Therapeutic protocols of monochromatic source 355 nm \( \lambda \)

**INTRODUCTION**

Artificial ultraviolet rays (UV) such as sunbeds, lamps, solar panels, are used both in the beauty and medical field, obviously for different applications. Besides broadband emission, narrowband UV has recently been introduced in the market: UVB (311 nm band – TL01), UVA2 (320-340 nm) and UVA1 (340-400nm). These wavelengths give considerable results in the treatment of psoriasis, vitiligo (UVB 311nm) and atopic dermatitis (UVA1). Further to these pathologies which results are consolidated, selected band phototherapy is being studied for other types of dermatosis. In principle an evaluation of the quantity of energy deliverable on the skin lets us identify an initial dose of: 0,2-0,4 J cm\(^2\) (UVB narrowband) and 1,2-1,5 J cm\(^2\) for UVA or UVA1.

**UVA1 ACTION MECHANISM**

Unlike UVB and UVA2 (315-340nm) the biological effects of UVA1 are obtained through aerobic reactions of photo-oxidation with the intermediate formation of reactive species of oxygen such as singlet oxygen, superoxide anion and hydroxyl radicals. The anaerobic formation of photo-products between tynines is completely unimportant. In Caucasians about the 37% of emitted UVA1 penetrates the skin until 6-9 mm therefore these wavelengths can effectively modulate the immunological and inflammatory activities of cellular populations resident not only in the epidermis but also in the derma. On Keratinocytes UVA1 induces the synthesis and the release of IL-6, IL-8, IL-10 (with consequent reduction of IL-12 and interferon-g), a-MSH (with reduction of IL-1 and TNF-a) and PGE2 (with inhibition of the activation of lymphoid cell Th1) and inhibits the expression of ICAM-1.5.

Unlike UVB and UVA2, UVA1 can induce the apoptosis of lymphoid cells T, in particular T helper, non only through delayed mechanisms, which depend on a synthesis “de novo” of some proteins, but even through precocious mechanisms, pre-programmed and independent from protein synthesis.

UVA1 provokes the production of PGE2 and thromboxanes in the Langerhans cells, but doesn’t affect the number and functionalities and does not induce its migration into satellite lymph nodes.

Finally, UVA1 can affect the activity of fibroblasts with increase of the synthesis of collagenases 1 and a reworking on the stroma with an increase in the urinary excretion of the waste products of collagen I and III.
THERAPY PROTOCOLS

The protocols for the photo-therapy UVA1 entail the irradiation of low (6.5-20J/cm²), medium (40-60J/cm²) or high dosages (100-130J/cm²) with no need to increase dosages during the therapy.

Cumulative doses for low dosages are estimated inferior than 300J/cm², those for medium dosages are included between 300 and 975J/cm² and for high dosages between 975 and 1840J/cm².¹,²,³,⁴

Usually non coherent UVA1 emitters have lighting radiations in a spectrum included between 340 and 400nm, but sometimes we can find radiations higher than 530nm and other infrared radiations have been isolated (780-300 nm). With monochromatic radiation, the wavelength of UVA1 is 355nm.

CLINICAL INDICATIONS

Atopic dermatitis

In controlled studies, short cycles with UVA1 with medium or high doses proved to be more effective than combined photo-therapy UVAB and topic application of steroids. ⁵,¹⁰ With low doses we obtain lower therapeutic results.¹⁰ To a clinic improvement we associate the reduction of the number of eosinophils both circulating and infiltrating skin and the reduction of the number and functionality of lymphoid cells T helper on damaged skin.

The number and the structure of the Langerhans cells do not change, instead.⁵,¹⁰

The expression of ICAM-1 on the Keratinocytes of the lesion reduces, but the plasmatic levels of circulating ICAM-1 don’t show variations. The plasmatic levels of Eosinophil Cationic Protein (ECP) reduce, while the results of the studies of modifications of other serum parameters, like CD23, mastocytosis tryptase, IFN-g and total IgE are conflicting.

Mycosis fungoides

High doses of UVA1 proved to be effective in the treatment of mycosis fungoides both in the initial phase of spots or plaques and in advanced shapes such as nodular or erythrodermic lesions.

