

Clinical work-up of a highly reactive nickel-allergic patient

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Nickel patch test reactivity may vary 250-fold, and some individuals may react even to very low concentrations (1). We describe a patient with a very low reactivity threshold for nickel.

Case Report

A 37-year-old woman complained about localized dermatitis at the site of jewellery exposure (ears and neck). She had previously suffered from dermatitis resulting from mobile phone exposure, a case story that was presented

on national television (2). Nickel allergy had been verified by patch testing prior to the current investigation.

Filaggrin testing

Filaggrin null mutation status (R501X and 2282del4) was assessed according to a method described previously (3). No null mutations were found.

Patch testing

Patch testing was performed with the European baseline series, except for nickel sulfate 5% pet., and with copper sulfate 2% pet., as previously detailed (4). No metal allergy was registered.

Serial dilution testing

Patch testing with a nickel sulfate (NiSO₄·6H₂O in 10% ethanol with 90% water) dilution series was performed

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with 15 µl of each dilution applied on a filter paper in a small Finn Chamber® (Epitest Ltd, Oy, Finland) on Scanpor® tape (Norgesplaster A/S, Alpharma, Vennessla, Norway): 200, 150, 50, 25, 12.5, 6.25, 3.125, 1.5, 0.5, 0.1, 0.05 and 0.0125 µg nickel/cm², and a vehicle control (supplied by the Copenhagen County Hospital Pharmacy). The reading scale suggested by Hindsén and Bruze (5), grading reactions from 0 to 8, was also used to assess reactions weaker than those fulfilling the criteria for a positive reaction. The threshold concentration for reactivity was defined as the lowest concentration giving a visible reaction (minimum score 1 = few papules with no erythema and no infiltration) on D4 in a continuous line of patch test reactions, starting from the highest test concentration. The threshold concentration in the patient was found to be 0.1 µg nickel/cm².

Scanning electron microscope testing

Jewellery to which the patient had reacted was collected for further examination (two earrings and three necklaces). Microstructural surface characterization and chemical analysis were performed on the surfaces of four of the items, with scanning electron microscope (JEOL 5900; JEOL, Tokyo, Japan) in combination with energy dispersive spectroscopy (Oxford Link ISIS analyser; Oxford Instruments, Oxford, UK), and INCAEnergy EDS software (Oxford Instruments) (Table 1).

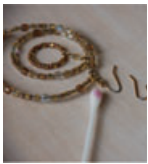
Nickel and cobalt release testing

Testing for nickel release was initially performed with the dimethylglyoxime (DMG) spot test prepared by the hospital pharmacy in the Capital Region of Copenhagen. The test solutions were 1% DMG in alcohol, and 10% ammonium hydroxide in water. Test results were negative except for a positive reaction at an earring post with a defective coating (jewellery E in Table 1 and Fig. 1). Nickel release in 1 week was then assessed, after storing items A–D in artificial sweat, with atomic absorption spectroscopy, which is capable of detecting a concentration of 0.01 mg of nickel per litre of artificial sweat, as according to EN 1811, the reference test method for showing compliance with the EU Nickel Directive. Each item was immersed in artificial sweat, and the results showed that 0.6 µg nickel/cm²/week was released from the dark earring with black stones (jewellery C in Table 1), whereas no nickel release was detected from items A, B, and D.

Discussion

This case report describes a multidisciplinary clinical work-up of a nickel-allergic patient who complained of

Table 1. Distribution of metals after surface energy dispersive spectroscopy (EDS) analysis on five items

		Content (%) of selected metals					
		Au	Cu	Ni	Pd	Sn	Zn
Jewellery A							
Decorative heart		45	41	1.3	1.5	9	3
Chain		37	40	1.3	1.4	17	3
Jewellery B							
Ring with stones		39	25	0	19	5.5	1.3
Lock		22	29	0.3	40	3.3	1.4
Chain		29	26	0.3	32	4	0
Jewellery C							
Pendant with stones		0	95	0.1	0	0	3
Post		0	91	0	0	0	5
Jewellery D							
Chain		0	78	0.01	0.03	0	19
Jewellery E							
		—	—	—	—	—	—

—, not performed.

frequent eruptions of dermatitis following skin contact with jewellery. Serial dilution patch testing with nickel sulfate revealed a very low elicitation threshold level for nickel. Although nickel allergy and dermatitis are associated with the filaggrin null genotype (3), no association could be identified for the two most frequent null mutations. Overall, we found definite nickel release from two jewellery items, and we discuss alternative explanations for the patient's intolerance to other items:



Fig. 1. Defective coating of an earring post resulting in nickel release as indicated by a positive dimethylglyoxime test result.

- (1) DMG testing revealed that the posts of a pair of 3-year-old piercing earrings (purchased for approximately €40) had coating defects resulting in nickel release (jewellery E) (Table 1 and Fig. 1). Consumers may not be sufficiently protected by the EU Nickel Directive in its current form. This notion is also supported by the facts that the patient often used a DMG test kit at home and that she was fully aware of her nickel allergy.
- (2) The assessment of nickel release in artificial sweat revealed that a pair of her earrings (jewellery C) released nickel in concentrations that may result in allergic nickel dermatitis (0.6 nickel/cm²/week).
- (3) Despite the low surface content of nickel in jewellery A and B (Table 1), nickel ions could have been released, as gold is known to accelerate the

release of nickel, owing to galvanic corrosion (6). Also, gold, which was present in jewellery A and B, may infrequently elicit allergic contact dermatitis (6). It is also possible that the patient reacted to palladium (not tested), as patients who are allergic to nickel often co-react to palladium chloride upon patch testing (7, 8). Palladium was found in high concentrations in jewellery B. Finally, we may have observed a false-negative reaction to 2% copper sulfate. Wörhl et al. suggested that 5% copper sulfate should be used for clinical evaluation, on the basis of a large patient series (9). Patients with nickel allergy may also be copper-allergic (10, 11).

- (4) Irritancy does occur following skin contact with jewellery, especially during warm and humid summer months. All jewellery could have caused irritancy.

We used various diagnostic tools to characterize metal exposure in a highly nickel-sensitive patient. We detected nickel release in two of five items, and, furthermore, one item contained nickel in small amounts that could potentially result in nickel dermatitis. Palladium and copper release may be of significance in highly nickel-reactive patients, owing to cross-reactivity, but this was not sufficiently examined and could not be confirmed in this case. It is becoming apparent that an increasing number of alloys are used to make jewellery, and that the composition is changing. We, therefore, recommend extensive metal allergen screening of patients with jewellery dermatitis. We plan to determine the composition of a large sample of jewellery in the near future to create a relevant jewellery patch test series.

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