Cupric Keratosis: Green Seborrheic Keratoses Secondary to External Copper Exposure

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Exogenous copper is a well-known cause of blue-green dyspigmentation of the hair, nails, and skin. We report the case of a patient with a blue-green discoloration of multiple seborrheic keratoses on his chest and back after swimming in a pool for rehabilitation of a back injury. Metallic analysis using atomic absorption spectrometry was performed on water samples from both the swimming pool and the hot tub the patient was using. Our dermatology clinic tap water was used as a control. Results of this analysis revealed an elevated level of copper in the swimming pool (2.750 ppm) and normal levels in the hot tub (0.502 ppm) and the control sample (0.891 ppm). The copper level in the swimming pool was more than double the recommended maximum set forth by the US Environmental Protection Agency. After the patient discontinued water exercises in the swimming pool, the green discoloration of the seborrheic keratoses disappeared rapidly. We believe this case represents the first report in the literature of the discoloration of epidermal growths secondary to exogenous heavy metal exposure.

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Heavy metals are a well-known cause of pigment changes in hair, nails, and skin. This pigment change takes place via deposition of metal particles and induction of epidermal melanin production. Much of the literature focuses on ingestion of heavy metals such as lead, mercury, silver, gold, bismuth, and arsenic as the cause of pigmentary discoloration.[1] However, copper, both through ingestion[2] and external exposure,[3] has been shown to cause a peculiar blue-green pigmentary discoloration of hair,[4-9] nails,[10] and skin.[3]

Case Report

At his biannual dermatologic examination, a 63-year-old white man expressed concern about the strange discoloration of what he called the "barnacles" on his chest and back. Over the preceding 2 weeks, he had noticed a gradual change in the color of the papules and plaques from the usual tan to a blue-green. Prior to this, the growths had been present and largely unchanged for many years. About one month before the clinic appointment, the patient had begun physical therapy and water exercise therapy for a back injury; for the water exercise therapy, he used both a swimming pool and hot tub at a local outpatient rehabilitation center.

On physical examination, the patient was noted to have numerous, pale green, waxy, "stuck-on"–appearing papules and plaques on his upper chest and back (Figure 1). There was also a blue-green discoloration of the hair on his chest and back (Figure 2) but no other dyspigmentation of his hair, nails, or skin.

The clinical features of these papules and plaques were consistent with seborrheic keratosis, but because of the unusual discoloration of the lesions, tissue samples from 3 papules were submitted for histopathologic examination. Histologic findings included regular acanthosis, hyperkeratosis, and horned pseudocyst formation consistent with seborrheic keratosis. Otherwise, the hematoxylin-eosin–stained sections were unremarkable, especially for discoloration or foreign particles.

The day following his visit to our clinic, the patient took water samples from both the swimming pool and the hot tub he was using for rehabilitation. A tap water sample was collected from our clinic to serve as a control. The 3 water samples were submitted for

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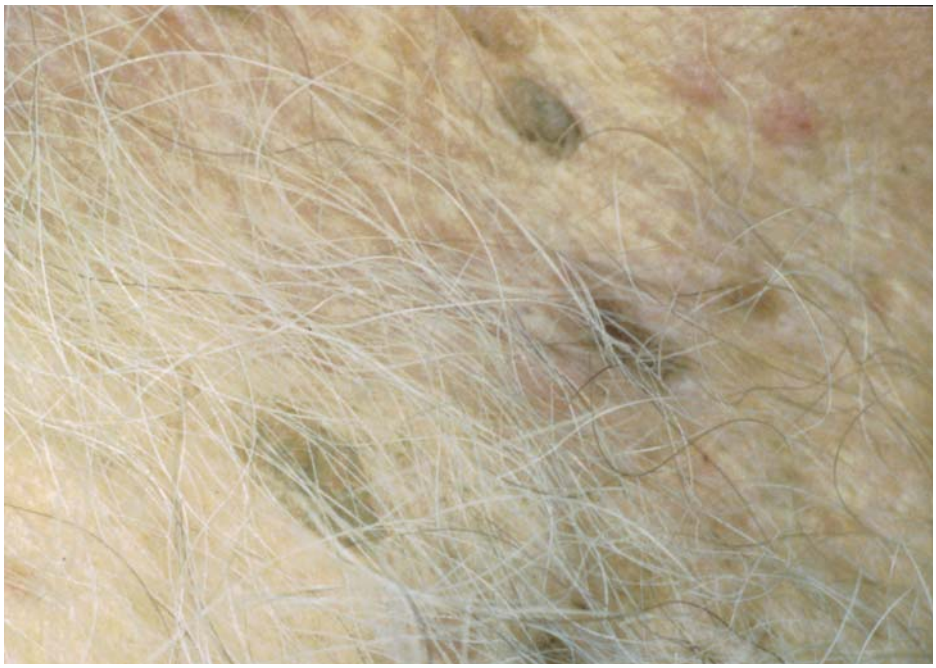

Figure 1. Multiple, waxy, green-brown papules and plaques on the upper chest.

