

Contact Dermatitis in the Atopic Child

Julia M. Kwan, MD; and Sharon E. Jacob, MD

The two major forms of contact dermatitis are irritant contact dermatitis and allergic contact dermatitis. Irritant contact dermatitis is seen in roughly 80% of contact dermatitis cases.¹ Irritant contact dermatitis is an inflammatory, but nonimmunologic dose- and time-dependent skin response to direct cellular injury caused by a skin irritant, and it does not require prior sensitization.^{2,3} Common irritants in the pediatric age group include excessive bathing, urine and feces in the diaper area, bubble baths, cleansers, or wipes.⁴

Allergic contact dermatitis (ACD) is a delayed-type, T-cell mediated hypersensitivity reaction (type IV immune response) wherein the allergens are small haptens that bind to epidermal carrier proteins to form complete



Figure. Classically, allergic contact dermatitis presents as a pruritic, eczematous dermatitis typified by edematous vesicles and papules coalescing into plaques.

Image courtesy of Sharon E. Jacob, MD. Reprinted with permission.

Julia M. Kwan, MD, is Dermatology Resident (PGY-3), Department of Dermatology, Naval Medical Center San Diego, CA.

Sharon E. Jacob, MD, is Associate Clinical Professor of Medicine and Pediatrics (Dermatology), Departments of Medicine and Pediatrics (Dermatology), University of California-San Diego, Rady Children's Hospital, San Diego, CA.

Address correspondence to: Sharon E. Jacob, MD; email: sjacob@contactderm.net.

Disclosure: The authors have no relevant financial relationships to disclose. The views expressed in this article are those of the authors and do not reflect the official policy or position of the Department of the Navy, Department of Defense, or the United States Government.

doi: 10.3928/00904481-20120924-15

antigens. Dermal dendritic cells in the skin process these antigens and present them to naive T cells in the lymph nodes, stimulating an immune response that results in T-cell activation and memory T-cell clonal expansion. Upon re-exposure to the same allergen, the sensitized T cells, primarily T helper 1 (Th1) type, home to the skin and release inflammatory mediators, producing intercellular edema of the epidermis and the clinical manifestations of ACD.^{2,3} Susceptibility to ACD varies according to age, frequency, type, and duration of allergen exposure.¹

The pathogenesis of allergic dermatitis (AD) is complex and multifactorial. Traditionally, AD has been categorized as an immune-

mediated condition driven primarily by Th2 cells,⁵ yet many now believe that the primary defect in AD is a disrupted skin barrier.⁶ AD patients often have insufficient amounts of filaggrin, which is critical for the skin to absorb atmospheric water and, thus, maintain moisturization. In addition, decreased amounts of ceramides, fatty molecules that promote water retention within the epidermis and prevent the ingress of foreign harmful substances, have also been demonstrated in the skin of atopics. The resulting compromised epidermal barrier facilitates the passage of pathogens, allergens, and irritants through the skin, leading to a cascade of events that initiates a Th2 response and the clinical manifestations of AD.

Over time, this defective skin barrier, by allowing ingress of allergens and irritants, can predispose the patient to both ACD and irritant contact dermatitis (ICD). Furthermore, recent evidence suggests that the severity and chronicity of AD may be influenced by Th1-type cell immunity.⁵ This transition to Th1 immunity could also effectively promote the development of ACD in these individuals.^{2,7-9}

EPIDEMIOLOGY OF ACD

The exact incidence and prevalence of ACD in children is unknown and difficult to quantify because the majority of pediatric patients are not referred for patch testing (the gold standard diagnostic method to confirm ACD). Also, pediatric ACD was previously overlooked, based on the belief that children had fewer exposures and less susceptible immune systems.¹⁰

Referral bias is a frequent confounder in estimating the prevalence of ACD in children. The overwhelming majority of published studies on pediatric ACD examine populations with recalcitrant dermatitis specifically consulted for patch testing on high clinical suspicion of ACD. Uncommon reports of patch testing in unselected (random) populations yield positive patch test rates ranging from 13.3% to 24.5%,¹⁰⁻¹³ which are much lower than the 14.5% to 70.7% prevalence rates noted in one review of the literature of published studies in symptomatic patients.¹⁴

Yet, it is imperative to understand that a positive patch test does not equate to the clinical diagnosis of ACD. In the absence of clinical correlation, a positive patch test indicates only a contact allergy or sensitization. The diagnosis of ACD requires that the

positive patch test allergen be relevant to the patient's current disease process. In other words, ACD can be confirmed when the avoidance of the offending allergen results in clinical resolution of the dermatitis.

