

CUTANEOUS REACTIONS TO ALLERGENS AND IRRITANTS IN COSMETICS*

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FOR THE PURPOSE of this paper the term cosmetics is used not only for preparations that are intended to enhance one's appearance but also the host of other substances that are used externally by both women and men to either improve or treat some functional abnormality of the skin. Although cosmetics are generally harmless, as their use increases and more and more preparations are manufactured and introduced, the incidence of dermatitis from them is increasing.

Chemical agents are the predominant causes of contact dermatitis, and in discussing the chemical causes of dermatitis these substances are divided by dermatological allergists into two groups: the primary irritants and the specific irritants. Primary irritants are those chemicals that will cause a dermatitis on the normal skin of any person at the site of contact if permitted to act in sufficient intensity or quantity for a sufficient length of time. Such a dermatitis is not due to hyper-

sensitivity and is not called an allergic dermatitis. On the other hand, specific irritants are those substances which will produce a dermatitis only in hypersensitive persons. They are sensitizers and do not necessarily cause demonstrable changes on first contact but may effect such changes in the skin that, after five to seven days or longer, further contact on the same or other parts of the skin will cause a dermatitis. This is due to specific sensitivity or allergy, and it is called an allergic dermatitis. Hypersensitive persons may more readily become sensitized to the so-called primary irritants in dilutions of these substances too weak to be irritants in the normal individual, or they may be affected by them on shorter exposure than would irritate the normal skin.

It has been stated that there is practically no chemical agent to which hypersensitivity or allergy cannot be acquired. Chemicals vary in their potentiality to cause sensitization but certain ones are more powerful sensitizers than others and are capable of sensitizing a larger percentage of the popula-

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tion using them. Paraphenylenediamine is a notable example. As a rule the stronger the concentration of the sensitizer and the longer the exposure, the greater the chance of sensitivity and dermatitis. However, continued exposure after sensitization may at times in some persons be followed by the development of hyposensitivity and tolerance.

Besides the actual chemical causes of a contact dermatitis there are predisposing causes inherent in certain individuals that play a part in their sensitivity to external irritants. Some of these factors are the type of skin, the degree of perspiration and the pH of the skin, and the amount of pigment. The defense mechanism of the skin can be altered by individual differences in these factors and make the skin more vulnerable to external irritants and sensitizers. This should be kept in mind by the cosmetic chemist in considering a formula for a product, and where on the skin and by whom it should be used.

Dermatitis caused by cosmetics is usually due to hypersensitivity, rarely to primary irritation, for any cosmetic may cause an allergic dermatitis in a hypersensitive person. However certain chemicals such as strong alkalis and resins, used in some cosmetics, are primary irritants, producing a dermatitis by their irritant action rather than because of the hypersensitivity of the individual. This type of reaction may occur with various preparations as depilatories, hair wavers and straighteners, hair lacquers,

hair bleaches, solvents and antiperspirants. Naturally these primary irritants, even in mild concentration, can more readily sensitize the skin and also cause an allergic type of dermatitis. There are many chemicals used in various cosmetic preparations which may produce a dermatitis by primary irritation and/or sensitization or by both. Schwartz and Peck (1) have compiled a partial list of these chemicals and the cosmetics in which they are used.

ALLERGY DEFINED

As cosmetic dermatitis is usually due to hypersensitivity it might be well to discuss briefly the general theory of allergy and its mechanism in relation to contact dermatitis. Allergy is defined as *any specifically acquired alteration in the capacity of living tissue to react to a substance*. This altered capacity to react is dependent upon an original or previous exposure to the same or an immunologically related substance; this casual substance is termed an allergen. When the allergen can be demonstrated to produce antibodies it is called an antigen. The phenomenon of allergy is usually explained as an antigen-antibody reaction. The allergen (antigen) supposedly produces antibodies in the tissues and the interaction between them causes the clinical picture of allergy, like urticaria, eczema, hay fever, etc. Although at times antibodies can be demonstrated in some types of cutaneous allergy by the method of

passive transfer, they have not conclusively been shown to be present in contact dermatitis. Passive transfer experiments by most investigators have given negative results; there is no proof that the reaction in an allergic contact type dermatitis, caused by chemicals, is based on the presence of specific antibodies and an antigen-antibody interaction. It is possible there are antibodies present in the affected skin but they have not been demonstrated with our present knowledge and laboratory techniques. However certain substances may be found within the tissue which react with the allergen, or the allergen may react at the site of application to form a modified allergen which then reacts with specific antibodies in the skin to produce the dermatitis. As yet these theories have not been proved and the problem is still to be solved.

At times there is a spread and even generalization of the dermatitis from its original site without contact of the specific sensitizing substance to the adjacent or distant areas of the skin. This brings up the interesting problem of the route of the spread of this sensitization. Although absorption does occur through the intact skin and its appendages, it does not seem plausible that the distant reaction is due alone to absorption of the antigen itself and its consequent hematogenous dissemination. Several other routes have been propounded and experimentally demonstrated. In cases of dermatitis appearing near

the site of actual contact, it has been shown that the sensitivity spreads centrifugally through the epidermis and cutis. The allergen or the antibodies, which cannot be demonstrated, in some way diffuse or circulate through the skin by means of so-called "trans-epidermal penetration" (2). However, where the sensitivity becomes generalized there are probably several routes of absorption and dissemination. Experiments tend to show that the spread of the offending substance, whether it be the allergen itself or its modified form, or antibodies, occurs not only through the epidermis and cutis and blood vessels, but also and mainly through the lymphatics (3). This concept seems to be the most logical explanation of the mechanism of the spread of the dermatitis.

