

Occupational Airborne Allergic Contact Dermatitis Caused by Gold

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Airborne allergic contact dermatitis caused by gold is rare, often not even suspected and hence not investigated. Our purpose was to elucidate the clinical relevance of gold-induced airborne contact dermatitis. We analyzed and discussed the occupational dermatitis of two women working as restorers. Both patients' test results showed positive reactions to gold sodium thiosulfate only. The stop-and-relapse test confirmed the diagnostic hypothesis of airborne contact allergy. Our patients turned out to be gold sensitized because of occupational exposure to gold dust and gold leaf.

GOLD ALLERGY was considered to be rare until the last decade, probably because testing for gold allergy was rarely done (and if done, it may have been inadequate) and because gold was thought to be an inert and insoluble metal.^{1,2} Case studies reported allergic reactions to jewelry,^{3,4} dental crowns and dentures,^{5,6} ear piercing,⁷ and gold plating.⁸ An increasing prevalence of positive patch-test reactions has been documented since the early 1990s, when Gold was added to the standard screening series in many countries.^{6,8,9} Gold allergy has turned out to be more frequent among women; this predominance may reflect increased contact with jewelry rather than increased susceptibility.¹⁰

The prevalence of airborne contact dermatitis is still underestimated today. The main problem is the variable nature of airborne reactions: as well as irritant and allergic airborne CD (two of the most common clinical presentations), many other airborne reactions have been reported, such as photoallergic reaction, erythema multiforme-like eruption, pigmented contact dermatitis, and contact urticaria.¹¹ Moreover, an airborne agent may induce more than one type of reaction. In many cases, airborne CD can mimic direct contact dermatitis. Finally, in only a few cases is it possible to isolate the responsible agent. It has been proven that occupation-induced reactions are still by far the most common manifestations of airborne CD.^{10,12,13}

Airborne allergic CD caused by gold was almost unknown before the 1990s; gold was not included in the 1986 list of airborne allergens published by Dooms-Goossens in 1986.¹⁴ Few cases were reported in 1988, including those of two women showing an association of eyelid dermatitis and gold allergy⁴ and that of occupational dermatitis in a man who worked in gold plating.⁸ In the late 1990s, two case reports identified airborne sensitization to gold as the cause of the patients' occupational dermatitis; these involved a foreman in a gold smelting room² and a gold-plating employee.¹²

Gold finally appeared on a list of airborne allergens in 2001.¹³ In the same year, gold was defined as a common cause of facial and eyelid dermatitis, and the North American Contact Dermatitis Group found it to be the most frequently encountered allergen causing eyelid dermatitis.^{15,16} The last update on airborne CD omits gold from the list of airborne allergens. At present, allergic airborne CD caused by gold is thought to be a rare phenomenon.¹¹

Case Reports

Case 1

A 23-year-old woman with no previous skin disease had worked for a year as a restorer probationer, attending the annual master "polychrome and golden frame and wooden opuses restoration" in a Florentine restoring school. Three days a week, she worked with two gilding techniques: (1) "leaf gilding," which involves the application of pure gold leaf to a wooden pretreated frame and requires many business days of work, and (2) "dust gilding," in which extremely fine gold dust (obtained by milling pure gold) is

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spread out by being dropped onto the pretreated surfaces of miniatures and icons, a process also used for retouching already-gilded objects. The patient always wore ordinary rubber gloves during her restoring work. Most of the time, she wore a little respiratory mask on her nose and mouth, so she had no oral contact with either the gold leaf or gold dust. She came to us at the end of the master course (ie, after 12 months of working) because of an eyelid dermatitis that had appeared 2 months previously. The patient had erythema on both upper eyelids (moderate on the right eyelid, mild on the left one) along with moderate thickening of the medial eyelid margins. Deepening of the eyelids' lines was mild (Fig 1). She claimed to have frequent itching of the eyelids. There was no other skin involvement. She used no topical products apart from moisturizing cream, and she wore golden jewelry with no problems.

After diagnosis, the patient tried to follow our advice and managed to avoid working with gold. Her eyelid skin gradually cleared in 2 months. Eight months later, she resumed a restoration job that involved some gilding. At the 12-month follow-up, we noticed a relapse of the airborne CD; the erythema was mild, but there was moderate lichenification of the upper eyelids and moderate itching (Fig 2). She confirmed that the dermatitis had reappeared after 1 month of her working.

Case 2

A 52-year-old nonatopic woman had been working for 20 years on a restoration. Five years before coming to our clinic, she had started working in a gilding laboratory once a week. She gilded old objects such as antique wooden frames and furniture, ceramic objects, and metallic and



Figure 1. Patient 1 at presentation.



