Absorption and concentration of UV radiation

Photo-sensitizing agent: production of reactive oxygen species

RIBOFLAVIN (VIT B2)

Absorbenza massimale a 370 nm

Lunghezza d'onda in nm
**RIBOFLAVIN (VIT B2)**

- Corneal endothelium and other eye structures protection (lens and retina)

0.1% Riboflavin reduces UV intensity up to 95%. Without Riboflavin the UV absorption of almost 30% by the endothelium and 50% by the lens was measured.

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**So, why RICROLIN TE?**

Because:
- It doesn’t need operating room
- Corneal thickness < 400 µ
- Easier technique
- Pre treatment VA maintenance
- Better patient compliance (children)
- No post-treatment pain
- No complications derived from disepithelization
Epithelial barrier

\[ \text{Shield effect} \]

Riboflavin Absorption

Laser intensity

CORNEAL EPITHELIUM

Riboflavin concentration in cornea of treated patient

Dott. Stefano Baiocchi
Trometamol

Trometamol (Tris-(hydroxymethyl)aminomethane) is an inert aminoalcohol with low toxicity used to mitigate, in vitro and in vivo, carbon dioxide and others acids, thanks to its buffer action. It’s present in a large variety of products, i.e. cosmetics and drugs, like buffer solution thanks to its intracellular and extracellular alkalinizing action. Its side effects are extremely rare; in fact, in literature, is reported only one case regarding a periorbital dermatitis induced by a gel containing trometamol.

So, trometamol is extremely well tolerated.

Trometamol

- **Increase efficacy**
  (Abdelkader H et al., *AAPS PharmSciTech.*, 2007)
- **Decrease toxicity**
  (U.S. Pharmacopoeia, Vol. XXII)
- **Improve pharmacokinetic, pharmacodynamic e biodisponibility (liposolubility)**
- **Combined with EDTA allow the transit through the tight-junctions**
  (Cover et al., *Microbios*, 58 1991)
SENsibilizzazione allergica

Conclusioni

Sulla base dei risultati ottenuti, interpretati secondo quanto previsto dalla norma UNI EN ISO 10993-10:2004, il prodotto in esame "SOLUZIONE OFTALMICA IPOTONICA A" deve essere definito NON SENSIBILIZZANTE.

IRRITAZIONE OCULARE

Nel corso dello studio si sono osservate le seguenti anomalie:

- Cornea: nulla di anormale
- Iride: nulla di anormale
- Congiuntiva
  - rossore: Nulla di anormale
  - chemosi: nulla di anormale
  - spuro: nulla di anormale

Conclusioni

Sulla base dei risultati ottenuti, interpretati secondo quanto previsto dalla UNI EN ISO 10993-10:2004, il prodotto in esame "SOLUZIONE OFTALMICA IPOTONICA A" deve essere considerato come NON IRRITANTE.
Group Treatment Observations Assessments of corneal damage

1 Ricrolin 30 µl drops every 3 min for 2 h Slit-lamp evaluation and photographs before treatment, and immediately after the last eye drop instillation; then 12, 24 and 36 h.

Methylene blue will be used as dye to assess the corneal damage.

Quantification of corneal riboflavin TE uptake was assessed by densitometry analysis. *p<0.05 vs. CTR
**Inclusion criteria**

- 20 eyes of 20 patients (14 males and 6 females)
- Age included between 12 and 42 years (mean age 27 years)
- Increasing Keratoconus I and II level (Amsler – Krumeich classification)
- Treated the eye with higher corneal curvature index and lower corneal thickness
- Contralateral eye used as control
- Mean corneal thickness 412.9 micron

**Materials and methods**

- Controls: T0, 7 days, 15 days, 1 month, 3, 6 and 9 months
- VA tested in conditions of natural miosis with LogMar ETDRS tables
- Instruments:
  - biomicroscopy
  - ultrasounds and optic pachimetry
  - corneal topography and aberrometry
  - corneal OCT
  - endothelial cells counter
Height 3 mm, diameter 12 mm (external) and 10.5 (internal), basal flange of 2 mm. The cylinder, introduced under the eyelid edge and directly on the cornea, works as a blepharostat, holds Ricrolin TE down, protects limbus from UV rays.

