Original Article

Clinico-epidemiological and Patch Test Profile of Patients with Suspected Allergic Contact Dermatitis to Cosmetics in a Tertiary Care Hospital in the Southern Philippines: A 3-year Retrospective Study

Zacaria B. Pario Jr., Karla Phoebe B. Castaños, Andrea Isabel Contreras

Department of Dermatology, Southern Philippines Medical Center, Davao, Philippines

Abstract

Background: Allergic contact dermatitis (ACD) is a common skin inflammatory reaction occurring at the site of challenge with a contact allergen in sensitized individuals and one of the most common causes for consultation in dermatology clinics. Patch testing is a method for detecting the causative component in suspected cases of ACD. Awareness about the causative allergen aids in reducing morbidity and can significantly minimize the impact of ACD in the affected people.

Objectives: The study aimed to measure the number of relevant positive reactions in patch tests being performed in our institution in patients with ACD to cosmetic products.

Methods: A total of 60 patients who were diagnosed with ACD to cosmetics and underwent patch testing were reviewed to identify the clinico-epidemiological and patch test profiles of these patients.

Results: The study showed that the mean age of patients was 42 comprising mostly of females. Most of the patients were unemployed, office workers, and medical workers. The most common cosmetic products that caused ACD include soaps, shampoos, lotions, and moisturizers. Nickel is still the most tested positive among these patients, followed by fragrance mixes and 4-phenylenediamine base. They are widely distributed in cosmetic products, especially in soaps and lotions. The pattern of dermatitis revealed facial dermatitis to be the most common reason for consult of these patients.

Conclusion: Patch test is valuable in the setting of establishing the etiology of ACD to cosmetic products.

Keywords: Allergic contact dermatitis, cosmetics, patch test

Address for correspondence: Dr. Zacaria B. Pario Jr., Phase 2, Block 18, Lot 21, RER Subdivision, Kauswagan, Cagayan de Oro 9000, Misamis Oriental, Philippines. E-mail: gozaibepario@gmail.com

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Introduction

Allergic contact dermatitis (ACD) is a common skin disease caused by a T-cell-mediated immune reaction to usually innocuous allergens. It is an inflammatory reaction occurring at the site of challenge with a contact allergen in sensitized individuals. It is characterized by redness, papules, and vesicles, followed by scaling and dry skin. It constitutes an important cause of dermatology appointments and even removal of patients from their activities, affecting both quality of life and

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occupational commitments. ACD is considered one of the most common dermatologic diseases and the primary cause of occupational disease. Recent studies found that ACD could be responsible for 50%–60% of occupational contact dermatitis and 20%–30% of all occupational diseases.[1]

Cosmetics have been defined as any preparation applied to the skin, mouth, hair, or nails for the purpose of cleansing and enhancing appearance. 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 toothpaste, 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. It is estimated that 1%–3% of the world population is in some way sensitized to a cosmetic product or its ingredients with a female preponderance. Contact allergy to cosmetic allergens is on the rise in developing countries like India due to the increasing use of cosmetics. Patch testing with standard series identifies the responsible allergens in almost 70%–80% of cases of contact dermatitis; however, many important cosmetic-related allergens may be missed using standard series alone.[2]

Patch testing is a method for detecting the causative component in suspected cases of ACD. The allergens that are included in every series may differ from one place to another. Awareness about the causative allergen aids in reducing morbidity and can significantly minimize the impact of ACD in the affected people.

In a 7-year retrospective study in India by Hassan *et al*. on 582 patients, nickel sulfate was the most common allergen identified in the study. Other allergens identified were cobalt sulfate, potassium dichromate, neomycin sulfate, paraphenylenediamine, and fragrance mix.[3] A similar study in Massachusetts by Tam *et al*. that included 2373 patients found that the top five allergens included nickel, fragrance mix I, balsam of Peru, neomycin, and bacitracin.[4] Another similar Israeli study by Zafrir *et al*. included 343 children and adolescents. Results showed that nickel is the most common allergen in Israeli children, especially girls. The study concluded that patch testing should be instituted in the pediatric group with suspected ACD.[5]

Cosmetic dermatitis commonly presents with erythematous scaly patches or a more diffuse erythema. Pigmented cheilitis has been reported from allergy to ricinoleic acid and castor oil used in lipsticks.[6] Cosmetic dermatitis seems to be more prevalent in certain age groups. In a study in 2017 of 58 patients by Garg *et al*., the age group ranged from 9 to 60 years, but majority of patients belonged to age 20–40 years old, with a female-to-male ratio of 1:6.25. The most common cosmetics used by the patients were soaps, followed by face creams, hair dye, henna, perfume, lipsticks, shaving creams, and nail paints.[6] A similar study conducted among 50 patients by Kumar *et al*. revealed that face creams, hair dyes, and soap were the most frequently suspected cosmetics. Males were commonly suspected to have allergy to hair dye, whereas females were suspected to have allergy to face products. The incidence was highest among people who use hair dye (80%). There was also increased prevalence seen in users of face products, shaving creams, and perfumes.[2,4]

