Review Article

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Skin Pigmentation Disorders

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Abstract

Many pigmentary skin illnesses influence appearance, mental health, and social functioning. The main skin pigmentations include hyperpigmentation and hypopigmentation. Clinically, albinism, melasma, vitiligo, Addison's disease, and post-inflammatory hyperpigmentation from eczema, acne vulgaris, and drug interactions are the most common skin pigmentation problems Anti-inflammatory, antioxidant, and tyrosinase-inhibiting medications cure pigmentation. Oral and topical medications, natural therapies, and cosmetic products can help. This review covers pigmentation types, causes, and treatments.

Keywords: Skin, Pigmentation disorders, Hypopigmentation, Hyperpigmentation.

INTRODUCTION

Human skin pigmentation and melanin synthesis vary greatly due to genetics, UV exposure, and medicines. Many pigmentary skin diseases affect patients' appearance, mental health, and social functioning. The two main skin pigmentation types are hyperpigmentation and hypopigmentation.[1] Albinism, melasma, vitiligo, Addison's disease, and post-inflammatory hyperpigmentation from eczema, acne vulgaris, and drug interactions are the most frequent skin pigmentation disorders in clinical practice. Pigmentation can be treated using anti-inflammatory, antioxidant, and tyrosinase-inhibiting drugs. Oral and topical drugs, natural therapies, and cosmetic products can treat skin pigmentation, but a doctor should be consulted before starting any new treatment. This review covers pigmentation varieties, causes, and treatments.

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MATERIALS AND METHODS

This investigation was done in a tertiary care plastic surgery department. This review article examines 30 papers on disorders related with skin pigmentation disorders from Scopus, PubMed, Google scholar, and the internet.

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RESULTS

Based on the inclusion criteria 30 articles were studied to discuss Skin pigmentation disorders under following headings:

1. Background
2. Pathophysiology
3. Management
4. Conclusion

DISCUSSION

Background

Melanin production determines skin colour. Melanocytes in the epidermis produce eumelanin and pheomelanin. Pheomelanin lightens skin, while eumelanin darkens it. The dark brown pigment eumelanin absorbs UV rays, protecting the skin from sunburn. Lighter skin tones have lower eumelanin levels than darker ones. Another benefit of eumelanin is skin cancer prevention.[1,2] Pheomelanin is lighter yellow-red. Higher levels of pheomelanin cause lighter skin tones and sunburn because it absorbs UV rays less effectively than eumelanin. Melanoma and other skin cancers can be prevented by pheomelanin. Melanin synthesis for the melanocortin G-protein-coupled receptor 1 (MC1R) is controlled by gene locus q24.3 on chromosome 16. The MC1R gene controls tanning, skin and hair colour, and melanoma risk. Genetics, sun exposure, and melanocyte-stimulating hormones such ACTH, lipotropin, and MSH produce this variance (MSH). More melatonin causes greyish-brown skin. The MC1R gene controls tanning, skin and hair colour, and melanoma risk.

Pathophysiology

Genetics, UV exposure, and drugs cause most skin pigmentation. The formation mechanism has these phases. UV creates free radicals. Both free radicals and UV radiation activate biological molecules that affect melanocytes, which produce pigment.[2,3] Tyrosinase converts tyrosine into red or brown melanin pigments. Tyrosinase, which produces colour, is activated by biological molecules. Melanin is lost when skin cells reach the surface and are shed during exfoliation. Skin colour comes from melanin granules from adjacent keratinocytes. Multiple drugs can lighten skin pigment. Antibiotics increase melanin production and skin colour. Skin pigmentation may increase with birth control tablets.

