

## Original Research Article

# A study on correlation between allergen and allergic contact dermatitis

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**Received:** 19 October 2017

**Revised:** 05 November 2017

**Accepted:** 08 November 2017

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### ABSTRACT

**Background:** Agents which cause contact dermatitis are simple chemical compounds and by themselves these agents will not cause sensitization and are called haptens. These require another molecule usually a protein called the carrier molecule derived from the epidermis to cause allergic sensitization. The confirmation of contact dermatitis is done by the patch testing. There is no substitute for the patch test in the management of allergic contact dermatitis.

**Methods:** After selecting the patient suspected to have allergic contact dermatitis the findings were recorded in the proforma which also includes the systemic examination of CVS, CNS, GIT and respiratory system to study systemic correlation if any. Investigation were done which included Hb%, TLC, DLC, urine routine and microscopic examination, patch testing and other special investigations if required. The patient was subjected to patch testing after the acute stage has subsided and the patient was on no therapy with topical or systemic steroids prior to patch testing.

**Results:** The incidence of allergic contact dermatitis due to cosmetics was found in 7 (5.6%) cases. In that hair dye (PPD) inducing dermatitis was found in 4 (57.4%) and due to hair oil 1 (14.2%), kumkum 1 (14.2%) and Sun silk shampoo 1 (14.2%). The incidence of PPD sensitivity in this series of 125 cases was 4 (3.2%).

**Conclusions:** PPD is a well-known potent sensitizer, it is a chief constituent of the commonly used hair dyes and also some other cosmetics like nail polish.

**Keywords:** Allergen, Allergic contact dermatitis, PPD

### INTRODUCTION

Contact dermatitis is an inflammatory response of the skin to an exogenous substance (irritant and or allergen). The substance or the agent which produces this type of dermatitis is called the contact antigens or the contactant. Contact dermatitis accounts for the physical, psychological, economical discomfort, loss of work, sick leave of the affected individuals as well as pose a medico – legal problems to the factory management. Contact dermatitis accounts for the workmens compensation claim for skin diseases and it also associated with significant morbidity.

Contact dermatitis accounts for 4-7% of dermatological consultations. The common sensitizers vary from place to place and from time to time. Potential sensitizers will give positive reactions in all countries though their ranking may vary e.g. Neomycin is a common sensitizers all over the world, in India nitrofurazone is the commonest incidence of plant dermatitis varies from country to country and depends on the local flora, poison-ivy and poison-oak dermatitis is very common in North America, primulaobconica is common in Europe and contact dermatitis due to plant *Parthenium hysterophorus* has assumed epidemic proportion all over India.<sup>1</sup>

The incidence of contact dermatitis also varies widely, depending upon the occupation. Habits, immediate

environment of the patient or populations. Contact dermatitis is classified on the mechanism by which the contact allergic contact dermatitis, irritant contact dermatitis, contact photodermatitis and contact urticarial.<sup>2</sup>

Agents which cause contact dermatitis are simple chemical compounds and by themselves these agents will not cause sensitization and are called haptens. These require another molecule usually a protein called the carrier molecule derived from the epidermis to cause allergic sensitization.

The confirmation of contact dermatitis is done by the patch testing. There is no substitute for the patch test in the management of allergic contact dermatitis. Though patch testing is a time consuming investigation, involves more visits to the hospital and is unpleasant or even associated with minor side effects still it is more beneficial in detection of the cause of the dermatitis. It is helpful in management of patient, improving the prognosis, and a way of developing and strengthening the bond between doctor and patient without which the treatment of eczema can never be at its best.<sup>3</sup>

Patch testing is a very simple test, easy to perform, sufficiently accurate if applied properly. It is based on the principle that in allergic individuals the whole of skin is capable of reacting with the causative antigens. It was introduced in the year 1896 by Jadasshon.

The committee on occupational dermatoses of the American medical association (1939) defined occupational dermatoses as “a pathological condition of skin for which an occupational factor can be shown to be a major casual or contributory factor” this includes the various agents to which the individual is exposed during their professional activities, past time, hobbies, sports or social responsibilities. Occupational contact dermatitis account for 20-80% of all occupational disease in various countries in that two third of cases constitute irritant contact dermatitis others include allergic contact dermatitis.<sup>4</sup> The occupational dermatoses create physical, psychological, economical discomfort, sick leave, loss of job as well as medico-legal problems for the factory management. The occupational contact dermatitis includes the nurses, doctors, pharmacist exposed to various drugs the factory workers to various industrial products, the sportsmen to various sports items, painter to paints and chemicals, house wives, caterers to the vegetables. The substances varies from country to country and from time to time and the common substance include metals, rubber chemicals, resins, soldering fluxes, cutting fluids, solvents, soaps and detergents, plants and food stuffs.

