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Review Article

Consensus on management of acne-induced post-inflammatory hyperpigmentation: an Indian perspective

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ABSTRACT

Post-inflammatory hyperpigmentation (PIH) is a multifactorial disorder linked to alterations in melanin pigment because of inflammatory skin condition or any injury. Acne-induced PIH is one of the common presentations observed in dermatological consultations in India, especially in females of younger age group. A wide range of topical depigmenting agents are available for effective clearance of hyperpigmentation in patients affected with acne. Besides, chemical peels and cosmetic procedures like lasers and light therapies are commonly employed. However, treatment of acne-induced PIH is challenging in Indian clinical settings for multiple reasons such as relapsing of the condition and long-standing nature of the disease; the tendency of treatment to cause pigmentation; insufficient clinical data on natural ingredients; and lack of clinical practice guidelines, exclusively for the management of PIH in Indian patients. An experts' panel discussion involving dermatologists all over India was conducted to review the evidence-based concept of acne-induced hyperpigmentation, and to obtain expert opinions on effective and practical management of acne-induced PIH in Indian settings. This article outlines consensus expert opinions aimed at identifying, diagnosing, and managing acne-induced PIH using topical depigmenting agents in Indian patients. It also highlights effective preventive strategies, the role of patient counselling and education regarding awareness about the disease and its treatment strategies.

Keywords: Acne, Post-inflammatory hyperpigmentation, Treatment, Photoprotection, Depigmenting agents

INTRODUCTION

Post-inflammatory hyperpigmentation (PIH) is defined as an acquired, reactive cutaneous hypermelanosis occurring after pre-existing inflammation or injury.[1,2] Acne is one of the most common inflammatory skin disorders, that results in hyperpigmentation in the epidermis or dermis, or both, causing PIH.[3,4] Hyperpigmentation is a common

event after acne, especially in individuals with skin of colour, who are supposed to be predisposed to pigment alteration.[4,5] Hyperpigmentation in acne-affected patients may occur within a few days after the inflammation and erythema have resolved.[4,6] Acne-induced PIH is a result of increased production or redistribution of melanin, after cutaneous insult on melanocytes.[5] Acne-related PIH is associated with psychosocial distress, reduced self-respect and an impaired quality of life. To avoid further impairment in the quality of life and psychological suffering in patients with acne, an awareness of PIH and its treatment is necessary.[7]

There exists a variety of medications and procedures for the treatment of acne-induced PIH, including topical depigmenting agents such as hydroquinone, azelaic acid, kojic acid, retinoids, and procedures like chemical peels, laser and light therapies.[8] However, these treatment options tend to cause further pigmentation, especially in people with darker skin type.[9] Given the long-standing and relapsing nature of the condition, the treatment of PIH is challenging. Thus, the ideal therapy needs to enhance the efficacy of existing treatment, provide long-lasting effects and prevent any relapse.[10,11] In India, there is a lack of specific clinical guidelines for the management of acne-induced PIH. Besides, evidence from clinical trials supporting the use of natural ingredients in the management of acne-induced PIH is scarce.

METHODS

Experts' group meetings including 110 dermatologists were conducted across eleven major cities in India – Delhi, Ludhiana, Ghaziabad, Mumbai, Nagpur, Kolkata, Bengaluru, Hyderabad, Ahmedabad, Kochi, and Chennai in 2018-2019. The main purpose of the meetings was to discuss the evidence-based concept of acne-induced hyperpigmentation and provide expert opinion on effective management of acne-induced PIH. Clinical insights were drawn based on a set of questions (Table 1) on epidemiology, causative factors, diagnosis, and treatment practice in the Indian scenario.

We performed a literature search using PubMed, Google and Google Scholar. We identified relevant articles using Boolean operators and/or for search terms/keywords such as acne, post-inflammatory hyperpigmentation, treatment, photoprotection, depigmenting agents, and prevention. In all, 24 published research articles, systematic reviews or meta-analyses were used for the preparation of this consensus paper.

Table 1: Set of clinical questions.

S. no.	Question
1	In daily clinical practice, which age group and gender commonly report with acne-induced PIH?
2	According to you, which skin type do you observe to be more prone to acne-induced PIH?
3	Is there any association between severity or grade of acne and development of PIH?
4	What are the common risk factors or causes that may increase the risk of PIH development?
5	What are the common clinical features of acne-induced PIH?
6	How is acne-induce PIH diagnosed? Are there are any specific tests or clinical investigations that needs to be performed?
7	What are the common topical and non-topical treatment options for management of acne-induced PIH?
8	What is the role of topical combination therapy in PIH management?
9	What is the significance of photoprotection in the management of acne-induced PIH?
10	Which are the chemical treatments and cosmetic procedures that can be considered for acne-induced PIH?
11	What is the importance of patient education and counselling as a part of management strategy?
12	What are effective preventive measures for acne-induced PIH?