Causes of Hypopigmentation

Most cases of low melanin concentration are caused by skin trauma like blisters, infections, burns (Figure 1), chemical exposure, and other lesions. After healing, injured skin is paler than surrounding skin. Genetic disorders can cause skin hypopigmentation in other areas. Albinism, melasma, fungal infections, pityriasis versicolor, alba, and vitiligo can cause hypopigmentation. Albinism is caused by low melanin content at birth. Albinos have white skin, dark blue eyes, and white hair. The hereditary melasma disorder can generate brown or blue-gray patches on the arms or face. Hormones, sun, and contraceptives can cause hypopigmentation. Although the Malassezia genus causes tinea versicolor, commonly known as pityriasis versicolor, fungi can infect humans and change their skin color. Malassezia alters skin melanin pigmentation, causing little discolorations. Pityriasis alba, a skin ailment affecting adolescents and teens, causes oval or circular hypopigmented lesions with soft scales. Darker skin makes face, upper body, and arm lesions more visible, which may be slightly erythematous before becoming hypopigmented. A common hypopigmented skin disorder is depigmentation, when the skin gets completely white. Vitiligo, an auto-immune disorder, causes depigmentation by causing melanocyte loss and white chalky macules on the skin. Vitiligo develops smooth, white skin areas. Vitiligo is often overlooked. Pityriasis alba, a skin ailment affecting adolescents and teens, causes oval or circular hypopigmented lesions with soft



Fig. 1: Hypopigmentation patches in the burns scar

scales. Darker skin makes face, upper body, and arm lesions more visible, which may be slightly erythematous before becoming hypopigmented. Vitiligo, an autoimmune disease that causes depigmentation, is characterized by white chalky macules on the skin and melanocyte loss.

Causes of Hyperpigmentation

Chloasma and melasma are hormonal hyperpigmentation (Figure 2). Oestrogen and progesterone, which increase melanin synthesis under sunlight, are responsible for this condition, which is common in women. Hyperpigmentation results from hormone replacement therapy. Melanocyte counts diminish with aging, while remaining cells proliferate and specialize. These physiological changes show how aging becomes more apparent after 40. Post-inflammatory hyperpigmentation occurs after chemical exposure, burns, wounds, psoriasis or atopic dermatitis, and acne. After healing, the skin is blacker and discoloured. Papules, pustules, and acne can infect the dermis. Skin illnesses that increase melanin synthesis cause dark patches. Similarly, fatty gland and hair follicle infections produce hyperpigmentation. Hyperpigmentation rarely occurs with mild acne. Squeezed, squashed, or pierced acne lesions deepen and colour. Pregnancy-related birthmarks, age spots, acne scars, and antibiotics, birth control medications, antimalarials, and tricyclic antidepressants can induce hyperpigmentation.[2,3] The rare disorder Addison's disease causes black skin patches and diminished adrenal gland activity. Laser or light treatment may cause hyperpigmentation.



Fig. 2: Hyperpigmentation patches over the cheek

MANAGEMENT

Measurement of Pigmentation

A Mexameter MX16 narrow band reflectance spectrophotometer measured pigmentation on damaged and unaffected skin on each face. The Melasma Area and Severity Index (MASI) measured melasma severity.

Drugs for Treatment of Skin Pigmentation

Tranexamic Acid

Tranexamic acid reversibly shuts off plasminogen lysine binding sites, preventing the plasminogen activator from converting it to plasmin. This lowers abnormal fibrinolysis and blood loss. Tranexamic acid aids tyrosinase in untangling, according to recent studies. Hyperpigmentation may be prevented by lowering melanin synthesis.[4,5] This frequently utilized pharmacological method is effective against pigment spots and easy to access. Histological examination confirmed significant decreases in mast cell counts, vessels, and epidermal pigmentation. Oral tranexamic acid is a safe and effective melasma treatment.[6,7]

Isotretinoin

Isotretinoin is the 13-cis-retinoic acid derivative of vitamin A, in treating acne vulgaris, oral isotretinoin exerts its effects by reducing sebaceous gland activity, the development of Propionibacterium acnes, and inflammation. This facilitates pore cleaning, and inhibits the growth of new lesions. The administration of 20 mg of Accutane (isotretinoin) orally. They are applied directly to the affected area, and can lighten or darken the skin. The main advantage of topical creams is that they can be used at home, and do not require a trip to the doctor. Additionally, they are typically less expensive than oral medications.[8,9,10]

Salicylic Acid

Salicylic acid, podophyllum resin and podofilox are a few examples of topical keratolytics that are administered topically to the skin, to soften keratin.

