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Review

Art of prevention: Allergic sensitization through damaged skin: Atopic, occupational, and stasis dermatitis



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ABSTRACT

The prevention of allergic contact dermatitis hinges on maintaining the integrity of the skin barrier and responding appropriately when it is disturbed. Although intact skin is subject to sensitization via highly irritating allergens, such as poison ivy, acutely inflamed and chronically inflamed skin is subject to sensitization to allergens without inherent irritant potential. In the chronically inflamed state of atopic dermatitis, sensitization to proteins, such as food, also carries a risk for systemic contact dermatitis via ingestion of the allergen. Minimizing the development of irritant dermatitis is key to preventing sensitization. However, in patients with already chronically inflamed skin, reducing the use of products to the involved areas, recommending hypoallergenic products with caution, and taking measures to prevent biofilm formation are also integral to preventing sensitization to chemicals and proteins, such as food and commensal organisms.

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Preventing sensitization on damaged skin

Contact allergy in healthy versus damaged skin

Healthy skin with a normal lipid layer, keratinocytes, and a diverse microbiome is tolerogenic (i.e., less likely to sensitize to contactants; [Chinthrajah et al., 2016](#)). Allergens that cause sensitization in the healthy population are usually also potent irritants.

For example, poison ivy first causes irritation and then sensitization through the inflamed skin ([Hurwitz et al., 1984](#)). These allergic contact reactions lead to Th1 skewed dermatitis that usually stays with the patient for life ([Newell et al., 2013](#)) but rarely cause systemic contact dermatitis.

Damaged skin implies compromised barrier function. When skin is damaged, pattern recognition receptors of the innate immune system (e.g., defensins) are secreted. These recognize injury and/or microbes and predispose to allergic sensitization. Subsequently, the T cells that mediate dermatitis are educated as

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Th1 or Th2 cells depending on the environment and timing of the sensitization (Novak et al., 2010).

For skin that is acutely inflamed, moderately potent allergens that have only mild irritant potential can become allergens with Th1 skewing. For example, neomycin applied to an abrasion, an area of acute inflammation, is more likely to induce sensitization than if applied to intact skin. In chronically inflamed skin, such as in patients with atopic dermatitis who have a genetic deficit in barrier integrity, sensitization can occur to very weak allergens that rarely sensitize healthy individuals. Chronic stasis dermatitis is a similar scenario. Examples of allergens that affect chronically inflamed skin include tocopherol acetate (vitamin E), lanolin, parabens, food proteins, and commensal organisms (Kohli and Nedorost, 2016).

Notably, allergy to food proteins occurs almost exclusively in patients with genetic barrier dysfunction (also known as atopic dermatitis) and in food handlers who may have chronic hand dermatitis due to wet work (Hjorth and Roed-Petersen, 1976). Likewise, sensitization to commensal organisms can occur where chronic barrier dysfunction creates an environment hospitable to biofilms, such as in atopic dermatitis and stasis dermatitis. Biofilms create a high concentration of antigen per unit area, which promotes sensitization. For example, sensitization to *Candida albicans* can occur in women with chronic vaginal yeast infections and result in vulvodynia due to an immune response to normal yeast colonization (Ramirez De Knott et al., 2005).

Some patients sensitized in the context of chronic dermatitis will react after ingestion or inhalation of their allergen with dermatitis (including recall at a previous positive patch test site) and an antigen-specific urticarial response, which is known as systemic contact dermatitis. Examples of allergens associated with systemic contact dermatitis include nickel (Jensen et al., 2004) and sorbic acid (Raison-Peyron et al., 2000). Chronicity of dermatitis may be a factor in promoting the Th2 skewed response that underlies systemic contact dermatitis (Ellenbogen et al., 2018).

Practical interventions

Prevent irritant dermatitis by minimizing rapid wet-to-dry cycles: Instruct patients to remain in a high humidity environment after bathing until the skin is completely dry to prevent chapping. Discourage lip-licking, and suggest substituting alcohol-based hand cleanser for hand washing in seasons when indoor heating is in use because alcohol is less irritating than water in the setting of low ambient humidity (Jungbauer et al., 2004). If patients do wet work, encourage them to wear cotton gloves under occlusive gloves.

