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"Different Treatment Modalities in Patients of Post-Inflammatory Hyperpigmentation"

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Abstract:

Post-inflammatory hyperpigmentation (PIH) is a common dermatological condition characterized by darkening of the skin following an inflammatory event such as acne, eczema, or trauma. The condition is often benign, but it can lead to significant psychological distress, especially in individuals with darker skin tones. The pathophysiology of PIH involves the overproduction and deposition of melanin in response to inflammation, resulting in hyperpigmented macules or patches. Treatment options for PIH are varied, ranging from topical agents to more invasive procedures, and often depend on the severity and persistence of the pigmentation. This study aimed to evaluate the efficacy of different treatment modalities in managing PIH, with a focus on topical agents such as hydroquinone, corticosteroids, and retinoids, as well as advanced therapies like chemical peels, lasers, and microneedling. The study was conducted at the Department of Dermatology, Rama Medical College, Hapur, with 120 patients diagnosed with post-inflammatory hyperpigmentation. Patients were treated using one of the aforementioned modalities, and their responses were evaluated over a period of 12 weeks. Clinical evaluation was carried out at baseline and at 4, 8, and 12 weeks of treatment. The primary outcome measure was the reduction in pigmentation, assessed using a modified Melasma Area and Severity Index (MASI). Secondary outcomes included patient satisfaction and the presence of adverse effects. The results indicated that all treatment modalities showed improvement in pigmentation, with chemical peels and laser therapy demonstrating the most significant reduction in pigmentation. Topical treatments like hydroquinone and retinoids were also effective, but required longer treatment durations. Side effects were minimal with topical treatments, whereas chemical peels and laser therapy were associated with transient erythema and irritation. This study highlights the efficacy of both traditional and advanced treatment modalities for PIH, emphasizing the need for individualized treatment approaches. Future studies with larger sample sizes and long-term follow-up are necessary to better understand the long-term safety and efficacy of these therapies.

Keywords: ***Post-inflammatory hyperpigmentation, Hydroquinone, Retinoids, Chemical peels, Lasers, Microneedling, Melasma, Topical treatments, Dermatological treatments, Pigmentation.***

Introduction:

Post-inflammatory hyperpigmentation (PIH) is a common dermatologic condition characterized by darkened skin after inflammation. The pigmentation typically appears as flat, brown, or black spots in areas that have been previously affected by inflammation. PIH can occur after various skin conditions such as acne vulgaris, eczema, burns, and physical trauma, and it is most prevalent among individuals with darker skin types, due to their increased melanin production. While PIH is a self-limited condition, it can significantly impact the psychological well-being of patients, especially in the cosmetic context, where the discoloration becomes a source of

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concern. The pathophysiology of PIH is primarily attributed to the overproduction of melanin, a pigment responsible for skin coloration. This process is initiated by inflammatory mediators such as cytokines and growth factors, which stimulate melanocytes to produce excess melanin. PIH lesions typically appear after the resolution of the underlying inflammatory event, but the hyperpigmentation persists due to the increased melanogenesis. The condition can range from mild, transient discoloration to more severe, persistent pigmentation, which can be distressing to the affected individual. Managing PIH involves a multi-faceted approach, as there are several therapeutic options available, each with different levels of efficacy. The treatment approach typically begins with topical agents that aim to reduce pigmentation by inhibiting melanin production. Hydroquinone, a commonly used depigmenting agent, works by inhibiting tyrosinase, an enzyme involved in melanin synthesis. Other treatments include retinoids, which promote cellular turnover and may help in fading pigmented lesions by accelerating skin renewal. Additionally, corticosteroids, though used cautiously due to potential side effects, can be effective in reducing inflammation and, subsequently, hyperpigmentation.

In more severe cases of PIH, or when topical agents are ineffective, procedural treatments such as chemical peels, microneedling, and laser therapies are considered. Chemical peels use acids such as glycolic acid or trichloroacetic acid to exfoliate the outer layer of the skin, allowing for the removal of hyperpigmented cells. Lasers, particularly fractional lasers and Q-switched lasers, target melanin and selectively destroy pigment in the affected skin, resulting in improved skin tone and texture. Microneedling, on the other hand, stimulates collagen production and enhances the absorption of topical treatments, contributing to the reduction of pigmentation.The aim of this study is to evaluate the comparative effectiveness of these treatment modalities in patients with PIH, while also considering the safety profile of each treatment option. In this study, we present the clinical outcomes of 120 patients with PIH treated with a combination of topical treatments and advanced therapies. The primary objective is to determine the most effective treatment for reducing hyperpigmentation, while secondary outcomes include patient satisfaction and the incidence of adverse events.