This facilitates the peeling of skin cells, supports the skin's capacity to retain moisture, and aids in the treatment of dry skin conditions, and is generally used to treat skin diseases, such as psoriasis, warts, keratoses, and acne. Because of its keratolytic qualities, salicylic acid, a lipophilic B-hydroxy acid, is frequently used in cosmetic product formulations as a skin scaler for lightening. Arachidonic acid is reduced from converted prostaglandins and thromboxanes by COX1 and COX-2 inhibitors. Salicylic acid also has anti-inflammatory and antibacterial effects.[11] Twenty Latin American women over the age of 18 with moderate to severe bilateral melasma participated in a small, potential randomized controlled trial to compare the efficacy of salicylic acid 20–30% scaler every two weeks, followed by up to eight weeks, in combination with hydroquinone 4% twice daily for 14 weeks, versus hydroquinone 4% alone.

Topical Steroids

Topical steroids are the most often recommended drug in dermatology. The dosage varies from one to three times per day. Betamethasone 0.05% and clobetasol 0.05% are examples of topical steroids. The NF-Kappa B inhibitors betamethasone and clobetasol are glucocorticoids that prevent neutrophil apoptosis and demarginating. Betamethasone and clobetasol are phospholipase A2 inhibitors, which also reduce the production of arachidonic acid derivatives.[12]

Tri-Luma Combination cream

Tri-Luma, a triple combination cream is sold that includes the active components tretinoin, hydroquinone, and fluocinolone in concentrations of 0.01%, 4%, and 0.05%. Hydroquinone is the most frequently used skin-lightening or depigmenting substance. It treats dyschromic skin diseases such as melasma, chloasma, freckles, and post-inflammatory hyperpigmentation, by suppressing melanin production. It stops tyrosinase from converting L-3, 4-dihydroxyphenylalanine into melanin, due to its structural similarity to a specific analogue of melanin. Retinol cures skin aging. It has been shown that it might be beneficial for concerns related to skin aging.[13-15] Antimicrobial creams and ointments like silver sulphadiazine were also used in preventing the pigmentation disorders in burn injuries.

Curcumin

The antioxidants in turmeric extract can help prevent skin aging and pigmentation diseases like melasma by neutralizing free radicals. Curcumin also lightens skin. It reduces hyperpigmentation and lightens skin by reducing tyrosinase production. Turmeric contains curcuminoids, which gently exfoliate dead skin cells and promote skin regeneration, reducing hyperpigmentation and black spots. The study indicated that turmeric extract reduced skin inflammation and improved skin health in psoriasis, eczema, and acne patients.[16]

Ruxolitinib

Ruxolitinib has a low affinity for JAK3, but is a solid and selective inhibitor of JAK2 and JAK1. Ruxolitinib reduces the plasma levels of pro-inflammatory cytokines, and inhibits myeloproliferative neoplasms by downregulating the JAK-STAT pathway. Randomized controlled trials recommended using ruxolitinib 1.5% cream for treating vitiligo twice daily in various patients.[17] This was shown to demonstrate clinically excellent re-pigmentation of all body areas, including the acral region, after 24 weeks, with continued improvement through week 52.[18]

Plant-based and Natural Remedies

Vitamin A, B, C, and E are essential for healthy skin and can treat pigmentation. Each vitamin, found in foods or supplements, offers benefits. The most common vitamins in cosmetics are niacin, pantothenic acid, and biotin.[19] Vitamin niacinamide, used in facial creams and masks, reduces enlarged pores, fine wrinkles, and dullness. Pantothenic acid moisturizes dry, flaking skin. Biotin is in many hair, nail, and skincare products. Vitamin C, an antioxidant, inhibits tyrosinase by binding to copper and reducing the oxidative polymerization of melanin precursors, preventing melanin formation in the melanogenesis pathway. Turmeric extract has been used therapeutically since ancient times. Due to curcumin, it has health benefits for pigmentation and skin issues and a yellow colour. Curcumin reduces skin inflammation caused by psoriasis and eczema due to its anti-inflammatory properties.[20,21]