With the increasing use of cosmetics, there has been a rise in the prevalence of contact dermatitis. In a study conducted in India by Sharma *et al*., there was an increase in patch test positive patients from 59.2% in 2000 to 72.6% in 2018. Dermatitis and hyperpigmentation were the predominant manifestation of contact dermatitis to cosmetics. The study included 100 patients and revealed that preservatives have been found to cause epidemics of ACD to cosmetics which included quaternium-15, formaldehyde, iodopropynyl butylcarbamate, and methyldibromo glutaronitrile among others. Skin-lightening creams also seem to be a common offending agent, and thimerosal was the common allergen, followed by cetrimonium and gallate mix. The prevalent use of skin-lightening creams in the Philippines stem from the stigma towards dark-colored skin and the preference for lighter-colored skin.[7]

Cosmetic products labeled as "natural" are increasing in popularity. This is due to a general belief among consumers that these products are safe and have health and environmental benefits. This does not hold true in most cases. A study conducted by Bruusgaard Mouritsen *et al*. on the natural ingredients in cosmetic products revealed that at least 121 different naturally derived cosmetic product ingredients are included in cosmetic products. Some natural components that can cause allergic reactions include milk, peach, peanuts, lanolin, and beeswax. The study concluded that supplemental patch tests with naturally derived ingredients may be prudent in patients manifesting skin reactions to cosmetic products.[8]

The demand also for hair cosmetics has been increasing which include cleansers, conditioners, style control, coloring, and relaxing products. Hair dyes have been reported to

be strong sensitizers. P-phenylenediamine remains an important allergic contactant. In one study conducted in Thailand by Boonchai *et al*., preservative agents such as methylchloroisothiazolinone/methylisothiazolinone (MI) demonstrated the highest percentage of positive patch test reactions. Surfactants also cause dermatitis, cocamidopropyl betaine being the most common surfactant causing positive reactions, whereas perming agents were less problematic in comparison.[9]

After metals, fragrances are the most frequent causes of ACD. The estimated prevalence of contact allergy to fragrance substance is 6%–14% in patients with contact dermatitis and 1.7%–4.1% in the general population. In a retrospective study done in 2018 by Silvestre *et al*., geraniol was the most frequent allergen in fragrance. The study suggested a specific fragrance series for patients positive for any fragrance marker.[1]

To summarize, the trend of using cosmetics and skin/hair care products has been on an upsurge in developing countries and is an important cause of ACD. As the only Philippine Dermatological Society accredited referral and training hospital in Mindanao, the Department of Dermatology of Southern Philippines Medical Center (SPMC) is an ideal institution to gather data regarding the allergens that are positive through patch tests in this region.

Objectives

The study aimed to measure the number of relevant positive reactions in patch tests being performed in the Department of Dermatology of the SPMC in patients with ACD to cosmetic products. The study further aimed to determine (1) the baseline demographic characteristics of patients who had undergone the patch such as age, sex, and occupation, (2) the allergen profile of patients based on the number and proportion of relevant positive reactions on the patch testing performed, (3) the top allergens diagnosed by patch testing, (4) the top affected sites of dermatitis and association between dermatitis location and type of allergen, and (4) the significant association between cosmetic product and type of allergen.

Methods

This study utilized a retrospective, descriptive design conducted at the Department of Dermatology of the SPMC. The study protocol was submitted and approved by the hospital Ethical Review Board. Patients with ACD to cosmetic products who underwent patch testing from January 2018 to December 2020 were included in the study. Patients' charts were retrieved and reviewed. Those with incomplete records were excluded from the study. To protect the patient's anonymity and secure their confidentiality, a patient code associated per patient during the recording of the data entries was made. Variables such as age were analyzed using standardized measuring tools, and standard values made use of mean and standard deviation. For categorical data, descriptive statistics namely frequencies and percentages were employed. The data which were used in this study were the following data sets: age, sex, and occupation. In terms of the allergen profile and proportion of relevant positive reaction, a frequency distribution was utilized. Positive substances are allergens that tested positive during the patch testing. Relevant substances are allergens that are found in the suspected cosmetic product. Substances are deemed positive and relevant when it tested positive in patch testing and are also found in the suspected cosmetic product. The statistical association between cosmetic product and type of allergen was analyzed using the Chi-square test for independence.

