Limbal Stem Cell Transplantation in a Case of Alkali Burn

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Alkali Burns

- Alkali burns are considered a true ophthalmological emergency
- Epidemiology:
  Age: 15-25y
  Sex: males
  Industrial accidents
  Home accidents

Mechanism of action of an alkali

- Hydrophilic and lipophilic
- Rapid penetration of tissues
- Hydroxyl ions: saponification of membranes
- Hydrolysis of interfibrillar glycosaminoglycans
- Susceptible to enzymatic degradation
- Hydration with thickening and shortening of collagen
- Disruption of extracellular matrix
Case:

Age: 21 y
Sex: male
C/O: Injury to the right eye with highly concentrated caustic soda used in soap manufacture since 2 hrs.

He said he washed his eyes immediately with copious amount of water. And sought medical advice before he came to me but he was not given emergency treatment.

- Before asking about symptoms and before clinical examination we started irrigation with normal saline solution 0.9 % for about 20 min. after instillation of a topical anaesthetic.

- Then the patient said he is photophobic, has severe pain, lacrimation, loss of vision.
Clinical examination:

- **Uncorrected V/A:** OD HM OS 1.0
- **Slit lamp exam.:**
  - Severe conjunctival injection all around the cornea except the area surrounding the lower half of the cornea which was blanched.
  - Particulate matter was found in the lower fornix and removed with a cotton swab.
  - Cornea was totally opacified.
  - Iris details were not seen.
  - IOP was not raised digitally.

### Classification of severity of ocular surface burns by Roper-Hall

<table>
<thead>
<tr>
<th>Grade</th>
<th>Prognosis</th>
<th>Cornea</th>
<th>Conjunctiva/limbus</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Good</td>
<td>Corneal epithelial damage</td>
<td>No limbal ischaemia</td>
</tr>
<tr>
<td>II</td>
<td>Good</td>
<td>Corneal haze, iris details visible</td>
<td>&lt;1/3 limbal ischaemia</td>
</tr>
<tr>
<td>III</td>
<td>Guarded</td>
<td>Total epithelial loss, stromal haze, iris details obscured</td>
<td>1/3–½ limbal ischaemia</td>
</tr>
<tr>
<td>IV</td>
<td>Poor</td>
<td>Cornea opaque, iris and pupil obscured</td>
<td>&gt;½ limbal ischaemia</td>
</tr>
</tbody>
</table>
# New classification of ocular surface burns


<table>
<thead>
<tr>
<th>Grade</th>
<th>Prognosis</th>
<th>Clinical findings</th>
<th>Conjunctival involvement</th>
<th>Analogue scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Very good</td>
<td>0 clock hours of limbal involvement</td>
<td>0%</td>
<td>0/0%</td>
</tr>
<tr>
<td>II</td>
<td>Good</td>
<td>&lt;3 clock hours of limbal involvement</td>
<td>&lt;30%</td>
<td>0.1–3/1–29.9%</td>
</tr>
<tr>
<td>III</td>
<td>Good</td>
<td>&gt;3–6 clock hours of limbal involvement</td>
<td>&gt;30–50%</td>
<td>3.1–6/31–50%</td>
</tr>
<tr>
<td>IV</td>
<td>Good to guarded</td>
<td>&gt;6–9 clock hours of limbal involvement</td>
<td>&gt;50–75%</td>
<td>6.1–9/51–75%</td>
</tr>
<tr>
<td>V</td>
<td>Guarded to poor</td>
<td>&gt;9–&lt;12 clock hours of limbal involvement</td>
<td>&gt;75–&lt;100%</td>
<td>9.1–11.9/75.1–99.9%</td>
</tr>
<tr>
<td>VI</td>
<td>Very poor</td>
<td>Total limbus (12 clock hours) involved</td>
<td>Total conjunctiva (100%) involved</td>
<td>12/100%</td>
</tr>
</tbody>
</table>

