The Effect of Phototherapy and Photochemotherapy on the Eye

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Abstract

**Purpose:** 1- Studying ocular changes that might occur due to exposure to different types of phototherapy and photochemotherapy. 2- Evaluating the methods used for ocular protection in Phototherapy Unit Dermatology Department, Faculty of Medicine Cairo University (Kasr Al-Aini Hospital).

**Methods:** The study included 57 patients with variable diseases. Thirty patients received PUVA, twenty patients received NB UVB and seven received both PUVA and UVB. Duration of treatment ranged from 4 to 13 months. Every patient was subjected to ocular examination before and after treatment (visual acuity testing using Snellen chart or decimal fraction chart; anterior segment examination by Slit lamp; measurement of intraocular pressure using applantation tonometer and fundus examination using indirect ophthalmoscope). Fundus fluorescein angiography or optical coherence tomography were done if any posterior segment abnormality was suspected by the ophthalmologist.

**Results:** Although there was no significant development of ocular changes in the anterior or posterior segment, mild diminution in VA (92 lines) was detected in a significant patients treated with PUVA, but not in NB UVB patients.

This diminution showed significant correlation with duration of treatment only in those who received both PUVA and UVB. There was no significant increase in the incidence of cataract in patients treated with PUVA or UVB; however some sporadic cases were reported during treatment with PUVA. The incidence of these changes might be related to other factors like aging, but the effect of PUVA can not be excluded.

**Conclusion:** We could therefore conclude that patients receiving PUVA, both PUVA and UVB or NBUVB in Dermatology Department Kasr Al-Aini Hospital, are not at increased risk of developing cataract, anterior or posterior segments complications up to the duration of thirteen months of exposure. The significant incidence of diminution of visual acuity (mostly £2 lines); in patients receiving PUVA was not associated with significant ocular abnormalities and may be attributed to the use of unbranded sunlases or to personal refractive error during examination. Patients receiving NBUVB showed no significant decrease of VA. This indicates that NBUVB is safer as regards effect on eye.

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Key Words: Eye – Phototherapy – Photochemotherapy.

Introduction

PHOTOTHERAPY and photochemotherapy are widely used methods in treating numerous skin diseases including psoriasis, vitiligo, mycosis fungoides, and various eczematous conditions [1].

UV light is the most common cause of radiation injury to the eye. The cornea largely absorbs UV radiation. UV radiation damage to the corneal epithelium is cumulative, similar to the effects with cutaneous epithelium (sunburn). Prolonged exposure to solar UV radiation can lead to chronic solar toxicity, which is associated with several ocular surface disorders e.g. pinguecula, pterygium, climatic droplet keratopathy, and even squamous metaplasia and carcinoma. The ocular cancer associated with UV radiation is epidermoid carcinoma of the bulbar conjunctiva [2].

Psoralens add to the phototoxic effect of UV therapy. Psoralen binds covalently to lens protein which results in formation of additional damaging photosensitizers in the lens. The most important effect on the eye occurs in the form of cataract [3].

Protection against UVR photodamage can be achieved through natural filtering capacity of the eye 4 or through artificial measures e.g. sunglasses. The protection of unbranded sunglasses had poor efficacy for UVA and UVB spectra, while branded sunglasses were found to provide good protection against UVA but not UVB [5].

Aim of the study:

Studying any ocular changes that might develop due to exposure to different types of phototherapy and photochemotherapy aiming at evaluating the methods of ocular protection used in Phototherapy Unit Dermatology Department, Faculty of Medicine, Cairo University (Kasr Al-Aini Hospital).
Patients and Methods

This prospective study included 57 patients (45 females and 12 males) with variable skin diseases. Patients were recruited randomly from the phototherapy unit, Dermatology Department, Kasr Al-Aini Hospital. Thirty patients received Psoralen plus ultra violet A (PUVA), twenty patients received Narrow band ultraviolet B (NB UVB) and seven patients received combined PUVA rays (which includes PUVA+NBUVB (3 patients) or PUVA + Broad band ultraviolet B (BBUVB) (3 patients) or topical PUVA + NBUVB (one patient).

