

Pine pollen allergy in northern Arizona

Geraldine L. Freeman, MD

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Allergy to pine trees is generally held to be rare and clinically insignificant. Skin test sensitivity to pine pollen antigen was found in 12 of approximately 826 (1.5%) atopic patients in a northern Arizona private allergy practice. There were five women and seven men and their ages ranged from 6 to 59 years. All were residents of the pine tree area for at least 2 years. All 12 reacted to the antigen of the predominant ponderosa pine and five also reacted, usually less strongly, to Colorado pinyon pine. Eight patients had spring season rhinoconjunctivitis and four others had perennial symptoms. Four of the 12 also had asthma. Some patients had clinical symptoms coinciding with pine pollen season.

INTRODUCTION

Pine pollen allergy has generally been held to be notably infrequent and only a few cases were recorded before 1980.^{1,2} Recent reports, however, from the New England³ and the California Bay areas⁴ suggest a low to moderate incidence of positive pine pollen skin tests with or without symptomatic pollinosis in certain geographic locations.

Northern Arizona is the site of the largest ponderosa pine (western yellow pine) forest in the Continental United States. Most of the forested area of Arizona is located in the north and encompasses approximately 25,000 square miles or 25% of the state. Flagstaff is the major community in the northern part of the state, situated at an elevation of 7,000 feet with a population of 50,000. The forest has been preserved throughout the city. Ponderosa (western yellow) pine is the major conifer in the area and Colorado pinyon pine also occurs locally in lesser stands.⁵ Total annual precipitation (19") as rain and snow far exceeds that in Arizona's large desert cities. Following is a report of the incidence and clinical correlates of pine pollen allergy found in patients treated in a private clinical allergy practice in Flagstaff.

PATIENTS AND METHODS

Patients

The study population consisted of all patients from Flagstaff, Arizona and the surrounding heavily forested area who were initially seen as part of a private allergy consultation practice from March 1978 through December 1989. There were 1354 patients, consisting primarily of adults older than 12 years.

Skin Tests

All patients were prick tested on the back using *Pinus ponderosa* (ponderosa pine, Greer Laboratories, Lenoir, NC) and *Pinus edulis* (Colorado pinyon pine, Hollister-Stier Laboratories, Spokane, WA) 1:20 glycerosaline antigen extracts. If these epicutaneous tests were non-reactive, intradermal testing with 1:1,000 aqueous extract was done on the upper arm. A positive skin test to pine antigen was so rare that it was immediately repeated for confirmation. Hollister-Stier *Pinus ponderosa* extract was added to the testing protocol in 1988. There was opportunity to test six of the patients with *Pinus radiata* (Monterey pine) pollen extract (Hollister-Stier Laboratories).

The conifers (cone producers) include the pine family and the cypress family containing juniper/cedar. Accordingly, patients were also tested with two or three common local junipers [*Juniperus osteosperma* (Utah juniper), *Juniperus scopulorum* (Rocky Mountain juniper), *Juniperus monosperma* (one-

seed juniper)] and with *Cupressus arizonica* (Arizona cypress) (Greer Laboratories). In addition, all patients were skin tested with a battery of approximately 50 tree, weed, and grass pollens; mold spores, animal danders, feather, and miscellaneous inhalant antigens.

These tests were interpreted by standard techniques⁶ on a 0 to 4+ scale and only reactions equal to or greater than the 2+ histamine control (5 to 10-mm wheal with erythema) were considered positive. Positive controls using histamine prick and intradermal (histamine phosphate, 2.75 and 0.0275 mg/mL, respectively) as well as negative diluent controls were included to validate the skin test reactivity of each patient. Tests were applied and read by the author.

RESULTS

Of the 1354 patients surveyed, 826 (61%) were estimated by systematic survey⁷ to be atopic. This definition was based on two or more positive skin test responses (including separate species of pines or junipers) to the 55 antigens used and compatible history with examination. Twelve of these 826 (1.5%) patients showed skin test reactivity to pine pollen antigens (Table 1). All 12 reacted to ponderosa antigen and five of these 12 concomitantly showed reactivity to pinyon. There were no patients who reacted to pinyon antigen without simultaneously reacting to ponderosa. Nine of the 12 reacted by prick technique and the other three

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were prick negative but intradermal positive. All tests were reproducible with same size wheals; repeat tests at later dates in several patients were unchanged. The addition of a second source of ponderosa extract yielded no differences.

