

Patch testing in patients with suspected cosmetic dermatitis: A retrospective study

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Summary

Background: Growing use of cosmetics has led to an increase in the incidence of allergic contact dermatitis (ACD) to cosmetics. Patch testing helps to confirm allergy to cosmetics and pinpoint the exact offending allergens.

Aims and Objectives: The study aimed to find the frequency of positive patch test reactions in cases with suspected ACD to cosmetics, and the common allergens responsible for it.

Methods: This is a retrospective record-based study of 58 patients, with suspected ACD to cosmetics, who had undergone patch testing with Indian standard series and Indian cosmetic and fragrance series from January 2013 to December 2015.

Results: The majority of patients (60.34%) belonged to the age group of 20–40 years. The most common site of involvement was face (94.8%) followed by neck (22.4%). The most commonly implicated cosmetics in history were soaps (53.4%), and face creams (24.1%). The most common allergens detected on patch testing were cetrimide (20.7%) and thimerosal (15.5%) followed by paraphenylenediamine (6.9%), and fragrance mix (5.2). Positive allergic reactions were obtained in 2.12% of the patches.

Conclusion: Most common cosmetic products implicated for causing ACD were face creams, soaps, and hair dyes. The principal culprit allergens were cetrimide and thimerosal.

KEYWORDS

cosmetic dermatology, cosmetics, contact dermatitis, contact allergy

1 | INTRODUCTION

Cosmetics have been defined as any preparation applied to the skin, mouth, hair, or nails for the purpose of cleansing, enhancing appearance, giving a pleasant smell or providing protection.¹ A wide variety of products can be included in this category including perfumes, deodorants, aftershaves, hairsprays, lipsticks, nail varnishes and extensions, moisturizers, emollients, hair colors and styling agents, cleansers and wipes, mascara, eye shadow, makeup, makeup removers, sunscreens, depilatories, soaps, shampoos, shower gels, bath oils

and toothpastes and many more. Cosmetic and skin care products form an essential part of daily grooming. On an average, a woman uses 12 personal care products a day, containing a total of up to 168 ingredients, and a man uses six personal products with up to 85 ingredients daily.² It is estimated that 1–3% of the population is sensitized to a cosmetic or cosmetic ingredient with a female preponderance.³ However, the actual rate is estimated to be much higher, because most people just stop applying the offending cosmetic instead of seeking medical advice for mild allergic or irritant reactions. The most common causative allergens are fragrances and

preservatives. The other important ones include paraphenylenediamine, UV filters, tosylamide formaldehyde resin in nail varnish, lanolin and its derivatives and cocamidopropyl betaine.¹

Contact allergy to cosmetic allergens is on a rise in developing countries like India due to increasing use of cosmetics. Patch testing with standard series identifies the responsible allergens in almost 70-80% cases of contact dermatitis; however, many important cosmetic-related allergens may be missed using standard series alone. There is a paucity of studies from Indian subcontinent to support patch testing with cosmetic series in addition to standard series in patients with suspected contact allergic dermatitis to cosmetics.⁴ Therefore, we attempted to study the common allergens in cosmetics, responsible for causing allergic contact dermatitis (ACD).

2 | MATERIALS AND METHODS

The study was conducted in the department of Dermatology of a tertiary care center as a retrospective record-based study. A total of 58 patients of age 3-60 years who had presented with suspected ACD to cosmetics from January 2013 to December 2015 and had undergone patch testing with Indian standard series (ISS) and Indian cosmetic and fragrance series (ICFS) were included in the study. The study was approved by the ethical committee of the institute. A detailed history of the symptoms, cutaneous lesions, use of cosmetics including their duration of use, exacerbation of dermatitis with cosmetic use, personal and family history of atopy, and seasonal variation was recorded from the proforma. The findings of clinical examination were also recorded. The patch testing had been performed by the modified Finn chamber method utilizing the ICFS, and ISS approved by the contact dermatitis forum of India (CODFI), and manufactured by "Chemotechnique Diagnostics." Patch testing was also performed with suspected personal cosmetics.