Prevent chronic inflammation due to stasis dermatitis: Prescribe gradient compression stockings for patients with swollen legs to be worn whenever they are not in bed.

Use emollients with caution on inflamed skin: Daily head-to-toe use of emollients delayed the onset of atopic dermatitis in high-risk neonates in a small study, although larger studies failed to validate this result (Chalmers et al., 2020; Simpson et al., 2014).

There are also problems with the use of emollients in established dermatitis. Sensitization to the emollient itself is common, especially in young children with atopic dermatitis, as in the case of sensitization to lanolin (Mailhol et al., 2009). Additionally, some products marketed to patients with atopic dermatitis contain food proteins, such as oat; sensitization to these may lead to systemic contact dermatitis when later ingested. It may be impractical to avoid irritant dermatitis so completely that sensitization to the emollient does not occur, so instead minimizing the ongoing use of emollients and aggressive treatment of early dermatitis may be the best way to prevent the contact sensitization that is part of severe atopic dermatitis. Emollients do not help all patients with

dermatitis, and studies showing benefit were short to medium (days to weeks) in duration. Data on long-term benefits are lacking (van Zuuren et al., 2017).

Recommend hypoallergenic products with caution: Although higher-potency allergens that sensitize on healthy skin are commonly identified with patch testing, lower-potency allergens such as foods (e.g., oats and vitamin E) are less commonly tested and more frequently used in hypoallergenic products. Lower-potency allergens are more likely to be allergens in patients with atopic dermatitis than in healthy individuals, which may also be the same group of individuals most inclined to seek out these products (Kohli and Nedorost, 2016). Furthermore, attempts to replace identified allergens often lead to replacement allergens, which is also known as the Dillarstone phenomenon (Dillarstone, 1997).

Although it is reasonable to avoid nonessential components, such as fragrance, it is not possible to recommend specific products that will not produce an allergy for any given patient. Therefore, we should not attempt to suggest avoidance of specific allergens. Comprehensive patch testing of all cutaneous exposures (including proteins such as latex, food, and pollen) in patients without a history of anaphylactic symptoms is the only accurate way to recommend products on a personalized basis for patients with dermatitis.

Prevent biofilms that may predispose to sensitization to commensal organisms: As of early 2020, there is no evidence to guide the prevention of biofilms that may predispose to sensitization to commensal organisms. In theory, acidifying the cutaneous surface may help promote barrier integrity, and cleansing may help reduce bacterial and yeast burden. Therefore, it is possible, but unproven, that low pH cleansers marketed as pH balanced that are regularly used may help prevent severe dermatitis characterized by sensitization to bacteria such as *Staphylococcus aureus* (in atopic dermatitis) and *Pseudomonas aeruginosa* (in stasis dermatitis). Vinegar may be helpful as a cleanser in stasis dermatitis because it kills *P. aeruginosa*; however, the persistence of low pH after topical exposure to vinegar is unlikely to be sufficient to restore the barrier (Luu et al., 2019).

Application of these principles to health care workers during the COVID pandemic: Instruct health care workers to use alcohol-based hand sanitizers in preference to handwashing during the winter season as previously noted. Although trials are lacking, the use of powder under occlusive masks to prevent maceration of the skin is more mechanistically based than is the suggestion to apply emollients in this humid environment.

Conclusion

Your grandmother probably had it right: Less is more. Encourage patients to keep their skin clean with daily bathing, but avoid excessive cleansing. Discourage use of topical products unless dermatitis is present and then recommend a topical medication or emollient with as few components as possible, to be used as directed and stopped when the skin is clear. If the dermatitis worsens, consider patch testing. If an allergen is detected with patch testing and the patient has had chronically inflamed skin, counsel on strategies to avoid ingestion of the allergen or related allergens.

Conflict of Interest

None.

