



The color of skin: green diseases of the skin, nails, and mucosa



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Abstract Greenish staining of human skin may result from a gamut of causes, such as chlorosis, exogenous copper, resolving ecchymosis, drugs, green textile dyes, green tattoos, apocrine and eccrine chromhidrosis, hyper biliverdinemia, chloromas, use of green dyes during tube feeding in patient with multiorgan failure, *Pseudomonas* infections, and Wells' syndrome in its second stage. Physicians may rarely encounter patients with green skin, hair, nails, or mucosae.

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Introduction

One of the most popular comic book superheroes is the Hulk, whose powerful muscular build is covered by a distinctive green skin. Although the Hulk's luxuriant look was created by Stan Lee and Jack Kirby of Marvel Comics, his green skin does have its real-life counterparts.¹

The Boy with Green Hair was a famous 1948 American fantasy-drama film directed by Joseph Losey. The central character of the movie was Peter, a young war orphan who was subject to ridicule after he awakens one morning to find his hair mysteriously turned green. Physicians may rarely encounter patients with green skin, hair, nail, or mucosae. Greenish discoloration may result from a wide variety of causes, such as chlorosis,^{2–5} exogenous copper,^{6,7} resolving ecchymosis,⁷ drugs,^{7–9} green dyes from clothes,⁷ green tattoos,⁷ apocrine chromhidrosis,¹⁰ eccrine chromhidrosis,^{8,11–13} hyper biliverdinemia,^{11–13} chloromas,¹⁴ use of green dyes during tube

feeding,¹⁵ *Pseudomonas* infections,¹⁶ and Wells' syndrome in its second stage.¹⁷

Human chlorosis

Perhaps, the most memorable historic cause of a green skin shade in people was chlorosis. This once-prevalent disease is characterized by a shallow-green facial complexion in asthenic teenage girls and young unmarried women.^{2–4} The name chlorosis was coined by a professor of medicine Jean Varandal (1563–1617) in 1615 from the Greek *chloros*, meaning “green,” as a result of the greenish tint that he noted on the skin of his patients.^{3,5} This led to the popular English term “green sickness.”³

It was a popular diagnosis in 18th, 19th, and early 20th centuries for lethargic young women with a number of psychologic (anorexia nervosa, sexual frustration, or love-sickness), gynecologic (excessive blood loss or amenorrhea), and/or gastrointestinal (dyspepsia, peptic ulcer, vomiting, constipation) complaints.^{2,4} The diagnosis of chlorosis had found its way into the common parlance of the day²;

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however, the disease had fortuitously disappeared completely by the early part of the 20th century.³

Social aspects, the lack of perspective for young girls in society at that time, was once thought to be the root cause of the disease, and the disappearance of the ailment may be partially attributed to improved diagnostics but more so to changes in the social position of women around the turn of the 20th century. The 19th century had produced great advances in the study of blood morphology, the chemistry of the coloring matter, and the physiologic role of iron. Of late, chlorosis has been recognized as a microcytic anemia.² In 1832, two important papers appeared concerning the role of iron in chlorosis. The first reported that he observed a diminution of the iron content of the blood of chlorotics, and a French physician, Pierre Blaud (1773/1774-1859), introduced pills containing ferrous sulfate and potassium carbonate for the treatment of chlorosis.³ Although it became generally accepted that the underlying cause was dietary iron deficiency,⁴ the precise pathogenesis of chlorosis remained controversial.

Copper-induced green skin

Copper, both through ingestion and external exposure, has been shown to cause a peculiar blue-green pigmentary discoloration of hair, nails, and skin.⁶

Wearing copper jewelry can sometimes cause a localized greenish discoloration of the underlying skin.⁷ The green color stain of skin by copper is due to the acidic sweat, which leaches the copper from the metallic ornaments that reacts with chloride and bicarbonate in the sweat; thus, forming copper salts, namely copper chloride and copper carbonate that are green in color.⁷ The oxidation of copper also partly contributes to the coloration. Formation of the colored salts of copper is also caused by contact with soap and water.