This paper summarizes consensus experts' opinions on the burden of acne-induced PIH and its management using topical medical treatments in Indian clinical practice. The consensus draft has been formulated by the experts' suggestions. Consensus derived from the experts' discussion follows each section in the article.

ACNE-INDUCED POST-INFLAMMATORY HYPERPIGMENTATION

Acne is a common occurrence in teenagers and adults. Scarring and PIH are the two main complications of acne.[12] Topical retinoids are the mainstay for acne management, and also for maintenance therapy.[13] There is a need for early and efficacious treatment to minimize the potential impact of acne-associated PIH.[13] Beneficial action of topical retinoids on the dermis has further demonstrated their efficacy on secondary lesions of acne, i.e. scarring and pigmentation.[14] Retinoids are believed to offer dual benefits on both acne lesions and PIH blemishes. Thus, retinoid therapy is suggested to provide improved treatment benefits and enhance treatment compliance. Retinoid therapy causes lightening of dark spots and improvement of overall skin tone and texture.[13]

Squeezing and popping the acne lesions may contribute to PIH. Unlike acne scars, PIH is usually reversible.[3] The course of acne-induced PIH is often unpredictable; it may

be transient and resolve within months (mostly epidermal hyperpigmentation). In a few cases, there can be permanent discolouration of the skin (dermal hyperpigmentation).[1,12] The time taken for depigmentation usually depends on the colour contrast between the pigmented macule and the natural skin tone.[3]

EPIDEMIOLOGY

In India, 80% of the population presents skin colour heterogeneity on the face, irrespective of gender and age. There are three most common hyperpigmentary disorders in India - melasma, PIH and actinic lentigines.[15] Acne-induced PIH can occur in all skin types but is most commonly observed in Fitzpatrick skin types III to VI or in people with skin of colour. The frequency and severity of pigmentary changes vary among people, and in people with darker skin tone, it is higher.[2] They show a long-lasting and higher intensity of hyperpigmentation.[1,2] Indian epidemiological data suggests that more than 70% of people (<35 years of age), both women and men with history of acne develop hyperpigmentation. It is observed to be more frequent and severe in people with prolonged or recurrent acne inflammation.[6,15]

The expert panel opined that acne-induced PIH is commonly observed in teenagers and young adults, especially females, particularly in the age group of 15-30 years. Besides, they stated that pigmentation is more predominant in people with grade II and III acne. However, people with darker skin type are more prone to acne and tend to have an increased risk for PIH.

ETIOLOGY

Acne-induced PIH is mediated by several different endogenous factors relevant to the patient, and exogenous factors based on the etiology and intensity of the inflammation.[16] A wide range of stimuli, such as dermatoses, trauma, aesthetic cutaneous procedures like lasers, chemical peels, ultraviolet radiation, and drugs, which may cause pigmentary changes in the skin could trigger an inflammatory reaction.[1,2] Common causes of PIH in people with skin of colour include acne vulgaris, atopic dermatitis, and impetigo. PIH is a common event after acne in people with skin of colour.[1,2]

The expert panel indicated that acne-induced PIH is likely to be more prevalent in people with poor nutritional status, including those with iron and vitamin B12 deficiencies. Besides, the panel stated that dry skin, atopic dermatitis, seborrhoea, metabolic disorders such as thyroid disorders, injuries, pregnancy and intake of contraceptive pills make a person prone to PIH. Other factors that may influence the development of hyperpigmentation include pricking and scratching of pimples, lack of use of sunscreen, frequent facial scrubbing, excessive use of cosmetics or home remedies, obesity, insulin resistance, excessive physical workout and prolonged exposure to the sun.

CLINICAL FEATURES

PIH appears as a blemish, or skin discolouration, occurring as asymptomatic irregular macules or patches in the same manner as the inflammation.[1] In acne-affected patients, PIH occurs in areas of acne papules, pustules, and nodules. In addition, the severity of PIH reflects the severity of the inflammatory process and the underlying tendency of PIH development.[3] Depending on the skin type and depth, or location of hyperpigmentation, PIH in acne-affected patients appears as discoloured macules, typically in shades of brown and black; and may sometimes appear as pink, red, or purple.[3] If hyperpigmentation is in the epidermis, patches appear tan, brown, or dark brown; and if hyperpigmentation is within the dermis, a blue-grey discolouration is observed. Both types of patches can coexist.[1,2]

The expert panel opined that in people with acne, the presence of light and dark pigments or inflammation maybe a sign of PIH development. Acne lesions originally appear red, and while healing, they progress to purple, brown and black pigmentation. They may appear as epidermal type hyperpigmented macules or papules. Moreover, patients with acne presenting with more erythema and inflammation are more likely to develop PIH irrespective of the duration.

