

Assessing the validity of self-reported history of rash caused by metal or jewellery

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Summary

Background. The use of metal-containing bio-devices is becoming increasingly common. Self-reported history of dermatitis with metal exposure is not established as being predictive for metal allergy.

Objectives. To assess the validity of two screening questions addressing metal allergy.

Methods. At Massachusetts General Hospital Contact Dermatitis Clinic, 2132 consecutive patients were asked either 'Do you get rashes when jewellery touches your skin' (Q1; N = 1816) or 'Do you get rashes when metal touches your skin?' (Q2; N = 316) before being patch tested.

Results. Testing showed that 20% of subjects had positive reactions to nickel, 7.4% had positive reactions to cobalt, and 5.8% had positive reactions to chromium. Q1 was 40% sensitive (95%CI: 35–45%). The positive predictive value (PPV) was 51%, and the negative predictive value (NPV) was 82%. Q2 was 77% sensitive (95%CI: 68–84%). The PPV was 71%, and the NPV was 84%. Q2 was 37% more sensitive than Q1 ($p < 0.0001$), with a higher relative risk (RR) (4.75, $p < 0.001$) than Q1 (RR = 3.01, $p < 0.001$).

Conclusions. Patient-reported metal allergy, although not perfect, is a reasonable method for metal allergy screening to help identify those needing further objective evaluation by patch testing.

Key words: chromium; cobalt; epidemiology; jewellery; metal allergy; nickel.

Allergic contact dermatitis (ACD) is a common dermatological disease presenting for treatment, with a yearly prevalence in the United States and Europe ranging from 15% to 20% (1–3). ACD accounted for 9.2 million visits to physicians in 2004 (4). Experts agree that patch testing is the gold standard for diagnosing ACD. Given the prevalence and associated cost of contact dermatitis, it is essential to assess epidemiological trends and identify cost-effective methods for diagnosing and treating these patients.

Because obtaining a self-reported history of allergy is both practical and cost-free, previous studies have sought to validate screening questions. In small studies, personal history did not provide an accurate estimate of the true prevalence (5–10). The aim of this study was to attempt to validate two questions by retrospectively examining patch test results collected over a 10-year period. In theory, characterizing the efficacy of these screening questions can help to determine which patients need patch testing prior to and after procedures in which metal-containing devices are implanted.

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Patients and Methods

Study population

Between July 2006 and September 2016, 2132 consecutive patients were referred to the Massachusetts General

Hospital Contact Dermatitis clinic in Boston, MA, USA for patch testing. Patients were referred by dermatologists, allergists, primary-care physicians or surgeons for evaluation of suspected ACD. Among these, 1816 patients were asked the question 'do you get rashes when your skin is exposed to jewellery?' (Q1). During the last 12 months of the study, 314 patients were asked 'do you get rashes when your skin is exposed to metal?' instead (Q2).

Patch testing

After being asked one of the two validation questions, all patients were patch tested. The allergens tested were customized on the basis of the patient history, with most being screened with the Chemotechnique (Vellinge, Sweden) North American baseline series and a modified cosmetics/preservative series. The reactions were read by a single physician (P.C.S.) on day (D) 2 and then again on D3 or D4. Results were categorized as allergic (+, ++, +++), doubtful (?+), irritant (IR), or negative (negative). Negative, IR and doubtful reactions were not considered to be allergic reactions. An allergic reaction was defined as both erythematous and infiltrative (11).

Statistics

Statistical analysis was performed on cobalt, chromium, and nickel. Sensitivities, specificities, negative predictive values and positive predictive values (PPVs) for the two screening questions were computed with 95% confidence intervals (CIs). A true positive was defined as a patient's affirmative answer to one of the screening questions, and their subsequent allergenic reaction to any of the following: cobalt chloride, potassium dichromate, or nickel sulfate. Chi²-tests were employed using SAS 9.4 (SAS, Cary, NC, USA) statistical software to compare sensitivities and specificities.

