Quillaja bark (soapbark)–induced asthma

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A 24-yr-old man developed sensitization to Quillaja bark (soapbark) dust at his work place. Within 3 mo of being employed in a factory processing Quillaja bark to produce saponin, he experienced asthma symptoms while handling the bark but only nasal symptoms on being exposed to the purified saponin. Bronchial provocation using Quillaja bark dust resulted in immediate bronchoconstriction as well as faintness, diffuse erythema, and hypotension. Radioallergosorbent test (RAST) using the pulverized crude Quillaja bark was markedly positive, and cross-reactivity between gum acacia and gum tragacanth was demonstrated using this technique.

Occupational asthma due to inhalation of a variety of wood dusts has been described. Dusts of western red cedar,[1] cedar of lebanon, oak, and mahogany,[2] California redwood,[3] kejaat,[4] boxwood,[5] iroko,[6] cocobolo,[7] ramin,[8] and African zebrawood[9] have been found to cause asthma. To the best of our knowledge, asthma due to Quillaja bark dust (*Quillaja saponaria* or soapbark tree) has not been reported. This report concerns a patient who developed sensitization to Quillaja bark dust leading to rhinitis and asthma.

CASE REPORT

This 24-yr-old Caucasian male was evaluated because of an 11-mo history of asthma. He first noticed wheezing 3 mo after starting work as a "spray drier operator" in a local factory manufacturing "saponin dust" from Quillaja bark. During the same period he had also noticed rhinorrhea and lacrimation and itchiness of the eyes. He gave no personal history of eczema or food or drug allergies but he had allergic rhinitis for several years, and his sister had allergic rhinitis. He smoked 20 cigarettes per day for several years.

The patient noticed sneezing followed by dyspnea and wheezing within a few minutes of being exposed to the raw bark dust. This persisted despite the use of a protective mask (mine safety mask). He noticed only nasal symptoms after exposure to the saponin dust. There was significant improvement in his asthma symptoms during weekends and while on vacation when he was away from the job for as long as 10 days. On initial examination, the only abnormal physical finding was scattered wheezes heard on auscultation of the chest.

TABLE I. Specific IgE to vegetable materials by RAST: Percent binding of anti-IgE labeled with ^{125}iodine after incubation

Allergen	Patient	Control
Quillaja bark	19.3, 26.5 } 22.4	3.1, 3.2 } 3.2
Gum arabic	32.5	3.1
Gum tragacanth	30.8	3.1

Skin tests

Skin prick and intradermal tests to a battery of common allergens were done by standard techniques.[10] Several tree and grass pollens as well as ragweed, pollen, and molds gave strong reactions. House dust was positive only on intradermal testing. Skin testing using Quillaja bark and other wood dusts was not accomplished because the patient was lost to follow-up before tests could be performed.

Radioimmunoassay

Total IgE was determined by the radioimmunosorbent test (RIST) (Phadebas, Pharmacia Labs., Piscataway, N. J.) and was markedly elevated at 2,000 IU/ml (1 IU = 2.2 ng). Normal value for IgE is 10 to 250 IU/ml. Specific IgE to

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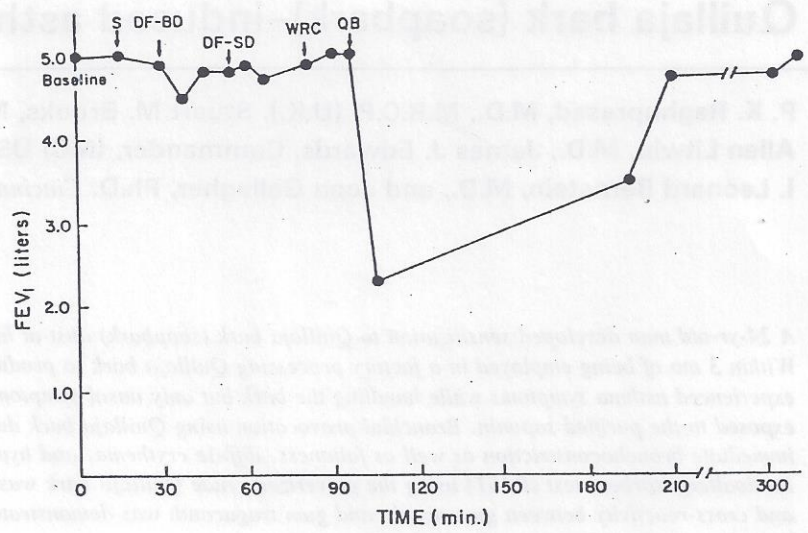

FIG. 1. Bronchial provocation testing for a number of different wood dusts. S: saline (control); DF-BD: Douglas fir bark dust; DF-SD: Douglas fir sawdust; WRC: western red cedar dust; QB: Quillaja bark dust. An immediate reaction is noted following the inhalation of Quillaja bark dust.

pulverized Quillaja bark, gum arabic, and gum tragacanth (Sigma Chemical Co., St. Louis, Mo.) were measured by modification of the radioallergosorbent test (RAST).[11] Each of these antigens at concentrations of 20 mg/ml was coupled directly to methyl cellulose disks activated previously by cynogen bromide dissolved in acetonitrile according to the method of Hoffman.[12] In the case of the pulverized Quillaja bark, alkaline extraction at pH 14 was necessary to solubilize the allergen. Results are expressed as percent binding and are calculated by dividing the counts per minute (cpm) per individual test by the total counts per minute added, then multiplying by 100.