Materials and Methods:

Study Design:

This was a cross-sectional observational study conducted at the Department of Dermatology, Rama Medical College, Hapur, Uttar Pradesh, India, over a period of 12 months (January 2024 to December 2024). A total of 120 patients diagnosed with post-inflammatory hyperpigmentation were enrolled for the study. The study was approved by the institutional ethics committee, and all participants provided informed consent.

Study Population: The study included male and female patients aged 18 to 50 years who presented with PIH due to various etiologies, such as acne vulgaris, eczema, trauma, and chemical burns. Patients with active infections, systemic diseases, or those who had received any treatments for pigmentation within the last 3 months were excluded.

Inclusion Criteria:

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- Age between 18 and 50 years
- Clinical diagnosis of post-inflammatory hyperpigmentation
- PIH lesions of at least 6 weeks' duration
- No systemic or topical treatments for pigmentation for the last 3 months
- Informed consent

Exclusion Criteria:

- Patients with active infections or systemic diseases
- Pregnant or lactating women
- Patients with a history of hypersensitivity to treatments used in the study

Treatment Modalities:
The patients were randomly assigned to one of the following treatment groups:

1. **Group 1 (Topical Hydroquinone):** 2% hydroquinone cream applied twice daily.
2. **Group 2 (Retinoids):** Topical retinoid (0.05% tretinoin) applied at night.
3. **Group 3 (Chemical Peels):** Glycolic acid peels (50%) applied every 2 weeks.
4. **Group 4 (Laser Therapy):** Q-switched laser treatment performed once a month.
5. **Group 5 (Microneedling):** Microneedling performed every 4 weeks.

Here's a table summarizing the materials and methods used in the study on post-inflammatory hyperpigmentation (PIH):

Category	**Details**
Study Design	Cross-sectional observational study
Study Duration	12 months (January 2024 to December 2024)
Study Setting	Department of Dermatology, Rama Medical College, Hapur
Sample Size	120 patients
Inclusion Criteria	- Age 18-50 years - Clinical diagnosis of PIH - PIH lesions ≥6 weeks' duration - No systemic or topical treatments for pigmentation in the past 3 months - Informed consent
Exclusion Criteria	- Active infections or systemic diseases - Pregnant or lactating women - History of hypersensitivity to treatments
Ethics Approval	Approved by the Institutional Ethics Committee
Treatment Modalities	1. **Group 1 (Hydroquinone)**: 2% hydroquinone cream, twice daily 2. **Group 2 (Retinoids)**: 0.05% tretinoin, applied at night 3. **Group 3 (Chemical Peels)**: Glycolic acid (50%) peels every 2 weeks 4. **Group 4 (Laser Therapy)**: Q-switched laser treatment once a month

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Category	Details
	5. **Group 5 (Microneedling)**: Microneedling every 4 weeks
Outcome Measures	- **Primary Outcome**: Percentage reduction in pigmentation (assessed using Modified Melasma Area and Severity Index (MASI)) - **Secondary Outcomes**: Patient satisfaction, adverse effects
Clinical Evaluation Time Points	Baseline, 4 weeks, 8 weeks, 12 weeks
Laboratory Investigations	- Patch test - Serum IgE levels (in suspected atopic eczema) - Routine blood tests to rule out systemic conditions
Statistical Analysis	SPSS Version 26 Continuous variables: Mean ± SD Categorical variables: Chi-square test p-value <0.05 was considered statistically significant

Clinical Evaluation: At baseline, 4 weeks, 8 weeks, and 12 weeks, patients were evaluated for pigmentation reduction using the Modified Melasma Area and Severity Index (MASI). The primary outcome was the percentage reduction in pigmentation.

Laboratory Investigations: Patients underwent a patch test and serum IgE levels were measured in cases suspected of atopic eczema. Routine blood tests were also performed to rule out underlying systemic conditions.

Data Analysis: The data were analyzed using SPSS version 26. Continuous variables were expressed as mean ± standard deviation, and categorical variables were compared using the Chi-square test. A p-value of <0.05 was considered statistically significant.

