

ORIGINAL ARTICLE

Photopatch testing in Asians: a 5-year experience in Singapore

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SUMMARY

Background

Photopatch testing is important for diagnosing photoallergic contact dermatitis. We aimed to evaluate the use of photopatch test at the National Skin Centre, Singapore.

Methods

All patients who had photopatch tests done between 2007 and 2011 at the National Skin Centre were included.

Results

Twenty-two patients were included. The mean age was 40.2. Female : male ratio was 3.4. The ethnic groups were Chinese (68%), Malay (4%), Indian (14%) and others (14%). Ten out of 22 patients (45.5%) had a positive photopatch test. There were 20 positive photopatch test reactions found in these 10 patients, and all 20 positive reactions were of current relevance. The frequencies of the positive photopatch test reactions were 2-hydroxy-4-methoxybenzophenone (oxybenzone) ($n = 6$), 2-hydroxymethoxymethylbenzophenone (mexenone) ($n = 3$), 2-ethylhexyl-4-dimethylaminobenzoate ($n = 1$), ketoprofen gel ($n = 1$) and the patient's own product ($n = 9$).

Conclusions

Our study suggests that sunscreen is the most common photoallergen to date as opposed to musk ambrette, which was the most common photoallergen in our earlier study in 1991–1993. This finding is similar to the recent European Multicentre Photopatch Test Study.

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Photopatch testing (PPT) is important for diagnosing photoallergic contact dermatitis (PACD). PACD is an uncommon dermatosis with an incidence estimated to be 2–10% among patients referred for investigation of a photo-exposed site dermatosis (1). It typically presents as an eczematous eruption with photodistribution. PACD is a delayed type IV hypersensitivity reaction thought to occur when an exogenous agent (photoallergen) is applied to the skin and subsequently exposed to ultraviolet (UV) radiation (2–4). The action spectrum that most commonly elicits a photoallergic response is UVA (320 to 400 nm) (2, 5).

Although results of PPT have been presented from many European centres, there have been few reports of the results of PPT in Asia. The allergens that cause PACD change in trends over time based on product use by a population. Our objectives were (i) to evaluate the photopatch test results in the last 5 years (2007–2011) at the National Skin Centre (NSC), a tertiary referral centre in Singapore, to identify common photoallergens; (ii) to compare the photopatch test results with the results of the first study (1991–1993) carried out at the NSC; and (iii) to compare the photoallergens in Singapore with those in other Asian and Caucasian studies.

METHODS

All patients who had PPT done between January 2007 and December 2011 at the NSC were included in the study. A retrospective review of these patients' electronic medical records was done, collecting data on demographics, pre-photopatch test diagnosis and positive photoallergens, including the relevance of the positive reaction. Some patients had concurrent patch testing with the standard series, and their own products and the results were recorded as well, indicating the positive contact allergens including the relevance of positive reaction.

At our centre, PPT was conducted according to the European consensus methodology except that a dose of 10 J/cm² UVA was used instead of 5 J/cm² UVA (1). Photoallergens (Chemotechnique Diagnostics, Vellinge, Sweden) were applied on the upper back in duplicate using Finn Chambers (Epitest Ltd Oy, Tuusula, Finland) on Scanpor tape (Norgesplaster A/S, Vennesla, Norway). After 48 h, one set was then irradiated with 10 J/cm² UVA, using a Mutzhas Supuvasun 3000 high-pressure metal-halide source (spectral output 340–440 nm, peak 370 nm; Mutzhas, Munich, Germany) with an irradiance of 29 mW/cm² at 20 cm distance. After irradiation, the photopatch test site was covered with UV-impermeable mate-

rial. The patients were advised to wear thick clothes to avoid exposure to sunlight. At 48 h post irradiation, both irradiated and unirradiated test sites were evaluated.

RESULTS

A total of 22 patients were recruited, of whom 17 (77%) were female. The mean age was 40.2 (range 6 to 76). The ethnic groups were 68% (*n* = 15) Chinese, 4% (*n* = 1) Malay, 14% (*n* = 3) Indian and 14% (*n* = 3) others.