Copper chloride is water soluble and is removed while bathing, whereas copper carbonate is water insoluble, which needs alcohol or acetone for its removal.⁷ A green-colored stain can also occur with ornaments made out of silver, gold, and brass, which contains copper.

To prevent the staining due to ornaments, a clear nail polish forming a polymer coating on the surface of the metal can be applied, which creates a barrier between skin and the metal. A coating of car or jewelry wax can also be applied for the same purpose.⁷ There are isolated case reports of blue-green pigmentation of seborrheic keratosis from excessive exogenous copper⁶ and localized pigmentation induced by subcutaneously inserted copper wire.⁷

Drug

Green discoloration of the skin can be caused by brilliant green, a presently obsolete topical antimicrobial.⁷ A case of homeopathic drug-induced green chromhidrosis leading to bluish-

green coloration of skin and nail has also been described by us.⁸ In this case, a middle-aged man presented with greenish discoloration of his hands and feet after consumption of a homeopathic medication for an upper respiratory tract infection. The patient's blood copper level at presentation was slightly raised. Histopathology of skin showed hyperkeratosis and mild acanthosis and normal eccrine glands, containing greenish particles. The patient's sweat showed high copper content on analysis, which normalized after stoppage of the medicine with concomitant disappearance of the skin discoloration.⁸ Green discoloration of blond hair and nails can also be seen with topical anthralin therapy for psoriasis.⁹

Apocrine chromhidrosis

Apocrine sweat may be colored slightly yellow, blue, or green in approximately 10% of healthy persons, without causing any discomfort. Apocrine chromhidrosis may manifest as a greenish discoloration of the apocrine gland bearing areas.¹⁰

Liver diseases

The green pigmentation of biliverdin in the skin after the oxidation of hemoglobin derived from the blood in the dermis is the most common cause of green pigmentation. Hyperbiliverdinemia is a rare, genetic hepatic disease, characterized by the presence of green coloration of the skin, urine, plasma, and other body fluids (ascites, breastmilk) or parts (sclerae) due to increased serum levels of biliverdin in association with biliary obstruction and/or liver failure.⁷ Association with malnutrition, medication, and congenital biliary atresia has been reported.

Greenish discoloration of skin can also occur due to eccrine chromhidrosis (Figures 1 and 2) in patients with hyperbilirubinemia.¹¹ The precipitating factors for this condition may be an increased level of water-soluble direct bilirubin, high fever, and a thick horny layer of skin.¹² Not all reported cases have met these criteria.^{11,13} Whereas hyperbilirubinemia, sweating, and fever are common, this type of pigmentation is rare, with other factors possibly contributing to its development.¹³

Chloroma

The name chloroma is derived from the Greek word *chloros* (an ancient Greek word for green). Chloromas are extramedullary neoplasms of myeloid precursor cells and usually present as reddish-blue skin lesions, but diascopy usually reveals a green hue. The green color is attributed to the presence of myeloperoxidase.

This color is rarely seen, because the green pigment fades readily on exposure to the air, and the red color of the blood masks the green pigment.¹⁴



Fig. 1 Green eccrine chromhidrosis on the chest wall.

Green skin discoloration associated with multiple organ failure with tube feeding

A previous report described a woman who developed a distinctive green skin discoloration, while receiving tube feedings colored with FD & C Blue No. 1.¹⁵ Blue food coloring is commonly added to tube feeding formulas to help monitor for pulmonary aspiration. FD & C Blue No. 1, also known as brilliant blue, is being used in foods, drugs, and cosmetics. The Joint Expert Committee on Food Additives of the World Health Organization lists the acceptable daily intake for FD & C Blue No. 1 as 12.5 mg/kg of body weight; however, bacterial contamination of stock bottles has been reported with blue coloring used to dye tube feedings. To keep away from bacterial contamination associated with the use of stock bottles, some commercial tube-feeding devices contain pellets that release FD & C Blue No. 1 at a rate of approximately 10 mg/h.¹⁵ This delivery rate is below the acceptable daily intake standard for patients weighing at least 25 kg. The precise cause of her hyperpigmentation was unknown, but the authors hypothesized that the green coloration might be due to the combined effect of



