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Low-cobalt diet for dyshidrotic eczema patients

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ABSTRACT



Background: Dyshidrotic eczema is a type of chronic intermittent dermatitis characterized by vesicles, dystrophic fingernail changes, and rarely bullae that affects the hands and feet. Many exogenous factors may trigger a flare including dermatophyte infections, contact irritants, and metal hypersensitivity. Although metal hypersensitivity does not play a role in all cases of dyshidrotic eczema, high oral ingestion of nickel and/or cobalt should be considered, regardless of patch test results.

Objective: We updated and simplified existing published guidelines for low-cobalt diets. A recent review of the literature showed that dietary cobalt restriction, a safe yet burdensome treatment option for dyshidrosis, is referenced to dated sources.

Methods: We have analysed current data for the cobalt content in common food items.

Conclusion: We propose a revised, point-based diet that will eliminate much of the dietary cobalt (and nickel) and reduce dyshidrotic eczema flares.

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Cobalt exposure

Cobalt exposure, whether by inhalation, orally, or topically, occurs in a wide array of circumstances. Workers in many hard metal industries, such as coal and metal mining, tungsten carbide industry (where cobalt acts as a binder), smelting and refining, and chemical production industries, often have the highest exposure levels [\(1, 2\)](#). The level of cobalt in the air is higher in areas near factories and in heavily industrialized cities [\(3\)](#). Regardless of the circumstance, environmental exposure may result in systemic toxicity or allergy, as well as cutaneous irritancy or allergy.

Cobalt toxicity

Chronic cobalt ingestion, at levels above a normal dietary intake, may lead to organ toxicity. For example, in the 1960s, cobalt chloride was an additive in beer as a foam stabilizer. Cobalt cardiomyopathy occurred in many heavy beer consumers and resulted in up to a 50% mortality rate [\(3\)](#). An established allergen in the occupational setting, cobalt causes allergic contact dermatitis.

Cobalt allergy

Cobalt exposure via inhalation may lead to cobalt-related asthma. Hard metal workers may develop cough, wheezing, and dyspnoea that often improves during weekends and holidays. Multiple reports have recognized an immunological correlation with specific immunoglobulin (Ig)E and IgG antibodies to cobalt [\(4, 5\)](#). Cobalt contact allergy may also lead to metal prosthesis failure and allergic vasculitis [\(2\)](#).

Cobalt and nickel

Allergic contact dermatitis from cobalt is a factor in hand dermatitis for sensitized patients handling hard metal tools. Nickel allergy and irritant hand dermatitis often precede allergic

contact hand dermatitis due to cobalt. Of patients who developed an occupational dermatitis, roughly 90% had developed jewellery dermatitis prior to employment and/or the onset of dyshidrotic eczema (6). A detailed jewellery history is especially important as even very low concentrations of metals may precipitate a flare of allergic contact dermatitis (7). Patients are frequently co-sensitized to nickel and cobalt; fortunately, the topical and systemic avoidance strategies are similar (8).

Dyshidrotic eczema and evidence for cobalt-induced systemic allergic dermatitis

Of particular interest, cobalt ingestion causing systemic allergic dermatitis in the form of dyshidrotic eczema. Dyshidrotic eczema is a type of chronic intermittent dermatitis that affects the hands and feet. Symptoms include pruritus and a burning sensation that may precede the development of vesicles, bullae, and dystrophic fingernail changes (9). Although the exact mechanism is not known, metal ions can likely function as both type I and type IV hypersensitivity allergens in the induction of systemic allergic dermatitis. Recent evidence even contends that metal ions act as an atypical hapten by activating T cells through human leucocyte antigen-independent pathways (10). In addition to antigen-presenting cells, antibodies may assist systemic allergic dermatitis in a manner similar to protein contact dermatitis (11).