PATHOGENESIS

Cutaneous inflammation in acne triggers an overproduction of melanin or irregular pigmentation in the skin.[2,3] Inflammatory stimuli activate melanocytes through specific biochemical signals and lead to pathogenesis of PIH as a normal response of the skin to the inflammatory stimulus.[17] Hyperpigmentation following skin inflammation involves two major processes – pigmentary incontinence and a cutaneous epidermal inflammatory response (Figure 1).[2,3,17]

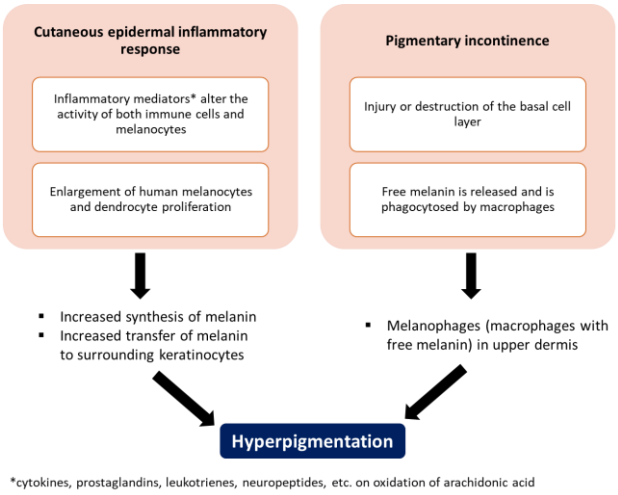

Figure 1: Pathophysiological processes in hyperpigmentation.

In figure 1 describes the hyperpigmentation following skin inflammation involves two major processes – cutaneous epidermal inflammatory response and pigmentary incontinence. In cutaneous epidermal inflammatory response, inflammatory mediators like cytokines, prostaglandins, leukotrienes, neuropeptides, etc. on oxidation of arachidonic acid alter the activity of both immune cells and melanocytes causing enlargement of human melanocytes and proliferation of dendrocytes. These processes lead to increased synthesis of melanin and increased transfer of melanin to surrounding keratinocytes, leading to development of hyperpigmentation. On the other hand, in the process of pigmentary incontinence, the basal cell layer is injured or destructed which releases free melanin. The macrophages phagocytose this free melanin and form melanophages in upper dermis which produce hyperpigmentation.

The expert panel agreed that inflammation and destruction of the basal epidermal layer play an integral role in the process of abnormal production or regulation of melanin, resulting in the development of skin hyperpigmentation.

DIAGNOSIS OF ACNE-INDUCED PIH

Clinical diagnosis of PIH involves eliciting history of previous inflammatory condition/s and physical examination of the lesion. One of the visual diagnostic methods is Wood's lamp examination, which allows a clinician to know the location of excess melanin, whether in the epidermis or dermis. However, Wood's lamp examination generally has a limited role for Indian skin, which is traditionally considered as dark skin. Skin biopsy can confirm the location of hypermelanosis. However, it is commonly used in case of unclear etiology.[17,18] Another essential diagnostic method includes subjective rating scales of pigmentation such as post-acne hyperpigmentation index (PAHPI), which can be effectively used in routine clinical practice.18 Noninvasive objective assessments for PIH are polarized light photography, colourimetry, diffuse reflectance spectroscopy (DRS), hyperspectral imaging (HSI), and reflectance confocal microscopy. These are reliable and reproducible, provide valuable quantitative information of the lesion and improve the clinical assessment.[18]

The expert panel opined that history taking is crucial to assess risk factors for PIH development. They emphasized that although PIH lesions are clinically apparent, specific tests such as dermoscopy examination and Wood's lamp examination may be necessary. However, the panel stated that Wood's lamp has limited use for Indian skin. In addition, clinical assessments for PCOS and thyroid disorders; vitamin D and B12 deficiencies; and insulin, iron and haemoglobin levels might be useful. They also stated that assessment scales such as global acne grading scale (GAGS), Rosenberg's self-esteem scale (RSES) and acne checklists/questionnaires could be considered to understand patient's tendency to develop PIH.