The majority of the patients were highly educated: 33% (*n* = 6) were professionals, 17% (*n* = 3) teachers, 17% (*n* = 3) students, 11% (*n* = 2) Singapore Armed Forces servicemen, 17% (*n* = 3) housewives and 5% (*n* = 1) construction workers.

The pre-photopatch test diagnoses comprised four major groups: (i) PACD (76%, *n* = 17), (ii) photoaggravated dermatitis (14%, *n* = 3), (iii) phototoxic reaction (5%, *n* = 1) and (iv) polymorphous light eruption (5%, *n* = 1).

Ten out of 22 patients (45.5%) had a positive photopatch test. There were 20 positive photopatch test reactions found in these 10 patients, and all 20 positive reactions were of current relevance. Six out of 22 patients had additional standard patch testing done. Four out of 6 patients (66.7%) had a positive patch test. There were eight positive patch test reactions, of which two reactions were of current relevance and the remaining six were of past relevance.

The frequencies of the positive photopatch test reactions were 2-hydroxy-4-methoxybenzophenone (oxybenzone), *n* = 6; 2-hydroxymethoxymethylbenzophenone (mexenone), *n* = 3; 2-ethylhexyl-4-dimethylaminobenzoate, *n* = 1; ketoprofen gel, *n* = 1; and the patient's own product, *n* = 9 (Table 1a and Table 1b).

Of the positive patch test responses, nickel sulphate was the most common allergen (*n* = 4), followed by potassium dichromate (*n* = 1), fragrance mix 1 (*n* = 1) and patients' own products, which included Olay cream and Physiogel cream (*n* = 2).

DISCUSSIONS

The clinical-demographic profiles of our patients are similar to those reported in the literature, with the mean age of patients being referred for PPT usually in the mid-40s (5–7). There was a preponderance of women, and this probably reflects a degree of referral bias, as women are thought to be more likely to seek specialist help for skin conditions and more likely to use cosmetics containing UV filters, as well as conventional sunscreens (6).

Table 1a. Photopatch test series 2007–2011 (22 patients)

No	Allergen	% petrolatum	No. photopatch test positive
1	Parsol 1789 (4-tertbutyl-4'-methoxy-dibenzoylmethane)	10	0
2	PABA (<i>p</i> -aminobenzoic acid)	10	0
3	Homosalate	5	0
4	Eusolex 6300 (3-(4-methoxybenzyliden) camphor)	10	0
5	Eusolex 6007, Escalol 507, octyl-dimethyl-PABA (2-ethylhexyl-4-dimethylaminobenzoate)	10	1
6	Eusolex 4360, Escalol 567, oxybenzone (2-hydroxy-4-methoxybenzophenone)	10	6
7	Parsol MCX, Escalol 557 (2-ethylhexyl-4-methoxycinnamate)	10	0
8	Mexenone (2-hydroxy-4-methoxymethylbenzophenone)	10	3
9	Eusolex 232, Novantisol (phenylbenzimidazol-5-sulphonic acid)	10	0
10	Sulisobenzene, Uvinyl MS-40, benzophenone 4 (2-hydroxy-4-methoxybenzophenone-5-sulphonic acid)	10	0
11	Drometrizole trisiloxane	10	0
12	Octocrylene	10	0
13	Octyl salicylate	5	0
14	Octyl triazone	10	0
15	Isoamyl- <i>p</i> -methoxycinnamate	10	0
16	Tinosorb S (bis-ethylhexyloxyphenol methoxyphenyltriazine)	10	0
17	Tinosorb M (methylene-bis-benzotriazolyltetramethylbutylphenol)	10	0
18	Uvinul A+ (2-(4-diethylamino-2-hydroxybenzoyl)-benzoic acid hexylester)	10	0
19	Uvasorb HEB (diethylhexyl butamido triazone)	10	0
20	Neoheliopan AP (diasodium phenyl dibenzimidazoletetrasulphonate)	10	0
		total	10

Allergens with positive reaction are highlighted in bold letters.

