

ON THE ALLERGEN IN HUMAN DANDER

FRANK A. SIMON, M.D.
LOUISVILLE, KY.

IN A study of the allergenic interrelationship of various mammalian danders, human dander was used as a negative control. In one of the cases, however, this substance could not serve as a negative control because the patient gave a positive skin reaction to human dander, and her blood contained reagins for it. The reactions, both direct and passive transfer, could be repeated at will. The transfers were carried out with chemically clean syringes and the controls, in both sensitized and normal skin sites, were negative.

The subject of reactions to human dander is a controversial one. Most competent allergists doubt the existence of hypersensitiveness to human dander. They ascribe reports of positive reactions to the presence of nonspecific irritants in the dander and to technical errors.

Van Leeuwen and his co-workers¹⁻⁴ published the first reports on allergy to human dander. They found that it gave positive tests in most of their allergic patients and negative tests in others; therefore, they considered a positive reaction to this substance as indicative of the "allergic state." These findings were neither confirmed nor accepted by most American workers. The term, "allergic state," without further qualification, would today be considered indefinite, because it does not indicate the type of allergy, whether atopic allergy, contact type allergy, drug allergy, bacterial type allergy, etc.

Murphy and Cobe⁵ called attention to the similarity between the skin reactions to human dander and histamine. The presence of a non-specific irritant (or universal hypersensitiveness?) is undoubtedly the cause of much of the conflict in opinions on this subject.

Keller⁶ reported positive skin reactions to dialyzed human dander extract in all of twenty-one cases of "spatexsudatives ekzematoid" (atopic dermatitis of adults). Controls in patients with other conditions were negative or the percentage of positive reactions was very low.

Hampton and Cooke,⁷ using dialyzed, standardized extracts, found that a high percentage of patients with dermatitis ("eczema," presumably of the atopic type) gave positive skin tests to, and had reagins for, human dander, whereas, in other manifestations of allergy, the incidence of skin reactions and of reagins was very much less. These

From the Departments of Medicine and of Bacteriology and Immunology of the University of Louisville School of Medicine.

authors also found partial cross neutralization between human dander and house dust, but found no cross relationship between reactions to human dander and other mammalian danders.

EXPERIMENTAL

Materials and Methods.—Combings of dander from the scalp, superficial scrapings of normal and diseased human skin, and other substances, as indicated, were used (Tables I and II). Extracts were made in 50 per cent glycerin, using a volume of fluid approximately twice that of the loosely packed material to be extracted. Oily substances were removed first with ether. Neither filtration nor any other standardization was used for the extracts for direct testing, which was done by the scratch method. For the passive transfer tests, intradermal injections of 1:100 carbolyzed buffered saline dilutions of centrifuged extracts were employed. (The quantities involved were usually so small that Seitz filtration would have involved large percentage losses of active material by adsorption to the filter.) Previously unused, or otherwise chemically clean, syringes were used for neutralization and passive transfer tests.

Skin Reactions to Direct Tests.—Skin tests were performed on fifty selected persons with eight preparations. The substances used, together with the reasons for their use, were as follows:

1. Human dander from the scalp of normal adults; this was the substance under investigation.
2. Epidermis from the sole of the foot of normal adults; in order to study the reaction to cornified epidermis without hair or products of sebaceous glands or hair follicles.
3. Epidermis from the arms and legs of a newborn infant (stillborn); to obtain the reaction of epidermis relatively free from bacterial and other external contaminants.
4. Vernix caseosa; because of its possible relationship to epidermis and because of absence of external contaminants.
5. Scrapings from the lesions of seborrheic dermatitis; because of the clinical association of this condition with excessive dander of the scalp.
6. Scales of exfoliative dermatitis; because they furnish an abundant source of epidermis from the general body surface.
7. Human serum (negative control).

An effort was made to obtain dander from the scalp of a newborn infant, but all the newborn infants examined were found to be free from dander.

The purpose of these tests was chiefly to obtain additional dander-sensitive patients for further study, although a comparison of the reactions to the eight substances listed was expected to yield some additional information.