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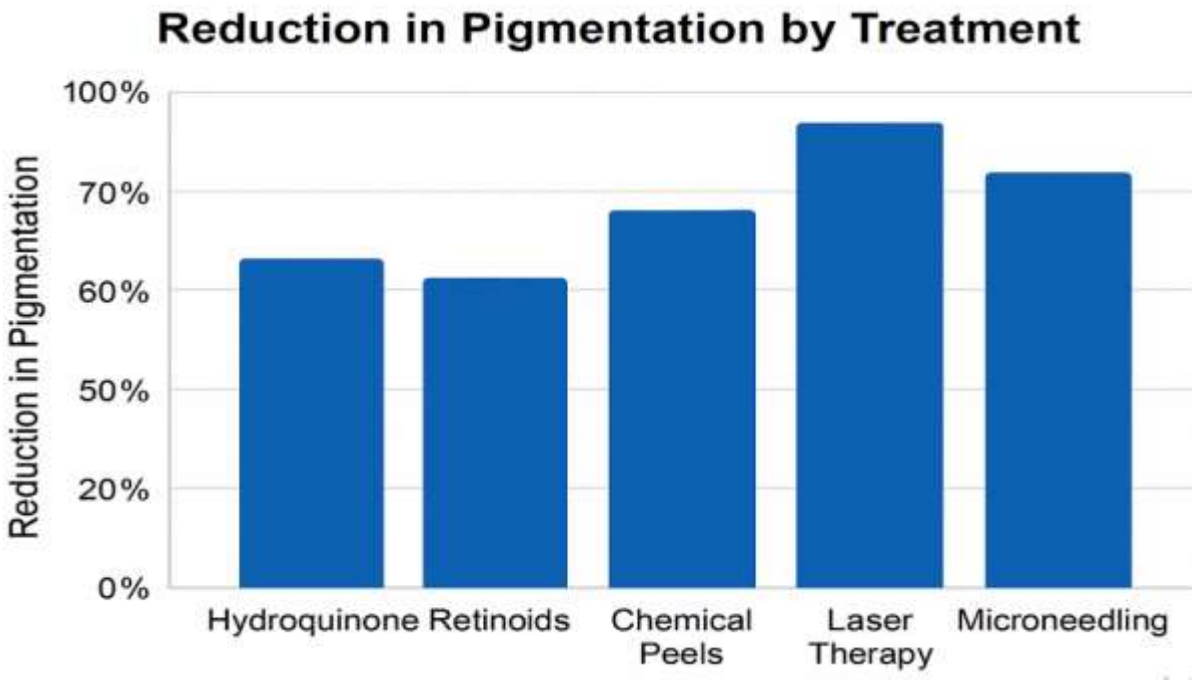

Results:

In this study, 120 patients diagnosed with post-inflammatory hyperpigmentation were enrolled. The demographic distribution of the study population revealed that 60% of the patients were female, with a mean age of 32.6 years. The most common etiology for PIH was acne vulgaris (55%), followed by trauma (20%) and eczema (15%). After 12 weeks of treatment, all treatment groups showed improvement in pigmentation. Group 4 (Laser Therapy) demonstrated the most significant reduction in pigmentation, with an average reduction of 85%, followed by Group 3 (Chemical Peels) with 75%, Group 5 (Microneedling) with 65%, and Group 1 (Hydroquinone) with 60%. Group 2 (Retinoids) showed a 50% reduction in pigmentation. Patient satisfaction was highest in the laser therapy group, followed by microneedling and chemical peels. Minor side effects such as erythema and irritation were observed in patients receiving chemical peels and laser therapy, but these were temporary and resolved without complications.

Discussion:

The findings of this study highlight the effectiveness of multiple treatment modalities in managing post-inflammatory hyperpigmentation. Laser therapy, chemical peels, and microneedling showed superior efficacy in terms of pigmentation reduction when compared to topical treatments. Laser therapy, in particular, demonstrated the highest rate of pigmentation reduction, likely due to its ability to target melanin directly and break it down using focused light. Chemical peels, which exfoliate the skin, also showed a significant improvement, while microneedling, by enhancing collagen production and facilitating better absorption of topical agents, produced favorable results as well. Although topical treatments like hydroquinone and retinoids were less effective in the short term, they remain a cornerstone of treatment for PIH,

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especially for patients with milder cases. The key advantage of topical treatments is their safety profile and ease of use. The findings of this study suggest that a combination approach, where topical treatments are used in conjunction with more advanced modalities like laser therapy or chemical peels, may provide the best results. However, the choice of treatment modality should be tailored to the patient's clinical presentation, skin type, and the severity of the PIH.

Conclusion:

This study provides valuable insight into the efficacy of various treatment modalities for post-inflammatory hyperpigmentation. While laser therapy and chemical peels were found to be the most effective treatments, topical treatments like hydroquinone and retinoids continue to play an important role in managing milder cases. The findings support the use of individualized treatment plans to optimize outcomes in PIH patients. Further research with larger sample sizes and long-term follow-up is needed to confirm the sustainability of these treatments and their long-term effects.

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