Characteristics of the 12 skin test positive patients are shown in Table 1. They are of all ages and essentially equally divided between the sexes. They had lived in the pine tree area for 2 to 40 years. All demonstrated allergic rhinitis or rhinoconjunctivitis, either seasonal, perennial, or perennial with primary spring season flareups. Except for the two children, patients reacted to a variety of seasonal pollen extracts, frequently weeds and grasses, and/or nonseasonal inhalants (not shown in table). Six of the 12 reacted to junipers but there was no global pattern of tree reactivity to the many spring pollinating trees in northern Arizona in these 12. (Two patients each reacted to gambel oak, and one each to Russian olive and Chinese elm). One had significant mold pattern sensitivity and five had one or more large reactions to animal danders or feathers. Several reacted to housedust mite (*Dermatophagoides farinae*).

Adult patients gave histories of mixed clinical sensitivities outdoors and indoors, several bothered by the prevalent juniper in their estimation

early in the year and complaints in other seasons designated as "spring" and "fall." The two children were unique in that essentially they reacted primarily to several pine pollen species. Patient 2 was a 10-year-old girl whose only positive test reaction in addition to the pine antigens was slight to intradermal cat dander to which she was clinically sensitive. During the peak of pine pollination season (May-June) she suffered rather severe rhinoconjunctivitis and this was observed in 2 successive years. She was also skin test positive to Monterey pine. The 6-year-old boy (patient 11) with perennial rhinitis and past otitis media with effusion had positive reactions to ponderosa and pinyon pine by prick and Monterey pine by intradermal with no other inhalant reactions.

Four of the 12 pine-sensitive individuals had current asthma and two of these, who were women, were corticosteroid-dependent. Patient 4 could not tolerate the outdoors when pine pollen was visible in May and June because of wheezing and eventually left the pine forest area. Her only positive pollen test reactions were to ponderosa and pinyon pines and her nonpollen reactions were to housedust mite and cat dander. The other similar patient (patient 6) reported, 7 years later, severe asthma during an outdoor yard

gathering attributed to pine pollen forcing her to leave the event. This visit was an opportunity to reskin test and her ponderosa reaction was as positive as it had been originally.

One man felt he was worse, particularly ophthalmic symptoms, when the pine pollen was visible (patient 10). Two of the patients lived outside Flagstaff in heavily wooded pine areas and one of these (patient 3) lived in an area in which juniper-pinyon predominated and ponderosa was less common. He was the only patient in whom the skin test reaction to pinyon was larger than to ponderosa. After patient 9 presented in 1989 with a strong clinical history of Monterey pine sensitivity while in southern coastal California for 18 years, that antigen was obtained and his skin test was positive to Monterey although less strongly than to ponderosa. His pinyon test was negative. He had lived in Flagstaff 4 years. Four other patients tested to Monterey (none with significant exposure history) reacted with less or equal intensity than they did to ponderosa.

DISCUSSION

In May and June, Flagstaff residents note a rain of yellow to green non-sticky pine pollen on streets, automobiles, and porches. In a 1-year study undertaken in 1970-71,⁸ Flagstaff botanists found pine polli-

Table 1. Pine Pollen Skin Test Positive Patients

Patient No.	Sex/Age, Yr	Years in Northern Arizona	Signs/Symptoms*	Occurrence*	Asthma	Pine Season Symptoms	Skin Tests*	
							Ponderosa	Pinyon
1	F/14	14	R	P	+	--	PR +	0
2	F/10	10	RC	S	-	++	PR +	PR +
3	M/49	3	RC	P/S	-	--	ID +	ID +
4	F/54	10	RC	P/S	+++	++	PR +	PR +
5	M/44	11	RC	P/S	-	+	PR +	0
6	F/59	40	RC	P	+++	++	PR +	0
7	F/35	12	RC	P	+	-	ID +	0
8	M/41	2	RC	P/S	-	+	PR +	0
9	M/46	4	RC	S	Past	++	PR +	0
10	M/40	9	RC	P/S	-	++	ID +	0
11	M/6	6	R	P	-	-	PR +	PR +
12	M/45	9	RC	S	-	+	PR +	PR +

* R = rhinitis, C = conjunctivitis, P = perennial, S = seasonal, PR = prick, and ID = intradermal.

nation mostly from May to July with small amounts detectable through October. Reflotation by wind is apparently the source of this allergen when the trees are not actively pollinating. Study of the forest soil revealed that the pollen is resistant to degradation. Pine dominates the annual pollen rain of all pollen-producing species and characteristically is a heavy producer. Pines are deep rooted trees, which accounts for their pollen dispersal in June, usually a drought month. Pollen counts were done from a gravity slide placed 1.5 m above ground on a protected window ledge and left from 1 to 4 weeks, depending upon the season. The relative amounts of specific tree, as well as grass and weed family pollens were tabulated according to season. These methods are not comparable to those in current use. No data have been collected and published since that study.

