Phototherapy in dermatology: Mechanisms, efficacy, and safety considerations.

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Introduction

Phototherapy is a well-established treatment in dermatology that utilizes specific wavelengths of ultraviolet (UV) light to manage various skin disorders. This therapeutic approach is widely used for conditions such as psoriasis, vitiligo, atopic dermatitis, and other inflammatory or autoimmune skin diseases. By targeting affected skin cells with controlled doses of UV radiation, phototherapy can modulate immune responses, reduce inflammation, and promote skin healing. This article explores the mechanisms, efficacy, and safety considerations associated with phototherapy in dermatology [1].

Phototherapy primarily involves three types of UV radiation: UVA (320–400 nm), UVB (280–320 nm), and UVC (<280 nm). In clinical settings, narrowband UVB (NB-UVB, 311–313 nm) and psoralen plus UVA (PUVA) therapy are the most commonly used modalities. NB-UVB works by inducing apoptosis of hyperproliferative T-cells in inflammatory skin diseases, thereby reducing immune-mediated damage. PUVA therapy, which involves the administration of psoralen—a photosensitizing agent—before UVA exposure, intercalates with DNA and disrupts cellular proliferation, making it particularly effective in severe or refractory cases [2].

Numerous clinical trials have demonstrated the effectiveness of phototherapy in managing chronic skin diseases. Studies show that NB-UVB is the preferred modality for psoriasis due to its superior safety profile and efficacy in long-term disease control [3].

For vitiligo, regular phototherapy sessions over several months can result in 50-75% repigmentation in responsive patients. In atopic dermatitis, phototherapy helps in cases where topical treatments fail, providing significant symptom relief with minimal systemic side effects [4].

While NB-UVB is generally safer and more widely used, PUVA therapy remains a powerful option for severe or treatment-resistant cases. PUVA therapy, however, carries a higher risk of skin aging and photodamage, requiring strict monitoring. In contrast, NB-UVB allows for long-term use with a lower cumulative risk of adverse effects, making it the preferred choice for pediatric and elderly patients [5].

Despite its benefits, phototherapy is not without risks. Acute side effects include erythema (akin to sunburn), dryness, and pruritus. Chronic exposure to UV radiation increases the risk of photoaging and, in rare cases, skin cancer, particularly with long-term PUVA use. Patients undergoing phototherapy should be carefully monitored, and protective measures such as shielding unaffected skin and wearing UV-blocking goggles are recommended [6].

Phototherapy is contraindicated in individuals with photosensitive disorders such as lupus erythematosus or xeroderma pigmentosum. Patients with a history of skin cancer or severe actinic damage should also be carefully evaluated before initiating treatment. Additionally, certain medications, such as tetracyclines and retinoids, can enhance photosensitivity and increase the risk of burns or pigmentation changes [7].

The success of phototherapy depends on personalized treatment protocols, which take into account skin type, disease severity, and previous response to therapy. Treatment is usually administered two to three times per week, with gradual dose increments based on skin tolerance. The minimum erythema dose (MED) is often used to determine an individual's optimal exposure level to minimize risks while maximizing therapeutic benefits [8].

Advancements in technology are shaping the future of phototherapy. Excimer lasers (308 nm) offer targeted treatment for small, resistant patches of psoriasis and vitiligo, reducing overall UV exposure [9].

Home-based phototherapy devices are becoming more accessible, allowing patients with chronic skin conditions to maintain long-term treatment adherence. Research is also exploring photodynamic therapy (PDT) for conditions like actinic keratosis and non-melanoma skin cancers, expanding the potential applications of light-based therapies [10].

Conclusion

Phototherapy remains a cornerstone of dermatologic treatment, offering a non-invasive, effective, and relatively safe option for managing various skin disorders. Its mechanisms, primarily immune modulation and apoptosis induction, make it particularly valuable in chronic and autoimmune skin diseases. While safety concerns exist, careful patient selection, dose adjustments, and monitoring can mitigate risks. With continued research and technological innovations, phototherapy is expected to remain a key therapeutic modality

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***Received:** 1-Mar-2025, Manuscript No. aarcd-25-162357; **Editor assigned:** 4-Mar-2025, PreQC No. aarcd-25-162357 (PQ); **Reviewed:** 17-Mar-2025, QC No. aarcd-25-162357; **Revised**: 24-Mar-2025, Manuscript No. aarcd-25-162357 (R); **Published**: 31-Mar-2025, DOI:10.35841/aarcd-8.2.253.*

***Citation:** Wang E. Phototherapy in dermatology: Mechanisms, efficacy, and safety considerations. Res Clin Dermatol. 2025;8(2):253.*

in dermatology, improving patient outcomes and expanding treatment options.

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Citation: *Wang E. Phototherapy in dermatology: Mechanisms, efficacy, and safety considerations. Res Clin Dermatol. 2025;8(2):253.*