Results

A total of 60 patient charts were reviewed. Twenty were male and 40 were female, with a mean age of 42.17 ± 14.71. Most of the patients were unemployed, followed by office workers and medical workers [Table 1].

Patch testing results show that mascara had the highest percentage of suspected positive reactions, followed by eye shadows and moisturizers. The products that had the highest number of relevant patch test cases were shampoo, followed by lotion and soap. The products that had the

Table 1: Demographic profile

Characteristics	Total, *n* (%)
Age (years), mean±SD	42.17±14.71
Age group, frequency (%)	
0–19	1 (2)
20–39	28 (47)
40–59	23 (38)
≥60	8 (13)
Sex, frequency (%)	
Male	20 (33)
Female	40 (67)
Occupation	
Unemployed	20 (33)
Medical worker	7 (12)
Business owner	5 (8)
Construction worker	5 (8)
Teacher	2 (3)
Home-based worker	2 (3)
Electrician	1 (2)
Seafarer	1 (2)
Police officer	1 (2)
Saleslady	1 (2)
Manicurist	1 (2)

SD: Standard deviation

Table 2: Results of patch testing with patient's cosmetics

Suspected product	Positive, *n* (%)	Relevant, *n* (%)	Positive and relevant, *n* (%)	Suspected antigen
Shampoo	28 (40)	21 (30)	21 (30)	Methyldibromo glutaronitrile Methyl isothiazolinone Fragrance mix Fragrance mix II CI+Me–isothiazolinone Paraben mix Formaldehyde
Eye shadows	27 (65.9)	7 (17.1)	7 (17.1)	Nickel sulfate Methyldibromo glutaronitrile Colophony Potassium dichromate
Mascara	27 (73)	5 (13.5)	5 (13.5)	Nickel sulfate Methyldibromo glutaronitrile Colophony Potassium dichromate
Soap	25 (38.5)	20 (30.8)	20 (30.8)	Methyldibromo glutaronitrile Fragrance mix Fragrance mix II Methyl isothiazolinone CI+Me–isothiazolinone Paraben mix
Lotion	21 (38.2)	17 (30.9)	17 (30.9)	Methyldibromo glutaronitrile Fragrance mix Fragrance mix II Methyl isothiazolinone CI+Me–isothiazolinone Paraben mix
Hair dye	12 (40)	9 (30)	9 (30)	4-phenylenediamine base Textile dye mix
Perfume	17 (33.3)	17 (33.3)	17 (33.3)	Balsam of Peru Fragrance mix Fragrance mix II
Moisturizer	9 (42.9)	6 (28.6)	6 (28.6)	Methyldibromo glutaronitrile Paraben mix

Table 3: Top allergens

Substance	Tested positive, *n* (%)
Nickel sulfate	21 (35)
Fragrance mix	10 (17)
Fragrance mix II	7 (12)
4-phenylenediamine base	7 (12)
MDBGN	6 (10)
Thiuram mix	6 (10)
Cobalt chloride	5 (8)
Balsam of Peru	5 (8)
Textile dye mix	5 (8)
CI+Me–isothiazolinone	4 (7)
Neomycin sulfate	4 (7)
Paraben mix	3 (5)
Potassium dichromate	3 (5)
Mercaptobenzothiazole	3 (5)
Methyl isothiazolinone	3 (5)
Colophony	3 (5)
Tixocortol-21-pivalate	2 (3)
Myroxylon pereirae resin	2 (3)
Epoxy resin	2 (3)
N-isopropyl-N-phenylenediamine	2 (3)
Clioquinol (chinoform)	2 (3)
Formaldehyde	2 (3)
Benzocaine	2 (3)
Mercapto mix	1 (2)
Sesquirterpene lactone mix	1 (2)
Quaternium 15	1 (2)
Budesonide	1 (2)

MDBGN: Methyldibromo glutaronitrile

highest number of both positive and relevant patch test results were perfume, followed by lotion and soap, then shampoo and hair dye [Table 2].

The most common allergen identified were nickel, followed by fragrance mix, then followed by both fragrance mix 2 and 4-phenylenediamine base. The least identified common allergens were mercapto mix, sesquirterpene lactone mix, quaternium, and budesonide [Table 3].

The most prevalent patterns of dermatitis were facial dermatitis, followed by hand dermatitis. Hand, food, trunk, and disseminated dermatitis were the third most common patterns [Table 4].