An often-cited example of a clinically irrelevant patch test is that of thimerosal, a preservative previously found in many immunizations that

**It is imperative to
understand that a positive
patch test does not equate to
the clinical diagnosis of ACD.**

continued to elicit a high rate of positive patch tests despite no current clinical exposure sources. One study that speaks to clinical relevance showed that an unselected eighth-grade school population had only a 0.7% prevalence for current ACD with a 7.2% prevalence for past or present ACD.¹³

Nonetheless, there is increasing evidence to suggest that childhood ACD is not as rare as previously believed, and is, in fact, a growing concern in this population. It has been established that contact sensitization can occur at a young age.¹² In 2008, two US studies demonstrated that both adults and children referred for patch testing had comparable rates of ACD.^{15,16} The studies also emphasize that differences in the age at exposure and the frequency, type, and length of exposure required to induce sensitization to specific chemicals are significant in the development of ACD. These exposure patterns likely account for the common, but slightly different

contact allergens in adults vs. children referred for patch testing as well as the variability among geographic locales.¹⁶⁻¹⁸

CLINICAL PRESENTATION

As with any skin condition, a thorough history and physical examination is key. Particularly important is obtaining a detailed history of the patient's as well as siblings' and parents' exposures to hygiene products, clothing and footwear, jewelry, topical medications or herbal supplements, hobbies and extracurricular activities (athletic gear and equipment), recent travel, and environments.¹ As the reactions of ACD do not occur until 24 to 48 hours after the re-exposure to the sensitized allergen, it is vital to obtain a detailed account of all events in the preceding week.¹⁹

Because AD, ACD, and ICD may all present as eczematous dermatitis, it may be difficult to distinguish between them based on clinical findings alone. Classically, ACD presents as a pruritic, eczematous dermatitis typified by edematous vesicles and papules coalescing into plaques. These lesions are highly geometric or linear, and correspond to the sites of greatest allergen exposure and often spread beyond. Sometimes, the eruption can favor certain locations based on skin sensitivity. For example, tosylamide/formaldehyde in nail polish tends to cause ACD symptoms on the thinner skin of the eyelids and neck (see Figure, page 422), but spares the initial sites of contact on the thicker skin of the hands and fingers.¹⁹ "Id" reactions, wherein the lesions are distant from the initial contact site of the culpable allergen or in a generalized distribution over the body, can also occur in ACD. Such

Course Director

David W. Kimberlin, MD

Professor of Pediatrics
Sergio Stagno Endowed Chair
in Pediatric Infectious Diseases
Co-Director, Division of Pediatric
Infectious Diseases
The University of Alabama
Birmingham, Alabama

Program Committee

Stan L. Block, MD, FAAP

University of Kentucky
College of Medicine
Louisville, Kentucky

Joseph A. Bocchini Jr., MD

Louisiana State University
Health Sciences Center
Shreveport, Louisiana

James H. Brien, DO

McLean Children's Hospital
at Scott & White
Temple, Texas

Richard F. Jacobs, MD*

Arkansas Children's Hospital
Research Institute
Little Rock, Arkansas

Sarah S. Long, MD

St. Christopher's
Hospital for Children
Philadelphia, Pennsylvania

**Will not be in attendance*

Faculty

C. Buddy Creech, MD, MPH

Nashville, Tennessee

Kathryn M. Edwards, MD

Nashville, Tennessee

Lawrence F. Eichenfield, MD

San Diego, California

Margaret C. Fisher, MD, FAAP

Monmouth, New Jersey

Sheldon L. Kaplan, MD

Houston, Texas

George H. McCracken Jr., MD

Dallas, Texas

Mark H. Sawyer, MD

San Diego, California

Gordon E. Schutze, MD

Houston, Texas

Samir S. Shah, MD, MSCE

Cincinnati, Ohio

Stanford T. Shulman, MD

Chicago, Illinois



What's different in 2012:

NEW FORMAT

To achieve a well-balanced program, we'll round up "The Usual Suspects" in our morning review sessions and update your practice with sessions on "The New Developments" in the afternoons.

