CASE REPORT

Infectious pseudochromhidrosis in the setting of dupilumab use

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INTRODUCTION
Chromhidrosis (or true chromhidrosis) and pseudochromhidrosis are rare conditions of colored sweat.1 In chromhidrosis, colored sweat is secreted from apocrine or eccrine sweat glands.1 However, in pseudochromhidrosis, sweat becomes colored after secretion by exogenous factors such as dyes, paints, chemicals, or pigment-producing microorganisms, such as chromogenic bacteria.2 When the color is due to chromogenic microorganisms, the condition is referred to as infectious pseudochromhidrosis (IPCH; Table I).2 Different species can cause different colored sweat: Bacillus species and Malassezia furfur are associated with blue sweat, Corynebacterium species are associated with brown or black sweat, Serratia marcescens is associated with pink sweat, and Pseudomonas aeruginosa is associated with blue-green sweat.2 IPCH is proposed to be triggered by medications that alter the pH and microflora of the skin.2 Treatment with oral erythromycin and topical erythromycin or clindamycin has led to improvement in patients with IPCH.1 Here we report a case of blue IPCH caused by Bacillus cereus in the setting of dupilumab use.

CASE REPORT
A 15-year-old boy presented to the Department of Dermatology at Michigan Medicine with concerns of blue sweat for the past 7 months. His dermatologic history was notable for atopic dermatitis, keratosis pilaris, pincer nail deformity, and chronic paronychia. He also had food and environmental allergies and asthma. For atopic dermatitis, he was prescribed dupilumab ("DUPIXENT," Sanofi, and Regeneron Pharmaceuticals Inc; 300 mg injection every 14 days), a dual inhibitor of interleukin 4 and interleukin 13.3 After nearly 3 months of dupilumab use, the patient observed that while wiping his arms for the injections, the alcohol swabs turned blue (Fig 1). He had no special diet other than avoiding egg and milk products, denied eating many artificially colored foods, and denied frequent wearing of dark or blue clothing. His other medications included albuterol (90 mcg/actuation inhaler), fluticasone (110 mcg/actuation inhaler), mupirocin 2% ointment, and sertraline (25 mg). His primary care physician prescribed chlorhexidine gluconate 4% topical liquid after onset of the blue sweat. Approximately 1 month before presentation, he discontinued dupilumab because of pain associated with injections.

Physical examination revealed blue discoloration when cleaning his arm, hand, and axillae with alcohol swabs. No fluorescence was observed on Wood's lamp examination. A bacterial swab of the skin of both arms palms was positive for B cereus, coagulase-negative Staphylococcus, and Micrococcus luteus. No biopsy was performed.

A diagnosis of IPCH was made based on clinical features and the presence of B cereus on the skin. The patient was prescribed oral erythromycin (250 mg 3 times a day) and topical clindamycin (2 times a day for 10-17 days), which has previously been reported to lead to improvement in patients with IPCH.1 He reported that the blue sweat resolved

Abbreviation used:
IPCH: infectious pseudochromhidrosis
with the antibiotic treatment, which he used intermittently for several months, further strengthening the IPCH diagnosis. Approximately 1 month after discontinuing the antibiotics, the blue sweat returned.

**DISCUSSION**

Because this patient presented with blue sweat, the differential diagnosis included chromhidrosis or pseudochromhidrosis, which are both rare conditions of colored sweat. Many features of this case favored pseudochromhidrosis over chromhidrosis. The generalized distribution of the blue sweat made apocrine chromhidrosis less likely. Additionally, the negative Wood’s lamp examination made a diagnosis of apocrine chromhidrosis less favorable. Apocrine chromhidrosis is often because of oxidation of lipofuscin, and an increased number of yellow-brown lipofuscin granules in the apocrine glands is observed on Wood’s lamp examination. An eccrine source was also considered, since ingestion of dyes or colored foods can cause eccrine chromhidrosis; however, the patient denied eating many artificially colored foods. Therefore, pseudochromhidrosis emerged as the likely diagnosis. Because of the absence of dye or chemical exposures, an infectious source was suspected. The IPCH diagnosis was confirmed with positive cultures for *B cereus*.

*B cereus* is a gram-positive, spore-forming bacterium that causes food poisoning, local infections, and systemic infections. *Bacillus* species have also previously been associated with blue IPCH.

