaceae, parietaria, dermatophagoides, alternaria etc.);
- prick tests for nickel (with 1 mg/ml and 10 mg/ml nickel sulphate (NiSO4);
- ENT examination – either routine or with fibrolaryngoscopy;
- nasal provocation test for nickel performed with a small piece of cotton wool (diameter 1-2 mm) impregnated with NiSO4 solution at a concentration of 10 mg/ml after a placebo test with physiological saline 15. The cotton wool was applied to the anterior opening of the inferior nasal meatus for 1 hour as described elsewhere 11,15.

The patients were submitted to anterior active basic rhinomanometry and post nasal provocation test rhinomanometry. Student t test was used in the statistical analysis of the results (Table II). A significant difference in values was observed: 1.6 ± 0.5 Pa/cm2/sec. after the provocation test and 0.8 ± 0.1 Pa/cm2/sec. before the provocation test. Results were highly significant with a p value of < 0.01.

The oral provocation test was performed, after 1 month on a low nickel diet, using capsules at a dosage of 5-10-20 mg (Lofarma test dose) (after placebo provocation with lactose) which was taken at an increasing dosage at 1-week intervals.

During this test, cutaneous lesions, ventilation index (PEF, FEV1), some symptoms (rhinorrea, nostril obstruction, cough, dyspnoea) were monitored.

Computed tomography (CT) of paranasal sinuses, as well as bronchoconstriction test with metacholine were carried out in patients with associated bronchial asthma.

**Results**

- Patch tests carried out for the most common metals revealed positivity only to nickel sulphate.
- ENT examination revealed chronic rhinitis in all the patients.
- CT of the paranasal sinuses demonstrated inflammation of sinuses and either turbinates hypertrophy in all the patients.
- Nasal provocation test was positive and provoked rhinorrea, sneezing and nostril mucosa increasing of oedema 15-30 minutes after inhalation of nickel sulphate.
- Rhinomanometry demonstrated an increase in nasal resistance in all patients in basal conditions; a further expansion of this parameter was observed also in the nasal provocation test (Table II).
- Prick tests for the most common respiratory allergens were negative.
- Prick tests for nickel were positive in one third of the patients (7 out of 20 patients).
- Metacholine provocation tests were positive in 11 cases (PD 20 Fev1 268 ± 25).

**Discussion and conclusions**

Rhinitis and asthma due to nickel sulphate allergy have very rarely been described in the literature 2,3,5,6,11-15 and reports have referred to very few, or even only one patient. The paucity of data in this respect is due either to the rarity of this condition, or to the difficulty in formulating correct diagnosis, which can be reliably reached only by the finding of positivity to the nickel sulphate oral provocation test. In the group of females studied in the present investigation the allergy to nickel sulphate exposure not due to working

<table>
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<th>Basic rhinomanometry</th>
<th>Post nasal provocation test rhinomanometry</th>
<th>Student t test</th>
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<td>0.8 ± 0.1</td>
<td>1.6 ± 0.5</td>
<td>p &lt; 0.01</td>
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hazard was incontrovertible as also the nasal mucosa oedema (rhinitis) present in each patient. Moreover, prophylaxis and therapy with a diet low in nickel content are also difficult, since total compliance on behalf of the patient is necessary for at least 2-4 months for a reliable evaluation of effectiveness. Our patients confirmed that it is difficult to accept a strict and prolonged diet low in nickel content, but when achieved, a gradual and progressive reduction in nasal or bronchial symptoms (cough, dyspnoea) or an improvement in functional parameters (PEF, FEV1, PD20, FEV1 = 467 ± 37) was observed, allowing a progressive reduction and withdrawal of symptomatic therapy (nasal corticosteroids or antihistamins).

One question remains unanswered: are rhinitis and asthma due only to Gell and Coomb’s type I and type III reactions?

References