SPOT THE RASH

This new addition to the meeting will bring the popular monthly challenge you see in print to a new level with interactivity. Presenters will test your skills on pediatric dermatology issues, kicking off the meeting with a fun and exciting mental workout.

TOP 10

To round out the meeting, our experts will carefully review journal articles published throughout the year and provide perspective and action items on the 10 most applicable to your daily practice.

CLASSROOM STYLE

We have eliminated round tables and are implementing a classroom setup for improved visibility and to foster greater interaction between our experts and colleagues.

November 17-18, 2012

New York Marriott Marquis



The Twenty-Fifth Annual INFECTIOUS DISEASES IN CHILDREN[®] SYMPOSIUM

More CME • Exciting new sessions • A vibrant location

Experience a meeting that offers the features you value most

Agenda highlights

Earn up to 16.25 AMA PRA Category 1 Credits™

SATURDAY, NOVEMBER 17

Spot the Rash

Lawrence F. Eichenfield, MD

The Usual Suspects

Lyme Disease: Fact and Fiction

Margaret C. Fisher, MD, FAAP

Vaccines 2013: An Update on Uptake

Mark H. Sawyer, MD

Keynote Address: Bacterial Meningitis –

A New Look at an Old Foe

George H. McCracken Jr., MD

What's Your Diagnosis?

James H. Brien, DO

Lunch Symposium

Outlook on RSV: Emerging Science

This portion of the meeting is supported by an educational grant from MedImmune.

Symposium Director: Robert Belshe, MD

The New Developments

Kawasaki Disease: Typical, Incomplete and the Newer Immunomodulatory Treatments

Stanford T. Shulman, MD

The Resurgence of Measles in Our Neighborhood

Mark H. Sawyer, MD

Red Book 2012 Update

Sarah S. Long, MD

Diagnosis and Treatment of Pneumonia in Children: National Guideline Recommendations

Samir S. Shah, MD, MSCE

Neonatal Viral Infections

David W. Kimberlin, MD

Challenging Cases from Private Practice

Stan L. Block, MD, FAAP

SUNDAY, NOVEMBER 18

Breakfast Symposium

HPV Disease Update 2012

This portion of the meeting is supported by an educational grant from Merck & Co, Inc.

Symposium Director: Kenneth A. Alexander, MD, PhD

The Usual Suspects

Antibiotics: What's New, and How Do We Best Use What We Already Have?

George H. McCracken Jr., MD

Sinusitis: A Diagnostic and Management Update

Stan L. Block, MD, FAAP

Lymphadenopathy: The Big, the Bad and the Ugly

C. Buddy Creech, MD, MPH

Keynote Address: Staph Aureus: Continuing Developments in the Epidemic

Sheldon L. Kaplan, MD

What's Your Diagnosis?

James H. Brien, DO

Lunch Symposium

Infection Protection: New Insights and Ideas for Assessing and Treating Bacterial Conjunctivitis

This portion of the meeting is supported by an educational grant from Alcon Laboratories, Inc.

Symposium Director: Rudolph S. Wagner, MD

The New Developments

HPV Disease Manifestations and Prevention

Joseph A. Bocchini Jr., MD

Once Bitten, Twice Shy – Preventing Mosquito and Tick Bites

Gordon E. Schutz, MD

Clostridium difficile – New Diagnostics and Therapeutics

C. Buddy Creech, MD, MPH

PFAPA: Reassuring Families When Periodic Fevers Affect Children

Kathryn M. Edwards, MD

Top 10 Infectious Disease Articles of 2012 for the Pediatrician

Sarah S. Long, MD; Gordon E. Schutz, MD

Ask Us Anything

David W. Kimberlin, MD

LAST CHANCE

REGISTER BY
OCTOBER 12

TO SAVE \$100!

IDCNewYork.com

Toll-free: 1-877-307-5225, ext. 219 or 476



Scan the code to register or to see more details on our 25th anniversary meeting.

This continuing medical education activity is sponsored by



The Infectious Diseases in Children Symposium is supported, in part, by educational grants from Alcon Laboratories, Inc., MedImmune and Merck & Co, Inc.

ACCREDITATION: Vindico Medical Education is accredited by the Accreditation Council for Continuing Medical Education to provide continuing medical education for physicians.

