Adverse Effects of Skin Protective Products, Including Sunscreens

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Contents

Abstract

Adverse effects to skin protective products are rare in general. Potential side effects include aggravation of preexisting disease, e.g. irritant contact dermatitis, and allergic contact dermatitis. Potential contact allergens include preservatives, emulsifiers, and fragrances. It is recommended to include patient's own skin protection products when patch testing in case the hand dermatitis does not improve or is even worsening in spite of secondary prevention efforts. Confirmatory repetitive open application tests (ROAT) may be useful in doubtful reactions.

Keywords

Allergic contact dermatitis · Barrier cream · Photoallergic contact dermatitis · Sunscreens · Systemic absorption

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1 Core Messages

The overall incidence of adverse reactions to skin protection products seems to be low. Possible types of adverse reactions include aggravation of preexisting irritation, induction of allergic contact dermatitis, photocontact dermatitis, and enhancement of percutaneous absorption of particular chemicals.

Skin protection products may have unsatisfactory protective action or they may even aggravate the preexisting disease, such as irritant contact dermatitis (ICD). In rare instances, the product ingredients themselves may induce allergic contact dermatitis (ACD). In addition, the potential of some preparations to enhance penetration of certain hazardous substances through the epidermal barrier in the experimental setting caused concern. Altogether, barrier and after-work creams apparently only rarely induce adverse effects, judging by the low number of published case reports on intolerance reactions and experimental studies in the scientific setting.

While many authors reported a satisfactory protective action of PCs, others found no protection (see also ▶ Chap. 49, "Occupational Skin Products") or even aggravation of ICD in the

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experimental setting. A particular "skin protector" aggravated irritation due to sodium hydroxide and failed to provide action against two other irritants, SLS and toluene, in a guinea-pig study (Frosch et al. 1993). Also using a guinea-pig model, it was shown that treatment with inappropriate BCs may increase skin irritation induced by cutting oil fluids (Goh 1991). Especially, protection against organic solvents such as toluene, cumene, and octane appears to be a difficult field (Wigger-Alberti et al. 1998; Schliemann-Willers et al. 2001; Schliemann et al. 2014). Experimental efficacy testing of six skin protection products that were claimed to protect against "organic solvents" in a human repetitive irritation test failed to show benefit of any product, while two out of six products even aggravated skin irritation induced by n-octane and cumene significantly (Schliemann et al. 2013). These examples illustrate that the protective action of prework creams may be highly specific and depend on the type of irritant chosen. Accordingly, it is highly desirable that manufacturers should provide efficacy proofs for skin protective products resulting from standardized efficacy testing. Preferably, this should be performed by using in vivo test models that should take the various fields of intended use and different types of irritants into account (Fartasch et al. 2015).

Apart from insufficient efficacy against irritants or even amplification of barrier damage, cream constituents may induce allergic contact dermatitis. Intolerance of skin protection products or after-work creams should be considered in case of worsening of the preexisting hand eczema without other potential explanation. Patch testing should not only include the product as is but also the ingredients should be ordered from the manufacturer and patch tested in appropriate concentration(s) and vehicles according to the pertinent literature (de Groot 2009). It is important to identify the single responsible allergen in order to prevent further relapses caused by the same ingredient in other cosmetics used on the impaired skin or by working material. A subsequent confirmatory repeated open application test (ROAT) with the product (Fig. 1) can be very useful in cases of doubtful reactions, especially in atopics, to

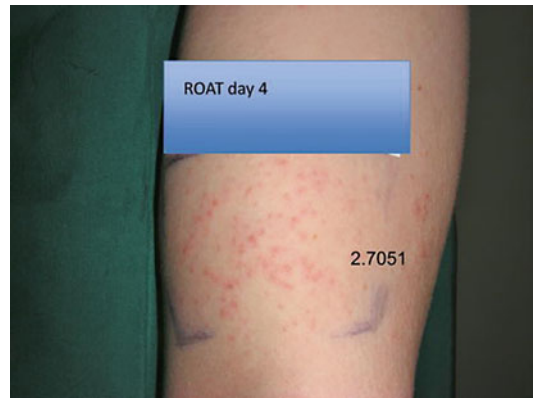

Fig. 1 Positive ROAT example, clinical picture showing numerous itchy erythematous papules

