

Nickel Allergy: Localized, Id, and Systemic Manifestations in Children

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Abstract: Nickel is the most common allergen causing allergic contact dermatitis in patch-tested children, especially in female children. Allergy to this metal can manifest in a variety of ways. In this case series, we present four children to illustrate the different presentations of nickel allergy confirmed by patch testing. Localized, id, and systemic nickel reactions are reviewed, as well as the diagnosis and management of nickel allergic contact dermatitis. While localized dermatitis in areas of direct contact to the allergen is the most common and easiest form of nickel allergy to identify, recognition of varying presentations is critical as these can result in more chronic and severe symptoms, and can be misdiagnosed as atopic dermatitis.

Nickel is a chemical element found ubiquitously in the environment and used with high frequency worldwide. In most industrialized nations, this metal is manufactured into steel and a variety of alloys containing cobalt, palladium, iron, titanium, gold, and magnesium (1). These alloys appear in common every-day items such as jewelry, eyeglass frames, belt buckles, jean snaps, zippers, coins, and keys, and are the main reason nickel ranks as the most common positive allergen among patch-tested populations (1). Recent evidence demonstrates that the prevalence of nickel allergy in the United States has almost tripled in the last two decades, with rates of nickel patch test positivity around 9.7% in the early 1980s (2) increasing to 26% just this past year (3). This rising prevalence led to nickel being named “allergen of the year” in 2008 by the American Contact Dermatitis

Society and a push for new initiatives to encourage U.S. government regulation of nickel content based on the 1994 European Union Nickel Directive (4).

Despite the high prevalence of nickel sensitization reported among children, current rates are still considered to be low estimates of the true prevalence in the general pediatric population, as nickel allergy can present in many ways, and confirmatory patch testing is not always performed (5). In this report, we present four cases of children with variable presentations of allergic contact dermatitis (ACD) to nickel and their patch test results, summarized in Table 1. For each of these patients, the presence of clinically relevant nickel exposure was confirmed with dimethylglyoxime testing; contact allergy was confirmed by positive thin-layer rapid-use epicutaneous (TRUE) patch tests; and clinical relevance

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was determined by identifying exposures and observing improvement of their dermatitis with avoidance of nickel. The clinical manifestations of localized, id, and systemic responses are also reviewed.

CASE REPORTS

Case 1

An 8-year-old Asian girl presented to our clinic for patch testing after referral for a 1-year history of persistent, pruritic dermatitis on her abdomen and posterior thighs that was recalcitrant to standard therapies. Her mother noted that “silver” jewelry seemed to make the dermatitis worse. On examination, the girl had symmetric erythematous, slightly lichenified eczematous plaques on both posterior thighs, along with pink scaly papules infraumbilically, correlating with exposure to her metal school chair studs and jean snaps, respectively (Fig. 1A,B).

Case 2

A 15-year-old African American girl presented for patch testing with complaints of intolerance to costume jewelry and a gradually worsening, intermittent, pruritic generalized dermatitis for the past 6 years. On examination,

lichenified, hyperpigmented plaques with follicular accentuation were noted on her posterior auricular, infraumbilical, jawline, posterior neck, bilateral shoulders, lateral upper thighs, and lower back areas (Fig. 2A,B). After patch testing, she was educated regarding avoidance of nickel, and given the extensive nature of her dermatitis, prescribed a low-nickel diet.

Case 3

A 9-year-old African American boy with a recalcitrant dermatitis for 6 years presented to our clinic for patch testing. Per mother’s report, the dermatitis was limited to the region around his umbilicus for years before she noticed it spreading to involve other areas of his body. On examination, hyperpigmented, scaly plaques were noted infraumbilically and involving his trunk, lateral upper thighs, and buttocks (Fig. 2C,D). His dermatitis correlated with exposure to metal jean snaps and coins in his pockets.