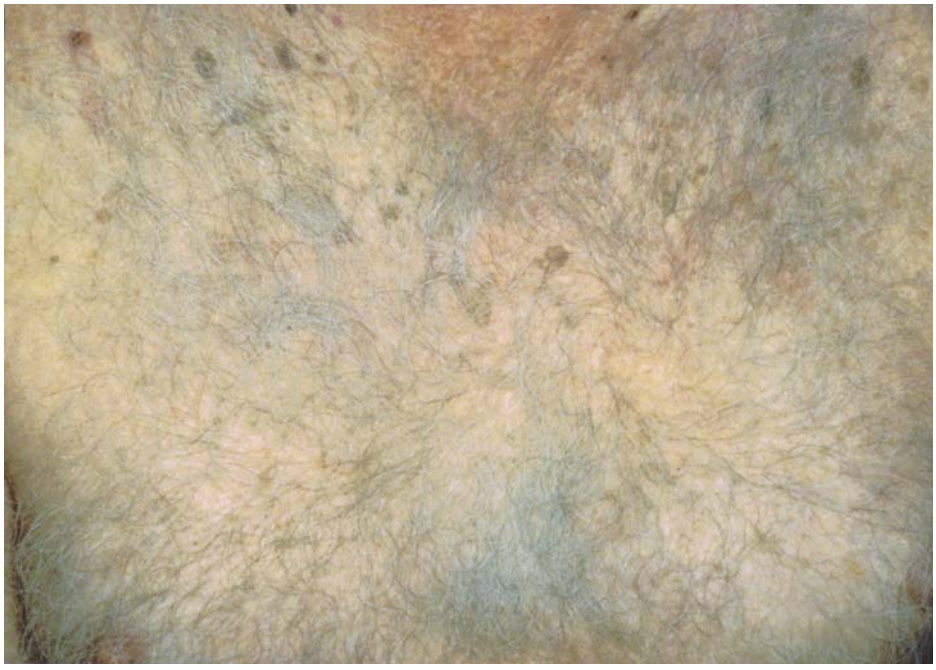

Figure 2. Green discoloration of seborrheic keratoses apparent in the background of blue-green discolored hair.

analysis and comparison. The metallic analysis consisted of testing the water samples for 6 metals: copper, chromium, iron, lead, selenium, and silver (Table). The analysis was performed using a PerkinElmer® AAnalyst 100 Atomic Absorption Spectrometer. US Environmental Protection Agency methodology was followed.

The level of copper in the rehabilitation swimming pool was 2.750 ppm, which represents a greater than 2-fold increase over the maximum contaminant level goal set forth by the US Environmental Protection Agency (<1.3 ppm).[11] In previous studies, the copper levels in tap water associated with green hair ranged from 1.15 to 9.94 ppm, with a mean level of 3.47 ppm.[4] Concentrations exceeding 3.0 ppm may cause copper toxicity, inducing severe nausea and vomiting.[12]

Samples of the discolored seborrheic keratoses from this patient and normal-appearing seborrheic keratoses from healthy volunteers were submitted for metallic analysis and comparison. Unfortunately, the specimens

Metallic Analysis and Comparison (parts per million)*

Sample	Copper	Chromium	Iron	Lead	Selenium	Silver
Rehabilitation swimming pool	2.750	<0.025	<0.061	0.002	<0.001	<0.100
Rehabilitation hot tub	0.502	<0.025	<0.061	<0.002	<0.001	<0.100
Clinic tap water	0.891	<0.025	<0.061	0.002	<0.001	<0.100

*The analysis was performed using a PerkinElmer® AAnalyst 100 Atomic Absorption Spectrometer.

evaporated because of an error in the dehydration process and were unavailable for further analysis.

The patient subsequently discontinued his pool exercises, and the color of the seborrheic keratoses gradually faded to tan during the subsequent month. We concluded that the elevated level of copper in the swimming pool was the cause of the dyspigmentation.

Comment

Green hair, the most common manifestation of skin contamination due to copper exposure, is caused by deposition of copper in the hair shaft.[13] Microscopic examination of these hairs reveals loss of the cuticle and the presence of scattered micropits on the surface of the hair shaft, which allow penetration of the copper crystals. Hair damage from sun exposure, dyeing, weaving, or bleaching can predispose the hair to copper-induced dyspigmentation.[4] As in our patient, the pigment change is often secondary to elevated copper levels in tap or swimming pool water. An increased copper level in tap water is attributable to the corrosion of copper pipes.[2] In addition to corrosion, an elevated copper level in swimming pools also can result from the use of copper-based algicidal chemicals.[14]

Topical chelating agents such as penicillamine 2.5% (250 mg capsule dissolved in 5 mL of water and 5 mL of shampoo)[2,4,13,15] or edetic acid[8] are the treatments of choice, if treatment is necessary. Other treatments include bleaching with hydrogen peroxide 3% for 2 to 3 hours[16] or the use of 1-hydroxyethyl diphosphonic acid 1.5%.[13] Often, as in our patient, the discoloration improves without treatment. To our knowledge, this case represents the first report in the literature of what we have termed *cupric keratosis*, or the discoloration of seborrheic keratoses from excessive exogenous copper.

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