CREDIT DESIGNATION: Vindico Medical Education designates this live activity for a maximum of 16.25 AMA PRA Category 1 Credits™. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

FACULTY/PLANNER DISCLOSURE POLICY: In accordance with the Accreditation Council for Continuing Medical Education's Standards for Commercial Support, all planners, teachers and authors involved in the development of CME content are required to disclose to the accredited provider their relevant financial relationships. Relevant financial relationships will be disclosed to the activity audience.

Priority Code: 830-24

reactions may occur with allergens such as nickel, which is one of the top causes of systemic contact dermatitis.¹

In contrast, ICD is typically less edematous and usually presents as discrete, linear, or geometric erythematous patches matching the contact sites of the offending irritant. Whereas ACD is usually pruritic, ICD is more often characterized by burning.

The location of the body sites involved can also be helpful in the diagnosis. For example, one might suspect clothing allergens when the dermatitis is focused on areas of the body such as the flexures of the extremities or subaxillary bands where garments may chronically rub against the skin. Facial, neck, or periorbital dermatitis may suggest allergy to preservatives or fragrances in cosmetic products.¹⁹ A periumbilical, neck and wrist, or earlobe dermatitis might indicate exposure to nickel in the clasps of jeans, necklace, bracelets, or earrings.¹

DIAGNOSIS

Patch Testing

Epicutaneous patch testing is the gold standard for the diagnosis of ACD. The process involves placing defined, preselected concentrations of suspected chemical allergens under occlusion on unaffected areas on the patient's back and/or inner arms. Intramuscularly injected and oral corticosteroids should not be administered within 4 and 2 weeks, respectively, of the patch test or during testing as they extinguish the patients' response to the chemicals.

In addition, topical steroids should be discontinued to the back and upper arms (the sites of patch testing) 7 days before and during the entire week of the patch test. However, patients are encouraged to use topical corticosteroids and emollients to treat skin eruptions that develop on sites other than where the patches are

placed. Additionally, patients may take oral antihistamines to control pruritus.

Within 48 hours, the patches are removed and the first reading of any reactions is performed. Irritant reactions, which may be follicular or erythematous in nature, may be noted at this first reading, but typically resolve by the time of the delayed read,

Th1 and Th2 reactions are not mutually exclusive and can occur concurrently in atopic patients.

which is performed between 3 and 7 days.^{1,18} As previously mentioned, positive patch tests must be clinically correlated with the patient's active dermatitis. Avoidance of the suspected allergen with resolution of the dermatitis definitively confirms the diagnosis of ACD.

Currently, patch testing is limited by the fact that the commercially available Thin-Layer Rapid-Use Epicutaneous (T.R.U.E.) test is only approved for individuals 18 years of age and older. Furthermore, allergens may need to be selected specifically for the patient based on exposures because patient size may limit the number of patches that can potentially be placed. Thus, it becomes imperative to screen children with individualized allergens based on personal exposure history and clinical distribution of the dermatitis.

TREATMENT

Topical therapies with corticosteroids, emollients, and calcineurin inhibitors, and — if indicated — oral corticosteroids may provide initial symptomatic relief while an avoidance regimen is instituted. Complete avoidance of the offending allergen or irritant is the ultimate treatment

for sustained relief of ACD or ICD. Education of the patient, parents, primary health care providers, and teachers is of utmost importance to ensure adequate avoidance of these allergens.¹

Special Considerations for ACD and AD

It is commonly accepted that AD patients may be more susceptible to ICD because the compromised skin barriers of AD patients may allow easier penetration of topical substances on the skin with subsequent irritation.²⁰ The coexistence of AD with ACD has also been demonstrated.⁹ In the past, patients with AD were considered to be less susceptible to developing ACD because of decreased Th1-mediated cellular immunity.³

Yet, more recent evidence suggests that although AD is initiated by Th2, it shifts to a predominantly Th1-immunity in the chronic phase.⁵ In addition, it has been noted that atopic, but not nonatopic, patients can have positive patch test reactions within 24 hours and that this is a Th2 (type I immediate hypersensitivity) response.^{5,21,22} In addition, both nonatopic and atopic patients who have ACD will manifest positive patch test reactions at 48 to 96 hours, the time frame required to elicit a type IV hypersensitivity reaction.² Indeed, it has been demonstrated that Th1 and Th2 reactions are not mutually exclusive and can occur concurrently in atopic patients.²³ Thus, it is notable that nickel, which consistently tops the list of clinically relevant allergens in multiple studies,^{9,15,16} is not only capable of inducing both type I and type IV hypersensitivity reactions,²⁴ but has also been shown to induce higher rates of contact allergy in those with loss-of-function filaggrin gene mutations, commonly seen in atopic patients.²⁵

More than one study has demonstrated that the rate of contact

sensitization may be proportional to the duration and/or severity of the AD.^{8,26} Belhadjali and colleagues⁸ proposed that the much higher prevalence of contact sensitization in atopic patients (60.9%) compared with those with moderate (37.5%) or mild (30%) AD related to the more frequent exposures to topical and oral medications, emollients, and cleansers that atopic children experience.

