CHAPTER 39

# ULTRAVIOLET TREATMENTS IN DERMATOLOGY

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## INTRODUCTION

Although the sunlight has been known to have therapeutic effects in cutaneous diseases since 2000 BC, ultraviolet (UV) has been available as a therapeutic modality in the past century. It has been shown to be efficient in the treatment of many dermatoses by both its locally immunosuppressive effects and the inhibition of epidermal hyperproliferation and angiogenesis. It also induces the apoptosis of T lymphocytes.[1-5]

In this article, different types of phototherapeutic modalities have been described.

### 1. UV spectrum

UV radiation has three major wavelengths: UV-A (320–400 nm), UV-B (290–320 nm) and UV-C (200–290 nm). UV-A is divided into UV-A1 (340–400 nm) and UV-A2 (320–340 nm).

### 2. Types of UV treatment

The types of UV therapy used for the treatment of dermatologic diseases are UVB phototherapy (broad band UVB (BB-UVB), narrowband UV-B (NB–U-VB) and excimer laser), UVA phototherapy (psoralen and UV-A light photochemotherapy (PUVA), and UV-A1 phototherapy).

## GENERAL PRINCIPALS

Phototherapy is exposing the skin to UV on a regular basis under medical supervision. Treatments are mainly given in dermatology clinics in which phototherapy units are well established.

There have many different commercial types of phototherapy devices developed. The devices include different UV lamps emitting different wavelengths of light. These phototherapy devices should be regularly calibrated.

The staff of the phototherapy unite should include at least a trained dermatologist together with a trained nurse or technician. A complete history and physical examination must be performed for all patients who are considered for treatment with phototherapy. The patients should be informed to adhere to the follow-up visits to have optimal improvement. The treatment protocol should be performed under the direction of the trained dermatologist. The patients must be examined once a month or more often when necessary. The nurse or technician should monitor the patients in each visit for any abnormal finding.

## UVB PHOTOTHERAPY

UVB phototherapy types are broad band UVB (BB-UVB) phototherapy, narrowband UV-B (NB–U-VB) phototherapy and excimer laser therapy.

### 1. BB-UVB Phototherapy

BB- UV-B (280–320 nm) phototherapy was introduced in the 1960s, using a filtered wavelength of UV-B light. It was the first type of restricted UV wavelength phototherapy and was used to treat psoriasis and uremic pruritus. However, BB UVB was found not to be effective as PUVA in the treatment of psoriasis.

Since NB-UVB was found to have superior features in the treatment of psoriasis, BB–UV-B is almost no longer used in practice.

### 2. NB–UVB Phototherapy

Since NB–UV-B (311–313 nm) was found to be more efficacious and safer than BB–UV-B therapy, it was gradually replaced for especially the treatment of psoriasis in 1990's. Comparing with BB–UVB, NB–UV-B has a greater amount of energy with less potential for burning and has more immunosuppressive effects.[6]

In table I, the indications, contraindications and side effects of NB-UVB phototherapy are seen.

### 1. Dosage and protocol

The initial dose may be determined either according to the MED or the skin type. If MED testing is possible, 50-70% of MED is recommended as the initial dose. Increases

of 5% to 10% are recommended till to maintain a mild amount of erythema for optimal results. Maximal

UV-A doses are increased by 20% to 40% of initial dose at each successive treatment. It's applied twice weekly.

Bath PUVA is generally used in Europe, it has not approved by FDA. Bath PUVA has been shown to have similar efficacy with oral PUVA. In bath PUVA the cumulative UVA dose is 2 to 6-fold lower than oral PUVA.[29-32]

The disadvantage of bath PUVA is the high cost of establishing an efficient bath PUVA unit.

### 6. Paint and Soak PUVA

Paint and soak PUVA are commonly used for localized areas.

In paint PUVA, 0.005% 8-MOP in an ointment or lotion form is applied directly on lesions using gloves. The area is then irradiated with UV-A. It's applied twice weekly.

Soak PUVA is generally used for the lesions on the palms and soles. The affected areas are immersed in a basin of water containing 0.03% 8-MOP for 20 to 30 minutes before UV-A exposure. It's applied twice weekly.

### 7. Cautions

In topical PUVA, psoralen may not be detectable in the blood of patients used in localized areas such as palmoplantar area. However; it may be detectable when used over a large body surface area.[33,34]

### 8. Mechanism of Action of PUVA

Psoralen intercalates between DNA base pairs. When the skin is subsequently exposed to UV-A, psoralen-DNA cross-links are formed. Then pyrimidine dimers that prevent DNA replication are formed and this results in T lymphocyte and keratinocyte cell cycle arrest. UVA irradiation has effects on both epidermal keratinocytes and Langerhans cells. It also penetrates into the dermiş and has effects on dermal dendritic cells, fibroblasts, endothelial cells, and mast cells.[35]

PUVA leads to depletion of lymphocytes in the epidermis. On the other hand, reactive oxygen species are formed when excited psoralens react with molecular oxygen. This leads to cell and mitochondrial membrane damage from lipid peroxidation and it can result in cell death. Singlet oxygen-mediated reactions and free radicals also act to alter proteins and lipids within the cell. PUVA therapy also alters cytokines and cytokine receptor. It causes a decline in keratinocyte epidermal growth factor receptor activity and a decreased expression of Th1/Th17-mediated cytokines IFN-gamma and IL-23 in the epidermis and dermis of psoriatic lesions.

### 9. UV-A1

UV-A1 was introduced in the early 1990s. The longer wavelength (340 to 400 nm) of this spectrum enables the UV light to penetrate deeper in the skin and reach the dermal components. It has an effect to upregulate the matrix metalloproteinases. UV-A1 induces T- and B-cell apoptosis, decreases Langerhans cells and mast cells, and inflammatory cytokines. It upregulates matrix metalloproteinases, and decreases collagen production. UV-A1 also decreases inflammatory cytokines TNF-alpha, IFN-gamma and IL-12. UV-A1 has immunomodulatory functions by causing photoisomerization of cis to trans UCA. UV-A1 were shown to produce increased collagenase mRNA and protein and to decrease hydroxyproline and collagen levels.[8,9,36]

It has been used to treat atopic dermatitis and sclerotic skin diseases. There are typically 3 different dosing levels of UV-A1: low dose (10–20 J/cm2 per treatment), medium dose (50–70 J/cm2), and high dose (70– 130 J/cm2). For most disease processes, the medium dose is the most widely used, as it has been shown to be superior to low dose and is as efficacious as high-dose UVA1. UV-A1 has been found to be effective for treating atopic dermatitis and localized scleroderma. Indications for UV-A1 are similar to those for PUVA and NB–UV-B. Because of the deeper penetration of UV-A, it is more frequently used for dermal conditions. Indications of UV-A1 therapy are morphea, lichen sclerosis, atopic dermatitis, cutaneous graft-versus-host disease, cutaneous mastocytosis, granuloma annulare, lichen planus, mycosis fungoides, necrobiosis lipoidica, pityriasis lichenoides, sarcoidosis.

The side effects of UV-A1areerythema, pruritus, hyperpigmentation, blister formation, and photoaging. Polymorphic light eruptions and herpes simplex virus reactivation may be seen.

Although there have been some case reports of Merkel cell carcinoma and melanoma during UV-A1 phototherapy, there is no larger studies evaluating the risk of skin cancer with UV-A1 phototherapy. [8,9,36]

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