MANAGEMENT OF ACNE-INDUCED PIH

The main goal in the management of acne-induced PIH is to achieve an even skin tone or a tone that matches the basal skin tone. However, treatments are variable, and depend on the extent of injury or inflammation, and length of sun exposure.[5] In acne management, sustained remission is expected to prevent the occurrence of new acne lesions.[14] Another essential objective of acne treatment is the prevention of long-lasting acne-associated complications such as scarring, PIH, and erythema.[14]

Medical treatment

The primary step in the management of PIH should include treating the underlying inflammatory skin conditions. Early treatment initiation for PIH may be associated with faster resolution and prevention of further darkening.[2,6] It is necessary to assess available therapeutic options to optimize relief and comfort for patients with acne-induced PIH.[1] There are topical and non-topical treatment options usually employed for the management of acne-induced PIH.

Topical treatment

The management of PIH in acne-affected patients necessitates the effective topical treatment with multiple strategic actions of single or combination agents (Figure 2).[3]

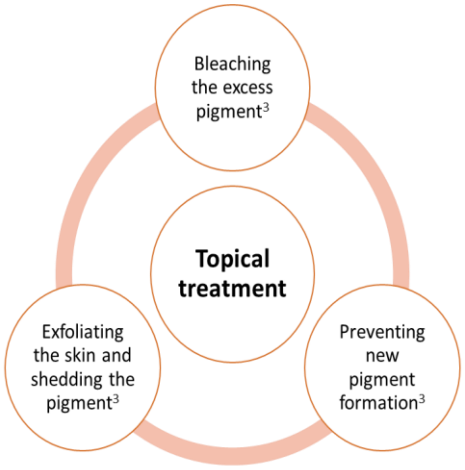

Figure 2: Strategies for topical treatment.

In figure 2 describes the topical treatment approach includes employing treatment modalities like bleaching the excess pigment, preventing new pigment formation, exfoliating the skin and shedding the pigment, or combination of these modalities.

Strategies for topical treatment

Besides the gold standard, which is hydroquinone, there are various skin depigmenting agents with differing mechanisms of action, available for the management of acne-induced PIH.[3,19] Topical depigmenting agents include azelaic acid, kojic acid, licorice extract, retinoids and niacinamide, among others.[2,20] They work by regulating melanin synthesis and diffusion, thus proving useful in the treatment of PIH (Table 2).[2,14,21] They are typically used to treat epidermal PIH as deeper pigmentation does not respond well to these agents.[2] Topical cosmeceutical products also play a vital role in the management of PIH.[22] They work by selectively targeting hyperplastic melanocytes, and inhibiting key regulatory steps in melanin synthesis.[22] In addition, phytochemicals and other natural ingredients are being used as alternative treatment options for the management of acne-induced PIH.[19] Here, a word of caution is in order. Some tyrosinase inhibitors (e.g. quercetin) and antioxidants stimulate melanin formation; flavonoids (may) increase free radicals instead of scavenging them.[23] Although they have potential benefits in the management of PIH, most of these have in vitro evidence and lack substantial clinical evidence of efficacy, rendering their long-term efficacy and safety questionable.[19]

Table 2: Clinical use of topical depigmenting agents for treatment of PIH.

No.	Depigmenting agent	Mechanism	Clinical use
1	Hydroquinone (2%-4%)	Inhibition of tyrosinase and melanin synthesis.[2]	It is effective as monotherapy and has been formulated with other depigmenting agents like retinoids, antioxidants, glycolic acid, sunscreens, and corticosteroids, to increase efficacy.[2]
2	Retinoids (0.01 to 0.1%)	Modulation of cell proliferation and differentiation; induction of apoptosis of mature melanocytes; acceleration of epidermal turnover; and anti-inflammatory effects.[2,14,21]	They are effective alone or in combination with other agents such as hydroquinone for the treatment of PIH2. Adapalene (0.1 to 0.3%) and tazarotene (0.05 and 0.1%), third generation synthetic topical retinoids, are effective in the treatment of PIH, particularly acne-induced PIH.[1,2]
3	Azelaic acid (20%)	Tyrosinase inhibition. Selective cytotoxic and antiproliferative effects toward abnormal melanocytes through the inhibition of DNA synthesis and mitochondrial enzymes.[2]	Azelaic acid is commonly used for acne vulgaris and melasma in addition to PIH2
4	Kojic acid (1 to 4%)	Inhibits production of free tyrosinase.[1]	It can be used in combination with glycolic acid or hydroquinone1. It can be formulated with other lightening agents, including glycolic acid and hydroquinone, to increase efficacy.[2]
5	Niacinamide (2%-5%)	Decreases melanosome transfer to keratinocytes without inhibiting tyrosinase activity or cell proliferation.[2] It may also interfere with the cell-signaling pathway between keratinocytes and melanocytes to decrease melanogenesis.[2]	Topical niacinamide is effective when used alone or in combination with N-acety glucosamine for the treatment of melasma and UV-induced hyperpigmentation in fair-skinned and Asian patients It demonstrates great stability, and is unaffected by light, moisture, acids, alkalis, or oxidizers.[1,2]
6	N-acetyl glucosamine 2%	Inhibition of tyrosinase and melanin synthesis.[2]	N-acetyl glucosamine containing cosmeceuticals have greater stability, good skin penetration, and overall tolerability. It is typically used as monotherapy or in combination with niacinamide, providing greater depigmentation benefits.[2]
7	Ascorbic acid (5%-10%)	Antioxidant and anti-inflammatory properties.[2]	It demonstrates skin lightening effects and photoprotective properties.[2] It can be formulated with other depigmenting agents, such as hydroquinone, and is generally well tolerated.[2]
8	Licorice extract	Melanin dispersion and removal.[2]	Licorice root extract is a common ingredient found in many skin-lightening cosmeceuticals. Glabridin, an active ingredient in licorice extract, has anti-inflammatory effects.[2]