Patch test readings were taken after 48 hours and 96 hours. The results of patch testing were analyzed as per the recommendations of the International contact dermatitis research group:

? +	=	Doubtful reactions	Faint macular erythema only
+	=	Weak positive reaction	Erythema, infiltration, possibly papules
++	=	Strong positive reaction	Erythema, infiltration, papules and vesicles
+++	=	Extreme positive reaction	intense erythema, bullous reaction
-	=	Negative reaction	
IR	=	Irritant reaction	
NT	=	Not tested	

Positive allergic reactions were further interpreted as clinically relevant or irrelevant. The clinical relevance was defined as definite (product used by the patient containing the allergen tested positive), probable (testing could not be performed but a known exposure to a product containing the allergen was present), possible (a possible

exposure history to a product known or strongly suspected to contain the allergen was present or a positive test result to a product suspected to contain the allergen). The reactions were considered clinically relevant if any of the above three could be found.⁵

3 | RESULTS

The age group of our patients ranged from 9 to 60 years, with the mean age of 36.28 ± 11.76 years. The majority of patients (60.34%) belonged to the age group of 20-40 years. There were 50 females and eight males (M:F=1:6.25). A total of 35 females in our study were homemakers (60.3%), eight were students (13.8%), five were in clerical job (8.6%), three were computer engineers (5.2%), and one each were beautician, nurse, cook, saleswoman, retired technician, garment shop owner, and in church service.

The mean duration of symptoms was 29.58 ± 35.71 months. The duration of symptoms ranged from 7 days to 15 years, and the majority of patients (53.4%) had a duration of less than a year. The most common presenting complaints were itching (60.3%), hyperpigmentation (46.5%), redness (41.4%), and papules/plaques (27.6%). The other symptoms were less frequent, such as burning sensation (17.2%), scaling (13.8%), dryness (10.3%), fissuring (5.2%), eruptions (3.4%), oozing (3.4%), and stinging (1.7%).

Face was involved in 94.8% of the patients. The second common site of involvement was neck (22.4%), followed by forearms (17.2%), arms (10.3%), hands (10.3%), scalp (5.2%), feet (3.4%), and legs (1.7%). History of atopy was present in a total of six patients (10.3%). Majority of the patients had no seasonal variations (84.5%); however, six patients experienced a winter aggravation (10.3%), and three patients had summers exacerbation of symptoms (5.2%). Many patients did not report any aggravating factors (53.4%); however, others experienced exacerbation of dermatitis with sun exposure (13.8%), application of hair dye (10.3%), kumkum (5.2%), lipstick (5.2%), bindi (3.4%), henna (3.4%), face cream (3.4%), and soaps (3.4%). We recorded all the cosmetics used by the patients



FIGURE 1 Dermatitis of proximal nail folds due to nail paint

TABLE 1 Allergens used, positive patch test reactions, and their clinical relevance

