Postinflammatory hyperpigmentation: A comprehensive overview

Epidemiology, pathogenesis, clinical presentation, and noninvasive assessment technique

Narumol Silpa-archa, MD,[a,b] Indermeet Kohli, PhD,[a] Suteeraporn Chaowattanapanit, MD,[a,c] Henry W. Lim, MD,[a] and Iltefat Hamzavi, MD[a]
Detroit, Michigan, and Bangkok and Khon Kaen, Thailand

Learning objectives
After completing this learning activity, participants should be able to recognize characteristics of PIH and similar conditions; discuss the pathogenesis of PIH and similar conditions; and describe how to perform an objective evaluation for PIH.

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Postinflammatory hyperpigmentation (PIH) commonly occurs after various endogenous and exogenous stimuli, especially in dark-skinned individuals. PIH is one of the most common complications of procedures performed using laser and other light sources. The severity of PIH is determined by the inherent skin color, degree and depth of inflammation, degree of dermoepidermal junction disruption, inflammatory conditions, and the stability of melanocytes, leading to epidermal and dermal melanin pigment deposition. The depth of melanin pigment is the key factor to predict prognosis and treatment outcome. Epidermal hyperpigmentation fades more rapidly than dermal hyperpigmentation. Various inflammatory disorders can eventually result in PIH. The evaluation of pigmentation using noninvasive tools helps define the level of pigmentation in the skin, pigmentation intensity, and guides therapeutic approaches. This first article in this 2-part series discusses the epidemiology, pathogenesis, etiology, clinical presentation, differential diagnoses, and investigation using noninvasive assessment techniques that objectively determine the details of pigmentation. (J Am Acad Dermatol 2017;77:591-605.)

Key words: colorimetry; hyperpigmentation; hyperspectral imaging; melanin; melanocytes; photography; racial/ethnic; reflectance confocal microscopy; reflectance spectroscopy; skin phototypes.

From the Department of Dermatology,[a] Henry Ford Hospital, Detroit; Department of Dermatology,[b] Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok; and the Department of Medicine,[c] Faculty of Medicine, Srinagarind Hospital, Khon Kaen University, Khon Kaen.

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Reprint requests: Iltefat Hamzavi, MD, Department of Dermatology, Henry Ford Medical Center — New Center One, 3031 W Grand Blvd, Ste 800, Detroit, MI 48202. E-mail: ihamzav1@hfhs.org.

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INTRODUCTION

Key points

- **Postinflammatory hyperpigmentation can occur in all skin phototypes but is most common in dark-skinned individuals**
- **Certain dermatoses can cause postinflammatory hyperpigmentation without noticeable inflammation**

Postinflammatory hyperpigmentation (PIH) is a common, acquired pigmentary disorder caused by cutaneous endogenous inflammation, external injury, or cutaneous procedures.[1,2] In each individual, inflammatory dermatoses can produce clinical hyperpigmentation, hypopigmentation, or both. PIH presents locally in previous areas of inflammation. When erythema subsides, a hyperpigmented macule or patch that can range in color from tan to black is left behind. PIH tends to occur most noticeably among individuals with Fitzpatrick skin phototypes (SPTs) III to VI.[3-5] Although PIH is easily diagnosed from the patient's history and the presence of inflammation, several dermatoses lead to PIH without noticeable inflammation. Visual assessment is one of the criterion standards for evaluating PIH, but it is subjective and has interobserver variability. The use of noninvasive techniques can avoid this limitation. This article presents an overview of the epidemiology, risk factors, pathogenesis, etiology, clinical manifestations, and certain hyperpigmentation disorders resulting in PIH. In addition, the evaluation of PIH using noninvasive objective assessment techniques that provide more reliable, reproducible outcome measurements are also discussed.

EPIDEMIOLOGY

Key points

- **Dark-skinned individuals constitute most of the world's population**
- **The increasing percentage of individuals with skin of color in the United States makes a better understanding of skin of color–related cutaneous disorders important**
- **In individuals with skin of color, postinflammatory hyperpigmentation is one of the most common complications of procedures performed using laser and other light sources**

Dark-skinned individuals, commonly referred to as patients with skin of color (SOC), constitute most of the world's population. They include Africans, African Americans, Native Americans, Hispanics, Latinos, people of Caribbean descent, Pacific Islanders, East Indians, Pakistanis, Eskimos, people of Middle Eastern descent, Koreans, Chinese, Vietnamese, Filipinos, Japanese, Thais, Cambodians, Malaysians, Indonesians, and Aleuts.[6] In 2000, individuals with SOC represented 30% of the US population, and by 2050, the US Census Bureau has estimated that a minimum of 50% of Americans will be those with SOC.[7] It is therefore important and relevant that a better understanding of cutaneous disorders related to SOC be obtained.

El-Essawi et al[8] reported that uneven skin tone and skin discoloration are 2 of the most concerning skin problems among Arab Americans, with >50% of the survey participants expressing such concerns. Among 3000 Latino patients, the incidence of hyperpigmentation and melasma was reported to be between 6.0% and 7.5%.[9] In a study conducted in Singapore, PIH tended to occur among Asians with darker skin, showing the importance of the degree of constitutive cutaneous pigmentation in the development of PIH.[10] Alexis et al[11] reported that dyschromia was 1 of the top 5 disorders in 1412 African Americans, whereas this diagnosis was not among the top 10 diagnoses in white patients.

PIH is also the most common complication of laser resurfacing in those with SOC.[12] Chan et al[12] reported a PIH prevalence of 11.1% to 17.1% among Asians who had undergone fractional laser resurfacing. The incidence of PIH after ablative fractional carbon dioxide laser treatments in SPT IV patients was as high as 92%,[13] compared with 23% in patients with SPT I to III undergoing similar procedures[14]; in SPT I to III patients exposed to deep fractional carbon dioxide laser treatments, PIH was observed in only 1.2% of patients.[15]

PATHOGENESIS AND ETIOLOGIES

Key point

- **Intensity of postinflammatory hyperpigmentation is determined by the inherent skin color, degree and depth of inflammation, degree of disruption at the dermoepidermal junction, inflammatory conditions, and stability of melanocytes**

Pigmentary alteration from preceding inflammatory dermatoses can lead to hyperpigmentation, hypopigmentation, or both, relying on the number and function/activity of melanocytes after inflammation. Inflammation that affects the dermoepidermal junction tends to develop dyspigmentation. The difference of these responses is not well-clarified. Ruiz-Maldonado and Orozco-Covarrubias[16] proposed an "individual chromatic tendency" hypothesis. After cutaneous inflammation or injury,