Research Article

Post Penetrating Keratoplasty Glaucoma

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ABSTRACT:

Aim: To study of incidence, etiological factors contributing to secondary glaucoma following Penetrating Keratoplasty (PK).

Materials and methods: It was a prospective study carried out at tertiary eye care centre for period of 2 years. Inclusion criteria: All the patients who were operated for optical penetrating keratoplasty & not having pre existing glaucoma. Exclusion criteria: primary graft failure, early post PK glaucoma, intraoperative complications, repeats PK. In all the patients, every standard pre-operative, operative, post-operative management were done.

Results: Out of 98 patients, the most common age group of 30-45 years include 33(33.67%) patients, males (69, 70.41%) were more than females (29, 29.59%). The UBM was done in 50 patients - suggestive of 16(32%) had PAS(Peripheral Anterior Synechia); 18(36%) had adherent leucoma; 28(56%) had phakic, 13(26%) had PCIOL; 3(6%) had ACIOL; 6(12%) had aphakia. The 70(71.43%) were done PK, while 28(28.57%) were done triple surgery (PK, Cataract removal, IOL implantation). The post PK glaucoma was developed in 11 (11.2%) patients by the end of 3rd month, while 24(24.4%) patients by end of 6th month postoperatively. Out of 24 patients, 20(83.4%) were treated medically, 3(12.5%) surgically while cyclocryo was done in 1(4.1%) patient. The preoperative risk factors- ACIOL, Aphakia, PAS were found statistically significantly associated with post PK glaucoma with P-value -0.0133, 0.0466, 0.005 respectively.

Conclusions: The post PK glaucoma was more common in 15-45 years of age, with more common in male. The high risk factors includes-PAS(32%), Graft rejection(14.4%), Graft failure(27.6%), Adherent leucoma(33%), ACIOL, Aphakia. Triple surgery, Graft size >8mm the UBM aids in indentifying risk factors & thus in pre operative evaluation, surgical planning & prognostication.

Key words: Penetrating keratoplasty, Glaucoma, risk factors, Ultrasound BioMicroscopy, PAS, graft failure

INTRODUCTION

According to World Health Organisation, 45 million people worldwide are bilaterally blind, of which 6-8 million are blind due to corneal diseases. Penetrating Keratoplasty (PK) , with its refined technique and advance research has promised visual rehabilitation to a majority of corneal blind people. Glaucoma following Penetrating Keratoplasty is a serious problem on account of its frequency of occurrence, risk of graft failure, irreversible visual loss, difficulty in
diagnosis and management. (incidence: 9% to 30%) In 1969, Irvin and Kaufman (13) first reported the high incidence of increased intraocular pressure following PK. Since then, various authors have reported the incidence of Post PK Glaucoma to be from 9 to 31% in early post-operative period (10,12,13) and from 18 to 35% in the late post-operative period. Risk factors are pre-existing glaucoma (12), aphakic and pseudophakic bullous keratopathy, mesodermal dysgenesis, irido-coenear-endothelial syndrome, perforated corneal ulcer, adherent leukoma, previous PK, trauma, combined PK and cataract extraction, performance of vitrectomy during PK.

The chronic elevation of intraocular pressure (IOP) is a cause of significant ocular morbidity and it is an important underlying factor in the poor visual acuity which frequently follows successful keratoplasty.

Awareness of susceptible groups and avoidance of pre-disposing factors may allow rigorous supervision, so early diagnosis may be made and prolonged survival of vision in such compromised eyes. Improved technology like Ultrasound BioMicroscopy (UBM) has given a new hope that we can identify high risk eyes in presence of opaque media pre-operatively and so, improve the post-operative results.

MATERIALS AND METHODS
Prospective analytic study of post PK glaucoma was done at M & J Western Regional Institute Of Ophthalmology, Civil Hospital, B J Medical College, Ahmedabad, Gujarat between January 2008-2009.

108 pt. were included but because of various reasons some pts. excluded from study and final analysis was done with 98 eyes of 98 patients

Inclusion criteria-
- Patients operated for PK
- If grafting was done in both the eyes, only first eye operated was included in the study

Exclusion criteria
- Any intra operative complications
- Eyes which developed early post op glaucoma (within 1 month)
- Any pt. with pre op. Glaucoma or Glaucoma in other eye
- Primary graft failure or other post op. Complications
- Re PK
- Systemic illness

Fig.1 UBM: Peripheral anterior synechia

Pre op. Assessment
A Complete General and ocular history, comprehensive ocular examination including; slit lamp examination, Intra Ocular Pressure (IOP) measurement with Tonopen, Gonioscopy and Best corrected visual acuity.

