

## Skin Prick Test - A Useful Tool in Diagnosis of Unexpected Triggers and Management of Allergy

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### Abstract

The prevalence of allergy is on the rise with increase in urbanisation and environmental pollution. Skin Prick Test serves as a useful tool for detecting the allergens that trigger allergy in atopic individuals. The Skin Prick Test can be done with a few allergens (3 or 4 substances) or sometimes as many as 40 to 50 substances. In this paper, we have emphasized the importance of performing Skin Prick Test with more numbers of allergens while dealing with a patient of allergy during the management of allergic rhinitis, asthma or urticaria. We should bear in mind that a significant number of these patients also suffer from Food Allergy Syndrome, which is often missed and underdiagnosed, if the SPT is done with fewer number of allergens.

**Keywords:** Skin Prick Test; Allergy; Allergic Rhinitis; Food Allergy

### Abbreviations

SPT: Skin Prick Test; IgE: Immunoglobulin E; ARIA: Allergic Rhinitis and its Impact on Asthma; AR: Allergic Rhinitis; HEPA: High Efficiency Particulate Air

### Introduction

Allergies are a number of conditions caused by hypersensitivity of the immune system of an individual to a particular substance or more often, substances, in the environment around him. Allergic diseases include hay fever, food allergies, atopic dermatitis, allergic rhinitis, asthma and anaphylaxis. The inflammatory mechanism involves Immunoglobulin E antibodies (IgE), a part of the body's immune system, binding to an allergen (in the environment) and then to a receptor on mast cells or basophils where it induces the release of inflammatory chemoreceptors such as histamine. Diagnosis is typically based on a person's medical history. However, diagnosis of allergy by history alone can be misleading. Studies have shown upto 32% false positive identification of allergen triggers for cat allergy, 48% for pollen allergy, as high as 75% for house dust mites, 27% for dog and 54% for tree pollen when compared with formal allergy assessment including SPT.

SPT is the most effective diagnostic test to detect suspected cases of IgE mediated allergic conditions. It is even considered the gold standard in the assessment of allergy due to inhalant allergens [1,2]. SPT is indicated in all conditions which are IgE mediated such as allergic rhinitis, asthma, urticaria, food allergies [1]. They help in detecting the sensitivity of a particular allergen and this knowledge can be applied for planning immunotherapy for further treatment of the atopic individual [3].

The reactivity to skin test depends on three factors [3]:

1. An intact immune system.
2. The presence of IgE sensitized mast cells which can release mediators when they are exposed to the antigen.
3. Skin which can respond with the release of histamine by developing an immune response as exhibited by erythema and induration. This kind of allergic response depends on the individual's previous exposure to the environmental antigen [3]. However, they do not measure the level of exposure. Hence to assess the presence of allergen, specific IgE antibodies SPT is to be preferred over blood allergy testing as it is more sensitive and specific [3].

## Materials and Methods

### Inclusion criteria

All patients with alleged history of allergy, aged 8 to 80 years, both sexes, chronic history of allergy not relieved or just temporarily relieved by symptomatic treatment were included.

### Exclusion criteria

Patient with skin lesions (leprosy, eczema, dermatographism), patient with any major medical disease such as diabetes mellitus, hypertension or Ischemic heart disease, patients on antihistamines and steroids, patients with hypersensitivity reactions, immunocompromised patients were excluded.

We assessed patients presenting in our OPD for nasal and other symptoms related to allergy. We selected patients having persistent allergic symptoms as per the new classification of allergic rhinitis [4].

the form of multivitamins and oral steroid applications were also included. History was taken in detail to rule out other causes of rhinitis, asthma and nasal polyposis. Clinical examination was done to confirm the etiology of allergic origin.

Out of a total of 25 patients, 16 were male and 9 were females; 4 patients were below 18 years of age.

After confirmation of allergic etiology by history and examination, patients were asked to stop medication if any, like 2<sup>nd</sup> generation antihistamines and other antiallergic medications for a minimum period of 7 days prior to STP. Those who were on cetirizine and levocetirizine were shifted to pheniramine maleate for 7 days. The test can be done after stopping pheniramine maleate for 48 hours [5]. If the patient is on oral steroids these have to be stopped 10 days prior to the test. None of our patients were on other contraindicated drugs like beta blockers, antidepressants, phenothiazines and omalizumab.

### Allergy kit and laws in India to practice immunotherapy

Allergenic extracts are concentrated solutions or suspensions used for diagnosis and treatment of allergic disorders. 198 commonest commercially licenced allergens were tested by using a standard kit.

The kit contains - 129 food allergens, 28 pollen, 11 fungi, 8 animal epithelia, 12 dust mixtures and mites, 9 insects and 1 latex.

