Management of Glaucoma in Patients with Keratoprosthesis

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Abstract: Standard keratoplasty is known to fail in eyes with refractory corneal blindness such as Stevens-Johnson syndrome, chemical burns, ocular cicatrical pemphigoid and multiple failed grafts. Keratoprosthesis (K-Pro) have improved the visual potential of these eyes (Figs 1 and 2) (Courtesy: Geeta K Iyer, Cornea Department, Medical Research Foundation, Chennai). However, glaucoma, which is often pre-existent, is a common complication and can compromise the results. This article reviews the underlying causes, as well as the challenges and pitfalls in the diagnosis and treatment of glaucoma in patients with keratoprosthesis.

Keywords: Keratoprosthesis, glaucoma drainage devices, cyclophotocoagulation.

INTRODUCTION

Standard keratoplasty notoriously fails in eyes with refractory corneal blindness such as Stevens-Johnson syndrome, chemical burns, ocular cicatrical pemphigoid and multiple failed grafts. Keratoprosthesis (K-Pro) have improved the visual potential of these eyes (Figs 1 and 2) (Courtesy: Geeta K Iyer, Cornea Department, Medical Research Foundation, Chennai). However, glaucoma, which is often pre-existent, is a common complication and can compromise the results.

PREVALENCE AND MECHANISM OF GLAUCOMA

Details of prevalence are mentioned in Table 1.

The mechanism of glaucoma is difficult to establish and is often related to the underlying disorder. Tauber et al found a prevalence of 26% (29 patients) of 111 patients diagnosed with ocular cicatrical pemphigoid (OCP).5 27 of these were diagnosed with glaucoma for a mean period of 11.3 years prior to the development of OCP. The authors discussed the possible mechanism as possibly a genetic predisposition to both diseases; glaucoma drug induced cicatrization or changes in aqueous outflow attributed to conjunctival cicatrization, leading to raised episcleral venous pressure. Tsai et al reported a prevalence of glaucoma in 46.9% of patients diagnosed with severe ocular surface disease ocular surface disease, which included those with OCP and Stevens-Johnson syndrome (SJS).6 They also found a prevalence of 55% in 18 patients with chemical/thermal injuries in their series.

In the immediate postoperative period, inflammation and mechanical angle collapse and pre-existing angle closure, can contribute to elevated intraocular pressure (IOP). Late postoperative elevations of IOP may be attributed to steroid response as well as peripheral anterior synechiae formation.

CHALLENGES IN DIAGNOSIS

Intraocular Pressure Measurement

Intraocular pressure measurement is a challenge. Most publications report the use of digital palpation for estimation of IOP. This method, in experienced hands, often provides a fairly accurate estimation, with over estimation, rather than under estimation being the rule.7 The Proview phosphen tonometer (Proview, Bausch and Lomb pharmaceuticals,Inc,Tampa-FL) is also a useful tool to provide a more objective way of assessment.8 It is based on the principle that pressure applied to the sclera generates a phosphen spot. The threshold pressure for creating a phosphen spot may provide an estimation of IOP. Kumar et al found an IOP of 18 to 20 mm Hg, using a Proview tonometer, in 5 of their patients who underwent OOKP and developed glaucoma.
Optic Nerve Head Assessment

Optic nerve head assessment using indirect lenses with the slit lamp biomicroscope is possible following surgery. Kumar et al used the Heidelberg retina tomography II and the optical coherence tomography (OCT 3) in all of 15 eyes of 15 patients who underwent OOKP. Good quality scans were possible in 7 of 15 eyes using the OCT and in 11 of 15 eyes using the Heidelberg retina tomograph (HRT).

Psychophysical Tests

The optical qualities of the various prostheses used may affect contrast sensitivity and psychophysical sensitivities, confounding visual field assessment. Falcinelli et al have compared the use of pattern electro retinograms (PERGs), visual evoked potentials (VEPs), contrast sensitivity and automated perimetry in 19 patients who underwent OOKP; 9 of whom had glaucomatous optic neurpathy. The results were compared with 17 normal subjects who were matched for age and gender. Among these, VEP showed the best accuracy (79%) in discriminating between glaucomatous and nonglaucomatous eyes.

Ultrasound Biomicroscopy

Ultrasound biomicroscopy is a useful tool to assess the anterior segment in these eyes. UBM was performed in 22% of eyes, which developed glaucoma in a series reported by Netland. 14% had an open angle and 8% showed angle closure. UBM was not possible in the remaining 78%.

Management

Use of topical medications is an issue in these eyes with a diseased ocular surface prior to surgery. Absorption through
the buccal mucous membrane in those who undergo M-OOKP may be unpredictable. Systemic acetazolamide is most often used for IOP control.

### Glaucoma Drainage Devices

Surgical management involves the use of glaucoma drainage devices which may be used prior to, along with K-Pro surgery, or during the postoperative period. Netland et al reported on the use of Ahmed valve implants in 35 eyes and Krupin valve in one eye of 36 patients who developed glaucoma in their series. The implant was inserted during the K-Pro surgery in 29 eyes, and following surgery in 7 eyes. It was placed either in the superonasal or supertemporal quadrants. IOP was controlled in 29 (81%). 5 eyes (14%) showed progression of glaucomatous damage despite surgery. Tube related complications included a blocked tube in 4 eyes (11%), conjunctival erosion and aqueous leak in 1 (3%), choroidal effusion in 3 (8%) and suprachoroidal hemorrhage in 1 (3%).