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Study Approval

The author(s) confirm that any aspect of the work covered in this manuscript that has involved human patients has been conducted with the ethical approval of all relevant bodies.

References

- Chalmers JR, Haines RH, Bradshaw LE, Montgomery AA, Thomas KS, Brown SJ, et al. Daily emollient during infancy for prevention of eczema: The BEEP randomized controlled trial. *Lancet* 2020;395(10228):962–72.
- Chinthrajah RS, Hernandez JD, Boyd SD, Galli SJ, Nadeau KC. Molecular and cellular mechanisms of food allergy and food tolerance. *J Allergy Clin Immunol* 2016;137(4):984–97.
- Dillarstone A. Cosmetic preservatives. *Contact Dermatitis* 1997;37(4):190.
- Ellenbogen Y, Jiménez-Saiz R, Spill P, Chu DK, Waserman S, Jordana M. The initiation of Th2 immunity towards food allergens. *Int J Mol Sci* 2018;19(5):1447.
- Hjorth N, Roed-Petersen J. Occupational protein contact dermatitis in food handlers. *Contact Dermatitis* 1976;2(1):28–42.
- Hurwitz RM, Rivera HP, Guin JD. Black-spot poison ivy dermatitis. An acute irritant contact dermatitis superimposed upon an allergic contact dermatitis. *Am J Dermatopathol* 1984;6(4):319–22.
- Jensen CS, Lisby S, Larsen JK, Veien NK, Menné T. Characterization of lymphocyte subpopulations and cytokine profiles in peripheral blood of nickel-sensitive individuals with systemic contact dermatitis after oral nickel exposure. *Contact Dermatitis* 2004;50(1):31–8.
- Jungbauer FH, van der Harst JJ, Groothoff JW, Coenraads PJ. Skin protection in nursing work: Promoting the use of gloves and hand alcohol. *Contact Dermatitis* 2004;51(3):135–40.
- Kohli N, Nedorost S. Inflamed skin predisposes to sensitization to less potent allergens. *J Am Acad Dermatol* 2016;75(2):312–7.
- Luu LA, Flowers RH, Kellams AL, Zeichner S, Preston DC, Zlotoff BJ, et al. Apple cider vinegar soaks (0.5%) as a treatment for atopic dermatitis do not improve skin barrier integrity. *Pediatr Dermatol* 2019;36(5):634–9.
- Mailhol C, Lauwers-Cances V, Rancé F, Paul C, Giordano-Labadie F. Prevalence and risk factors for allergic contact dermatitis to topical treatment in atopic dermatitis: A study in 641 children. *Allergy* 2009;64(5):801–6.
- Newell L, Polak ME, Perera J, Owen C, Boyd P, Pickard C, et al. Sensitization via healthy skin programs: Th2 responses in individuals with atopic dermatitis. *J Invest Dermatol* 2013;133(10):2372–80.
- Novak N, Koch S, Allam JP, Bieber T. Dendritic cells: Bridging innate and adaptive immunity in atopic dermatitis. *J Allergy Clin Immunol* 2010;125:50–9.
- Raison-Peyron N, Meynadier JM, Meynadier J. Sorbic acid: An unusual cause of systemic contact dermatitis in an infant. *Contact Dermatitis* 2000;43:247.
- Ramirez De Knott HM, McCormick TS, Do SO, Goodman W, Ghannoum MA, Cooper KD, et al. Cutaneous hypersensitivity to *Candida albicans* in idiopathic vulvodinia. *Contact Dermatitis* 2005;53(4):214–8.
- Simpson EL, Chalmers JR, Hanifin JM, Thomas KS, Cork MJ, McLean WH, et al. Emollient enhancement of the skin barrier from birth offers effective atopic dermatitis prevention. *J Allergy Clin Immunol* 2014;134(4):818–23.
- van Zuuren EJ, Fedorowicz Z, Christensen R, Lavrijsen APM, Arents BWM. Emollients and moisturisers for eczema. *Cochrane Database Syst Rev* 2017;2(2):CD012119.