TABLE I
DIRECT SKIN TESTS WITH HUMAN DANDER AND OTHER SUBSTANCES

CASE NUMBER	CLINICAL DIAGNOSIS	AGE OF PATIENT	HUMAN DANDER (SCALP)	SEBORRHEIC DERMATITIS SCALES	PSORIASIS SCALES	EXFOLIATIVE DERMATITIS SCALES	EPIDERMIS OF NEW-BORN INFANT	VERNIX CASEOSA	EPIDERMIS FROM SOLE OF FOOT	HUMAN SERUM
1	Atopic dermatitis	12 yr.	+++	+	-	-	-	-	-	-
2	Atopic dermatitis	19 yr.	++	+	-	-	-	-	-	-
3	Atopic dermatitis	35 yr.	+	-	-	-	-	-	-	-
4	Atopic dermatitis	4 mo.	+	-	-	-	-	-	-	-
5	Atopic dermatitis	3 mo.	++	-	-	-	-	-	-	-
6	Atopic dermatitis	25 yr.	++	-	-	-	-	-	-	-
7	Atopic dermatitis	8 mo.	+	-	-	-	-	-	-	-
8	Atopic dermatitis	30 yr.	+	-	-	-	-	-	-	-
9	Atopic dermatitis	14 yr.	+	-	-	-	-	-	-	-
10	Atopic dermatitis	13 yr.	+	+	-	-	-	-	-	-
11	Atopic dermatitis	3 mo.	+	+	-	-	-	-	-	-
12	Atopic dermatitis	4 mo.	+	+	-	-	-	-	-	-
13	Atopic dermatitis	24 yr.	+	+	-	-	-	-	-	-
14	Atopic dermatitis	24 yr.	+	+	-	-	-	-	-	-
15	Atopic dermatitis	26 yr.	+++	++	-	-	-	-	-	-
16	Atopic dermatitis	22 mo.	++	++	-	-	-	-	-	-
17	Atopic dermatitis	21 yr.	+++	++	-	-	-	-	-	-
18	Atopic dermatitis	12 yr.	+	+	-	-	-	-	-	-
19	Atopic dermatitis	17 mo.	+	+	-	-	-	-	-	-
20	Atopic dermatitis	21 yr.	+	+	-	-	-	-	-	-
21	Atopic dermatitis	21 yr.	+	+	-	-	-	-	-	-
22	Atopic dermatitis and hay fever	30 yr.	+	+	-	-	-	-	-	-
23	Atopic dermatitis and hay fever	11 yr.	+	+	-	-	-	-	-	-
24	Asthma	20 yr.	-	-	-	-	-	-	-	-
25	Asthma	52 yr.	+	+	-	-	-	-	-	-
26	Asthma	40 yr.	-	-	-	-	-	-	-	-
27	Asthma	62 yr.	-	-	-	-	-	-	-	-
28	Asthma	38 yr.	+	-	-	-	-	-	-	-
29	Asthma	39 yr.	+	-	-	-	-	-	-	-
30	Asthma	17 yr.	-	-	-	-	-	-	-	-
31	Asthma	22 yr.	+	-	-	-	-	-	-	-
32	Hay fever	18 yr.	-	-	-	-	-	-	-	-
33	Hay fever	28 yr.	-	-	-	-	-	-	-	-
34	Hay fever	32 yr.	+	-	-	-	-	-	-	-
35	Hay fever	27 yr.	-	-	-	-	-	-	-	-
36	Hay fever	32 yr.	+	-	-	-	-	-	-	-
37	Hay fever	38 yr.	++	-	-	-	-	-	-	-
38	Hay fever and asthma	35 yr.	+	+	-	-	-	-	-	-
39	Hay fever and asthma	19 yr.	+	+	-	-	-	-	-	-
40	Hay fever and asthma	12 yr.	-	-	-	-	-	-	-	-
41	Normal adult	44 yr.	+	+	-	-	-	-	-	-
42	Normal adult	37 yr.	-	-	-	-	-	-	-	-
43	Normal adult	28 yr.	+	-	-	-	-	-	-	-
44	Normal adult	22 yr.	-	-	-	-	-	-	-	-
45	Normal adult	42 yr.	-	-	-	-	-	-	-	-
46	Normal adult	38 yr.	-	-	-	-	-	-	-	-
47	Normal adult	52 yr.	+	+	-	-	-	-	-	-
48	Normal adult	29 yr.	+	+	-	-	-	-	-	-
49	Normal adult	30 yr.	+	-	-	-	-	-	-	-
50	Normal adult	26 yr.	-	-	-	-	-	-	-	-