The study revealed a significant relationship between the distribution of allergens and the suspected products. Fragrance mix was found lotions, shampoos, soaps, and perfumes, whereas fragrance mix 2 was found in lotions, shampoos, and soaps. Paraben was identified in moisturizers, soaps, and shampoos. CI+Me- Isothiazolinone was detected in shampoos and soaps, whereas methyldibromo glutaronitrile was found in moisturizers and lotions. MI was

Table 4: Clinical patterns

Patterns of dermatitis	Frequency (%)
Facial dermatitis	14 (23)
Hand dermatitis	11 (18)
Hand and foot dermatitis	9 (15)
Trunk dermatitis	9 (15)
Disseminated dermatitis	9 (15)
Foot dermatitis	8 (13)
Total	60 (100)

present in shampoos and soaps and 4-phenylenedimine base in hair dyes. Potassium dichromate and textile dye mix were present in mascaras. Formaldehyde was found in shampoos [Table 5].

Discussion

Due to the rise in commercially available cosmetic products in the market, more and more people have immediate access to these products giving rise to increasing cases of ACD. While there is a negative impact on makeup products, there was a reported increase in the use of eye products.[10] In this study, the mean age of patients was 42 with females using more cosmetics, more readily seeking consult, and undergoing patch testing. Most of the patients were unemployed, office workers, and medical workers. Recent studies showed that the diagnosis of ACD impacts the quality of life and work productivity,[11] ultimately resulting to a negative impact on employment and economics.[12]

The study showed that the most common household cosmetic products that could cause ACD include soaps, shampoos, lotions, and moisturizers. Even makeup such as eye shadows and mascaras were noted to have allergic components as well as different perfumes and hair dyes. While nickel is still the most tested positive among these patients, followed by fragrance mixes and 4-phenylenediamine base, the latter two were the most relevant allergens. They are widely distributed in cosmetic products, especially in soaps, lotions, and hair products.

The pattern of dermatitis revealed facial dermatitis to be the most common reason for consult of these patients. These may be due to cosmetic products mostly applied on the face such as soap, moisturizers, and makeup. The high incidence of hand dermatitis may also be due to the use of hands in the application of different cosmetic products on the body.

It is important to note the association of different cosmetic products and the type of allergen as this can be pivotal in the management of patients suspected with ACD to

Table 5: The significant association between cosmetic product and type of allergen

	Formaldehyde	Paraben mix	Textile dye mix	CI+Me-isothiazolinone	Balsam of Peru	MDBGN	Nickel sulfate	Methyl isothiazolinone	Fragrance mix	4-phenylenediamine base	Fragrance mix II	Potassium dichromate	*P*
Lotion	0	3 (5)	0	1 (2)	0	2 (3)	0	1 (2)	6 (10)	0	4 (7)	0	<0.01
Eye shadow	0	0	0	0	0	1 (2)	4 (7)	0	0	0	0	2 (3)	
Shampoo	1 (2)	2 (3)	0	3 (5)	0	0	0	3 (5)	7 (12)	0	5 (8)	0	
Soap	0	2 (3)	0	3 (5)	0	1 (2)	0	2 (3)	8 (13)	0	4 (7)	0	
Moisturizer	0	4 (7)	0	0	0	2 (3)	0	0	0	0	0	0	
Hair dye	0	0	4 (7)	0	0	0	0	0	0	5 (8)	0	0	
Mascara	0	0	0	0	0	1 (2)	1 (2)	0	0	0	0	3 (5)	
Perfume	0	0	0	0	5 (8)	0	0	0	7 (12)	0	5 (8)	0	

MDBGN: Methyldibromo glutaronitrile

these products. The study revealed that fragrance mixes are widely used in different cosmetic products such as lotions, soaps, shampoos, and moisturizers. Other allergens also such as paraben, CI+Me–isothiazolinone, methyldibromo glutaronitrile, MI, 4-phenylenedimine, potassium dichromate, textile dye mix, and formaldehyde can also be found in a variety of cosmetic products.

This retrospective study only consisted of 60 patient charts that were reviewed. Hence, it is recommended that a bigger sample size and a longer duration of the study be done so that the number of positive allergens may be assessed.

Conclusion

Patch test is valuable in the setting of establishing the etiology of ACD. Adequate knowledge of the most common allergen components of the most common cosmetic products is key in the prevention and management of ACD to cosmetic products. Patient education focused on allergen avoidance and safe product use is an integral part of treatment. Knowledge of the most common allergens is important for clinicians to be able to provide this education and render holistic medical care.

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Conflicts of interest
There are no conflicts of interest.

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