THE PATCH TEST

An eruption due to a cosmetic usually begins abruptly and although it looks like a contact dermatitis, its appearance gives no particular clue to the specific cause. However by the history and several diagnostic criteria that are used by the experienced dermatologist, it is usually not difficult to decide whether a dermatitis is due to a cosmetic. Along with these criteria the patch test is a most important procedure, but to be of value it should be done correctly and interpreted intelligently.

The technique of doing a patch test is as follows: The cosmetic, in the form it is used, is placed on a

$\frac{1}{4}$ -inch square piece of white linen. If it is a powder it is moistened with water; if it is a solution the piece of linen can be soaked in it. The small patch is placed on the normal, intact skin of the inner surface of the arm or on the upper back and covered with a larger piece of oiled silk or other impermeable tissue. This is then covered and held in place by a strip of adhesive plaster. The patch is allowed to remain for twenty-four to forty-eight hours and the reaction noted on removal. This is called the closed patch test. The positivity of the test is read as 1, 2, 3, or 4 plus, depending on the degree of reaction. The test site should be observed again for possible delayed reactions one, two, and three days after removal of the patch.

It must be remembered that a negative patch test does not necessarily rule out the suspected substance as the cause of the dermatitis. The patch is usually not placed on the area of the skin that is inflamed and the site of the test may not be sensitive to the allergen at the time the test is performed. An example of this fact is seen in nail polish dermatitis. Usually the eruption appears on the eyelids and lower cheeks, but the test is not done in these areas. It is placed on the neck, arm or upper back and these sites may not be sensitive and may not react. One must also consider whether the test was done with the exact causative substance. In a dermatitis from a "cold wave" permanent, the reaction is generally

due to varying degrees of primary irritation, rarely to hypersensitivity to the ammonium thioglycolate solution itself. In other words the dermatitis may not have been caused by the cold wave solution but was due to irritation from the combination of the acid, the softener, and the fixative. A patch test with the ammonium thioglycolate, in the concentration that is ordinarily used, might and usually is negative, but tests with the other substances or a combination of them would probably be positive. It should be remembered that the patch test often does not simulate the manner in which the cosmetic is actually used, and that the length of exposure, friction, sunlight, and other factors may contribute to the sensitivity but are not duplicated in the test.

On the other hand a positive patch test with substances that are primary irritants does not necessarily prove they are the cause of the dermatitis or that the dermatitis is due to hypersensitivity. For example, it is not good procedure to do routine closed patch tests with soap, antiperspirants, depilatories, or other primary irritants. They would give positive reactions in twenty-four to forty-eight hours in a large percentage of people. This also occurs in patch testing with some creams and other preparations which contain volatile ingredients that are primary irritants in certain concentrations. As cosmetics are usually not covered when used, a large part of these volatile ingredi-

ents evaporate and in that level of concentration the product is not an irritant. However the closed patch test does not allow this evaporation and the cosmetic which is harmless in actual use may give a positive reaction with the covered test. For this reason the "usage tests" are employed to check and interpret the reactions obtained in patch tests with certain chemical substances. In trying to ascertain whether a cosmetic is the cause of a dermatitis it is at times better to apply the preparation daily to the same site of skin for a week in the same manner in which it is actually used. That will check on the closed patch test and determine the skin sensitizing and/or skin irritating properties of the particular cosmetic.

Besides its use to discover the specific cause of a dermatitis, the patch test is of great importance as a means of determining the possible danger of a preparation that is to be sold to the public. Before a new product is put on the market, the so-called "prophetic patch tests" should be done. In this procedure routine patch tests are performed on at least 200 subjects. The preparation is left on for twenty-four hours and reactions are noted that day and also twenty-four, forty-eight, and seventy-two hours after removal. Two weeks after the first tests were applied, the closed patch tests are repeated on the same subjects, allowed to remain for forty-eight hours, and the reactions are again read each day for three days after removal. The first series of

tests will indicate whether the cosmetic is a primary irritant. The second series will show its sensitizing properties. If there are no positive reactions in both series, it is usually safe to place the product on trial sale. However, again it must be remembered the pre-use patch test will not always avoid the possible occurrence of an allergic dermatitis in some persons. For that reason it is safest to also do the usage test besides the patch tests on the same 200 subjects. The product is applied daily for four weeks in the same area and in a similar manner as it would ordinarily be used. If no cases of dermatitis result, the product may then be put on sale. Even if all the tests are negative that does not mean an individual may not become sensitized after using the product for a variable length of time. Sometimes that question can only be answered after a sufficient trial by many persons over a long period of time.

In the competition of cosmetic manufacturers to outdo each other in their search for new products and changes and possible improvements in their old products, the incidence of dermatitis is bound to increase. However the cosmetic chemist can do a great deal to prevent or reduce this to a minimum. He should know the possible effects of the chemicals he intends to use in these preparations and he should be aware of their potentiality to sensitize and irritate the skin. With the help of the dermatologist he can be of service not only to the

manufacturer but to the consumer.

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