The manufacturer of allergenic extracts falls under schedule C and (C1) of Indian Drug and Cosmetic Act 1945. As per the direction issued by The Drugs Controller, India (No-12-26/78-DC) Dated 20<sup>th</sup> January 1978 - Allergen kits should be supplied only to allergy clinics equipped with necessary emergency kits and only to those physicians who have undergone training in allergy testing and immunotherapy [5].

### Procedure of skin prick test (SPT)

The forearm is cleaned with spirit and allowed to dry. Histamine and saline were tested on the volar aspect of the arm prior to starting the test. After 15 minutes of histamine and saline test, reading is done.

**Figure 1:** Classification of allergic rhinitis according to Allergic Rhinitis and Its Impact on Asthma (ARIA) guidelines. (Adapted from Bousquet J, Van Cauwenberge P, Khaltaev N. Allergic rhinitis and its impact on asthma. *J Allergy Clin Immunol.* 2001;108(5 Suppl):S147-334, with permission [4].

Though this classification is for allergic rhinitis, we included patients having history of urticarial rashes and oral food allergy symptoms also as they had persistent symptoms and they were required to take antihistamine almost every day. Patients having benign form of oral ulcers and were non-responsive or partially responsive with medical management by general practitioners in

Induration caused by Histamine > 3 mm and saline < 2 mm were further tested for other allergens (Saline is a control, if the saline test reading is more than 2 mm, it indicates dermatographism and the test cannot be done. Also, if histamine is less than 3 mm it indicates that either the patient is on antihistaminic drugs or non-allergic).

Markings were done on the volar aspect of the forearm by a stamp having 50 boxes of 1 cm each. One stamp is imprinted above and one below on the volar surface of the forearm. Care is taken not to go too far laterally, as the mast cell distribution is less on the lateral aspects. In children the surface area may not be sufficient to cover all the tests, in that case, the surface of their back can be used. If using the surface of the back for testing, it has to be kept in mind that the mast cell distribution is less on the lateral sides and on the midline along the vertebrae and hence these areas of the back should be avoided.

Once the markings are done, a single drop of allergen is placed in the box as per the number (numbering of boxes should be done by a beginner to avoid confusion while reading the test). With a lancet held at an angle of 45 degree, skin is pricked through the drop to get tenting, to make sure that it is only in the epidermis and not deep to it (blood should not be seen after the prick; also avoid pricking on subcutaneous blood vessels).

After 15 to 20 minutes of the prick, excess allergen drops are absorbed by mopping with (not wiping) cotton. In a reasonably dark room, a torch is held at 90 degree angle to the skin to see the elevation of induration which is then measured in millimetres. Any erythema around the induration is also measured separately. Pseudopodia or satellite indurations, if any, are also noted and marked against the allergen in the worksheet.

The size of induration of the allergen prick, equal to and above the histamine induration size is considered as positive or sensitive.

After assessing the history, duration of symptoms, severity of symptoms and the results of SPT, all patients were advised measures to control the exposure to allergens. Those with a history of a few months were treated with medical management like intrana-

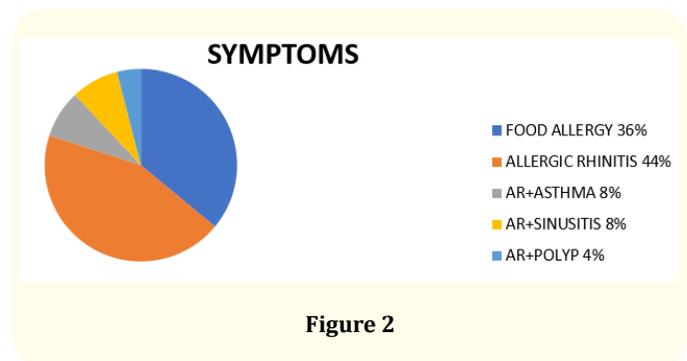
sal corticosteroid sprays and antihistamines. Those with long term symptoms, history of previous medical trial and complications of allergy like asthma, polyposis were advised immunotherapy for 2 to 5 years, along with control of acute symptoms with medical management like step up and step down approach as per ARIA Guidelines [6]. Those with food allergy were advised complete avoidance of food allergens which were positive to, along with 7 days of medical management to control acute reactions.

**Results**

In this group of 25 patients, 16 were males and 9 were females. Age range varied from 8 years to 75 years.

According to symptoms, in our group of 25 patients, 9 patients had food allergy and 16 had respiratory related allergy like, allergic rhinitis (AR) in 11 patients, AR with asthma in 2, AR with nasal polyp in 1 and AR with sinusitis in 2 patients.