For example, Mailhol and colleagues²⁶ showed that although contact allergy to topical treatments for AD was not high, it was also not negligible (6.2%), with the most common allergens being emollients and antiseptics (chlorhexidine). Similarly, Nedorost and colleagues²⁷ suggested that AD patients might have more frequent positive patch testing to components of topical medicaments than non-AD patients.

Along these lines, the North American Contact Dermatitis Group (NACDG) demonstrated a higher prevalence of concurrent AD in pediatric patients (compared with adults) who had a relevant positive patch test, which might suggest that AD is a higher risk factor for ACD in children than in adults;¹⁶ however, they also noted that AD is more common in children. A study on children referred for patch testing at the University of Miami demonstrated that there was a higher prevalence of certain allergens in their atopic population, specifically nickel, neomycin, disperse dyes, and myroxylon pereirae.⁹

In a study by Giordano-Labadie and colleagues²⁸ of 137 atopic children, the most frequent contact sensitizations were not to topical corticosteroids, but rather to metals (19.3%), of which nickel was the primary culprit (14.9%); fragrance (4.4%); lanolin (4.4%); balsam of Peru (2.6%); neomycin (2.6%); and emollients (2.6%). These allergens are not entirely dissimilar

to those reported in children with or without AD who were patch tested for suspected ACD in other study centers.^{9,16}

CONCLUSION

Quantifying the prevalence of ACD in the atopic populations (the majority of whom are children) is a difficult task because, as previously described, the lesions of AD and ACD can be similar in morphology. A high index of suspicion is required when diagnosing ACD in atopic patients. The general consensus is that ACD should be considered when atopic patients have worsening disease with an increase in the body surface area affected; disease unresponsive to traditional therapies; present with lesions in specific locations (eyelids, face, hands, neckfolds); have new-onset dermatitis; or present with dyshidrosis.^{1,16,29}

Studies have shown that identification of ACD as a possible exacerbating factor to an underlying atopic predisposition or as a possible alternative diagnosis can avoid the need for systemic therapies with significant adverse effects, particularly in a pediatric population that is still undergoing significant active growth and development.²⁹ Thus, patch testing should be undertaken if there is suspicion that ACD may be contributing to recalcitrant dermatitis in the atopic patient. Patch testing may need to be more individualized in the pediatric atopic population and consideration should be given to emollients, topical antibiotics, and topical corticosteroids if clinically indicated. ■