### Shunts to Distant Epithelialized Cavities

These have been advocated on the premise that drainage devices often lead to thick walled cavities which preclude adequate filtration of aqueous. Dohlman et al reported on their experience with Ahmed valve implants, which were modified to eliminate the polypropylene plate and enclose the valve in a silicon rubber housing. This was anchored to the sclera in the inferior quadrants. The distal tube was then introduced through a perforation in the orbital floor into the maxillary sinus, or was drawn to exit through the inferior fornix. Alternatively, the polypropylene plate was implanted in the superonasal quadrant. A tube which was sutured to the plate surface distal to the valve was then introduced into the lacrimal sac or ethmoid sinus. 34 eyes underwent the procedure with a mean follow-up of 4 years and 3 months. 2 tubes lead to the lacrimal sac, 6 to the ethmoid sinus, 16 to the maxillary sinus and 10 to the lower lid. All patients were advised low dose of prophylactic topical antibiotics.

One patient developed bacterial endophthalmitis. 3 developed tubes exposure and had to be removed; 4 developed hypotony. Loss of vision occurred in 7 eyes; one due to endophthalmitis, 2 due to retinal detachment, 3 due to high IOP and one due to uveitis.

IOP was judged to be low or normal on digital palpation in 13 of 14 eyes with OCP/SJS, 7 of 7 eyes with chemical burns and 13 of 13 eyes in the miscellaneous category, with or without medical treatment.

### Adjunctive Diode Cyclophotocoagulation

Rivier et al reported on their series of 18 eyes of 18 patients who underwent diode laser transscleral cyclophotocoagulation (DLTSC) either before (3 eyes), during (1 eyes) or after keratoprosthesis (14 eyes). A type I Dohlman Doane keratoprosthesis was used in 78% of these eyes. 17 eyes had undergone Ahmed valve implantation either along with or following the implantation of the keratoprosthesis. The G probe of the Iris Medical Diode laser unit (Mountain View, CA), was placed 6 mm from the center of the keratoprosthesis using calipers in those eyes in which the limbus was poorly defined. 15 to 20 spots, 1750 to 2000 mw, 2 seconds duration were applied for 270 degrees. Two complications occurred, conjunctival dehiscence in one and fungal endophthalmitis in another. At the final visit, mean best corrected visual acuity and number of antiglaucoma medications were not significantly different. IOP measured digitally, was significantly reduced up to 48 months following treatment.

### Endoscopic Cyclophotocoagulation

Anand Parthasarathy reported on one patient with Stevens-Johnson syndrome who underwent OOKP following multiple attempts at keratoplasty, developed uncontrolled glaucoma despite transscleral diode cyclophotocoagulation. He underwent this procedure one year following surgery using the diode laser, Endooptics, Little Silver, NJ, USA. A sclerostomy was made 10 mm from the

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**Table 1: Prevalence of glaucoma**

<table>
<thead>
<tr>
<th>Total number of eyes with keratoprosthesis</th>
<th>Total no; with glaucoma</th>
<th>No; with pre-existing glaucoma</th>
<th>No; with glaucoma following surgery</th>
<th>Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>181</td>
<td>78</td>
<td>66</td>
<td>12</td>
<td>Falcinelli¹</td>
</tr>
<tr>
<td>37</td>
<td>32</td>
<td>27</td>
<td>5</td>
<td>Hall Chew²</td>
</tr>
<tr>
<td>55</td>
<td>35</td>
<td>20</td>
<td>15</td>
<td>Netland³</td>
</tr>
<tr>
<td>15</td>
<td>5</td>
<td>5</td>
<td>Nil</td>
<td>Kumar⁴</td>
</tr>
</tbody>
</table>
center of the cylinder in this aphakic eye using an MVR blade, followed by limited anterior vitrectomy. The fiberoptic endoscope was then introduced and 180 degrees of the ciliary processes were treated. The end point of treatment was whitening and shrinkage of the ciliary processes. He had stable visual acuity, normal IOP and stable Goldmann visual fields at the end of one year.

CONCLUSIONS

Glaucoma is common in eyes with keratoprosthesis. Diagnosis and follow-up of this complication remains a challenge. Preoperative evaluation should include measurement of visual acuity, IOP measurement, ultrasound biomicroscopy and ultrasound examination of the posterior segment. IOP should be controlled to the maximum extent possible and may require transscleral cyclophotocoagulation and/or the use of glaucoma drainage devices along with or prior to the keratoprosthesis surgery to achieve the best result. Postoperative evaluation should include measurement of visual acuity, IOP assessment, disk evaluation and visual field assessment at each visit.

If progression of glaucomatous damage is confirmed, additional treatment with any one of the modalities mentioned is needed. However, visual prognosis is more guarded in this subgroup of patients undergoing keratoprosthesis surgery and the ideal method of diagnosis and management is yet to be established.

REFERENCES


“There is a wick within you that is waiting to become the light of your soul, when this inner flame burns brightly you will feel a magnificent awakening in your life”

— Bradford Keeney