Table 1. Prevalence of metal allergy (2006–2016) at Massachusetts General Hospital as compared with the findings of the North American Contact Dermatitis Group (NACDG) (2013–2014)

Metal	Positive reactions (%)	NACDG 2013–2014 (%)
Nickel sulfate 2.5% pet.	19.9	20.1
Cobalt chloride 1% pet.	7.3	7.4
Potassium dichromate 0.25% pet.	5.8	2.2

Results

Of the participants, 554 (26%) were male and 1576 (74%) were female. The average age was 46.9 years (range: 10–90 years). Metal allergy prevalences are summarized in Table 1. Our results for metal allergy are comparable with other prevalence data (12, 13).

Within the study population, 1816 patients were asked Q1 prior to patch testing; the remaining 316 patients were asked Q2. The results are summarized in Table 2. When we compared the validity of these two questions to help in screening for metal allergy and predict metal hypersensitivity reactions, we found that Q2 was 37% more sensitive than Q1 (95%CI: 31.5–42.1, $p < 0.0001$). Q1 was 8% more specific than Q2 (95%CI: 3.3–13.1, $p = 0.0002$). The relative risk (RR) of patch testing positively for metals for patients who answered in the affirmative to Q1 was 3.01 (95%CI: 2.91–3.1, $p < 0.001$), and the RR for Q2 was 4.75 (95%CI: 4.62–4.87, $p < 0.001$). Q1 and Q2 had PPVs of 51% and 71%, respectively.

Discussion

The sensitivity of Q2 is in the same range as previously reported for patch testing sensitivity, that is, 70–80% (14). It is more sensitive and has a higher PPV than Q1. If Q2 was answered in the affirmative, the patient was nearly five times more likely

Table 2. Sensitivity, specificity, positive predictive value and negative predictive value of two validation questions

	Ko et al. (present study)		Fors et al. (9)	Kieffer (11)	Fleming et al. (10)
	Question 1: 'Do you get rashes when your skin is exposed to jewellery?' (n = 1816)	Question 2: 'Do you have rashes when your skin is exposed to metal?' (n = 316)	'Do you get itching eczema from metal parts that come into contact with your skin?'	'Previous skin reactions under metal items such as zips and buttons?'	'Do you have skin reactions to nickel?'
Sensitivity, % (95%CI)	40 (35–45)	77 (68–84)	52%	65%	82%
Specificity, % (95%CI)	87 (85–89)	79 (72–84)	87%	98%	77%
Positive predictive value, % (95%CI)	51 (45–56)	71 (62–78)	32%	54%	54%
Negative predictive value, % (95%CI)	82 (79–83)	84 (78–89)	94%	98%	61%

CI, confidence interval.

to be metal-allergic. Although these results are not sufficiently sensitive/specific to recommend completely forgoing diagnostic patch testing if positive, there is distinct clinical utility in taking this clinical history. The American Contact Dermatitis Society (ACDS) recently published an opinion-based review of their suggestions for pre-implantation and post-implantation management of suspected metal allergy (15). Patients without a clinical history of metal allergy do not require routine screening prior to device implantation. The ACDS does not define a specific historical question to determine those who need metal allergy evaluation. We suggest that Q2 is the most suitable historical screening question with which to determine a patient's asymptomatic status. Metal allergy is one of many potential causes of post-implantation morbidity. Historical screening is probably less helpful in these patients.

There were several limitations of this study. One major discrepancy is the difference in sample size between the patients asked Q1 and those asked Q2. Q2 was added

to the standard history only in the last year of the study. Nonetheless, sensitivity and specificity differences were statistically significant. Our patient population was taken from a tertiary referral clinic, and may have a higher risk of allergy than the general population. Thus, metal allergy prevalence may be overestimated. That being said, the prevalence of nickel allergy was largely consistent with that found in other studies in the literature. Tests were read at D3 or D4, so late positive reactions might have been missed, and it is conceivable that the PPVs of both questions are underestimated.

In conclusion, although it is not perfect, clinical screening to determine metal allergy is useful for identifying patients in whom further evaluation for metal allergy by patch testing is appropriate. The question 'do you have rashes when your skin is exposed to metal?' seems to perform the best in predicting actual metal allergic dermatitis determined by patch testing. Clinical screening in addition to further objective testing is a valuable component for evaluating potential metal allergy.

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