differentiate mild irritant reactions (Hannuksela and Salo 1986). Preservatives, emulsifiers, and fragrances are the main potential allergens. Fragrances are ubiquitous and part of many domestic and occupational products intended for hand exposure (see also ▶ Chap. 40, "Fragrances and Essential Oils"). Hands with impaired epidermal barrier function are more prone to secondary contact sensitization. Therefore, the results of a systematic literature research revealing a possible association between fragrance allergy and hand eczema is not surprising (Heydorn et al. 2003). In the EU, 26 fragrances have to be labelled in cosmetics according to current regulation. As a result, a tendency of manufacturers to avoid those fragrances in favor of alternatives that they do not have to declare is observed in Germany (Fartasch 2009). The allergenic potential of those fragrances is unknown in many cases. It is recommended that manufacturers should avoid well-known sensitizers in their products and at best fragrances at all. Potent fragrance allergens such as limonene and geraniol may cause ACD in barrier creams (Tanko et al. 2009) and even when contained in rinse-off products such as hand cleansers (Topham and Wakelin 2003) or washing-up liquids used at the work place (Murphy and White 2003). Methyldibromo glutaronitrile is a meanwhile historic preservative that has caused an epidemic of contact allergy in Europe (Schnuch et al. 2011), with creams and lotions accounting for 31% of the identified causative products and

liquid soaps for 23% (Johansen et al. 2005). The substance was as well found to be relevant in work creams (Wong and Beck 2001). From 2008 on, it has been totally banned both from all leave-on and rinse-off cosmetic products in the EU and will therefore no longer be found in barrier creams and after-work creams in Europe (Communities 2007). Methylisothiazolinone (MI) and the potential cross-reacting to methylchloroisothiazolinone (MCI) is the biocide actually causing an epidemic of allergic contact dermatitis in Europe and the USA in cosmetics but also in household and industrial products (Pesonen et al. 2015; Vauhkala et al. 2015). 1.5% out of 2536 patients tested in Denmark reacted to MI, and exposure from cosmetic products, such as soaps and moisturizers, accounted for 32% of contact dermatitis caused by MI (Lundov et al. 2010). Contact allergy to MCI/MI or MI has not yet been explicitly published in the context of being a constituent of barrier – or after-work creams – but has been found in skin care products, and more often, in liquid soaps, hand cleansers, and skin wipes (Vauhkala et al. 2015). Quaternium 15 is one example of a group of formaldehyde donors used as preservatives in cosmetics. It may induce allergic contact dermatitis in persons allergic to formaldehyde, such as health care workers, as has been described after usage of a moisturizing lotion, (Microshield®) (Cahill and Nixon 2005). Chlorocresol is an antiseptic and preservative used not only in topical medications but also rarely in cosmetics. In a single patient from Australia, it was identified as the cause of a severe contact allergy after application of a common moisturizer, Sorbolene®, as a barrier cream (MacKenzie-Wood and Freeman 1997). Coconut diethanolamide (CDEA), manufactured from coconut oil, is used as a surface-active agent in cosmetics and altogether a rare contact allergen. Anyhow in Finland, two out of six patients were sensitized from a barrier cream, while three got sensitized from a hand-washing liquid and one from either hand-washing liquid or metalworking fluid (Pinola et al. 1993).

Skin protection products are commonly used together with protective gloves, and some products are explicit omit spacely claimed to reduce the unfavorable effects of prolonged occlusion on the epidermal barrier that are caused by gloves. Studies investigating the effects of barrier creams on leaching of allergens from glove material are scarce and produced conflicting results either by showing reduced or enhanced release (Baur et al. 1998; Allmers 2001). Ideally, skin protection products recommended to be used under gloves should be tested in this context.