S. No.	Allergens	Conc.	Positive allergic reactions, %	Positive irritant reactions, %	Clinically relevant reactions (%)
(a)					
ICFS Allergens					
1	Abitol	10	0	0	-
2	Amerchol L101	50	0	0	-
3	Benzyl alcohol	1	0	1.7	-
4	Benzyl salicylate	2	0	0	-
5	2-Bromo-2-nitropropane-1,3-diol	0.25	0	0	-
6	2-tert-Butyl-4-methoxyphenol	2	0	0	-
7	2,6-Di-tert-butyl-4-cresol	2	0	0	-
8	Cetyl alcohol	5	0	0	-
9	2-Chloroacetamide	0.2	0	0	-
10	4-Chloro-3,5-xyleneol	0.5	0	3.4	-
11	Gallate mix	1.5	1.7	3.4	R (50)
12	Geranium oil Bourbon	2	1.7	1.7	R (100)
13	2-Hydroxy-4-methoxybenzophenone	10	0	1.7	-
14	2(2-Hydroxy-5-methyl-phenyl) benzotriazole (Tinovin P)	1	0	1.7	-
15	Imidazolidinyl urea	2	0	0	-
16	Isopropyl myristate	20	3.4	0	R (100)
17	Jasmine absolute, Egyptian	2	0	0	-
18	Lavender absolute	2	0	0	-
19	Musk mix	3	0	0	-
20	Phenyl salicylate	1	0	0	-
21	Polyoxyethylenesorbitanmonooleate	5	0	0	-
22	Rose oil Bulgarian	2	0	0	-
23	Sorbic acid	2	3.4	0	R (100)
24	Sorbitanmonooleate	5	0	1.7	-
25	Sorbitansesquioleate	20	0	3.4	-
26	Stearyl alcohol	30	0	0	-
27	tert-Butylhydroquinone	1	0	0	-
28	Thimerosal	0.1	15.5	1.7	R (66.7), IR (33.3)
29	Triclosan	2	1.7	0	R (100)
30	Triethanolamine	2	0	1.7s	-
(b)					
31	Vanillin	10	0	0	-
32	Oleamidopropyl dimethylamine	0.1	0	0	-
33	Cetrimide	0.5	20.7	0	R (58.3), IR (41.7)
34	Jasmine synthetic	2	0	0	-
35	Hexamethylene tetramine	2	0	0	-
36	Petrolatum, white	100	0	0	-
37	Chlorhexidine digluconate	0.5	1.7	0	R (100)
38	Phenylmercuric acetate	0.01	1.7	0	IR (100)
39	Cocamidopropylbetaine	1	1.7	1.7	R (100)
40	2,5-Diazolidinylurea	2	0	1.7	-
41	Ethylenediaminedihydrochloride	1	0	0	-

(Continues)

TABLE 1 (Continued)

S. No.	Allergens	Conc.	Positive allergic reactions, %	Positive irritant reactions, %	Clinically relevant reactions (%)
42	Quaternium 15	1	1.7	0	R (100)
ISS Allergens					
43	Propylene glycol	5	0	0	-
44	5-chloro-2-methyl-4-isothiazolin-3-one	0.02	0	0	-
45	Neomycin sulfate	20	5.2	0	IR (100)
46	Cobalt chloride hexahydrate	1	3.4	1.7	R (100)
47	4-Phenylenediamine base	1	6.9	0	R (50), IR (50)
48	Paraben mix	15	3.4	1.7	R (50), IR (50)
49	Nickel sulfate hexahydrate	5	13.8	1.7	R (62.5), IR (37.5)
50	Colophony	20	1.7	1.7	IR (100)
51	Gentamicin sulfate	20	0	0	-
52	Epoxy resin	1	0	0	-
53	Fragrance mix	8	5.2	0	R (100)
54	Nitrofurazone	1	1.7	0	IR (100)
55	Chloro-m-cresol	1	0	1.7	-
56	Wool alcohol	30	0	1.7	-
57	Balsam of Peru	25	0	0	-
58	Clioquinol	5	0	0	-
59	4-tert-Butylphenolformaldehyde resin	1	1.7	0	R (100)
60	Formaldehyde	1	1.7	0	R (100)

irrespective of their relationship with dermatitis. The commonest cosmetics used by the patients were soaps (82.8%), followed by face creams (53.4%), hair dye (25.9%), henna (24.1%), perfumes (22.4%), bindi (17.2%), lipsticks (12%), shaving creams (10.3%), and nail paint (1.7%) (Figure 1).

Thirty-six study patients (62.1%) reacted positively to patch test with either one or more allergens of ICFS/ISS, or suspected personal cosmetics or both (Table 1). The most frequent cosmetics used by these patients were soaps (53.4%), face creams (24.1%), hair dye (22.4%), perfumes (15.5%), and shaving creams (8.6%).