**Grade 3 (5/35%) ocular surface burn following an accident involving an industrial alkaline chemical.**

![Image of a burn](image-url)
**Modified classification of ocular chemical injuries**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Cornea</th>
<th>Limbal ischaemia</th>
<th>Conjunctival involvement</th>
<th>Prognosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Clear: epithelial damage only</td>
<td>None</td>
<td>None</td>
<td>Good</td>
</tr>
<tr>
<td>II</td>
<td>Clear: epithelial damage only</td>
<td>&lt;1/3</td>
<td>&lt;1/3</td>
<td>Good</td>
</tr>
<tr>
<td>III</td>
<td>Hazy cornea &gt;1/3 OR &gt;1/3</td>
<td></td>
<td></td>
<td>Guarded</td>
</tr>
</tbody>
</table>

**Definitive Treatment**

- Wash with Boric acid 4% solution as an anti-dote…..???
- Antibiotic/Steroid combination eye drops.
- Cycloplegic eye drops
- Timolol/dorzolamide fixed combination eye drops to avoid rising of IOP.(by collagen shrinkage in the 1st 3 days or by clogging of the trabecular meshwork by inflammatory debris and scarring of the episcleral venous plexus after 1st week)
- Lubricant eye drops
- High dose of vitamin C effervescent 2g/day to enhance collagen production
Follow up

Follow up was done after 2 days and there was improvement in limbal ischemia that became 1/3 of the corneal diameter and V/A became 6/36. Cornea became more clear.

Further visits showed stability of the case and after 2 weeks he went to Dr. Amir Abu Samra and he advised him to do limbal stem cell transplantation.

Follow up

The patient went to another doctor and he put a bandage soft contact lens for 1 week and removed it and then fixed it again for another week.

He returned back to me and I removed the contact lens and found a very large epithelial defect taking stain with hypopyon.

I doubted infection and ordered culture and sensitivity to him which was sterile.

In this stage the cornea began to show signs of melting with ectasia, increased limbal ischemia to take the lower half again and V/A dropped to H.M. again.
Follow up

- Again he was advised to do Limbal Stem Cell transplantation and he was prepared together with his father for the operation so that both options of autologous and allogenic grafts are present.

- Dr. Amir has performed the operation and the decision was taken to do autologous graft from the fellow eye.
Limbal Stem Cells

• The surface of the cornea is made up of an epithelium, which is continuous with that of the surrounding conjunctiva. The transition between the corneal and conjunctival epithelia is formed by the limbal epithelium.

• There is now a substantial body of evidence, both scientific and clinical, pointing to the basal layer of the limbus epithelium as the location for putative corneal epithelial stem cells, CESC, also known as limbal stem cells, LSCs. (Ahmad S, Figueiredo F, Lako M. Corneal epithelial stem cells: Characterization, culture and transplantation. Reg Med 2006; 1: 29–44. Chee KY, Kicic A, Wiffen SJ. Limbal stem cells: The search for a marker. Clin Exp Ophthalmol 2006; 34: 64–73)

Limbal Stem Cells

• The limbal epithelium acts as a reservoir for the replacement of corneal epithelial cells that are normally continually lost from the corneal surface into the tear film. In addition, the limbal epithelium is thought to exert a “barrier” function in preventing the migration of conjunctival epithelium and its blood vessels on to the surface of the cornea.

• Upon significant injury to the limbal epithelium and the LCSs contained therein, the corneal epithelium cannot renew itself and conjunctival epithelium can encroach on to the corneal surface, a process called “conjunctivalization”.

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(a) Diagram illustrating the placement of auto-limbal explants at the 6 and 12 o’clock positions of recipient eye.


Surgical technique
• Follow up for the patient is still needed and we hope he can be prepared for a future successful keratoplasty
• Sutures were removed after about 4 weeks, amniotic membrane resided from the surface of the cornea leaving an area of clear healed cornea, vascularization surrounded the lower half again and V/A improved to 6/24
• He was followed for 4 months now and still V/A is 6/24

• New technique of ex vivo expanded autologous limbal epithelium is now available
• But it needs integration with a pathology lab and a highly qualified pathologist
• This can be the future for total loss of limbal stem cells
Successful Clinical Implementation of Corneal Epithelial Stem Cell Therapy for Treatment of Unilateral Limbal Stem Cell Deficiency

Take Home Message

- Alkali burns are true emergencies and should be treated as early as possible.

- Limbal stem cell transplantation is a hope for severe cases of limbal ischemia in alkali burns.
THANK YOU