Selective Allergy to Lobster in a Case of Primary Sensitization to House Dust Mites

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Abstract

Allergy to only 1 kind of seafood is uncommon. We report a case of selective allergy to lobster.
We studied a 30-year-old man who suffered generalized urticaria, facial erythema, and pharyngeal pruritus after eating lobster. He had a more than 10-year history of mild persistent asthma and sensitization to house dust mites. The study was performed by skin prick test, and prick-prick test, oral food challenge, specific immunoglobulin (Ig) E determinations by CAP (Phadia, Uppsala, Sweden) and ADVIA-Centaur (ALK-Abelló, Madrid, Spain), and IgE-immunoblotting.
The patient's serum recognized 2 allergens of around 198 kDa and 2 allergens of around 65 kDa from the lobster extract, allergens of around 15, 90, and 120 kDa from *Dermatophagoides pteronyssinus* extract, and allergens of around 15 and 65 kDa from *Dermatophagoides farinae* extract. Serum did not recognize purified shrimp tropomyosin.
Immunoblot-inhibition assay results indicated cross-reactivity between lobster and mite allergens.
This is the first report of selective allergy to lobster.

Key words: Allergy. Immunoblotting. Lobster. House dust mites. Seafood allergy.

Resumen

La monosensibilización a una clase de marisco es infrecuente. Se presenta un caso de alergia selectiva a langosta.
Se estudia un varón de 30 años, con asma persistente y sensibilización a ácaros hace más de 10 años, que presentó urticaria generalizada, eritema facial y prurito faríngeo, tras ingerir langosta. Se realizaron pruebas cutáneas (skin prick y prick-prick tests), provocación oral y detección de IgE específica mediante CAP, ADVIA-Centaur e immunoblotting.
El suero del paciente reconoció dos alérgenos de alrededor de 198 kDa y dos de alrededor de 65 kDa del extracto de langosta; alérgenos de alrededor de 15, 90 y 120 kDa del extracto de *D. pteronyssinus*, y de alrededor de 15 y 65 kDa del extracto de *D. farinae*. No reconoció tropomiosina purificada de gamba.
Mediante ensayos de immunoblot-inhibición se demostró reactividad cruzada entre alérgenos de langosta y ácaros.
Es el primer caso descrito de alergia selectiva a langosta.

Palabras clave: Ácaros. Alergia. Crustáceos. Langosta. Marisco

Introduction

The prevalence of allergy to shellfish is estimated to be 2%-3%. This percentage was determined in a cross-sectional epidemiological study involving 15 countries, and by a random telephone survey carried out in the United States [1,2]. Selective sensitization to only 1 kind of seafood is uncommon, since cross-reactivity between species is high. This cross-reactivity has been attributed to tropomyosin, the major allergen in allergy to crustaceans and molluscs [3].

Reported lobster allergens include tropomyosin, Pan s 1 from the spiny lobster *Panulirus stimpsoni*, and Hom a 1 from the American lobster *Homarus americanus* [4]. The highly conserved amino acid sequences of tropomyosin in invertebrates explain the cross-reactivity observed between crustaceans, molluscs, arthropods (cockroaches and chironomids), house dust mites, and nematodes [5-7].

House dust mites have been described as primary sensitizing agents in cases of selective allergy to molluscs such as limpet and terrestrial snail [8-11].

We present the case of a 30-year-old man sensitized to house dust mites and who tolerated some crustaceans, molluscs, and fish, yet presented allergic symptoms after eating lobster.

Our aim was to identify the allergens involved in the patient's allergy to lobster.

Case Description

A 30-year-old man with a 10-year history of mild persistent asthma and allergy to house dust mites (*Dermatophagoides pteronyssinus* and *Dermatophagoides farinae*) and pollen (*Plantago lanceolata*) presented generalized urticaria, facial erythema, and pharyngeal pruritus after eating shellfish on 3 separate occasions during a 2-year period. He associated the most recent episode with lobster. Since then, he has tolerated some crustaceans, molluscs, and fish, although he has avoided eating shrimp and lobster. No other food or drug allergies were reported, and he has not received immunotherapy for house dust mites. He mentioned the symptoms brought on by lobster during a routine review of his persistent asthma.