Topical sunscreens are recommended in outdoor professions as a part of a comprehensive UV protection strategy for outdoor workers to prevent acute sunburns, cumulative actinic skin damage, and nonmelanoma skin cancer (Glanz et al. 2007; Schmitt et al. 2011). Sunscreen chemicals, in particular UV filters, may as well cause allergic or photoallergic contact dermatitis. The diagnostic method in case of suspected photoallergy is photopatch testing. Photopatch testing should be considered in case a dermatitis predominantly affects UV-light exposed sites and in patients with chronic actinic dermatitis or obviously photoaggravated eczema. A European consensus statement on methodology, test materials, and interpretation of photopatch testing was given by the European Taskforce for Photopatch Testing (Bruynzeel et al. 2004). Benzophenones ranged among the most common sunscreen photoallergens in several studies (Schauder and Ippen 1997; Bryden et al. 2006; Agin et al. 2008; Victor et al. 2010) (reviewed in (Wong and Orton 2011). Other common sensitizers are para-aminonbenzoic acid PABA, isopropyl dibenzoylmethane (de Groot et al. 1987; Schauder and Ippen 1997), butyl methoxydibenzoylmethane (Bryden et al. 2006), oxybenzone (Cook and Freeman 2001), and octyl dimethyl, 4-tert-butyl-4′-methoxydibenzoylmethane in the USA (Victor et al. 2010). Isoamyl p-methoxycinnamate appears to be a rare photocontact allergen (Darvay et al. 2001; Ghazavi and Johnston 2011). Octocrylene (2-ethylhexyl 2-cyano-3,3-diphenyl-2-propenoate) is a filter covering UVB and short UVA that was recently shown to be both a photocontact allergen and a contact allergen (Avenel-Audran et al. 2010; Karlsson et al. 2011; Uter et al. 2017) and in addition has been reported as a cause of contact urticaria (Haisma and Schuttelaar 2017).

Other constituents of sun protection products might cause contact allergies as well. Recently, four cases of copolymer allergy to C30–38 olefin/isopropyl maleate/MA copolymer (CAS 75535-27-2) in a sunscreen were reported. Copolymers are chemical compounds that are used in many consumer products. They can be found in sunscreens, other cosmetic types, and topical medications and have been reported as a cause of contact allergy in cosmetics and adhesives (Kai et al. 2011). Other cases of allergic contact dermatitis were reported from Decyl Glucoside as a component of Tinosorb® (Andrade et al. 2010), from tetrasodium EDTA (Sanchez-Pedreno et al. 2009), and case reports upon further ingredients were reviewed in (Avenel-Audran 2010).

An additional concern regarding PCs is the possibility for enhanced penetration of particular industrial chemicals and carcinogenic substances. Skin protection preparations are aimed at prevention of irritant barrier impairment and not at prevention of systemic absorption. However, they are used also on already damaged skin and should not facilitate epidermal penetration of chemicals. Recent research demonstrated that it cannot be generally assumed that prework creams do reduce percutaneous absorption of chemicals, although there are examples of studies showing diminished dermal penetration, e.g., of N,N-dimethylformamide. Application of a particular barrier cream was indeed as effective as wearing impermeable rubber gloves in this study (Wang et al. 2006). Industrial solvents and aromatic amines are capable to penetrate through intact skin, and the penetration may go ahead without any visible signs of skin irritation, although the penetration rates through a damaged epidermal barrier are significantly higher than through healthy skin (Korinth et al. 2003, 2006, 2007). Using diffusion cells, it was demonstrated that penetration of three chemicals, namely, ethyleneglycol (EG), isopropylalcohol (IA), and 1,2,4-trimethylbenzene (TMB), was enhanced when the excised skin had been pretreated with a protective cream against water-based (EG and IA) and oil-based workplace substances, respectively (Korinth et al. 2003). A field study by the same group examined the influence of several factors on the percutaneous absorption of aromatic amines (AA) in the rubber industry (Korinth et al. 2007). The use of a protective cream and frequent washing were associated with increased systemic exposure to AA. The other protective measures, such as breathing masks, prolonged wearing of gloves, and afterwork creams were associated with decreased exposure. The authors suggest that some PCs may facilitate the adhesion of particles from the air to the skin in certain industries, as in the rubber industry the aromatic amines in the air are mainly bound to particles (Korinth et al. 2007). There are other examples, such as experimental studies with diffusion chambers or microdialysis that generated conflicting results, depending on the PC preparations and chemicals used (Loden 1986; Boman and Mellstrom 1989; Klede et al. 2005). These studies show that a potentially increased systemic toxicity risk of specific hazardous chemicals, due to epidermal penetration facilitated by barrier creams, should be considered in selected industries.

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