SPT included 198 allergens and histamine and saline as control. Hence a total of 200 test allergens were used per patient. In our group of 25 patients, total 4950 allergens were tested, out of which 133 were positive.



**Figure 2**

Out of 133 positive allergens, food allergen were 52 (39%), dust mites 52 (39%), pollen 17 (13%), fungi 5 (4%), insects 4 (3%) and animal protein 3 (2%).

Among 52 positive food allergens, prawns constituted 6 (12%), garlic 5 (10%), urad dal 4 (8%), milk 3 (6%), onion 3 (6%).

Among 52 positive dust mites, *Dermatophagoides farinae* constituted 19 (36%), *Dermatophagoides pteronyssinus* were 14 (27%), Blomia 14 (27%) and house dust 5 (10%).

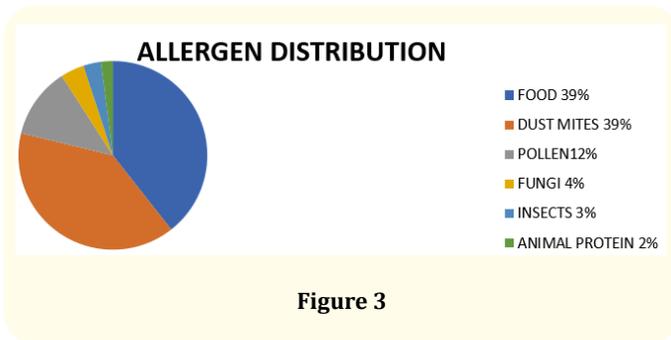


Figure 3

Among 17 positive for pollen, *Cassia siamea* constituted 3 (18%), *Acacia arabica* 3 (18%), *Cenchrus barbatus* 3 (18%) and *Cyperus rotundus* 2 (11%).

Among 5 positive tests for fungus, 3 were penicillium positive (60%).

One patient had cat allergen positive and one patient had human dander positive, both of them had AR.

### Management of allergy

Out of 25 patients:

- Patients who required only avoidance = 8 (32%)
- Patients advised avoidance with intra nasal steroids (INS) = 2 (8%)
- Patients advised avoidance with INS and antihistaminic = 6 (24%)
- Patients advised avoidance with INS with antihistamine and immunotherapy = 9 (36%).

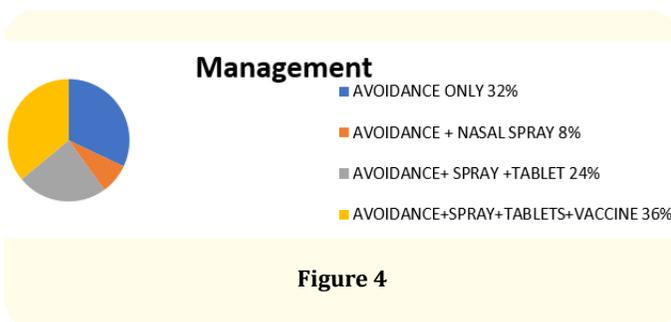


Figure 4

### Treatment

All 9 patients with food allergy related symptoms like oral ulcers and urticarial rash were given a 7 day course of oral steroids (Prednisolone 1 mg per kg), along with antihistamine for 10 days. They were asked to stop the offending food items (as detected by SPT) strictly and maintain a food diary. A few of these patients developed symptoms of urticaria again after 15 days. In such patients evaluation of the food diary was done and it was found that they adhered strictly to the avoidance measures but their food habit included 'Garam masala' (an Indian spice) which was a readymade packaged preparation and its constituents had some of the ingredients which these patients were allergic too. Hence, after changing the style of food preparation they were better and symptom free. One patient had a peanut and milk allergy as well. This patient was informed and warned about the possibility of anaphylaxis by accidental exposure and was asked to carry epipen for emergency safety. Also, immunotherapy was started for this patient.

All patients were advised regarding avoidance of allergens along with medication like intranasal corticosteroids, antihistamines and immunotherapy. Medical management was based on severity, for e.g. mild allergy was managed by intranasal corticosteroid only as the first line of management. If symptoms still persisted, antihistamines were added. All those with moderate to severe persistent allergy were started with intranasal corticosteroids along with leukotriene inhibitors and antihistamine combination along with immunotherapy. Few patients refused to take immunotherapy due to cost factor but the importance and possibility of immunomodulation was explained to them and thus they were convinced.