Table 1b. Photopatch test with patient's own product 2007–2011 (10 patients)

No.	Allergen	Concentration	No. photopatch test positive
1	Simple sunblock	As is	2
2	Banana Boat Dark Tanning Oil	As is	1
3	Kids Solait sun lotion	As is	1
4	Kiehl's SPF 15	As is	1
5	Baby Blanket Faces sunblock	As is	1
6	Neutrogena sunblock	As is	1
7	Heliocare Extreme SPF 50+	As is	1
8	Uriage SPF 50+	As is	1
9	Ketoprofen gel	As is	1
	Total		10

In this study, PACD was the final diagnosis in 10 out of 22 (45.5%) of the patients investigated. The rate of PACD was very high in our study population, as this selected group of patients was photopatch- tested when the index of suspicion of PACD was high. Sunscreen has emerged as the most common photoallergen that elicited PACD in our group of patients, and this is similar to some European countries, Australia and the United States (5, 6). One

patient had a positive reaction to her own ketoprofen gel (topical non-steroidal anti-inflammatory drugs), and this is one of the two most common agents found to be responsible for eliciting PACD (1).

There was a change in the most common photoallergen in our current study compared with our earlier study done by Leow *et al.* during the period of 1991–1993 (Table 2) (8). Musk ambrette used to be the most common photoal-

Table 2. Photopatch test series 1991–1993 (62 patients)

No.	Allergen	% petrolatum	No. photopatch test positive
1	6-methylcoumarin	1	0
2	Bithionol	1	0
3	Chlorpromazine	1	5
4	Diphenhydramine	1	0
5	3-(4-methylbenzylidene)-camphor	2	0
6	4-isopropylidibenzoylmethane	2	0
7	Fenticlor	1	1
8	Ethoxy-ethyl- <i>p</i> -methoxycinnamate	5	0
9	Hexachlorophene	1	1
10	Musk ambrette	1	8
11	Musk ketone	1	0
12	Mexenone (2-hydroxy-4-methoxy-4'-methyl-benzophenone)	2	1
13	PABA (<i>p</i>-aminobenzoic acid)	5	1
14	Parsol MCX (2-ethylhexyl-<i>p</i>-methoxycinnamate)	2	1
15	Promethazine	1	3
16	Quinine sulphate	1	1
17	Sulphapyridine	1	2
18	Tetrachlorosalicylanilide	0.1	2
19	Tribromosalicylanilide	1	0
20	Trichlorocarbonylanilide	1	1
		Total	27

Allergens with positive reaction are highlighted in bold letters.

lergen. It is a fragrant fixative used in both food and cosmetic industries. Interestingly, in the earlier series, it was found in *minyak atar*, fragrant oil used by Muslims before prayers (8).

The decline in the use of some products and the introduction of new ones have an impact on the prevalence of specific photoallergens that induce PACD. The allergens that cause PACD change depending on the products used by the population. In our study cohort, the majority were highly educated, and furthermore, Singapore is located just 1 degree north of the equator in Southeast Asia. The island does not have clear-cut seasons like summer, spring, autumn and winter, and the weather is warm and humid all year round. This is the more likely explanation for the usage of sunscreen as prevention of skin cancer and photoaging.

Although *p*-aminobenzoic acid (PABA) and its aminobenzoic acid esters (glyceryl PABA, padimate O and roxadimate) are effective sunscreen agents, their use has been limited by their side effects including allergic and photoallergic contact dermatitis (5, 9, 10). Hence, sunscreen manufacturers today are producing PABA-free sunscreen. This may explain why none of our patients

developed a positive reaction to PABA. Likewise, in the PPT studies in other centres, PABA is not the most frequent allergen highlighted, except for an earlier publication in Scandinavia (5).

From the literature, it seems that the change in trend, with sunscreen becoming the most common photoallergen, is similar in other parts of the world (5). Sunscreen is used much more commonly as the population gets more affluent, with increase in educational awareness of skin malignancy and photoaging. However, in the most recent study from India, fragrance mix is the most common photoallergen (11). This may be due to the fact that most of the study population has Fitzpatrick skin type IV to VI, hence less likely to be using sunscreen.

In conclusion, our study suggests that sunscreen is the most common photoallergen to date as opposed to musk ambrette, which was the most common photoallergen in our earlier study in 1991–1993. This finding is similar to those in the recent European Multicentre Photopatch Test Study and the United States (1, 2, 5, 6). The series of allergens used must be constantly updated to reflect newly identified and outdated photoallergens.

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