**Technique**

- **RICROLIN TE** 2h before the treatment (1 drop every 10 minutes)
- Anaesthetic drops preservative free
- Pilocarpine 1% drops
- Corneal silicon ring
- **RICROLIN TE** 15 min before UV, then every 3-5 min during UV exposure
- **CBM Vega** (CSO) 6 steps of 5 min each
• Ophthalmic office (no operating room)

• No surgical tissue

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**Therapy**

• Corneal washing with BSS
• Artificial tears (jaluronic acid and aminoacids)
• Antibiotic drops preservative free

![At the end of treatment](image1)

![After 2 days](image2)
### Results

#### Visus

<table>
<thead>
<tr>
<th>CXL Pre</th>
<th>1 month</th>
<th>3 months</th>
<th>6 months</th>
<th>9 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>UCVA</td>
<td>0.71±0.12</td>
<td>0.49±0.12</td>
<td>0.81±0.18</td>
<td>0.40±0.09</td>
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<tr>
<td>BCVA</td>
<td>0.35±0.23</td>
<td>0.26±0.10</td>
<td>0.48±0.29</td>
<td>0.22±0.08</td>
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</table>

#### Pachimetry

<table>
<thead>
<tr>
<th>CXL Pre</th>
<th>CXL Post</th>
<th>Controls Pre</th>
<th>Controls Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre: 412.9±21.5</td>
<td>Post: 410.3±15.3</td>
<td>Pre: 423.3±12.2</td>
<td>Post: 409.0±16.5</td>
</tr>
</tbody>
</table>

Data not statistically significant (p<0.05)

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### Results

#### endothelial cells counter (cell/mm²)

<table>
<thead>
<tr>
<th>CXL Pre</th>
<th>CXL Post</th>
<th>Controls Pre</th>
<th>Controls Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre: 2427 ± 236.4</td>
<td>Post: 2387 ± 361.0</td>
<td>Pre: 2523 ± 198.2</td>
<td>Post: 2474 ± 241.0</td>
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</tbody>
</table>

Data not statistically significant (p<0.05)

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### Results

#### Central keratometry (3 mm)

<table>
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<th>CXL Post</th>
<th>Controls Pre</th>
<th>Controls Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre: 51.0±10</td>
<td>Post: 41.3±21.9</td>
<td>Pre: 46.5±20.9</td>
<td>Post: 42.6±20.9</td>
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</table>

Data not statistically significant (p<0.05)
### Results

Maximal curvature (KcAK) and CLMI indexes (Ma, Mc)

<table>
<thead>
<tr>
<th></th>
<th>Pre CXL</th>
<th>1 month</th>
<th>3 months</th>
<th>6 months</th>
<th>9 months</th>
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</thead>
<tbody>
<tr>
<td>CXL</td>
<td>Controls</td>
<td>CXL</td>
<td>Controls</td>
<td>CXL</td>
<td>Controls</td>
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<tr>
<td>KcAK</td>
<td>±</td>
<td>±</td>
<td>±</td>
<td>±</td>
<td>±</td>
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<tr>
<td>Mc</td>
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<tr>
<td>Ma</td>
<td>±</td>
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</tbody>
</table>

Results

Corneal aberrometry

<table>
<thead>
<tr>
<th></th>
<th>Pre CXL</th>
<th>1 month</th>
<th>3 months</th>
<th>6 months</th>
<th>9 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>CXL</td>
<td>Controls</td>
<td>CXL</td>
<td>Controls</td>
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<td>Controls</td>
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<tr>
<td>Penn</td>
<td>±</td>
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<td>Coma</td>
<td>±</td>
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<tr>
<td>S.A.</td>
<td>±</td>
<td>±</td>
<td>±</td>
<td>±</td>
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</table>

**p<0.05**
Results

corneal OCT

Take home message

- Better compliance of the patient (possibility to treat patients under 15 years old and "complicated subjects")
- No post-treatment pain
- Corneal thickness < 380 micron
- Pre treatment VA maintenance
- Adjuvant treatment of “traditional CXL” (one technique has the opportunity to reinforce the effectiveness of the other)
Take home message

- **The trans epithelial CXL treatment doesn’t need operating room**
- **Corneal Silicon Ring works as a blepharostat, increase the contact time between Ricrolin TE and corneal epithelium, protects limbus and stem cells from UV rays**