Patch test with the allergens of ICFS revealed a positive result in 24 (41.38%) patients. Twelve (20.7%) patients had a positive patch test to cetrimide and 9 (15.5%) reacted positively to thimerosal. Reactions to isopropyl myristate and sorbic acid were positive in 3.4% patients each, while those to gallate mix, geranium oil Bourbon, triclosan, chlorhexidine gluconate, phenylmercuric acetate, cocamidopropylbetaine, and Quaternium 15 were positive in 1.7% patients each. Among the personal cosmetics tested, six (10.3%) patients reacted to hair dye (Figure 2), 5.2% to kumkum, and 3.4% to lipstick. It is difficult to correlate the positive reactions to the suspected cosmetic as not all the ingredients of cosmetics had been mentioned on the label, but a causal link could be commented upon in many cases.

The patch testing with allergens of ISS revealed a positive result to nickel sulfate hexahydrate in 13.8% patients, paraphenylenediamine in 6.9% patients, neomycin sulfate and fragrance mix in 5.2% patients each, cobalt chloride hexahydrate and paraben mix in 3.4% of patients each. Out of the total 3490 patch tests applied, positive



FIGURE 2 Positive patch test reaction to hair dye

allergic reactions were obtained in 2.12% patches (74/3490). Irritant reactions were observed in 15.5% and 10% of patients with allergens of ICFS and ISS, respectively.



FIGURE 3 Pigmented contact dermatitis due to bindi



FIGURE 4 Pigmented contact dermatitis over cheeks and forehead

4 | DISCUSSION

Recent studies have suggested an increased incidence of cosmetic dermatitis and also of newer antigens in cosmetics that cause allergies.^{6,7} Patch testing is the gold standard investigation in patients with suspected ACD to cosmetics.^{8,9} Patch testing with cosmetic series in addition to the standard series has been suggested to increase the capability to detect relevant allergens in such patients. ACD to cosmetics is more common in females as compared to males,¹⁰ which could be explained by a more frequent use of cosmetics, higher rates of sensitization by cosmetic allergens, and an increased rate of reporting, as females are more concerned about cosmetic appearance as compared to males. In concordance with this, we also had majority of females (86.2%) in our study. The majority of patients (60.34%) in our study belonged to the age group of 20-40 years. In a previous study, most of the patients with cosmetic reactions were distributed over a wider range of age group (20-60 years).¹¹

Itching has been found as the predominant symptom of ACD by cosmetics in previous studies which was also the major presenting complaint in our patients (60.3%).^{4,12} Other common presenting features were hyperpigmentation (Figure 3), erythema, and papules or plaques. Cosmetic dermatitis commonly presents with erythematous scaly patches or a more diffuse erythema.³ Pigmented cosmetic dermatitis is seen mainly in women of Indian subcontinent (Figure 4). Hyperpigmentation, occurring mainly on the cheeks, may follow or coexist with slight dermatitis. Pigmented cheilitis has been reported from allergy to ricinoleic acid in castor oil used in lipsticks.¹³ Components of kumkum, applied as a cosmetic to the forehead in Asian women, commonly cause a pigmented dermatitis.¹⁴ The eyelids, face, and neck are the sites most frequently involved in cosmetic allergy,^{3,4} as observed in our study also.