Duration of treatment ranged from 4 to 13 months. During the session, patients used dark eye glasses provided with the machine. In case of psoralen ingestion; dark eye glasses provided by the patients were worn during the rest of the day.

The mean age of the patients was 31.24 years, and most of them were skin types III and IV.

Every patient was subjected to full history taking, routine laboratory investigations and eye examination before and after treatment.

Diabetic, hypertensive, glaucomatous and cataractous patients were excluded from the study due to associated ocular changes.

Table (1): Summary of the clinical and demographic data.

<table>
<thead>
<tr>
<th>Number of patients</th>
<th>57 patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Mean± SD: 31 ± 15.7yrs</td>
</tr>
<tr>
<td>Sex</td>
<td>Female: 45 (78.9%) Male: 12 (21.1%)</td>
</tr>
<tr>
<td>Duration of treatment</td>
<td>Range:4-13 months Mean±SD: 7.95±2.8</td>
</tr>
<tr>
<td>Types of ttt</td>
<td>PUVA: 30 (52.6%) Narrow band UVB: 20 (35.1%) Combined PUVA: 7 (12.3%)</td>
</tr>
<tr>
<td>Diagnosis</td>
<td>Vitiligo: 42 (73.3%) Psoriasis: 7 (12.3%) MF: 5 (8.8%) LS: 1 (1.8%) Parapsoriasis: 1 (1.8%) Alopecia areata: 1 (1.8%)</td>
</tr>
</tbody>
</table>

Eye examination before and after treatment for all patients included:

- Visual acuity testing: With and without correction using Snellen chart or decimal fraction chart.
- Anterior segment examination: By Slit lamp for eye lid, conjunctiva, cornea, anterior chamber, iris and lens assessment.
- Fundus examination: Using indirect ophthalmoscope; for assessment of optic nerve head, retinal arteries, veins and retina.
- Fundus fluorescein angiography or optical coherence tomography were done if any posterior segment abnormality was suspected by the ophthalmologist.

Statistical methods:

Data was coded and entered using statistical package SPSS version 15. Data was summarised using mean and standard deviation for quantitative variables and percentage for qualitative variables. Comparison between groups was done using Chi Square Test for qualitative variables and non parametrical Wilcoxon Signed Ranks Test, Kruscal-Wallis Test, Mann-Whitney Test for quantitative variables. The values less than 0.05 were considered as statistically significant.

Results

I- Results of eye examination after Phototherapy and Photochemotherapy (Figs. 1-3) (Tables 2-4):

a- Changes in visual acuity:

- VA diminution was variable from mild to moderate and severe.
  - Mild diminution in VA: Decline of VA ≤2 lines.
  - Moderate diminution in VA: Decline of VA from 3-4 lines.
  - Severe diminution in VA: Decline of VA ≥5 lines.

In Patients treated with PUVA: VA was decreased in 12 patients (40%), while no change was seen in 18 patients (60%), this difference was statistically significant with p-value of 0.007. VA diminution was variable. 75% of affected patients showed mild decline of VA (≤2 lines); while (25%) showed moderate decline of VA (from 3-4 lines). Eye examination of patients with visual acuity diminution ≤2 lines showed 2 cases of increased intraocular pressure, from 3-4 lines showed one case of cataract, while the rest of the patients VA diminution was unexplained.

In patients treated with NB UVB: VA was decreased in 5 patients (25%), while no change was seen in 15 patients (75%) and this is a statistically non significant with p-value of (0.059). There was variable degrees of diminution as follows: 4 patients (80%) showed decline of VA ≤2 lines. 1 patient (20%) showed decline of VA from 3-4 lines.
In patients treated with combined PUVA: VA was decreased in 4 patients (57.2%), while 3 patients (42.8%) showed no change and this was statistically non significant with p-value of (0.076). There were variable degrees of diminution in VA as follows: 3 patients (75%) with mild diminution. one patient (25%) showed decline of VA from 3-4 lines with development of cataract.