According to the expert panel, effective depigmenting agents include retinol, isotretinoin, glycolic acid, azelaic acid, kojic acid, nicotinamide, arbutin, niacinamide, and combination of vitamins C and E. They also emphasized that depigmentation therapy should be individualized and initiated after the inflammation subsides. It is usually observed that with treatment, acne heals, but the appearing pigmentation causes patient discomfort. It is advisable to initiate early anti-pigmentation therapy for effective results. Use of anti-pigmentation agents such as glycolic acid, kojic acid or azelaic acid introduced in early stages of acne is beneficial. Kojic acid is well-tolerated in acne-induced PIH patients.

Isotretinoin is an effective treatment, since it reduces marks and scars within 3-4 weeks of therapy, depending upon the skin type. Topical retinoids show promising effects on PIH via activator protein pathway/metalloproteinase pathway. Prescribing retinoic acid with a moisturizer and sunscreen lotion reduces scarring. Glutathione can be considered as an oral therapy for the management of PIH. The use of injectable steroids (ILS) for acne-induced PIH is not advisable. When patients do not respond to medical therapy, procedural therapy might be suggested. Salicylic acid is highly preferred for effective reduction of pigmentation. Serum is often used as a topical treatment for acne-induced PIH. Azelaic acid can be used for PIH as it reduces inflammation of acne. Hyaluronic acid is also prescribed by some dermatologists. In addition, the experts emphasized that hydroquinone is preferred as an adjunctive treatment for the management of acne-induced PIH. Regarding cosmeceuticals, the experts agreed that cleansers are effective for cleansing superficial layers and they increase the efficacy of agents used for PIH. Also, application of benzoyl peroxide reduces oxidative stress and controls inflammation; but should be used with caution in people with sensitive skin (because it is a non-antibiotic anti-bacterial which is an important component for treatment of acne and for preventing resistance to Cutibacterium acnes)

Role of combination therapy

Combination treatment allows targeting multiple pathways in the process of melanogenesis and melanin distribution.5 Combination therapy appears to be more effective than monotherapy in the management of acne-induced PIH. Combination treatment with hydroquinone, retinoic acid, and corticosteroids is the most effective treatment for PIH.24 Other possible combination treatment options.[16,17,21,22,24] is shown in Table 3. As proposed by Kligman and Willis, optimal therapy for PIH should include four different agents – hydroquinone 4-5%, mid-potent steroid, topical retinoid, and sunscreens.[17] Retinoid enhances hydroquinone penetration into the epidermis and steroid decreases the inflammation caused by hydroquinone or retinoid. Antioxidants such as ascorbic acid and α-hydroxy acids may be used as additives to increase penetration and enhance the efficacy.[17]

Table 3: Possible combination therapies for management of PIH.[16,17,21,22,24]

Skin depigmenting and lightening agent	Combination agents
Hydroquinone	Retinoids Glycolic acid Ascorbic acid Vitamin E Corticosteroids
Mequinol	Tretinoin
Tretinoin	Hydroquinone Mequinol Corticosteroids α-hydroxy acids like glycolic acid, lactic acid
Azelaic acid	Glycolic acid
Kojic acid	Glycolic acid Hydroquinone
Ascorbic acid	Hydroquinone
Soy	Salicylic acid Retinol
Arbutin	Nicotinamide Retinaldehyde

The expert panel agreed that the combination treatment of depigmenting agents is chosen over monotherapy. Moreover, they highlighted the fact that triple combination therapy is usually not preferred in Indian patients. However, if needed, the triple combination of retinoid, steroids and hydroquinone can be recommended twice a week.