REFERENCES

1. Nijhawan RI, Matiz C, Jacob SE. Contact dermatitis: from basics to allergodromes. *Pediatr Ann.* 2009;38(2):99-108.
2. Akhavan A, Cohen SR. The relationship between atopic dermatitis and contact dermatitis. *Clin Dermatol.* 2003;21(2):158-162.
3. Fonacier LS, Aquino MR. The role of contact allergy in atopic dermatitis. *Immunol Allergy Clin North Am.* 2010;30(3):337-350.
4. Frielander SF. Consultation with the specialist: contact dermatitis. *Pediatr Rev.* 1998;19:166-171.
5. Grewe M, Bruijnzeel-Koomen CA, Schopf E, et al. A role for Th1 and Th2 cells in the immunopathogenesis of atopic dermatitis. *Immunol Today.* 1998;19(8):359-361.
6. Jacob SE, Miller J, Herro EM. Treating atopic dermatitis: tips for maintaining an effective epidermal barrier. *Skin Aging.* 2011;19(Suppl 1):1-11.
7. Lammintausta K, Kalimo K, Fagerlund VL. Patch test reactions in atopic patients. *Contact Dermatitis.* 1992;26(4):234-240.
8. Belhadjali H, Mohamed M, Youssef M, Mandhouj S, Chakroun M, Zili J. Contact sensitization in atopic dermatitis: results of a prospective study of 89 cases in Tunisia. *Contact Dermatitis.* 2008;58(3):188-189.
9. Jacob SE, Yang A, Herro E, Zhang C. Contact allergens in a pediatric population: association with atopic dermatitis and comparison with other north american referral centers. *J Clin Aesth Dermatol.* 2010;3(10):29-35.
10. Weston WL, Weston JA, Kinoshita J, et al. Prevalence of positive epicutaneous tests among infants, children, and adolescents. *Pediatrics.* 1986;78(6):1070-1074.
11. Barros MA, Baptista A, Correia TM, et al. Patch testing in children: a study of 562 schoolchildren. *Contact Dermatitis.* 1991;25(3):156-159.
12. Bruckner AL, Weston WL, Morelli JG. Does sensitization to contact allergens begin in infancy? *Pediatrics.* 2000;105:e3.
13. Mortz CG, Lauritsen JM, Bindselev-Jensen C, et al. Contact allergy and allergic contact dermatitis in adolescents: prevalence measures and associations. The odense adolescence cohort study of atopic diseases and dermatitis (TOACS). *Acta Derm Venereol.* 2002;82(5):352-358.
14. Mortz CG, Anderson KE. Allergic contact dermatitis in children and adolescents. *Contact Dermatitis.* 1999; 41(3):121-130.
15. Jacob SE, Brod B, Crawford GH. Clinically relevant patch test reactions in children — a United States based study. *Pediatr Dermatol.* 2008;25(5):520-527.
16. Zug KA, McGinley-Smith D, Warshaw EM, et al. Contact allergy in children referred for patch testing: North American Contact Dermatitis Group data, 2001-2004. *Arch Dermatol.* 2008;144(10):1329-1336.
17. Heine G, Schnuch A, Uter W, et al. Frequency of contact allergy in German children and adolescents patch tested between 1995 and 2002: results from Information Network of Departments of Dermatology and the German Contact Dermatitis Research Group. *Contact Dermatitis.* 2004;51(3):111-117.
18. Jacob SE, Steele T, Brod B, Crawford GH.

- Dispelling the myths behind pediatric patch testing — experience from our tertiary care patch testing centers. *Pediatr Dermatol*. 2008;25(3):296-300.
19. Militello G, Jacob SE, Crawford GH. Allergic contact dermatitis in children. *Curr Opin Pediatr*. 2006;18(4):385-390.
 20. Tupker RA, Pinnagoda J, Coenraads PJ, Nater JP. Susceptibility to irritants: role of barrier function, skin dryness and history of atopic dermatitis. *Br J Dermatol*. 1990;123(2):199-205.
 21. Young E, Bruijnzeel-Koomen C, Berrens L. Delayed type hypersensitivity in atopic dermatitis. *Acta Derm Venereol Suppl* (Stockh). 1985;114:77-81.
 22. Thepen T, Langeveld-Wildschut EG, Bihari IC, et al. Biphasic response against aeroallergen in atopic dermatitis showing a switch from an initial TH2 response to a TH1 response in situ: an immunocytochemical study. *J Allergy Clin Immunol*. 1996;97(3):828-837.
 23. Walsh ML, Smith VH, King CM. Type I and type IV hypersensitivity to nickel. *Australas J Dermatol*. 2010;51(4):285-286.
 24. De Mello LM, Bechara MI, Solé D, Rodrigues V. TH1/TH2 balance in concomitant immediate and delayed-type hypersensitivity diseases. *Immunol Lett*. 2009;124(2):88-94.
 25. Novak N, Baurecht H, Schafer T, et al. Loss-of-function mutations in the filaggrin gene and allergic contact sensitization to nickel. *J Invest Dermatol*. 2008;128(6):1430-1435.
 26. 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):801-806.
 27. Nedorost ST, Babineau D. Patch testing in atopic dermatitis. *Dermatitis*. 2010;21(5):251-254.
 28. Giordano-Labadie F, Rance' F, Pellegrin F, Bazex J, Dutau G, Scharze HP. Frequency of contact allergy in children with atopic dermatitis: results of a prospective study of 137 cases. *Contact Dermatitis*. 1999;40(4):192-195.
 29. Jacob SE, Burk CJ, Connelly EA. Patch testing: another steroid-sparing agent to consider in children. *Pediatr Dermatol*. 2008;25(1):81-87.