b- Changes in anterior segment:
- In Patients treated with PUVA: Only 2 patients (6.7%) showed increase in the intra-ocular pressure, while the remaining patients (93.3%) showed no abnormalities. This difference was statistically insignificant with p-value of (0.5).
- In patients treated with NB UVB: No change in the anterior segment was reported.
- In patients treated with combined PUVA: No change in the anterior segment was reported.

c- Changes in lens:
- In Patients treated with PUVA: Only one patient (3.3%) developed nuclear cataract, while 29 patients (96.7%) were free and this is statistically not significant with p-value of 1.
- In patients treated with NB UVB: No change in the lens was reported.
- In patients treated with combined PUVA: Only one patient (14.3%) had cataract and this change is statistically non significant with p-value of 1.

d- Changes in posterior segment:
- In Patients treated with PUVA: Only one patient (3.3%) developed increase in the cup disc ratio while 29 patients (96.7%) were free and this is statistically not significant with p-value of 1.
- In patients treated with NB UVB: No change in the posterior segment was reported.
- In patients treated with combined PUVA: No change on the posterior segment was reported.

e- Comparing the Changes of different phototherapeutic modalities on the eye: Resulted in non significant p-value.

III- Correlation of age of patients with ocular complications during phototherapy:
The age of the patient in this study did not influence the incidence of ocular changes in different eye segments with different therapeutic modalities.

Table (2): Ocular changes in patients treated with PUVA.

<table>
<thead>
<tr>
<th>Eye component</th>
<th>No change</th>
<th>Change</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of pt.</td>
<td>%</td>
<td>Number of pt.</td>
</tr>
<tr>
<td>VA</td>
<td>18</td>
<td>60</td>
<td>12</td>
</tr>
<tr>
<td>AS</td>
<td>28</td>
<td>93.3</td>
<td>2</td>
</tr>
<tr>
<td>Lens</td>
<td>29</td>
<td>96.7</td>
<td>1</td>
</tr>
<tr>
<td>PS</td>
<td>29</td>
<td>96.7</td>
<td>1</td>
</tr>
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</table>

* = Significant.

Table (3): Ocular changes in patients treated with NB UVB.

<table>
<thead>
<tr>
<th>Eye component</th>
<th>No change</th>
<th>Change</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of pt.</td>
<td>%</td>
<td>Number of pt.</td>
</tr>
<tr>
<td>VA</td>
<td>15</td>
<td>75</td>
<td>5</td>
</tr>
<tr>
<td>AS</td>
<td>20</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Lens</td>
<td>20</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>PS</td>
<td>20</td>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>

Table (4): Ocular changes in patients treated with combined PUVA.

<table>
<thead>
<tr>
<th>Eye component</th>
<th>No change</th>
<th>Change</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of pt.</td>
<td>%</td>
<td>Number of pt.</td>
</tr>
<tr>
<td>VA</td>
<td>3</td>
<td>42.8</td>
<td>4</td>
</tr>
<tr>
<td>AS</td>
<td>7</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Lens</td>
<td>6</td>
<td>85.7</td>
<td>1</td>
</tr>
<tr>
<td>PS</td>
<td>7</td>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>

Fig. (1): Ocular changes of patients treated with NB UVB vs. PUVA vs. Combined PUVA.
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Discussion

In patients treated with PUVA, 40% showed decrease in their visual acuity which is considered statistically significant; with \( p \)-value <0.05. VA diminution was variable: The majority of patients (75%) showed decline of visual acuity \(<2\) lines, while (25%) showed decline of VA 3-4 lines. Eye examination of patients with visual acuity diminution \(<2\) lines showed 2 cases of increased intraocular pressure, from 3-4 lines showed one case of cataract, while the rest of the patients VA diminution was unexplained.