The therapeutic action is most likely obtained by the activation of apoptosis mechanisms of malignant T cells filtrating epidermis and derma.⁷
**Lupus erythematosus**

Low doses of UVA1 can reduce the entity of some clinical appearance of systemic and subacute lupus erythematosus, like cutaneous lesions, arthralgia, morning muscular rigidity, asthenia, fever.

Such clinical improvement accompanies the increase of the number of leucocytes and the reduction of antibodies anti-nucleus and anti-ENA.

The therapeutic action is most likely obtained by the induction of apoptosis of T lymphoid cells infiltrating the skin and, in Keratinocytes, by the promotion of DNA reparation, by the interference and translocation of nuclear soluble antigens non-histone like the SSA/Ro and by the reduction of IL-12 levels.11

**Scleroderma**

High dosed of UVA1 have been successfully used in the therapy of morphea both in adults and in children, in acrosclerosis and systemic sclerosis.

Lesions show reduction of the derma thickness with reduction of collagen fibres and an increase of elastic fibres.9. The therapeutic action can be referred both to the reduction of the number of T lymphoid cells infiltrating the plaques and to the increase of collagen activity of the fibroblasts.9.

**Psoriasis**

In skin treated with psoralenes, the maximum photo-toxic and anti-psoriasic activity is obtained with wavelengths included between 320 and 330 nm. 13.

Two types of UVA sources are widely used for PUVA-therapy. Fluorescent UVA lamps emission pick is 352nm and emit about 0,5% in the UVB band. The emission of filtrated halogen-metallic lamps contains more UVA1 and UVB (1,5%-3,0%), higher irradiance, and a better space homogeneity of the emission.14

In the light of what written in literature we wanted to introduce a therapeutic protocol based on the same energetic intensities of UVA but without the aid of chemotherapy drugs.

In the therapy of psoriasis we therefore used high energy frequencies in weekly sessions that brought to a progressive remission of the therapy. We believe the effectiveness of this therapy comes from the demonstrated capability to reduce the proliferation of T lympho cells and the production of cytokines (both Th1 and Th2).
**Vitiligo**

We have done photo-therapies without the aid of chemotherapy drugs in medium doses with biweekly frequency. The treated lesions did not exceed the 25% of the total body surface and we excluded peripheral areas.

The treatment with ultraviolet rays with wavelength included between 320-400 nm (UVA) would be able to induce skin pigmentation, even if the action mechanism is partially unknown. A radiation in the UVA1 spectrum stimulates the proliferation and the migration of melanocytes from the hair follicle and from the margins of the lesion, the production of melanin, through the formation of photo-adduced with DNA and the induction of an inflammatory reaction.

### PROTOCOLS RESUMING TABLE

<table>
<thead>
<tr>
<th>Condition</th>
<th>J/cm² (single)</th>
<th>J (cumulative)</th>
<th>Weekly sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atopic dermatitis</td>
<td>20</td>
<td>1000</td>
<td>3</td>
</tr>
<tr>
<td>Mycosis fungoides</td>
<td>130</td>
<td>2000</td>
<td>2</td>
</tr>
<tr>
<td>Lupus erythematosus</td>
<td>6</td>
<td>250</td>
<td>2</td>
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<tr>
<td>Scleroderma</td>
<td>100</td>
<td>1500</td>
<td>2</td>
</tr>
<tr>
<td>Sclero athrophic lichen</td>
<td>100</td>
<td>1000</td>
<td>2</td>
</tr>
<tr>
<td>Psoriasis</td>
<td>130</td>
<td>1800</td>
<td>3</td>
</tr>
<tr>
<td>Vitiligo</td>
<td>100</td>
<td>1500</td>
<td>2</td>
</tr>
</tbody>
</table>

### SIDE EFFECTS

Negative short-term effects are rare and limited to the occasional appearance of a modest and reversible xerosis with pruritus and possible intensification of a pre-existing photo-dermatosis.

We didn’t observe long-term side effects on men, but studies on murine models do not permit to exclude potential carcinogen and an action promoting photo-ageing.