Non-topical treatment

Non-topical methods are second-line treatment options generally chosen for treating recalcitrant PIH. These include chemical or cosmetic procedures such as chemical peeling, laser treatment, etc. They, however, have a higher risk of worsening the condition compared to topical depigmenting agents.[6]

Superficial chemical peeling

Chemical peels used alone or in combination with lightening agents can be effective in all skin types, more commonly in patients with darker skin tones.[17] They work by accelerating exfoliation of the skin and thus reduce the melanin pigment.[3] Glycolic acid (20-70%) induces epidermolysis, dispersion of basal layer melanin, and increases dermal collagen synthesis. Salicylic acid (20-30%) induces keratolysis by disrupting intercellular lipid linkages between epithelioid cells.

Patients are also advised to avoid sun exposure and use sunscreen after chemical peel treatment.[17]

Laser therapy

Currently, there are many light or laser therapies that can target melanin-containing melanosomes. Light therapy has reported variable response and recurrence may be observed within 6–12 months. Other effective light therapies in the management of PIH include blue light photodynamic therapy and fractional photothermolysis.[17] Vascular laser or long-pulsed dye laser treats the vascular component of inflammation and reduces the inflammatory process, thereby reducing the risk of PIH.[6] Laser therapy with 1064 nm QS neodymium with yttrium-aluminum-garnet (Nd:YAG), is effective and provides a greater margin of safety in individuals with darker skin tone.[17]

Other methods

Other prospective methods include microdermabrasion and non-ablative lasers, which have not proven to be beneficial for the management of acne-induced PIH. However, the choice of these methods may depend on availability, expertise, and the degree of desperation.[3]

The experts were of the opinion that, in clinical practice, a combination of procedural and topical therapy is mostly preferred. They opined that salicylic acid or retinol peel, or a combination of salicylic acid and mandelic peels are effective for acne-induced PIH. However, if patients are already undergoing treatment with retinoid gel or adapalene cream; retinol peels should be preferred. The experts added that laser therapy could be employed alone, or in a combination with peels. However, lasers are considered only for dermal hyperpigmentation. Among light therapies, intense pulse light (IPL) filters are considered to provide remarkable outcomes for acne-induced PIH.

Non-medical treatment

Photoprotection

Sun exposure is associated with the development or worsening of hyperpigmentation as a result of stimulation of growth of melanocytes.[15] The importance of photoprotection in the management of PIH is often underestimated. Patient education regarding photoprotection is important to prevent worsening of PIH. Thus, daily use of sunscreens (SPF of≥15) and sun-protective measures such as avoidance of sun exposure and protective clothing is advised.1 Physical sunscreens are often combined with organic sunscreens to offer a broad protection spectrum.[15] Regular application of topical sunscreens, especially physical sunscreens, protect against both ultraviolet A and B radiations and result in optimal outcomes, if applied before initiation of treatment.[6]

The expert panel agreed that broad-spectrum physical and tinted sunscreens with SPF of 30 are usually preferred for acne-induced PIH. In addition, the application of hyaluronic acid before applying sunscreen is recommended to avoid skin dryness. They also suggested that all anti-acne prescriptions should include use of sunscreens since retinoids have photosensitizing ability and may result in pigmentation.

ROLE OF PATIENT COUNSELLING

In acne-affected patients, behavioural modification to avoid scratching, rubbing, and picking is necessary. The patients should be made aware that abnormal manual manipulation of lesions may lead to increased hyperpigmentation.[17] Despite adequate therapy for PIH, it may take quite some time for resolution of PIH. Thus, patient counselling for the natural course of PIH and the management aspects is a helpful tool to get the patients through the psychological stress of this condition.[6] It is also crucial to understand the fact that treatment for PIH may also cause irritation and worsen the existing condition.[2,6] Thus, proper counselling on the daily use of sunscreen, avoiding sun exposure, and wearing protective clothing is advised. In addition, a diet including vitamin D rich foods, seafood, or fortified foods and vitamin D supplementation is advised.[2]

Patient counseling regarding disease awareness, type of treatment, treatment-related effects, avoidance of pricking/popping the lesions as well as home remedies, regular sunscreen application, and personal hygiene is important. The experts stated that diet; especially food with high glycaemic index, has a role in acne-induced PIH. They recommended flax seeds, vitamin A, anti-oxidants, vitamin C rich foods and a healthy balanced diet for acne-free skin. Besides, avoidance of junk and oily food has also been advised.