Figure 2. Patient 1 at follow-up, 4 months after having resumed work.

glass pots. In addition to using leaf- and dust-gilding techniques, she had been doing gold plating, which is accomplished through an electrolytic process in a chemical bath and is used mainly for gilding metal objects. Nearly once every 1 or 2 months, she used the "fire gilding" technique, which involves the fusion of metallic gold. During her work, she wore ordinary rubber gloves and occasionally wore a respirator to protect the lower half of the face. The patient came to us because of a recurring dermatitis over the forehead and on the exposed parts of her forearms. It had first appeared 3 years previously; it fluctuated thereafter, improving on weekends and clearing on holidays. During this time, she customarily applied moisturizing creams and sometimes topical corticosteroids. At presentation, she showed a symmetric rash that involved both upper and lower eyelids and the skin between the eyebrows. The thickness of the upper eyelids was increased, and the lines of the eyelids were deepened (Fig 3). A mild erythema had spread on the anterior part of the neck. She complained of facial itching and a sensation of discomfort caused by the reduced elasticity of facial skin. No other skin areas were involved. She had no problems with occasionally wearing gold jewelry.

After diagnosis, the patient followed our advice by avoiding gilding techniques in her work in the restoration business. At her follow-ups, we observed a complete recovery from the airborne CD on her face and neck.

Patch Testing

Both patients' clinical histories excluded urticaria, dyspnea, rhinitis, and cough; neither the patients nor their families were clinically atopic. Signs of conjunctivitis or blepharo-



Figure 3. Patient 2 at the 1-month control.

conjunctivitis were absent on physical examination. On the first day, we performed prick tests with our standard airborne-allergen screening series to exclude respiratory allergy; both patients tested negatively to all antigens.

For patch testing, we used IQ Ultra Chambers (Chemotechnique Diagnostics, Vellinge, Sweden). Patches were removed after 2 days, and test sites were read on days 4, 6, and 8. The first patch tests were performed with the Società Italiana di Dermatologia Professionale e Ambientale (SIDAPA) 2005 standard series; both patients had negative results.

On the eighth day, we applied the second patch tests, using the 2006 metal screening series (Chemotechnique Diagnostics), which included zinc, mercury, aluminum chloride, aluminum, palladium, copper sulfate, tin, iridium, titanium oxide, zinc chloride vanadium, calcium titanate, molybdenum, manganese chloride, zirconium chloride, iron chloride, potassium dicyanoaurate, silver nitrate, lead chloride, and cadmium chloride. With the aim of testing for gold, we added gold sodium thiosulfate (GST)— $\text{Na}_3\text{Au}(\text{S}_{203})_2$, 99.0% pure—at a 0.5% concentration in petrolatum. Both patients had positive reactions only to GST, whereas the other metals yielded negative results. A typical papular eruption pattern was evident, with a similar intensity trend (++ at 48 hours, +++ at 4 days, ++ at 6 days, and + at 8 days).

We also inspected the patients' working environments with the aim of ascertaining the presence of gold dust and gold fumes in the air.

After we informed the two restorers about their occupational airborne CD, we suggested that they avoid

gilding techniques if possible. Periodic follow-ups were planned for 1 month and for 3, 6, and 12 months.

Discussion

Contact dermatitis is defined as being airborne on the basis of four factors: (1) the presence, in the environment, of a causative agent in a volatile form or as dust or droplets; (2) clinical symptoms; (3) the history of the patient; and (4) follow-up and the results of epicutaneous tests.¹⁰ The most frequent and typical manifestation of airborne allergic CD is eyelid dermatitis, followed by involvement of the face, neck, and other exposed parts of the body.

Exposure to soluble gold salts usually takes place in gold plating, gold smelting, photography, and glass and porcelain gilding.¹⁷ Gold fumes can probably cause airborne allergic CD by the formation of different new gold salts on the skin's surface during long-term contact between gold salts and skin. According to this hypothesis, the majority of patients sensitized to GST do not respond to metallic gold in daily life because the contact between the skin and the metallic gold produces only a small quantity of gold salts, which is not enough to elicit an allergic contact reaction.¹⁸ This is why the poorly soluble gold leaf is not good for patch testing for gold allergy. Another hypothesis is that microabrasives (eg, titanium dioxide) contained in cosmetic powders may abrade gold jewelry and cause the adsorption of gold particles, acting as a carrier to the face.¹⁹

Although a recurrence of false-positive reactions is reported, GST is presently the best antigen with which to patch-test for gold allergy, more reliable than gold chloride and gold sodium thiomalate.^{18,20} Because patients who have positive reactions to GST without obvious clinical relevance are common, GST is considered a sensible but not very specific indicator. Hence, the correlation between a positive test result and clinical symptoms is usually considered to be low.²¹

According to our experience, it is important to obtain an accurate personal and occupational anamnesis when lesions are located on the patient's air-exposed areas. Furthermore, the origin of gold exposure and sensitivity must always be verified before the results of patch testing is known, so the patient does not overestimate the significance of a positive result. In these cases, the unique sensitization to gold as determined by prick and patch tests and by the occupational-activity stop-and-relapse test confirmed our suspected diagnosis.

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