Natural Oils

Natural oils protect skin from environmental factors, reducing discolouration. Antioxidants and fatty acids in rosehip, jojoba, and argan oils reduce inflammation and brighten skin. Aloe vera lightens skin and treats hyperpigmentation without

side effects.[22,23] In single segment and emulsion structures, jojoba oil provides excellent lubricity without being oily or greasy. It can also help the skin regulate water during transpiration, lowering evaporation without blocking gases or water vapor. The study found that skin surface elasticity increased within 5 min and lasted for hours, suggesting a use in dry skin remedies. Jojoba liquid wax treated diaper rash as well as triamcinolone acetonide, nystatin, neomycin, and gramicidin. Additionally, jojoba oil reduces inflammation. It also possesses anti-acne and anti-psoriasis properties that dissolve sebum deposits in hair follicles by infiltrating them, removing comedones, and clearing the skin.[24,25]

Green tea extract

Green tea extractis anti-inflammatory, skin-protective, and rich in polyphenols and antioxidants. Green tea extract treats pigmentation and skin disorders in several ways. Green tea antioxidants catechins and epigallocatechin gallate (EGCG) fight free radicals that damage skin and accelerate aging. Green tea extract contains powerful anti-inflammatory properties that can reduce acne, eczema, and rosacea skin irritation. EGCG in green tea extract inhibits tyrosinase, lowering melanin synthesis and lightening skin. In addition, green tea extract may protect against UV radiation, which can damage skin and create pigmentation issues.[26]

Kojic Acid

Kojic acid beneficial in treating skin diseases and pigmentation concerns. It Inhibits tyrosinase lowers melanin formation, reducing dark patches and hyperpigmentation.[27] Kojic acid contains antioxidant and anti-inflammatory qualities in addition to blocking tyrosinase. This can help acne, rosacea, and other inflammatory skin problems. Other creams for melasma contain 2% kojic acid, 10% glycolic acid, and 2% hydroquinone.

Laser Therapy

Laser therapy has traditionally been the recommended treatment for skin discoloration. Lasering the affected area reduces melanin and evens out skin tone. Lasers can target pigmentation deeper and more covertly. Lasers may now target pigment under the skin without discomfort or injury. Thus, age spots and sun damage can be treated without pain. Modern lasers use optical energy and strong pulsed light to eliminate stubborn pigmentation. This breakthrough development allows faster and more effective patient treatment than ever before.[28]

Newer Topical creams and serums

Niacinamide, Kojic acid, Licorice extract, and mulberry extract designed to counteract pigmentation. These advanced compounds can eliminate dark spots, lighten skin tone, and improve skin clarity and texture. Niacinamide and kojic acid diminish skin discolouration by suppressing melanin production and tyrosinase activity. The treatment should also be paraben- and preservative-free to avoid skin sensitivities.[28]

Micro-needling

Skin collagen and elastin production is increased by micro-needling. Pricking the skin with little needles creates minute channels that can only be seen under a microscope.[29] This simple treatment boosts collagen synthesis and skin self-healing. Micro-needling is becoming the most common way to lighten skin molecules.

Chemical Peels

Chemical peels are used to remove the top layers of skin, which lessens the visibility of dark patches.

Combination Treatments

Combination therapies are proving to be even more effective at minimizing dark spots. These combination treatments include several acids, such as glycolic acid and lactic acid, which, when used together, can be much more potent than when used separately. These combined therapies, which neither lasers nor light-based devices can currently offer, can help with both facial discoloration, and uneven pigmentation on other parts of the body, with only one treatment.

Recent Advances

New technology makes skin pigmentation remedies more promising. Plasma pen therapy for skin pigmentation problems seems promising. A tailored plasma energy beam removes pigment

from the skin to cure freckles, age spots, sunspots, and melasma. Radiofrequency therapy for skin pigmentation problems is becoming more prominent. This method employs radio waves to break down melanin deposits in the skin, improving dark spots and skin tone and texture. Radiofrequency therapies are fast, safe, non-invasive, and require little rehabilitation.[30]

CONCLUSION

Skin pigmentations disorders are common problem in both developing and developed countries. In failed cases of medical management, Laser therapy is used. Plasma pen therapy and radiofrequency treatments are recent techniques. The cause of pigmentation disorders should be validated before treating the individual. Newer techniques are evolving over years in the era of cosmetic surgery.

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