Reports of IPCH caused by *Bacillus* species have proposed that medications (such as ranitidine, promethazine, and topiramate) that alter the skin pH and microflora may trigger *Bacillus* colonization and IPCH. Dupilumab was started 3 months before the onset of blue sweat, suggesting a potential association with the IPCH. It is possible that dupilumab may have led to alterations in the patient’s skin microflora. The blue sweat persisted after the patient stopped dupilumab injections due to injection-site pain; however, this may not necessarily rule out an association, if the effects on skin microflora were not quickly reversed. Indeed, it has been demonstrated that dupilumab can have effects on skin microflora for up to 18 weeks following the last injection.

In summary, this patient’s blue sweat was likely the result of *B cereus* colonization, potentially because of altered skin microflora following dupilumab use. This case highlights the importance of obtaining a comprehensive history when colored sweat is observed to differentiate between chromhidrosis and pseudochromhidrosis. If an infectious source is suspected, bacterial culture can be performed to elucidate specific microorganisms present, which can assist in the diagnosis of IPCH. Additionally, as in this patient, recent changes to

**Table I. Infectious pseudochromhidrosis: An overview**

| **Natural history** | Occurs in children and adults, male and female individuals |
|--------------------|----------------------------------------------------------|
| **Pathophysiology** | After secretion from the sweat gland, sweat is colored by chromogenic bacteria |
| **Diagnosis**      | Comprehensive history to determine risk factors, including medications and lack of exposure to dyes and chemicals |
|                    | Physical examination reveals colored sweat |
|                    | Negative Wood’s lamp examination |
|                    | Skin bacterial swab is positive for chromogenic bacteria |
| **Management**     | Benign and does not require treatment |
|                    | Can be treated with oral erythromycin and topical erythromycin/clindamycin |

Fig 1. Infectious pseudochromhidrosis. An alcohol swab from the arm revealed blue discoloration of sweat.
medications should be reviewed, and the medic-  
tions should be investigated for potential effects on  
skin microflora.

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Conflicts of interest  
None disclosed.

REFERENCES  
1. Tempark T, Wittayakornrerks, Jirasukprasert L, Chatproedprai S,  
Wananukul S. Pseudochromhidrosis: report and review of  
literature. Int J Dermatol. 2017;56(5):496-502. https://doi.org/10.1111/ijd.13495
2. Ingvaldsen CA, Leegaard TM, Kravdal G, Mørk C. Infectious  
pseudochromhidrosis: a case report and literature review. Acta  
Derm Venereol. 2020;100(1):adv0005. https://doi.org/10.2340/00015555-3338
3. Seeprüber M, Sour J, Walter A, Knop M, Wollenberg A.  
Dupilumab for treatment of atopic dermatitis. Expert Rev Clin  
Pharmacol. 2018;11(5):467-474. https://doi.org/10.1080/17512  
433.2018.1449642
4. Jaiswal AK, Ravikiran SP, Roy PK. Red eccrine chromhidrosis  
with review of literature. Indian J Dermatol. 2017;62(6):675.  
https://doi.org/10.4103/ijd.IJD_755_16
5. Glasset B, Herbin S, Granier SA, et al. Bacillus cereus, a serious  
cause of nosocomial infections: epidemiologic and genetic survey.  
PLoS One. 2018;13(5):e0194346. https://doi.org/10.1371/journal.  
pone.0194346
6. Hill S, Duffill M, Lamont D, Rademaker M, Yung A. Pseudo-  
chromhidrosis: blue discolouration of the head and neck.  
Australas J Dermatol. 2007;48(4):239-241. https://doi.org/10.  
1111/j.1440-0960.2007.00395.x
7. Castela E, Thomas P, Bronsard V, Lacour JP, Ortonne JP,  
Passeron T. Blue pseudochromhidrosis secondary to topiramate  
treatment. Acta Derm Venereol. 2009;89(5):538-539. https://doi.org/10.  
2340/00015555-0696
8. Callewaert C, Nakatsuji T, Knight R, et al. IL-4Rα blockade by  
dupilumab decreases Staphylococcus aureus colonization and  
increases microbial diversity in atopic dermatitis. J Invest  
Dermatol. 2020;140(1):191-202.e7. https://doi.org/10.1016/j.jid.2019.05.024