Occupational contact dermatitis manifest as irritant, allergic, contact urticarial, photocontact dermatitis. Hands are the most common sites involved, dust and vapours affect the face and the neck, feet and the legs are more often involved in cement workers, miners and labourers.<sup>5</sup>

## METHODS

The methodology included detailed history especially of potential sensitizers in the environment, occupation, hobbies, any contact with external application of cosmetics, drugs, ointments. An emphasis on past history was recorded regarding the mode of presentation, progression, medication taken and their effect on allergic contact dermatitis.

**Study period:** January 2013 – January 2016

### *Inclusion criteria*

Inclusion criteria were suspected cases of allergic dermatitis; age group less than 40 years.

### *Exclusion criteria*

Exclusion criteria were not willing to give consent for the study; age more than 40 years.

After selecting the patient suspected to have allergic contact dermatitis the findings were recorded in the proforma which also includes the systemic examination of CVS, CNS, GIT and respiratory system to study systemic correlation if any. Investigation were done which included Hb%, TLC, DLC, urine routine and microscopic examination, patch testing and other special investigations if required. The patient was subjected to patch testing after the acute stage has subsided and the patient was on no therapy with topical or systemic steroids prior to patch testing.

The procedure of the patch testing was standard procedure outlined by international contact dermatitis research group and North American contact dermatitis group. The standard test tray and ready-made patches used in the study include the allergens in the syringes supplied by Creative Drugs Ltd, Mumbai containing twenty antigens. In addition to above suspected contactants such as cosmetics, chemicals and others are tested according to the history of the patient.

The upper back was the site for patch testing in all cases the patches were placed on grossly normal, non-hairy skin. The patches were applied in vertical rows with a gap of four centimetres in between to avoid contamination. A record of the antigens applied on various patches and the patches were numbered. The instruction to the patient given was

- a) Not to wet the patch test area.
- b) To avoid rubbing or scratching any test sites.
- c) To remove the patch that causes severe itching or burning sensation without disturbing other patches.
- d) To report after 48 hours of application of patches.

The reading of the patch test was done after removing the patches, the sites marked with the pen and readings were

taken 30 min after removal of patches to avoid false positivity from the effects of the pressure of the patch test substance which may produce mild erythema or even dermographism which is usually transient. First reading was taken at 48 hours, if reaction was weak then second reading at 72 hours and at the end of one week. The reactions were graded according to be ICDR group

- -Ve reaction -- 0
- Erythema -- +
- Erythema and papules -- ++
- Papules and vesicles -- +++
- Superficial ulcers and bullae -- ++++
- Irritant reaction – IR

This study was undertaken at Bidar, Gulbarga attending the dermatology OPD of Bidar Rural Institute of Medical Sciences, Khaja Banda Nawaz Teaching and General Hospital and those who were hospitalized.

**Statistical analysis**

Data were presented in terms percentage, frequency and mean

**RESULTS**

The incidence of allergic contact dermatitis due to cosmetics was found in 7 (5.6%) cases. In that hair dye (PPD) inducing dermatitis was found in 4 (57.4%) and due to hair oil 1 (14.2%), kumkum 1 (14.2%) and Sunsilk shampoo 1 (14.2%). The incidence of PPD sensitivity in this series of 125 cases was 4 (3.2%).

**Table 1: Correlation between suspected antigen as per clinical data and confirmation by patch testing due to cosmetics.**

Antigen	No. of cases (N=7)	Tested	Positive
Hair dye (PPD)	4	4	3
Hair oil	1	1	1
Kumkum	1	1	1
Sunsilk shampoo	1	1	1

**Table 2: Correlation between suspected antigen as per clinical data and confirmation by patch testing due to topical medicaments.**

Antigens	No. of cases (N=10)	Tested	Positive
Nitrofurazone	3	3	2
Neomycin	2	2	2
Framycetin	2	2	1
Hydroquinone	1	1	1
Formaldehyde	1	1	1
Sticking plaster	1	1	1

It is seen from the table that out of 10 cases of allergic contact dermatitis due to topical medicaments 3 (30%) were due to nitrofurazone, 2 (20%) due to neomycin, framycetin 2 (20%) and hydroquinone 1 (10%), formaldehyde 1 (10%), sticking plaster 1 (10%).

**Table 3: Correlation between suspected allergen as per clinical data and confirmation by patch testing due to occupational antigen.**

Group-antigens	No. of cases (N=7)	Positive
Industrial-grease	2	2
Mechanical-grease, oil, petrol, diesel construction worker-cement		2
Potassium dichromate	4	2

Patch testing with nitrofurazone of the standard tray was found positive in 2 (66.6%) of 3 cases. Patch test with Neomycin, framycetin, hydroquinone (2%), formaldehyde, sticking plaster positivity was found in all cases. Neomycin is a well-known contact sensitizer.