Doria and Bhargava reported visual acuity changes for patients treated with PUVA sol. for eighteen months [6]. In contrast to our findings, Abdullah and Keczkes performed a 10 years follow-up study on 198 patients who were treated with PUVA between 1977 and 1987. All patients had a yearly ophthalmological evaluation and none of them developed impairment of their visual acuity [7]. Furthermore, Malanos and Stern had also found no relation between increase exposure to PUVA and visual impairment in 1237 patients treated for psoriasis [8].

The significant decrease in VA in patients receiving PUVA only might raise the possibility that it is due to the harmful effect of psoralen on the eye. The decrease of visual acuity was mostly from 1 to 2 lines decline which might also be due to personal refractive error during eye examination. On the other hand, the significant diminution of visual acuity with PUVA can not be neglected and needs further evaluation.

It’s worth to be mentioned that our patients used commercial non branded sunglasses for protection; which might have attributed to VA diminution or to the sporadic ocular changes. Otman and his colleagues stated that the protection of unbranded sunglasses had poor efficacy for UVA and UVB spectra [5].

We could not find any previous reports on the effect of NBUVB and combined PUVA on visual acuity to which we could compare our results.

In our study, there is no increase in cataract risk in patients treated with phototherapy and photochemotherapy.

Malanos and Stern and Backmann found that the incidence of cataract did not increase significantly and they concluded that increasing exposure to PUVA does not increase cataract risk among persons using eye protection [8,9]. However, Boukes et al. and Stern stated a higher incidence of cataract was noted in the PUVA patients compared to control [10,11].

As regards the effect on the anterior segment, our study showed that only 2 patients exposed to PUVA (6.7%) developed increase in the intraocular pressure, while patients exposed to NBUVB and combined PUVA patients showed no anterior segment changes.
Backmann performed a study on fifteen patients who were exposed to (PUVA). He reported a mild form of photokeratoconjunctivitis in 50% of the patients. The ocular manifestations included photophobia, conjunctivitis, keratitis, and dry eyes. None of the patients of this study developed any of those symptoms or signs [9].

Komericki et al., reported on a patient with atopic dermatitis who underwent NB UVB treatment to the facial area including the eyelids and developed severe keratitis with facial erythema [12], while in our study, no patients developed similar changes while treated with NB UVB, this may be because phototherapy was focused on the face in Komericki study.

As regards the effect on the posterior segment, our study showed one patient treated with PUVA (3.3%) had an increase in Cup Disc ratio, while 29 patients (96.7%) were free. For patients treated with NB UVB and combined PUVA no patients had any change concerning the posterior segment.

The development of macular degeneration was only reported by Doria and Bhargava in patients treated with PUVA sol; though they did not indicate the exact incidence [6].

There was no previous report on the effect of NB UVB and combined PUVA on the posterior segment.

In our study the age of the patients did not affect the incidence of any ocular changes.

Also in this study the duration of exposure to PUVA did not increase the risk of any ocular complications; this stands with Malanos and Stern who reached the same conclusion [8].

There was no correlation between duration of exposure to NB UVB and the risk of ocular complications. However a positive correlation between duration of exposure to combined PUVA and the incidence of diminution of visual acuity was found.

Although significant unexplained diminution of VA was detected with PUVA therapy and to lesser extent with combined PUVA; no significant ocular changes were obtained in patients treated in Phototherapy Unit, Kasr Al-Aini Hospital. On the other hand the sporadic incidence of cataract should not be neglected.

**Conclusion and Recommendations:** We could therefore conclude that patients receiving PUVA, combined PUVA or NB UVB in Dermatology Department Kasr Al-Aini Hospital, are not at increased risk of developing cataract, anterior or posterior segments complications up to the duration of thirteen months of exposure. The significant incidence of diminution of visual acuity (mostly <2 lines); in patients receiving PUVA and to lesser extent combined PUVA was not associated with significant ocular abnormalities and may be attributed to the use of unbranded sunglasses or to personal error. Patients receiving NB UVB showed no significant decrease of VA. This indicates that NB UVB is safer as regards effect on eye. The use of branded sunglasses for all patients treated with phototherapy and photochemotherapy is recommended with periodic and prolonged eye examination for at least one year after treatment.

**References**