### Allergen avoidance

The first-line treatment of allergic rhinitis involves the avoidance of relevant allergens (e.g. house dust mites, moulds, pets, pollens) and irritants (e.g. tobacco smoke). Patients allergic to house dust mites should be instructed to use allergen-impermeable covers for bedding and to keep the relative humidity in the house below 50% (to inhibit mite growth) by the use of Air conditioner [7]. Change of the bedding is advised twice a week. The bedsheet should be soaked in hot water for a few hours and allowed to dry in the sun to reuse. Patients are also asked to dry clean the curtains once a month. They are instructed to clean the furniture shelves regularly, as far as possible keep closed book shelves and use a vacuum cleaner to clean under the beds and wardrobes.

Pollen and outdoor mould exposure can be reduced by keeping the windows closed using window screen filters, using an air conditioner, and limiting the amount of time spent outdoors during peak pollen seasons. After returning back home from the outside environment, patients are advised to bath and change their clothes.

For patients allergic to animal dander, removal of the pet from the house is recommended and usually results in a significant reduction in symptoms within 4 - 6 months. However, compliance with this recommendation is poor and, therefore, the use of high-efficiency particulate air (HEPA) filters and restricting the pet from entering the bedroom may be needed in an attempt to decrease allergen levels. vacuum cleaning of the house including the sofas and beds is a must.

Measures for reducing exposure to mould allergens include cleaning with fungicides, dehumidification to less than 50%, remediation of any water damage, re-painting and HEPA filtration. These avoidance strategies can effectively reduce the symptoms of allergic rhinitis, and patients should be advised to use a combination of measures for optimal results [7].

Food allergens need special attention, as Indian food is known for spices and ready mix masala (spice), patients should be instructed about the same. Food diary is of help for various reasons as it becomes easy to identify the culprit food item easily and cross check with SPT.

## Discussion

A thorough history and physical examination are the cornerstones of establishing the diagnosis of allergy. However, allergy testing is important for confirming the underlying triggers that cause these allergies [7].

### Advantages of SPT [8]:

1. Reliable
2. Cheap
3. Safe
4. Convenient
5. Minimally invasive
6. Multiple allergens can be tested.

And hence, SPT is an excellent diagnostic tool with a positive predictive value in the range of 95 - 100 percentile [8,9].

In this study, special mention needs to be made about the fact that many patients with allergic rhinitis also exhibit food allergy. This indicates cross reactivity of the pollens and polysensitization phenomenon [10]. Owing to an increase in pollution and urbanization, there is a rise in the allergy, pollution and polysensitization. Knowledge of cross reactivity and confirmation on SPT allows us to omit specific fruits for the patients, like banana, cherry, watermelon, guava, orange which may be the trigger of allergic rhinitis. Hence in our study we have emphasized the importance of performing the SPT with maximum number of allergens. The number of allergens we use for SPT is 200. Many times, SPT is done with very few allergens (40 - 50). Because of this many food allergens are missed, which results in the food allergy being underdiagnosed. This has a significant impact on the therapy strategy. It is important to avoid foods that are related and have cross reactive proteins [10].

All patients exhibiting only food related allergic symptoms showed food allergy predominantly on SPT. In our study, one patient with peanut and milk allergy had to be started on Immunotherapy to prevent anaphylaxis.

Patients of allergic rhinitis with asthma or polyp had significant pollen allergy as a cause of complication. Also, Mumbai (the place of our Study population) being a coastal city is high in humidity; thereby dust mites are the predominant cause of allergic rhinitis here. Studies have shown that maintaining a relative humidity of less than 50% helps in reducing the numbers of house dust mites and their allergens [11].

Another interesting fact observed during our study of allergic patients was the relation of benign oral ulcers to food allergy. Patients with benign oral ulcers as detected by signs and clinical evaluation and labelled therefore as aphthous ulcers of the mouth were treated initially with multivitamins and probiotics but some of them either did not respond or were recurrent. We decided to perform an SPT in such patients after much research [12]. In 3 of our patients of benign oral ulcers, SPT revealed food allergy and avoidance of the offending agent provided relief in these patients. However further studies need to be done on this topic with a sizable number of patients to have a definite conclusion.

The most difficult task is the management of patients with urticarial rash. However, skin prick testing helps in a major way in the accurate management of such patients. Six of our patients with urticarial rash were detected with predominantly food allergy and were eventually managed successfully. The combination of food diary history and SPT was helpful in narrowing down the culprit for the urticarial rash.

There are 600 commercially licenced allergens, out of which, India being a tropical country, some of these can be excluded from SPT. Most of the studies done earlier made use of just 40 to 50 allergens and hence may not have scored the desired results or reliability from the skin prick testing. We recommend using 200 allergens as we did in our study for allergy screening.

### Conclusion

Skin Prick Test is a safe, convenient and reliable first line test in the management of allergies. We only recommend that instead of using the routinely used 40 - 50 allergens, it is imperative that we perform the Skin Prick Test with at least 200 allergens to get the optimum use of this wonderful tool.

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