Bindi, hair dye, and face creams were the most commonly suspected cosmetics in ACD due to cosmetics in a study on the pattern of cosmetic sensitivity in Indian patients.¹⁵ Skin care products (moisturizing and cleansing cream/lotion/milk) have been reported to account for the maximum number of cases of contact allergy to cosmetics in previous studies.^{12,15,16} This was in concordance with our

TABLE 2 Patients with positive reactions to their own cosmetics

Patient No.	Positive personal cosmetic	Positive allergens (ISS and ICFS)	Suspected cosmetics	Sites affected
1.	Hair dye	Paraphenylenediamine, cetrimide, thimerosal	Hair dye, shaving cream, soap	Face
2.	Hair dye, kumkum	Thimerosal	Hair dye, bindi, kumkum	Face
3.	Hair dye	Thimerosal, cetrimide, nickel sulfate	Hair dye, bangles, soap	Face, forearms, scalp
4.	Hair dye	Cetrimide, paraphenylenediamine	Hair dye, soap	Face, scalp, arms, forearms, trunk
5.	Kumkum, lipstick	Cetrimide, fragrance mix	Kumkum, lipstick, perfume, soap	Face, arms, feet
6.	Hair dye	Cetrimide, thimerosal	Hair dye, face cream	Face, scalp
7.	Kumkum, lipstick	-	Kumkum, lipstick, soap	Face
8.	Hair dye	Neomycin sulfate	Hair dye, henna	Face

study where soaps (53.4%) and face creams (24.1%) were the most common cosmetics causing ACD. Other common offending allergens were hair dyes, perfumes, and shaving creams.

The most common allergen tested positive in ICFS was cetrimide. Cetrimide is an antiseptic which is present in face creams, shaving creams, and shampoos. The other common allergens were thimerosal, which is an organic compound containing mercury and thiosalicylate, and is found in face creams, eye cosmetics, and perfumes; isopropyl myristate which is used as a thickening agent and emollient in many face creams, and shaving creams; and sorbic acid which is a preservative found in facial and eye makeup products, and shaving creams. In an Indian study by S. Singh et al.,¹⁰ the most frequently identified cosmetic allergens were fragrances and preservatives. We made an attempt to correlate the positive results of the cosmetics tested and the ingredients of cosmetics. A definite causal link was obtained in some cases such as face cream with thimerosal and isopropyl myristate, shaving cream with cetrimide and sorbic acid, hair dye with paraphenylenediamine, and perfume with thimerosal and fragrance mix. Nickel sulfate was the commonest positive allergen among the allergens of ISS. Nickel could be present as a contaminant in cosmetics, metal brushes used to apply makeup, bindi, and few eye cosmetics.³ Paraphenylenediamine is the main component of permanent hair dye, also found in bindi and henna. The other allergens included fragrance mix which is considered to be an important allergen of soaps and perfumes. Paraben mix is a preservative used in soaps, shampoos, and face creams. Cobalt chloride is usually present with nickel and is found in soaps, cosmetic pigments, and hair dyes. Eight patients out of 19 (42.1%) gave a positive reaction to the suspected cosmetic, thus confirming the presence of cosmetic contact dermatitis (Table 2). A previous study reported positive results to the suspected cosmetic in 50% of patients.¹⁵ Dogra et al.¹⁷ have reported 3.2% positivity with standard cosmetic kit and 3.3% with various cosmetics out of 2065 patches applied. Kumar P et al.⁴ have reported a rate of 3.75% positive reactions. Somewhat lower rate of positive reaction was observed in our study (2.12%).

Relevance of positive patch test reaction in this study was based on history of potential exposure as some patients could not supply the suspected cosmetics or were not willing to reuse them for patch testing.

To summarize, the trend of using cosmetics and skin/hair care products has been on an upsurge in developing countries like India. Consequently, there is a proportionate increase in the risk of sensitization to varied cosmetic allergens and allergic dermatitis to cosmetics. Many important cosmetic-related allergens may be missed by patch testing with standard series alone. Thus, additional testing with cosmetic series and offending personal cosmetic products should be undertaken to enhance the detection of relevant allergen/allergens, particularly in patients with a suspicion of cosmetic allergy. Moreover, we suggest that the common cosmetic allergens like cetrimide

and thimerosal should be added to the standard series in order not to miss these potential sources of cosmetic allergy.

CONFLICT OF INTEREST

The authors declared no conflict of interest.

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