Although not all dyshidrotic eczema is due to metal hypersensitivity, high oral ingestion of cobalt should be considered, regardless of patch test results. In 1979, Veien and Kaaber (12) first noted that oral challenge of nickel, cobalt, and chromium might result in a dyshidrotic flare even when the patch test results are negative. In fact, of 202 patients with patch test-negative dyshidrotic eczema, 25% flared after an oral ingestion of metal salts. The flare improved with a diet low in metal salts and recurred if the diet was stopped (8). Examining only patients with patch test-positive dyshidrotic eczema, over 50% flared after oral ingestion of metal salts (13). Although nickel sensitivity is more common than cobalt sensitivity, the two are quite linked. Rystedt and Fischer (6) reported that a quarter of nickel-sensitive patients developed a cobalt allergy and patients with simultaneous nickel and cobalt allergies have more severe dyshidrotic eczema. Of note, all discussed studies have used an oral 'challenge' of metal salts consisting of amounts in far excess of levels seen in a normal diet. However, multiple studies have demonstrated that even normal dietary levels of nickel and cobalt may cause a dyshidrotic eczema flare, especially among those patients who are patch test positive (14–16).

Other exogenous factors may serve as triggers of dyshidrotic eczema, such as dermatophyte infections (17). Therefore, a careful patient history should accompany any treatment plan of hand eczema. In particular, a history of jewellery intolerance and tinea pedis should be pursued.

Cobalt and vitamin B12

While hypersensitivity reactions have been related to cobalt exposure, there is no evidence linking these reactions to the vitamin B12 occurring naturally in foods: adenosylcobalamin and methylcobalamin. There are multiple reports detailing reactions to injections of the synthetically derived preparations of B12 including cyanocobalamin and hydroxocobalamin (18, 19). Regardless, the cobalt level contributed by vitamin B12 in foods is likely too insignificant an amount to be responsible for systemic allergic dermatitis (3, 20). Thus, the ingestion of foods high in cobalt causing systemic allergic dermatitis is due to cobalt not found in vitamin B12.

Role of disulfiram

If dietary and environmental avoidance fails, there is some evidence that disulfiram will reduce the frequency of flares in patients with dyshidrotic eczema and nickel allergy (21). Disulfiram is first metabolized (reduced) to diethyldithiocarbamate, which acts as a chelating agent for transition metal ions such as nickel and cobalt and results in the increased urinary excretion of the metals. However, there are considerable disadvantages associated with disulfiram treatment including dermatitis flares, hepatotoxicity, and dermatitis relapse after discontinuation of treatment (22). A low-metal diet is a safer, albeit more burdensome, alternative in the treatment of dyshidrotic eczema.

Objective



Published references regarding low-cobalt diets are antiquated and lack current data. For example, existing guidelines suggest an avoidance of beer. This recommendation reflects the use of cobalt chloride as a foam stabilizer during the 1960s. However, many international food safety administrations do not allow cobaltous salts to be used as foam stabilizers in beverages or in foods (1). Therefore, we have updated and simplified existing published guidelines for low-cobalt diets.

Results and Conclusions



We propose the following point-based diet to help patients limit their cobalt ingestion to a level below that which will cause a flare for most patients: <12 µg per day. After receiving patient feedback, we believe that patients are more likely to adhere to a point-based diet that permits ingestion of certain food items in moderation, as opposed to a diet that only lists food items that should be avoided. However, the best approach for each patient is the interventional diet that the individual patient will most likely adhere to while helping the patient to become aware of eating habits and portion sizes (26). We recommended that patients avoid both Brazil nuts and cow liver (25) and homeopathic/herbal remedies (27) due to high metal content. All other food items are assigned a specific point value (the first column in Table 1): 7, 5, 3, 2, or 1 point. A patient should add up the assigned points every time he ingests a food that is on the list while limiting daily intake to no more than a total of 12 points per day. The patient should also pay close attention to the listed serving size for food items. It should be noted that the amount of cobalt intake needed to induce systemic allergic dermatitis also depends on smoking status and environmental levels of cobalt in air, soil, and water (i.e. living near industry) (3). Foods not listed in the table have a point value of 0. Multivitamins should conservatively be given a point value of 2. The cobalt content in a multivitamin exceeds the level that would be expected given the vitamin B12 content (3, 25). Therefore, cobalt is a likely metal contaminant in multivitamins in a manner similar to homeopathic/herbal remedies (27). The proposed point-based diet will eliminate much of dietary nickel too.