**Table 4: Patch test with multiple allergens and its results.**

S. no.	Test with multiple Allergens	Results
1	PHh/nickel	+ve for nickel
2	PH/fragrance mix	+ve for fragraqnce Mix
3	Grease XG284, petrol, anti-freeze oil, diesel	+ve for grease, XG284, antifreeze oil
4	Grease, oil, petrol, diesel	+ve for grease
5	Grease XG284, diesel, petrol	+ve for frease
6	Hydroquinone/PABA	+ve for hydroquinone

**Table 5: Incidence of allergic contact dermatitis in patients with positive family hisdtory of atopy.**

No. of cases of ACD	Atopy	Percentage
125	3	2.4

**Table 6: Summary of patch test with standard allergen and also with suspected allergens.**

Summary of patch test	Total no. (N=125)	Percentage (%)
Patch test +ve patients	90	72
Patch test -ve patients	35	28

The incidence of allergic contact dermatitis due to occupational antigen was found in 5.6% in 125 cases.

The occupation in one individual was weapon fitter, the other was grinder. The patients were patch tested with the suspected contactant and found positive as mentioned in the table. In one individual with mechanic in profession subjected to patch testing with grease, oil, petrol and diesel and found positive for grease. Among the occupational antigen the last group included 4 patients of construction workers suspected of cement. Patch test positivity was seen in 2 (50%) case with potassium dichromate.

The chromate sensitivity varies from region to region and is due to the variations in the chromate content of the cement of the cement, the proper precautions in the form of protective boots, gloves and contact with dry or wet cement. Dry cement will not induce dermatitis. Wet cement become alkaline and can cause irritant dermatitis. Cement can cause allergic as well as irritant contact dermatitis. Pune city has undergone massive expansion in the last decade and increase rate of construction activities in Pune explains the increase incidences of contact dermatitis from cement.

**Table 7: Systemic correlations of allergic contact dermatitis in series of 125 cases.**

S. no.	Conditions	No. of patients
1	Diabetes mellitus	3
2	Cervical lymphadenitis	1
3	Br. Asthma	1
4	Maniac depressive psychosis	1
5	Hypertension	1
6	Generalized lymphadenopathy	1
7	HIV (asymptomatic)	1
8	Alcohol dependant syndrome	1
9	Hansens (BT)	1
10	Squamous cell carcinoma	1
11	Gynaecomasia	1

It shows the patch test with multiple allergens suspected and the results with patch test. In that 1 patient was found positive with more than one allergen.

The incidence was found in 3 (2.4%). In various studies the incidence of irritant dermatitis is more than allergic contact dermatitis in atopic individuals.

The number of patients subjected to patch testing and its results. The patch test positivity was found in 90 (72%).

Diabetes mellitus was found in 3 (2.4%) and others 1 (0.8%) each as mentioned in the table.

Contact dermatitis accounts a significant percentage of patients attending dermatology clinic. It accounts for 4-7% of dermatological consultations.

## DISCUSSION

PPD is a well-known potent sensitizer, it is a chief constituent of the commonly used hair dyes and also some other cosmetics like nail polish. Even in the past sensitization by PPD was considered a great hazard. The use of PPD due to its sensitizing property banned in Germany in early 19<sup>th</sup> century and was subsequently prohibited in France and in Sweden. In addition to hair dyes PPD is also present in furdyes, leather (used for processing), rubber (vulcanizing), printers ink, photographic work, x-ray fluids and lithography.<sup>6</sup> Occupational exposure to PPD also occurs in the rubber industries, leather processing industries, barbers who are engaged in hair dyeing of their customers. It is recommended that if a patient has a positive patch test reaction to PPD and apparently has no contact with a PPD containing substance, patch test should be performed with other para-amino compounds and azo-dyes with which PPD is known to cross react.<sup>7</sup> Other substances which cross react include PABA, its esters and sulphonamides. The patch test done of cosmetics from the suspected allergen from the history was found positive with patch testing.

125 cases of clinically diagnosed allergic contact dermatitis selected from the detailed history specially of potential sensitizers in the environment occupation and hobbies. Emphasis on past history regarding mode of presentation, progression and treatment taken were considered. The patients were subjected to patch testing with the standard allergen available and also with the suspected allergen from the history of the patient. The *Parthenium* dermatitis incidence was 80 (64%). The mode of presentation of PH dermatitis was airborne contact dermatitis in 55 (68.74%), phytophotodermatitis in 16 (20%), exfoliative dermatitis in 8 (10%) and localized to hands in 1 (1.25%). Of the 80 patient 64 subjected to patch testing as in standard occlusion, 16 were subjected to photopatch testing with 1% extract of PH antigen from leaves and flowers and positivity was found in 60 (75%). No significant difference was noted in photopatch test.