TABLE II

DIRECT (SCRATCH) AND PASSIVE TRANSFER (INTRACUTANEOUS) TESTS ON FIVE PATIENTS ALLERGIC TO HUMAN DANDER

TEST	DIR.	TRAN.	DIR.	TRAN.	DIR.	TRAN.	DIR.	TRAN.	DIR.	TRAN.
CASE NUMBER	1		15		17		20		21	
Human dander, adult scalp	+++	+++	+++	+++	++	+++	++	+++	++	++
Human dander, scalp of nun 1	+	++	+	+	++	++	+	+	+	+
Human dander, scalp of nun 2	+++	+++	+++	+++	++	+++	++	+++	++	++
Human hair, adult, scalp 1	±	++	++	+	++	++	+	+	++	++
Human hair, adult, scalp 2	+	++	+	+	+++	+++	++	++	++	++
Human hair, adult, scalp 3	+	++	±	±	++	++	+	+	+	+
Human hair, adult, scalp 4	-	-	-	-	-	-	-	-	-	-
Human hair, adult, scalp 5	+	+	±	+	±	+	-	±	-	-
Human hair, adult, pubic	-	±	-	±	±	+	±	±	-	-
Human hair, adult, axillary	-	-	-	-	-	-	-	-	-	-
Human hair, adult, thigh	-	-	-	-	-	-	-	-	-	-
Human hair, 1-year-old child, scalp	-	-	-	-	-	±	-	±	-	-
Human hair, 5-month-old child, scalp	-	-	-	-	-	-	-	±	-	-
Human hair, newborn infant 1, scalp	-	-	-	-	±	±	-	±	-	±
Human hair, newborn infant 2, scalp	-	-	-	-	-	-	-	-	-	-
Human hair, newborn infant 3, scalp	-	-	-	-	-	-	-	-	-	-
Human hair, newborn infant 4, scalp	-	-	-	-	-	±	-	-	-	-
Human hair, newborn infant 5, scalp	-	-	-	-	-	-	-	-	-	-
Human hair, newborn infant 6, scalp	-	-	-	-	-	-	-	-	-	-
Human epidermis, newborn infant, arms and legs	-	-	-	-	-	-	-	-	-	-
Human epidermic, sole of foot, adult	-	-	-	-	-	-	-	-	-	-
Sebaceous cyst, hair	-	-	-	-	-	-	-	-	-	-
Sebaceous cyst, wall	-	-	-	-	-	-	-	-	-	-
Sebaceous cyst "fluid" (ether residue)	-	-	-	-	-	-	-	-	-	-
Seborrheic dermatitis scales, Case 1	+	++	±	+	++	++	+	+++	+	+++
Seborrheic dermatitis scales, Case 2	+	++	±	++	+	++	+	++	+	++
Psoriasis scales	-	-	-	-	-	-	-	-	-	-
Exfoliative dermatitis scales	-	-	-	-	-	-	-	-	-	-
Cryptococcus	-	-	-	-	-	-	-	-	-	-
Pityrosporum ovale	-	-	-	-	-	-	-	-	-	-
Staphylococcus albus 1	-	-	-	-	-	-	-	-	-	-
Staphylococcus albus 2	-	-	-	-	-	-	-	-	-	-
Diphtheroid bacillus	-	-	-	-	-	-	-	-	-	-
Sarcina	-	-	-	-	-	-	-	-	-	-
Large gram-negative bacillus	-	-	-	-	-	-	-	-	-	-
Staphylococcus aureus 1	-	-	-	-	-	-	-	-	-	-
Staphylococcus aureus 2	-	-	-	-	-	-	-	-	-	-
Staphylococcus aureus 3	-	-	-	-	-	-	-	-	-	-
Large gram-negative spore-forming bacillus	-	-	-	-	-	-	-	-	-	-

RESULTS

1. The extracts of human scalp dander and, to a lesser extent, that of seborrheic dermatitis lesions were found to be slightly reactive in the

majority of skins tested, both in patients and normal adults. This reactivity was manifested by a very small wheal and often slight erythema, very slightly but perceptibly larger than that produced by the control scratch. The other five substances gave negative reactions (Table I).

2. In five patients, all with atopic dermatitis, the reactions to human dander and to seborrheic dermatitis scales were positive (Table I). These five patients were selected for further study.

Local Passive Transfer Reactions.—Passive transfer reactions to human dander were obtained with the sera of each of these five patients. The controls in normal skin sites were negative and the saline controls in sensitized sites, likewise, were negative. The same results were obtained with three different specimens of dander. Scales of seborrheic dermatitis gave similar, but smaller, reactions.