The amount of radioactivity bound by the patient's serum, compared with control sera from healthy, nonallergic volunteers never exposed to Quillaja bark dust, is shown in Table I. Mean percent binding of IgE in patient sera to Quillaja bark is 22.4% as compared with 3.2% for the control. Significant binding of 32.5% for gum arabic and 30.8% for gum tragacanth were also obtained in the patient's sera as compared with negligible binding in control sera.

Pulmonary function tests

Tests were essentially normal and performed using a precalibrated dry rolling seal spirometer (Model 220; Cardiopulmonary Instrument Corporation, Houston, Texas). Forced expiratory volume at 1 sec (FEV_1) was 4.8 L (104% predicted); forced vital capacity (FVC) was 6.3 L (108% predicted); and maximum expiratory flow at 50% vital capacity (V 50) was 5.5 L/sec (104% predicted). Tests were performed using methods reported previously.[13]

Methacholine challenge

A positive methacholine challenge was noted utilizing an aerosol-generating system which has been used routinely in our laboratory. There was a 20% fall in FEV_1 following the inhalation of 825 μg of methacholine.

Bronchial challenge tests

Tests were performed during an asymptomatic period by a modification of the method described by Pickering et al.[6] After baseline measurements of pulmonary function tests and inhalation of saline control, challenges to the wood dusts were achieved by vigorously shaking for 1 min a sealed plastic bag containing the specific dust, then opening the bag at the subject's chest level and allowing him to breathe the generated dust. The following wood dusts were used in sequence: powdered Douglas fir bark, Douglas fir sawdust, and western red cedar dust. No significant change in pulmonary function was noted on serial measurements of pulmonary function tests at 1, 5, and 15 min after inhalation of any of these wood dusts. After the first whiff of the Quillaja bark dust, the patient developed coughing; after three more breaths his face became flushed and diaphoretic and he complained of "feeling hot, sick, and weak." He then began weaving in the chair and was placed in the head-between-the-knees position. Audible wheezes were noticed. The pulmonary function tests at 1 min after inhalation gave the following values: FVC = 3.5 L, FEV_1 = 2.6 L, V 50 = 2.1 L/sec (Fig. 1). He manifested symptoms of asthma and anaphylaxis, including generalized erythema and hypotension which required treatment with epinephrine and intravenous steroids. With treatment, the FEV_1 returned to baseline value at 115 min after inhalation of the Quillaja bark dust (Fig. 1). Bronchial challenge with Quillaja bark dust was performed on an atopic volunteer subject after obtaining informed consent. This resulted in a burning sensation of the nostrils, sneezing, and slight cough, but no wheezing or changes in pulmonary function tests were noted.

DISCUSSION

Quillaia (kwil-la´yah) is the dried inner bark of *Quillaja saponaria* or soapbark tree, which is a native of Chile, Peru, and Brazil. It contains a saponin called quillain which gives it the unique property of forming a stable foam on shaking with water. This is achieved by the saponin's capacity to lower the surface tension of water. Until recently, in many countries quillaia had been used as a detergent in preference to soap for laundering fine fabrics. The same foaming action had been exploited by the aborigines of South America in killing fish, which are believed to have died from the foam interfering with the function of their gills. Human consumption has been known to lead to vomiting and diarrhea; injected intravenously, quillaia can induce hemolysis even in minute amounts.[14] The fact that the latter is not a problem when ingested orally is evident when one considers that certain common beverages such as root beer owe their foaming properties to the saponin.[14] Tincture of quillaia has been used medicinally in bronchitis and pleurisy and has been used commercially as an emulsifying agent in photographic emulsions and in multilayered coatings to permit spreading and adhesion of successive layers. Powdered *Quillaja saponin,* when dispersed in air, is known to cause sneezing, but asthma has not been reported to date.

Our patient experienced asthma within 3 mo of being employed in the factory. Furthermore, the onset of nasal and respiratory symptoms within minutes of exposure to Quillaja bark dust at work and the noticeable improvement while away from work on weekends and during vacation points to the occupational nature of the asthma. It may be argued, however, that in view of his personal and family history of allergic rhinitis, multiple skin-test reactivity, the extremely high IgE values, and the positive methacholine challenge, the subject had preexisting asthma and the dusty atmosphere at work simply aggravated his underlying condition. Bronchial asthma is known to be associated with hyperreactivity of airways to diverse nonspecific stimuli[15] and to drugs such as methacholine.[16, 17] However, the negative bronchial response to saline and various wood dust challenges in the face of the marked bronchospasm and anaphylactic reaction on challenge with the Quillaja bark dust, as well as high specific IgE to pulverized Quillaja bark extract, denote true allergy to the bark. The persistence of asthma while using a "protective" mask suggests small-diameter–sized dust as the carrier of the allergen(s). Of particular interest is the fact that the patient experienced an asthmatic reaction at the workplace while handling the raw bark but only rhinitis during the latter stages of the process of pure saponin preparation. Also noteworthy is the fact that he had positive RAST to the crude pulverized Quillaja bark, gum acacia, and gum tragacanth. While the chemical structure of the allergen(s) remains speculative, it is interesting that there is a striking structural similarity between the sapogenin quillaic acid and acacic acid, one of the ingredients of gum acacia and a known cause of occupational asthma.[18]

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