PREVENTIVE STRATEGY FOR ACNE-INDUCED PIH

Timely and appropriate acne intervention may control inflammation from progressing.[3] Effective control of inflammation may help prevent and minimize the severity and the course of PIH.[3,6] In addition, regular use of noncomedogenic and oil-free sunscreen (SPF of≥15) is highly recommended. Treatment for PIH can only be initiated when the acne has recovered completely. However, topical azelaic acid and topical retinoids can be incorporated during the active stage of acne treatment.3 In high-risk people (dark skin tone) treatment associated irritation may exacerbate the condition, suggesting prevention to be the most important strategy in these people.[1] It becomes necessary for a dermatologist to identify the high-risk population to treat potential underlying diseases first and avoid unnecessary surgery and cosmetic procedures.[1]

The expert panel agreed that initiation of isotretinoin at an early phase of therapy along with regular sunscreen use are so far the best preventive measures to prevent the

development of acne-induced PIH. They emphasized that aggressive treatment of acne with daily use of sunscreen; oral antioxidants and good skincare regimen are important components of a preventive strategy.

Recommendations for management of acne-induced post-inflammatory hyperpigmentation shows in Table 4.

Table 4: Recommendations for management of acne-induced post-inflammatory hyperpigmentation.

Area of focus	Experts' recommendations
Epidemiology	1) PIH is highly prevalent in teenagers and young adults, especially females particularly in the age group of 15-30 years 2) It is more predominant in people with darker skin type and grade II-III acne
Etiology	1) The most common factors associated with development of PIH are nutritional deficiency, skin disorders like acne, atopic dermatitis, metabolic disorders, certain medications, prolonged sun exposure, excessive use of cosmetics and home remedies, habits like pricking and scratching of pimples
Clinical features	1) Hyperpigmentation in patients with acne is mostly observed to be in the form of epidermal macules or papules which are brown or black in colour.
Pathogenesis	1) Inflammation and destruction of basal epidermal layer impairs production or regulation of melanin, and results in hyperpigmentation
Diagnosis	1) History taking to assess risk factors 2) Clinical tests such as dermoscopy examination and Wood's lamp examination 3) Laboratory assessments for PCOS, thyroid disorders, vitamin D and B12 deficiencies, and insulin, iron and haemoglobin levels 4) Assessment scales such as GAGS, rosenberg self esteem scale (RSES) and acne checklists/questionnaires
Medical treatment	Topical therapy 1) Effective topical depigmenting agents include retinol, isotretinoin, glycolic acid, azelaic acid, kojic acid, nicotinamide, arbutin, niacinamide, and combination of vitamin C and E 2) The topical product should be non-sticky and the vehicle should not be oily. Gel-based preparations and products which offer a matt finish are preferred 3) Anti-oxidants when given along with other therapies reduce occurrence of PIH. However, they may be associated with possible worsening of the condition due to melanin stimulation. 4) Nicotinamide, kojic acid and arbutin are considered good hyperpigmentation agents. 5) Combination treatment containing de-pigmentary molecules works better than monotherapy 6) Azelaic acid should be used in gradual increasing doses from 10 % to 20%. It takes approximately 2-weeks to start its action 7) Triple combination of retinoid, steroids and hydroquinone can be recommended twice a week Non-topical therapy 1) Salicylic acid or retinol peel or combination of salicylic acid and mandelic peels are effective for acne-induced PIH 2) Laser therapy could be employed alone or in combination with peels
Photoprotection	1) Broad-spectrum physical and tinted sunscreens with SPF of 30 are usually preferred for acne-induced PIH
Patient counselling	1) Patients should be made aware of nature of the disease, type of treatment, treatment-related effects, avoidance of pricking/popping the lesions and home remedies, regular sunscreen application, personal hygiene, and balanced diet
Prevention measures	1) Early initiation of acne therapy with isotretinoin and routine use of sunscreen are effective prevention measures 2) Daily skin care regimen is also equally important

CONCLUSION

Given the paucity of clinical evidence, there is a lack of clinical guidance on appropriate management of acne-induced hyperpigmentation. Besides, various depigmenting agents, including natural ingredients employed for the management of hyperpigmentation, have limited clinical data. This experts' consensus paper

has summarized clinicians' perspective towards managing acne-induced hyperpigmentation using topical depigmenting agents that can be effectively implemented in day-to-day clinical practice. The experts opined that topical use of combination therapy containing de-pigmentary compounds is beneficial over monotherapy. The experts have also addressed the significance of timely and appropriate acne treatment as an effective preventive strategy to reduce the risk of PIH development. In addition, they support the role of patient counseling, regarding the routine use of sunscreens and skin care to enhance the effectiveness of the treatment.