Case 4

A 16-year-old Hispanic girl presented with a 9-year history of a pruritic dermatitis that began on her infraumbilical area and arms. During the past year, the dermatitis had

TABLE 1. *Summary of Cases*

Case	Age	Sex	Race	Dermatitis location	Patch test result
1	8	F	Asian	Infraumbilical, posterior thighs	2+ Nickel sulfate
2	15	F	African American	Post-auricular, jawline, posterior neck, shoulders, infraumbilical, lateral thighs, lower back	2+ Nickel sulfate
3	9	M	African American	Infraumbilical, lateral thighs, buttocks, lower back	2+ Nickel sulfate
4	16	F	Hispanic	Full body including eyelids	1+ Nickel sulfate, 1+ cobalt, 1+ colophony, 1+ carba mix

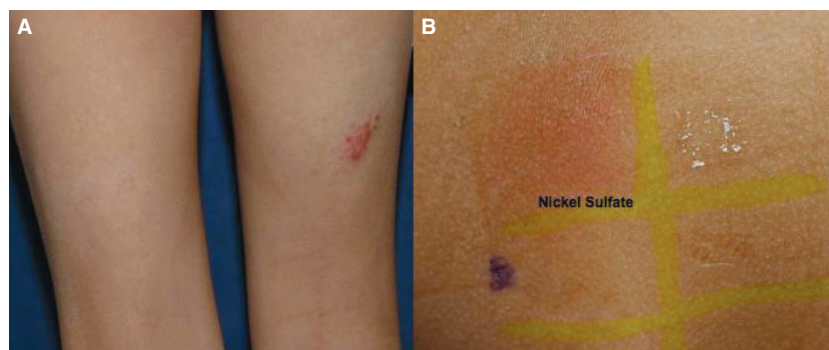


Figure 1. (A) Excoriated, erythematous plaque over posterior thigh localized to area of direct contact to metal chair knobs. (B) 2+ reaction to nickel sulfate on TRUE TEST patch.



Figure 2. (A) Periauricular hyperpigmented lichenified plaques and papules in the distribution of contact with earrings. (B) Papular id reaction over the lower back. (C) Hyperpigmented eczematous papules in the periumbilical region associated with belt buckles/jean snaps and id eruption over anterior chest. (D) Papular dermatitis over lateral thighs caused by contact with nickel-containing coins in his side pockets.



Figure 3. (A) Generalized excoriated papular eruption in a patient with systemic ACD to nickel. (B) An example of facial involvement with periorbital dermatitis, likely related to an ectopic transfer of nickel particles from the hands.

spread to the remainder of her body, including her face. What was believed to be atopic dermatitis was becoming progressively worse and more diffuse, despite the use of multiple mid and high potency topical corticosteroids and topical calcineurin inhibitors. On examination, excoriated, lichenified, erythematous papules, and plaques were noted over the majority of her body (Fig. 3A,B).

DISCUSSION

Allergic contact dermatitis to nickel is the clinical manifestation of a delayed-type hypersensitivity reaction (type IV). According to recent studies, women have a 3.74 relative risk of developing ACD to nickel when compared with men (1). In fact, the female-to-male ratio

of disease is 7–14 to 1 (6). In one population-based study of 85 children, 12.9% of patients under the age of five were nickel-sensitive (1).

Risk factors for the development of nickel allergy include female gender, young age, and body piercing, with perhaps the most important risk factor being the presence of body piercings. One study evaluating 567 Danish citizens discovered that patients with pierced ears had a significantly higher rate of nickel sensitization (14.8%) than those without (1.8%) (1). As approximately 82% of women have pierced ears (7), it is notable that a recent U.S.-based study found that 30.7% of 277 inexpensive earrings from San Francisco stores contained nickel, with the majority originating from stores targeting girls and younger women (7). The incidence of metal allergy in men also correlates with the number of piercings. Erlich et al demonstrated a 4% positive patch test rate in unpierced males compared to 11.1% in men with one piercing and 14.6% in men with multiple piercings (8).

Clinical Presentation

Historically, ACD to nickel was called “galvanization eczema” since it typically presented as hand dermatitis in miners and electroplating manufacturers (4). Today, however, nickel allergy is common among children and can present with a range of manifestations from localized dermatitis, to id reactions, to widespread systemic responses.

Localized A localized dermatitis in the areas of greatest contact with nickel is the most common presentation of nickel allergy (1). Studies have shown that the concentration of nickel needed to cause a reaction in the skin of highly sensitized patients can be as low as 0.44 $\mu\text{g}/\text{cm}$ (2,9). Common locations for dermatitis include the face, earlobes, wrist, neck, and periumbilical skin because of contact with eyeglasses, earrings, watches, necklaces, and belt buckles or snaps, respectively. Of these, the periumbilical site is most commonly affected (10). This observation was supported by our patients, who all demonstrated infraumbilical dermatitis at onset. Periauricular and facial dermatitis has also been reported to nickel in cell phones, and metal studs in chairs can cause dermatitis of the posterior thighs, as seen in case 1 (11).