Fundus examination, if possible or B scans (UltraSonoGraphy) to rule out any post Segment pathology.

Ultrasound BioMicroscopy (UBM) (Fig.1) was done in whom detail of anterior segment were not appreciated by slit lamp examination.

Operative procedure
All PK was done under a standard protocol, using peribulbar anaesthesia, by single surgeon. Preoperative Tab. Acetazolamide 500mg stat given to all patients; Injection Mannitol 20% intravenous 60 drops per minute was given to pts. assigned for triple procedure.

Corneal button size was determined according to the requirement (7 to 9.5 mm)

Donor cornea was 0.5 mm larger then recipient cornea.
In all pt. with Anterior Chamber IntraOcular Lens (IOL), the IOL was removed. Synechialysis, anterior vitrectomy and/or Pupilloplasty was done as and when required. Patient with significant cataract-triple procedure (PK + Cataract extraction + IOL) was done. Donor cornea was sutured with 4 cardinal and 12 interrupted sutures with 10/0 nylon suture. Anterior Chamber was formed with saline & air. Subconjunctival Injection Gentamycin + Dexamethasone were given. During surgery we keep in mind all risk factors and try to avoid them by -
- Keep graft size < 8 mm in most patients (if possible)
- Remove anterior chamber IOL, if it is responsible for pseudo phakic bullous keratopathy.
- Do proper anterior vitrectomy if vitreous in anterior chamber.
- Do pupiloplasty in case of floppy iris.
- Take short interrupted sutures.

Postoperative treatment includes: systemic antibiotics and analgesics for 5 days, Topical ofloxacin, Dexamethasone, cyclopentolate and lubricants.

**Post op. Glaucoma assessment**
Late onset post PK glaucoma is defined as glaucoma developing 4 weeks after PK. For the study purpose, pt. were followed at the interval of 1 month, 3 months and 6 months. Comprehensive ocular examinations including, measurement of IOP, Fundus for optic nerve evaluation, and Slit lamp examination and UBM (if media is opaque) (Fig.2&3) for any sign of graft failure. Pt. with raised IOP (> 21 mm of Hg with Toopen, evaluated by Ocular Coherence Tomogram and visual field analysis with Octopus perimeter (in presence of clear media with reasonable vision). Optic disc changes monitored in all cases of elevated IOP, either by serial disc photography (where possible) or by serial optic disc diagrams by the same surgeon.

Fig.2 Graft oedema due to raised IOP

Fig.3 Failed graft due to secondary glaucoma
Statistical Methods
Out of 98 patients, 24 were developed post PK glaucoma at the end of 6 months (24.5%).
Applying Fisher exact test and Chi-Square test, following causes have statistically significant association with post PK glaucoma.

- AC IOL- P-Value-0.013  
- Aphakia- P-value- 0.0466  
- Pre-op PAS – P value- 0.005  
- Triple procedure(PK+cat+IOL) – P value- 0.0031  
- Graft size (> 8.5 mm) – P value- 0.0073

RESULTS
Distribution of patients according to the type of surgery

<table>
<thead>
<tr>
<th>Type of surgery</th>
<th>No. of Patients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>PK</td>
<td>70</td>
<td>71.43</td>
</tr>
<tr>
<td>Triple</td>
<td>28</td>
<td>28.57</td>
</tr>
<tr>
<td>Total</td>
<td>98</td>
<td>100</td>
</tr>
</tbody>
</table>

Out of 98 patients 70(71.43%) were operated only for PK and 28(28.57%) for combined PK and cataract surgery

Distribution of patients according to graft size

<table>
<thead>
<tr>
<th>Graft size (mm)</th>
<th>No. Of patients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>06</td>
<td>6.12</td>
</tr>
<tr>
<td>7.5</td>
<td>64</td>
<td>65.31</td>
</tr>
<tr>
<td>8</td>
<td>19</td>
<td>19.39</td>
</tr>
<tr>
<td>8.5</td>
<td>03</td>
<td>3.06</td>
</tr>
<tr>
<td>9</td>
<td>02</td>
<td>2.04</td>
</tr>
<tr>
<td>9.5</td>
<td>04</td>
<td>4.08</td>
</tr>
<tr>
<td>Total</td>
<td>98</td>
<td>100</td>
</tr>
</tbody>
</table>

Graft size was 7.5mm in 64(65.31%) patients and was >8mm in 9 patients (9.18%)

On applying chi-square test graft size of >8mm was found statistically was significant of post PK glaucoma (P value-0.0073)