Fig. 2 Green eccrine chromhidrosis over the perinasal area.

the blue dye and the yellow color of jaundice. An alternate or contributing cause may be deposition of colored propofol metabolites.¹⁵

Bruise/ecchymoses

Localized greenish discoloration may be seen during resolution of a bruise or in an old bruise.⁷ The involved area changes in color from deep purple, to black and blue, to green, then to yellow, as the hemoglobin is degraded to bilirubin. These changes can be alarming to the patient who is not counseled to expect the possibility of color changes. The concern is mainly cosmetic and temporary, because most bruises resolve with time and leave no sequelae.

Cullen sign (periumbilical ecchymosis) and Gray Turner sign (flank ecchymosis), named after William Cullen (1710-1790) and George Gray Turner (1877-1951), respectively, are signs of abdominal wall hemorrhage and are generally associated with acute pancreatitis.¹⁸ These hemorrhagic areas, although usually bluish, may appear as green patches over the abdominal wall.¹³

Textile dyes

Temporary greenish discoloration of skin can occur from green-colored textile dyes.⁷

Green tattoo

Localized patterned greenish discoloration may occur due to decorative tattooing.⁷ In the United States, tattoo inks are subject to regulation by the U.S. Food and Drug Administration but the Food and Drug Administration says on their website that “FDA has not approved any tattoo pigments for injection into the skin” and that “many pigments used in tattoo inks are industrial-grade colors suitable for printers’ ink or automobile paint.” Tattoo inks can have heavy metals or metal oxides in them also.

Pseudomonas infections

Pseudomonas aeruginosa infection of the burns and cutaneous wounds impart a greenish hue, and *P. aeruginosa* can also cause green nail syndrome or chloronychia.¹⁶ The discoloration is due to the production of pyocyanin and pyoverdine by the bacteria and varies from blue-green to dark green (Figure 3). Because the discoloration is beneath the nail, it will not fade with washing or scrubbing. The condition is usually confined to one or two nails and can involve fingernails or toenails. The nail



Fig. 3 Green nail syndrome.

usually does not cause pain; however, the skin surrounding the nail, including the cuticle, may be inflamed.

Wells' syndrome in its second stage

Wells' syndrome is a distinctive dermatosis clinically akin to acute cellulitis with solid edema; it resolves spontaneously after weeks or months without sequel. Recurrences over many years are common. Characteristic findings for the disease with light microscopy include diffuse tissue eosinophilia and marked edema, fibrinoid "flame figures," and palisading microgranuloma. Eosinophilia of the peripheral blood is often present.¹⁷ When the acute redness and edema subside, lesions of Wells' syndrome become indurated and change their color to blue- or green-gray.¹⁷

Green Hair

Green hair is an unusual dermatologic condition usually due to the deposition of copper from exogenous sources.^{19,20}

This pigmentation of hair has generally been reported in patients with blond hair as a consequence of increased concentrations of copper in domestic or swimming pool water. Although an increased copper content of the affected hair seems to be a prerequisite, other predisposing factors have to be there for this situation to occur. These include previous hair damage (mechanical, sun exposure, bleaching, dyeing, and waving), frequent contact with chlorinated water, or use of alkaline shampoos.¹⁹ Microscopic examination of these hairs had revealed loss of the cuticle and the presence of scattered micropits on the surface of the hair shaft, which allow penetration of the copper crystals.⁶

Several options for treatment have been described for this problem, including application of hot vegetable oil, hydrogen peroxide, edetic acid– or D-penicillamine–containing shampoos, or hydroxyethyl diphosphonic acid.¹⁹

Conclusions

Discolored skin can take any hue of the spectrum of colors. Green skin, mucosa, nails, and hair may result from a multitude of etiologic factors; some are common, whereas others are medical curiosities. Green discoloration may be caused by exogenous agents or endogenous pigments and may result from conditions as innocuous as resolving bruise to serious systemic diseases.

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