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REFERENCES

1. Taylor S, Grimes P, Lim J, Im S, Lui H. Post-inflammatory hyperpigmentation. J Cutan Med Surg. 2009;13(4):183-91
2. Davis EC, Callender VD. Post-inflammatory hyperpigmentation: a review of the epidemiology, clinical features, and treatment options in skin of color. J Clin Aesthet Dermatol. 2010;3(7):20-31
3. Kubba R, Bajaj A K, Thappa D M, Sharma R, Vedamurthy M, Dhar S, et al Post-inflammatory hyperpigmentation in acne. Ind J Dermatol Venereol Leprol. 2009;75(S1):54
4. Chandra M, Levitt J, Pensabene CA. Hydroquinone therapy for post-inflammatory hyperpigmentation secondary to acne: Not just prescribable by dermatologists. Acta Derm Venereol. 2012;92(3):232-35
5. Vashi NA, Kundu RV. Facial hyperpigmentation: causes and treatment. Br J Dermatol. 2013;169(3):41-56
6. Eimpunth S, Wanitphadeedecha R, Manuskiatti W. A focused review on acne-induced and aesthetic procedure-related postinflammatory hyperpigmentation in Asians. J Eur Acad Dermatol Venereol. 2013;27(1):7-18.
7. Akinboro AO, Ezejiofor OI, Olanrewaju FO, Oripelaye MM, Olabode OP, Ayodele OE, et al. The impact of acne and facial post-inflammatory hyperpigmentation on quality of life and self-esteem of newly admitted Nigerian undergraduates. Clinic Cosmet Investigat Dermatol. 2018;11:245.
8. Oram Y, Akkaya AD. Refractory postinflammatory hyperpigmentation treated fractional CO2 laser. J Clin Aesthet Dermatol. 2014;7(3):42-4
9. Bae YC, Rettig S, Weiss E, Bernstein L, Geronemus R. Treatment of post-inflammatory hyperpigmentation in patients with darker skin types using a low energy 1,927 nm non-ablative fractional laser: A retrospective photographic review analysis. Lasers Surg Med. 2020;52(1):7-12
10. Arora P, Sarkar R, Garg VK, Arya L. Lasers for treatment of melasma and post-inflammatory hyperpigmentation. J Cutan Aesthet Surg. 2012;5(2):93-103.
11. Del Bino S, Duval C, Bernerd F. Clinical and biological characterization of skin pigmentation diversity and its consequences on UV impact. Int J Mol Sci. 2018;19(9):2668
12. Zawar V, Agarwal, M, Vasudevan, Biju V. Treatment of postinflammatory pigmentation due to acne with Q-switched neodymium-doped yttrium aluminum garnet in 78 Indian cases. J Cutan Aesthet Surg. 2015;8(4):222-6
13. See JA, Goh CL, Hayashi N, Suh DH, Casintahan FA. Optimizing the use of topical retinoids in Asian acne patients. J Dermatol. 2018;45(5):522-8
14. Leyden J, Stein-Gold L, Weiss J. Why Topical Retinoids Are Mainstay of Therapy for Acne. Dermatol Ther (Heidelb). 2017;7(3):293-304
15. Nouveau S, Agrawal D, Kohli M, Bernerd F, Misra N, Nayak CS. Skin Hyperpigmentation in Indian Population: Insights and Best Practice. Ind J Dermatol. 2016;61(5):487-95
16. Patel AB. Postinflammatory hyperpigmentation: Review of pathogenesis, prevention, and treatment. Pigment Int. 2014;1:59-69
17. Callender VD, St Surin-Lord S, Davis EC, Maclin M. Postinflammatory hyperpigmentation: etiologic and therapeutic considerations. Am J Clin Dermatol. 2011;12(2):87-99
18. Silpa-Archa N, Kohli I, Chaowattanapanit S, Lim HW, Hamzavi I. Postinflammatory hyperpigmentation: A comprehensive overview: Epidemiology, pathogenesis, clinical presentation, and noninvasive assessment technique. J Am Acad Dermatol. 2017;77(4):591-605
19. Hollinger J, Kunal Angra K, Halde R. Are natural ingredients effective in the management of hyperpigmentation? A systematic review. J Clin Aesthet Dermatol. 2018;11(2):28-37
20. Ortonne JP, Bissett DL. Latest insights into skin hyperpigmentation. J Investig Dermatol Symp Proc. 2008;13(1):10-4
21. Kang HY, Valerio L, Bahadoran P, Ortonne JP. The role of topical retinoids in the treatment of pigmentary disorders: an evidence-based review. Am J Clin Dermatol. 2009;10(4):251-60
22. Sarkar R, Arora P, Garg KV. Cosmeceuticals for Hyperpigmentation: What is Available?. J Cutan Aesthet Surg. 2013;6(1):4-11

23. Matsuo M, Sasaki N, Saga K, et al. Cytotoxicity of flavonoids toward cultured normal human cells. Biol Pharm Bull. 2005;28:253-59.
24. Chaowattanapanit S, Silpa-Archa N, Kohli I, Lim HW, Hamzavi I. Post inflammatory hyperpigmentation: A comprehensive overview: Treatment options and prevention. J Am Acad Dermatol. 2017;77(4):607-21.

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