Table. Results of Allergologic Work-up

Allergens		CAP, kU_A/L	ADVIA Centaur, kU_A/L	SPT, mm	PPT, mm	Oral Food Challenge
Environment	*Dermatophagoides pteronyssinus*	21.4		11		
	Der p 1		4.7			
	Der p 2		60.9			
	Dermatophagoides farinae	12.6		8		
	Der f 1		0.4			
	Der f 2		47.2			
	Plantago lanceolata			10		
	Alternaria alternata, *Cladosporium herbarum*, *Penicillium notatum*, *Aspergillus fumigatus*; dog, cat, horse, and cow dander			Negative		
Food	Milk, egg, wheat, corn, soybean, peach, apple			Negative		
	Fish: cod, hake, whiff, tuna, sole			Negative		
	Shellfish battery: crab, mussel, clam, snail, squid			Negative		
	Shrimp	0		3	Negative (raw and cooked)	Negative (cooked)
	Lobster	2.9		NA	6 (cooked)	Patient refused
Tropomyosin	Shrimp (Pen a 1)		0.04			
	D pteronyssinus (Der p 10)		0			

Abbreviations: NA, not available; PPT, prick-prick testing; SPT, skin prick testing.

Oral informed consent for this study was obtained from the patient.

Skin prick tests (SPTs) were performed using commercial allergens (environmental and food allergens) provided by Bial-Aristegui (Bilbao, Spain). Histamine dihydrochloride and saline solution were used as positive and negative controls, respectively.

Prick-prick tests (PPTs) were performed with raw and cooked shrimp and cooked lobster. An SPT response was considered positive if the maximum wheal diameter was at least 3 mm greater than that produced by the negative control.

We performed an oral food challenge with cooked shrimp, but the patient refused an oral food challenge with lobster.

Specific immunoglobulin (Ig) E determinations to *D pteronyssinus* and *D farinae*, shrimp, and lobster were performed using the CAP system (Phadia, Uppsala, Sweden). Specific IgE determinations to major allergens of mites (Der p 1, Der p 2, Der f 1, Der f 2), shrimp tropomyosin (Pen a 1), and *D pteronyssinus* tropomyosin (Der p 10) were performed using the ADVIA-Centaur Platform (ALK-Abelló, Madrid, Spain) (Table).

We acquired the kind of lobster indicated by the patient (*Palinurus elephas*) at a local market, and homogenized 4 g of the raw abdomen in a mortar with 40 mL of phosphate-buffered saline before centrifugation at 4500*g* for 15 minutes. The supernatant was then dialyzed against distilled water overnight at 4ºC.

Twenty micrograms of protein from the lobster extract reduced with 5% 2-mercaptoethanol at 100ºC for 5 minutes, 3 µg of purified shrimp tropomyosin, and 15 µg of both *D pteronyssinus* and *D farinae* extracts (ALK-Abelló) were loaded in 12% acrylamide minigels for electrophoresis (150 V) under standard sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE) conditions. The separated proteins were electro-transferred onto nitrocellulose membranes (Bio Rad Trans-Blot, Supported Nitrocellulose Membrane 0.45 µm) and incubated overnight with 500 µL of the patient's serum diluted in 10 mL of incubation buffer (10 mM Tris saline pH 7.4, 1% Tween 20, 5% fetal bovine serum). IgE-binding proteins were detected using a 1:1000 dilution of monoclonal anti-IgE antiserum (Ingenasa, Madrid, Spain) in incubation buffer, and a 1:2500 dilution of an alkaline phosphatase–labeled goat antimouse antiserum (Biosource Int, Camarillo, California, USA), as described elsewhere [12].