STUDY OF THE BIOLOGIC ORIGIN OF THE ALLERGEN

The existence of allergic activity in human dander is to be regarded as having been established by previous investigators and confirmed by the present studies. The next problem was to investigate the source and nature of the allergen because these might have a bearing upon its possible clinical significance and upon the problem of allergy to products derived from the patient's own tissues (Hecht, Sulzberger, and Weil.⁸). The following sources were considered: (1) particulate matter suspended in the air, such as house dust, orrisroot, wool, silk, cotton, feathers, pollen, etc.; (2) bacteria, fungi, or other microorganisms growing on the scalp; (3) stratified squamous epidermal cells from the scalp; (4) cells from the hair or hair follicles; and (5) secretion of sebaceous glands.

These possibilities were investigated as follows: Direct skin tests were performed on the five patients with extracts of various substances in order to determine whether or not a correlation existed between the reactions to human dander and any other substance or substances. These tests included: (1) one hundred and ninety-two common foods and inhalants (including house dust, feathers, cottonseed, wool, silk, orrisroot, karaya gum, and many pollens); (2) eleven microorganisms cultured from the scalp (Tables I and II) (on plan agar, blood agar, and Sabouraud's media); (3) dander from the scalp of two persons who keep their heads covered with cloth day and night (two nuns who sleep in nightcaps); (4) hair from the scalps of several adults and children; (5) hair from six newborn infants (presumably with a minimum of contamination by microorganisms or by various dusts from the air); (6) pubic hair; (7) axillary hair; (8) hair from the thigh; (9) epidermis from arms and legs of a newborn (stillborn) infant; (10) hair, fluid, and inner cyst wall from a dermoid cyst* (free from micro-

*Dermoid cyst of the ovary, supplied by Dr. A. J. Miller, Pathologist, University of Louisville, School of Medicine.

organisms and other external contaminants); and (11) scales from the lesions of psoriasis, exfoliative dermatitis, and seborrheic dermatitis.

Local passive transfer tests were performed with the substances named above. Antibody neutralization studies (in vitro) were carried out in order to determine whether or not any other substance would cross react with human dander (neutralize the dander antibody).

RESULTS

CASE 1.—The patient gave positive reactions to human dander and scalp hair, and dog dander; slightly positive reactions to seborrheic dermatitis scales, and to several foods and inhalants. Both human and dog dander transferred well. Neither neutralized reagins for the other. Testing of this patient is incomplete because she moved from the city.

CASE 2.—This patient gave positive reactions to human dander and scalp hair; slightly positive reaction to seborrheic dermatitis scales. None of the common inhalants or foods gave a definitely positive reaction. Antibody neutralization was attempted, nevertheless. House dust, orrisroot, bluegrass pollen, feathers, silk, wool, ragweed pollen, and cottonseed failed to neutralize reagins for human dander.

CASE 3.—This patient gave positive reactions to human dander, human hair from the scalp (slightly positive to pubic hair), seborrheic dermatitis scales, house dust, feathers, wool, silk, egg, and pork. Antibodies for human dander were not neutralized by house dust, feathers, wool, silk, egg, or pork.

CASE 4.—This patient gave positive reactions to human dander, human hair from the scalp and pubic hair, seborrheic dermatitis scales, silk, ragweed pollen, karaya gum, several fungi, and foods. None of the inhalants or foods neutralized reagins for human dander. (Neutralization not attempted with scalp or pubic hair, or seborrheic dermatitis scales.)

CASE 5.—This patient gave positive reactions to human dander, human scalp hair, seborrheic dermatitis scales, ragweed pollen, horse and cow dander, house dust, and several foods. Antibodies for human dander were not neutralized by any of the other substances (except human hair and seborrheic dermatitis scales) (Table II).

DISCUSSION

The origin and nature of the allergen are of theoretical and, perhaps, clinical importance. The reason for believing that the allergen is not a constituent present in stratified squamous epidermis in general is the following: patients who give skin reactions to human scalp dander and human scalp hair do not react to epidermis from the general body surface of an adult and of a newborn infant; to scalp hair from a newborn infant; to hair, sebaceous material, and inner lining of a dermoid cyst; or to scales from the lesions of psoriasis and exfoliative dermatitis.

organisms and other external contaminants); and (11) scales from the lesions of psoriasis, exfoliative dermatitis, and seborrheic dermatitis.

Local passive transfer tests were performed with the substances named above. Antibody neutralization studies (in vitro) were carried out in order to determine whether or not any other substance would cross react with human dander (neutralize the dander antibody).