Allergy to pine pollen has in the past been held to be extremely rare and the pollen has been used as a negative control for nasal and conjunctival provocation tests.⁹ Pine pollen as a negative control in individuals who have been exposed is no longer acceptable. The large size and "waxy exine"^{4,10} have been suggested as reasons for the pollen hypoallergenicity as well as low immunogenicity. This study reveals a remarkably low level of sensitization in a population living in a dense pine environment suggesting low allergenicity.

All 12 pine pollen-reactive patients in this study experienced rhinitis and/or conjunctivitis. In eight patients the symptoms were seasonal, primarily spring. It is difficult in most of these cases specifically to attribute symptoms to pine pollen because most patients also reacted to grass and other pollens present in the environment during the pine pollen season. In one case, however, (patient 2) the patient reacted by skin test only to ponderosa and pinyon pine and to intradermal cat

dander. She showed upper respiratory symptoms primarily during the pine pollen season suggesting a symptomatic response to pine pollen. Two women had late onset asthma, corticosteroid-dependent, and one found it necessary to leave the area. The other could not tolerate being outdoors May or June. No conclusions can be made regarding asthma and pine pollen allergy in this small group.

There is some variability from different regions in incidences of positive pine pollen skin tests reported (Table 2). In this study done in the ponderosa pine area of northern Arizona, 12 of 826 (1.5%) atopic persons reacted to pine pollen antigen by skin test (prick and intradermal combined). In the Northeast, there was approximately a 6% prick incidence in several studies with Eastern white pine^{3,11} and 16.5% positive incidence in the 1982 study when prick and intradermal reactions were combined. In contrast, in the West, 2.7% reacted to Monterey pine in San Francisco⁴ which is similar to this report of 1.5% to ponderosa, combining prick and intradermal results in atopic patients. Whether this reported difference between eastern and western United States is related to exposure to differing pine species, proximity of the trees, differences in skin test antigen sources, test concentrations, test procedures and/or different populations examined is not known. There are major pine forests in the Southeast US and in the Northwest;

however, data from these geographic areas are absent from the literature. Recently a report from Spain¹² found 3.9% (four of 103) patients skin test positive (prick) to local *Pinus pinea*.

Immunologic cross reactivity between the junipers and the pines and among the various pine species has not been extensively studied. Several published studies suggest no cross reactivity between pine and juniper.^{13,14} There were numerous patients in this practice that reacted to juniper but not to pine. Conversely, only six of the 12 pine pollen-allergic patients reacted also to juniper. Thus, the possibility of cross reactivity between junipers and pine seems remote. While both pines and junipers are conifers (cone producers), they are in different families of the class gymnospermae. As regards specificity of ponderosa versus pinyon, of the 12 patients skin test reactive to ponderosa pine, five also reacted to pinyon pine. Of the five reacting to both, the ponderosa reaction was stronger in those who lived in ponderosa areas and pinyon more reactive in the one living in a predominantly pinyon-juniper environment. While these data suggest ponderosa-pinyon specificity, cross reactivity cannot rigorously be excluded. Tests with Monterey pine were added late in this series; these results are presented only in anecdotal form. The studies from New England and California have shown that pine pollen reactivity was part of an overall tree

Table 2. Comparative Pine Pollen Skin Test Surveys

Type of Pine	PRICK +	PRICK or ID +
Boston (Eastern white pine)		
Farnham (1982)*	6.5%	16.5%
Kalliel (1986)†	6.0%	
Farnham (1988)‡	12.7%	27.3%
San Francisco (Radiata pine)		
Harris (1985)§	2.2%	2.7%
Flagstaff (Ponderosa pine)		
Freeman	1.1%	1.5%
Spain (<i>Pinus pinea</i>)		
Armentia (1990)¶	3.9%	

* (11), † (3), ‡ (10), § (4), || (this report, and ¶ (12).

reactivity pattern in patients.^{3,4,11} That is, patients that reacted to pine pollens also reacted to a variety of other tree pollens. Our studies, in contrast, did not show this pattern.

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Request for reprints should be addressed to:
Geraldine L Freeman, MD
Allergy Department
Cigna Healthplan of Arizona
755 E McDowell Rd
Phoenix, AZ 85006

CROSSREACTIVITY BETWEEN CAT ALLERGEN AND DUST MITE EXTRACTS

Allergenic components of cat pelt extract were identified using sera from 15 patients with clinical allergy to cats and positive skin tests and RAST to cat extract. The two components with the highest IgE-binding frequency were a 14-kD component (86% of the sera) and a 29-kD component (73% of the sera tested). After purification by electroelution the 29-kD fraction bound specific IgE to *Dermatophagoides pteronyssinus* and inhibited a RAST assay of a 29-kD component (*Der pI*) purified from a *Dermatophagoides pteronyssinus* extract.

These observations may explain positive skin tests with some commercial cat allergen extracts in patients with allergy to *Dermatophagoides pteronyssinus*.

—RMS

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