Immunoblotting-inhibition assays were performed by incubating the patient's serum for 3 hours at room temperature, with 15 µg of the lobster extract, 5 µg of purified shrimp tropomyosin, and 15 µg of both *D pteronyssinus* and *D farinae* extracts before immunoblotting.

The patient had positive results for *D pteronyssinus* and *D farinae* extracts by CAP, and for their purified allergens Der p 1, Der p 2, Der f 1, and Der f 2 by ADVIA-Centaur. The study performed with shrimp was weakly positive for SPT, although the results of specific IgE determination by CAP, PPT, and oral food challenge proved negative (the patient tolerated up to 8 g of cooked shrimp during the challenge, and normal servings have been tolerated several times since). The study performed with lobster gave positive results by CAP and PPT. However, the patient refused the oral food challenge with lobster. Purified tropomyosins from shrimp (Pen a 1) and *D pteronyssinus* (Der p 10) were negative by ADVIA Centaur (Table).

The patient's serum recognized 2 proteins of around 198 kDa and 2 of around 65 kDa from the lobster extract by

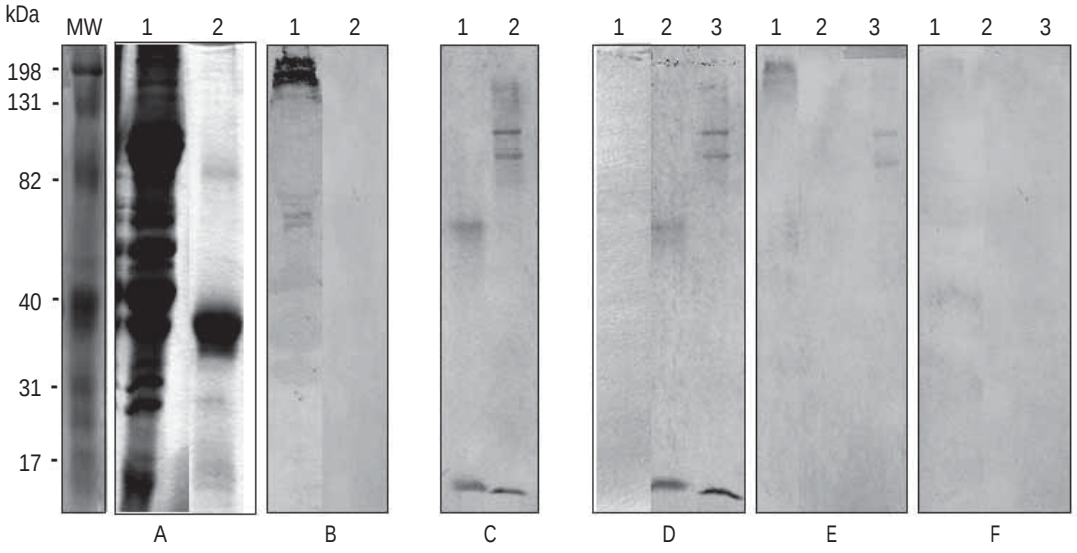

Figure. A, SDS-PAGE and Coomassie staining. B, IgE-immunoblotting performed with the patient's serum: lane 1, lobster (*Palinurus elephas*) raw extract reduced by 2-mercaptoethanol; lane 2, purified shrimp tropomyosin. C, IgE-immunoblotting with *Dermatophagoides pteronyssinus* extract (lane 1) and *Dermatophagoides farinae* extract (lane 2). D, Immunoblotting-inhibition assay with lobster extract: lane 1, lobster extract reduced with 2-mercaptoethanol; lane 2, *D pteronyssinus* extract; lane 3, *D farinae* extract. E, Immunoblotting-inhibition assay with *D pteronyssinus* extract: lane 1, lobster extract reduced with 2-mercaptoethanol; lane 2, *D pteronyssinus* extract; lane 3, *D farinae* extract. F, Immunoblotting-inhibition assay with *D farinae* extract: lane 1, lobster extract reduced with 2-mercaptoethanol; lane 2, *D pteronyssinus* extract; lane 3, *D farinae* extract. MW indicates molecular weight marker.

immunoblot (Figure, B; lane 1), but it did not recognize shrimp tropomyosin (Figure, B; lane 2). Furthermore, the serum recognized a protein of around 15 kDa in the *D pteronyssinus* and *D farinae* extracts (probably Der p 2 and Der f 2 allergens), a protein of around 65 kDa in the *D pteronyssinus* extract (Figure, C; lane 1), and 2 proteins of around 90 and 120 kDa in the *D farinae* extract (Figure, C; lane 2).