The incidence of contact dermatitis due to wearing apparel and jewellery was found in 21 (16.8%). The Ni dermatitis was found in 11 (18.8%). In the Ni dermatitis ear ring (ear piercing) was the common mode of sensitization in 8 (72.72%). The other 3 cases of Ni sensitivity were due to spectacle frame, wrist watch and necklace. The increase incidence of Ni dermatitis was found in females and in the age group of early teens (10-19yrs), which was found in 5 (45.45%) of total 11. The increased incidence of Ni sensitivity is due to rapid modernization and trend towards use of artificial jewellery.

The incidence of footwear dermatitis was noted in 10 (8%). In one case contact vitiligo was due to footwear.



The incidence of allergic contact dermatitis due to topical medicaments was found in 10 (8%) of 125 cases. Among that nitrofurazone was the commonest found in 3 (2.4%). Patch test positivity was found in 2 (66.6%). Others included Neomycin 2 (1.6%), framycetin 2 (1.6%), 1 (0.8%) each due to hydroquinone, formaldehyde and sticking plaster. Patch test positivity was found in all above cases.

The incidence of occupational antigens was found in 7 (5.6%) of 125 cases. In that industrial allergen in 2 (1.6%), 1 (0.8%) allergen in mechanic and 4 (3.2%) were due to cement in constructional workers.

The incidence of allergic contact dermatitis due to cosmetics was found in 7 (5.6%) of 125 cases. The incidence of hair dye (PPD) dermatitis was noted in 4 (3.2%). 1 (0.8%) each were due to hair oil, kumkum, Sunsilk shampoo.

A positive history of atopy in the family was observed in 3 (2.4%) of 125 cases of allergic contact dermatitis.

There was a good co-relation between clinical diagnosis and confirmatory patch test with standard and suspected antigens.

The frequency of sensitization to neomycin varies with the prescribing habits of the doctor in a particular region, indiscriminate use of corticosteroid-neomycin combination, easy availability of neomycin, sale as counter product without prescriptions. The severity of the dermatitis varies depending on the degree of exposure. The patch testing with base, preservatives should be done as the hypersensitivity can occur due to them also. Neomycin is the common sensitizer all over the world and the second common sensitizer in India.

Nitrofurazone is one of the most commonly used antibacterial agent because it is effective, cheap, commonly prescribed by the general practitioners, surgeons and household remedy without prescription. It is the most common sensitizer in India.

The patients of contact dermatitis undergo prolong periods of mental stress, resulting in loss of time, socio-economic disability, decreased productivity and human sufferings. These factors may perpetuate a psychiatric illness. The increase incidence of PH dermatitis in Pune is attributed to its abundant growth, increase awareness of the dermatitis due to it. The incidence of contact dermatitis due to wearing apparel and jewellery in which Ni sensitivity is due to rapid modernization use of cheap jewellery among all socio-economic group of individuals. The footwear dermatitis is due to the rapid use in high fashion. The increase incidence of cement dermatitis is due to the increased construction activities in Pune. Patch test is very useful tool available for the dermatologists, this simple test is accurate if properly applied, which

helps in the management and prognosis of the patient as well as strengthens the bond between doctor and patient without which the management of eczema is not at its best.

In view of large incidence of contact dermatitis induced by *Parthenium hysterophorus* the below mentioned methods are beneficial.<sup>8,9</sup>

1. To reduce the quantity of antigen to which the patient is exposed by removing as much of the causative plant as possible from the immediate environment of the patient especially the residence and place of work, to reduce the quantity of antigen in the patient's environment.
2. To cover as much of the skin of the patient as possible by wearing full sleeve, high neck shirts, long pants, socks, shoes and cap/turban etc. to protect a major portion of the skin.
3. To wash the uncovered areas with soap and water as frequently as possible, to remove the antigen from the skin before it is able to penetrate the skin.
4. Use of barrier cream on the exposed areas after every wash to slower down the penetration of the antigen into the skin.

## CONCLUSION

It is concluded that if a patient has a positive patch test reaction to PPD and apparently has no contact with a PPD containing substance, patch test should be performed with other para-amino compounds and azo-dyes with which PPD is known to cross react. Other substances which cross react include PABA, its esters and sulphonamides. The patch test done of cosmetics from the suspected allergen from the history was found positive with patch testing.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: The study was approved by the institutional ethics committee*

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**Cite this article as:** Nagure AKB, Guruprasad KY. A study on correlation between allergen and allergic contact dermatitis. *Int J Res Dermatol* 2017;3:459-64.