RESULTS

CASE 1.—The patient gave positive reactions to human dander and scalp hair, and dog dander; slightly positive reactions to seborrheic dermatitis scales, and to several foods and inhalants. Both human and dog dander transferred well. Neither neutralized reagins for the other. Testing of this patient is incomplete because she moved from the city.

CASE 2.—This patient gave positive reactions to human dander and scalp hair; slightly positive reaction to seborrheic dermatitis scales. None of the common inhalants or foods gave a definitely positive reaction. Antibody neutralization was attempted, nevertheless. House dust, orrisroot, bluegrass pollen, feathers, silk, wool, ragweed pollen, and cottonseed failed to neutralize reagins for human dander.

CASE 3.—This patient gave positive reactions to human dander, human hair from the scalp (slightly positive to pubic hair), seborrheic dermatitis scales, house dust, feathers, wool, silk, egg, and pork. Antibodies for human dander were not neutralized by house dust, feathers, wool, silk, egg, or pork.

CASE 4.—This patient gave positive reactions to human dander, human hair from the scalp and pubic hair, seborrheic dermatitis scales, silk, ragweed pollen, karaya gum, several fungi, and foods. None of the inhalants or foods neutralized reagins for human dander. (Neutralization not attempted with scalp or pubic hair, or seborrheic dermatitis scales.)

CASE 5.—This patient gave positive reactions to human dander, human scalp hair, seborrheic dermatitis scales, ragweed pollen, horse and cow dander, house dust, and several foods. Antibodies for human dander were not neutralized by any of the other substances (except human hair and seborrheic dermatitis scales) (Table II).

DISCUSSION

The origin and nature of the allergen are of theoretical and, perhaps, clinical importance. The reason for believing that the allergen is not a constituent present in stratified squamous epidermis in general is the following: patients who give skin reactions to human scalp dander and human scalp hair do not react to epidermis from the general body surface of an adult and of a newborn infant; to scalp hair from a newborn infant; to hair, sebaceous material, and inner lining of a dermoid cyst; or to scales from the lesions of psoriasis and exfoliative dermatitis.

The reasons for believing that the allergen does not have its origin in accidental contamination of dander with suspended dust particles from the air are:

1. Patients who react to skin tests with human scalp dander and hair react to the same degree to dander obtained from persons whose scalps are kept covered almost continuously, day and night.

2. Reagents for human dander are not neutralized by the common atmospheric dust particles.

3. There is no constant correlation between the reactions to human dander and atmospheric dusts.

The fact that patients who are allergic to human dander give positive skin reactions also to the scales of seborrheic dermatitis obtained from the face, neck or elsewhere is in agreement with the clinical observation that this disease is often associated with excessive dander.

The allergen of human dander may occur in the desquamated epidermal cells of the scalp as the result of some physiologic maturation process specific for the scalp epidermis. It is also possible that the allergen may have its origin in some microorganism living, but not always pathogenic, on the scalp. This hypothetical microorganism (not obtained in my cultures from the scalp) may, under certain circumstances, become pathogenic and result in the disease, seborrheic dermatitis. In fact, it is possible that these findings may be of as much importance for the study of the nature of seborrheic dermatitis as they are for atopic dermatitis.

The reasons for the microorganism theory of origin are chiefly of a negative character, namely, (1) suspended atmospheric dust particles are excluded for the reasons enumerated above, and (2) while hair from the adult scalp, with its opportunity for contact with microorganisms, elicits reactions, hair from the scalp of a newborn infant and hair and other constituents of a dermoid cyst fail to produce reactions.

SUMMARY

1. The existence of allergy to human dander is an established fact.
2. The clinical significance of this fact remains to be investigated.
3. Our present knowledge warrants only the conclusion that this allergy is often associated with atopic dermatitis; that while in some cases it may possibly be of etiological significance, in many other cases it is, quite possibly, merely a concomitant, subclinical sensitivity.

4. The experimental data here presented suggest that the human dander allergen is present also in scales of seborrheic dermatitis, but absent in numerous other scales and other materials.

5. The significance of these findings in relation to some problems of seborrheic dermatitis is discussed briefly.

The author wishes to thank Dr. H. T. Knighton for his assistance in culturing the microorganisms, and Dr. C. W. Emmons, Senior Mycologist, United States Public Health Service, for supplying the culture of *Pityrosporum ovale*.