Recognition of house dust mite allergens was not inhibited when the patient's serum was pre-incubated with the lobster extract (Figure, D; lanes 2 and 3). However, the 2 bands of around 65 kDa from the lobster extract disappeared, and the 2 bands of around 198 kDa were partially inhibited when serum was pre-incubated with *D pteronyssinus* extract (Figure, E; lane 1). Finally, both pairs of bands of around 198 kDa and 65 kDa from the lobster extract were fully inhibited when the serum was pre-incubated with *D farinae* extract (Figure, F; lane 1).

Lobster allergens were not inhibited by purified shrimp tropomyosin (data not shown). This is consistent with the ADVIA-Centaur results and the fact that the patient's serum did not recognize shrimp tropomyosin in immunoblotting.

Discussion

Although allergic reactions to seafood are frequent, a selective allergy to only 1 kind of shellfish is exceptional. Our patient presented symptoms only after eating lobster, but he tolerated other kinds of crustacean, mollusc, and fish. He showed specific IgE to high-molecular-weight protein bands (around 198 kDa and 65 kDa) from the raw lobster extract by IgE immunoblotting, but his serum did not recognize tropomyosin. These results suggest that homologous allergens to Der p 14 and Der f 14 (apolipophorins of 177 kDa), Der p 4 (α-amylase of 60 kDa), and/or Der f 18 (chitinase of 60 kDa) could be present in the lobster extract.

Two allergens other than tropomyosin have been characterized from shrimp (*Penaeus monodon*), a 40-kDa arginine kinase (Pen m 2) [13], and a 20-kDa sarcoplasmic calcium-binding protein [14]. As far as we know, allergens other than tropomyosin have not been described for lobster.

With regard to house dust mites, the patient had positive results to *D pteronyssinus* and *D farinae* and their purified allergens Der p 1, Der p 2, Der f 1, and Der f 2. The inhibition assays showed that *D farinae* was a more potent inhibitor of the lobster immunoblot than *D pteronyssinus*, although the CAP value of *D farinae* was lower than that of *D pteronyssinus*.

Allergy to molluscs such as limpet and terrestrial snails has been described in patients with previous allergy to house dust mites [8-11]. Although the responsible allergens have yet to be determined, it seems that previous sensitization to house dust mites could explain sensitization to these molluscs. Further evidence for this theory was provided by an epidemiologic study in 169 allergic children who had never eaten snails and did not complain of allergic reactions to shellfish. Sensitization to snails was reported in 30% of children who were allergic to house dust mite, probably due to a primary sensitization to mites [11].

There are 5 reports of allergy to barnacle (*Pollicipes pollicipes*) [15]. All these patients had mite-related asthma and allergic rhinoconjunctivitis, and none of them had received mite-specific immunotherapy. Only 1 of these patients had a positive value for specific IgE to tropomyosin when studied by CAP (86 kU_A/L).

A review of the literature revealed that tropomyosin does not seem to be involved in cross-reactivity between limpet, terrestrial snail, and barnacle and mites. There could be 2 profiles of sensitization to shellfish: one in which tropomyosin is involved as a panallergen, with patients who do not tolerate several crustaceans and/or molluscs, and another with selective sensitizations to a kind of mollusc or crustacean in mite-allergic patients with allergens other than tropomyosin.

We present the first report of a selective allergy to lobster in a patient with primary sensitization to house dust mite.

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