Id Reactions An id response refers to involvement of skin areas lacking direct contact with nickel caused by autosensitization from immune cells circulating throughout the body (1). In one study evaluating 30 children under the age of 18 with proved ACD to nickel, id reactions were observed in 50% of patients (10). Nickel id reactions tend to present as pruritic papules over the

upper arms, thighs, knees, and elbows along with a periumbilical dermatitis, although they can also appear as generalized lichenoid papular eruptions (12). Id reactions are known to be more persistent than localized lesions, as they can last months after the localized plaques have cleared (10). A recent study of 38 children with id reactions to nickel found that the presentation was most often mistaken for atopic dermatitis in 37% of the children (12). Cases 2 and 3 in our series exhibited id reactions to nickel, in addition to their localized dermatitis.

Systemic A more extensive presentation of nickel allergy involves a systemic response, and is sometimes triggered by dietary ingestion of nickel. In 1984, Andersen et al. coined the term “baboon syndrome” to characterize the generalized dermatitis with particular involvement of the buttocks, anogenital area, flexures, and eyelids frequently observed in patients with systemic contact dermatitis (SCD) to nickel (13). Similar findings identified in our case 4. The recent North American Contact Dermatitis Group data demonstrated that of 122 patients with food-associated ACD, the most common allergen responsible was nickel, identified in 48.7% of the cases (14). According to one meta-analysis, SCD from oral exposure to nickel occurs in a dose-dependent fashion, and exquisitely sensitized individuals can react to just 0.22–0.35 mg of daily nickel intake from foods and/or tap water (1). A list of foods with high nickel content is provided in Table 2. Besides dietary nickel, other sources of exposure known to cause SCD include implantable endovascular, orthopedic, and dental devices (1). Systemic contact dermatitis to nickel has also been reported to present with chronic urticaria, erythema multiforme, vasculitis, and polymorphic erythema (15).

Diagnosis & Management

Although ACD to nickel is often diagnosed on the basis of high clinical suspicion, the *gold standard* for

TABLE 2. High Nickel-Content Foods (Irrespective of Soil Content)

Whole wheat/grains/oats
Cocoa
Chocolate
Peanuts
Tea
Gelatin
Baking powder
Soy products
Red kidney beans
Legumes
Dried fruits
Canned foods
Strong licorice
Certain vitamin supplements

definitive diagnosis remains epicutaneous patch testing, as a history of skin reaction to metal objects alone has not been shown to be a reliable indicator of nickel sensitivity (16). Patch testing is able to effectively improve quality-of-life measures in patients by allowing identification and avoidance of the responsible allergen (5).

Avoidance is the mainstay of therapy; however, symptomatic relief from nickel ACD often requires concomitant medical therapy. Mid- to high-potency topical steroids along with antihistamines may be used, in addition to moisturizers, which aid in repairing the skin barrier. Systemic steroids should be reserved for severe acute reactions involving >10% of BSA and are tapered over 3 weeks to help prevent rebound flares (1). As a comprehensive review of management is beyond the scope of this article, we acknowledge the importance of this topic and direct the reader to key sources (17,18).

For patients with SCD, dietary restriction may be helpful. Veien et al. demonstrated that of 90 nickel-sensitive patients, 64% experienced clinical improvement on a low-nickel diet after 1–2 months, and of the 55 patients who maintained the diet long-term, 73% exhibited improvement of their dermatitis after up to 2 years of follow-up (19). Furthermore, Antico and Soana found that a low-nickel diet effectively controlled symptoms in 44 of 112 nickel-sensitive patients after just 4 weeks (20). Of note, these subjects experienced clinical flares after being re-challenged with oral nickel (20).

CONCLUSION

As the rates of nickel sensitization among children continue to increase, it is imperative for clinicians to be able to recognize the various forms in which ACD to this allergen may present. Although the most common manifestation involves a localized dermatitis in sites of direct contact to nickel, such as the peri-umbilical or pierced-earlobe region, it is necessary to be aware of the other presentations including id and systemic reactions, especially as the latter forms can be more persistent and debilitating, and may often be confused for atopic dermatitis.

CONFLICTS OF INTEREST

This center performed an Allerderm-sponsored PREA TRUE TEST clinical trial of panel 1.1, 2.1, and 3.1 in children and adolescents. The authors have no other financial disclosures to declare related to the content of this article.

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