Incidence of Glaucoma according to the indications for penetrating keratoplasty

<table>
<thead>
<tr>
<th>Indications for keratoplasty</th>
<th>Total no. Of patients</th>
<th>Glaucoma No. Of patients</th>
<th>Glaucoma Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corneal scarring</td>
<td>41</td>
<td>08</td>
<td>19.51</td>
</tr>
<tr>
<td>Adherent leucoma</td>
<td>23</td>
<td>08</td>
<td>34.78</td>
</tr>
<tr>
<td>Corneal dystrophy</td>
<td>10</td>
<td>01</td>
<td>10.0</td>
</tr>
<tr>
<td>PBK</td>
<td>20</td>
<td>04</td>
<td>20.0</td>
</tr>
<tr>
<td>ABK</td>
<td>04</td>
<td>03</td>
<td>75.0</td>
</tr>
<tr>
<td>Total</td>
<td>98</td>
<td>24</td>
<td>24.5</td>
</tr>
</tbody>
</table>

Post PK glaucoma was seen in 75% of patients with ABK, 34.78% patients with adherent leucoma followed by PBK, corneal scaring and corneal dystrophy.

Anterior chamber IOL & Post PK Glaucoma

<table>
<thead>
<tr>
<th>AC IOL</th>
<th>Post PK Glaucoma</th>
<th>No</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>03</td>
<td>00</td>
<td>03</td>
</tr>
<tr>
<td>NO</td>
<td>21</td>
<td>74</td>
<td>95</td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
<td>74</td>
<td>98</td>
</tr>
</tbody>
</table>

On applying fisher exact test, preop finding of AC IOL was found statistically significant and associated with post PK glaucoma(P value 0.0133)

Aphakia and Post PK Glaucoma

<table>
<thead>
<tr>
<th>Aphakia</th>
<th>Post PK Glaucoma</th>
<th>Post PK Glaucoma</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Present</td>
<td>Absent</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>04</td>
<td>02</td>
<td>06</td>
</tr>
<tr>
<td>No</td>
<td>20</td>
<td>72</td>
<td>92</td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
<td>74</td>
<td>98</td>
</tr>
</tbody>
</table>

On applying chi-square test aphakia found stastically significant associated with post PK glaucoma (P value-0.0466)
Peripheral Anterior Synechiae (PAS) & Post PK Glaucoma

<table>
<thead>
<tr>
<th>PAS on UBM</th>
<th>Post PK Glaucoma</th>
<th>Post PK Glaucoma</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>09</td>
<td>07</td>
<td>16</td>
</tr>
<tr>
<td>No</td>
<td>06</td>
<td>28</td>
<td>34</td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
<td>35</td>
<td>50</td>
</tr>
</tbody>
</table>

On applying chi-square test pre op finding of PAS on UBM was statistically significantly associated with post PK glaucoma.(P value-0.005)

Type of surgery and Post PK Glaucoma

<table>
<thead>
<tr>
<th>Type of surgery</th>
<th>Post PK Glaucoma</th>
<th>Post PK Glaucoma</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triple</td>
<td>09</td>
<td>18</td>
<td>27</td>
</tr>
<tr>
<td>PK</td>
<td>05</td>
<td>37</td>
<td>42</td>
</tr>
<tr>
<td>Total</td>
<td>14</td>
<td>55</td>
<td>69</td>
</tr>
</tbody>
</table>

On applying chi-square test triple procedure was found statistically significant associated with post PK glaucoma.(P value- 0.031)

DISCUSSION

In the present prospective analytic study of 98 patients undergone optical PK, around half (49%) of the patients have risk of development of glaucoma leading to graft failure for remaining years of life.

Post PK glaucoma is the second leading cause of graft failure after graft rejection. In this study ,out of 98 patients, 14(14.3%) developed graft rejection , 24(24.5) glaucoma, 16(16.3%) graft infection & 27(27.6%) developed graft failure. Similar rate for graft rejection was noted by Maguire, Starkk, Gottasch J et al(16) and for glaucoma by Foulks GN & Olson RJ (18).

The chronic elevation of intraocular pressure (IOP) is a cause of significant ocular morbidity and it is an important underlying factor for the poor visual acuity which frequently follows successful keratoplasty. Pathophysiology of post pk glaucoma is multifactorial and related to the distortion of the angle with collapse of the trabecular meshwork, suturing technique, post operative inflammation, use of corticosteroids, PAS formation and pre-existing glaucoma. Oedema and inflammation after surgery lead to further compromise in trabecular meshwork function and it is also aggravated by angle distortion.

Angle compression is reduced by deep, less tight and short sutures, suture bites equal on either side of the wound (28), small graft size, donor corneas larger than that of the recipient, thinner recipient corneas and large overall corneal diameter. Zimmerman et al (27) reported that oversized donor buttons (0.5mm larger than the host bed) in aphakic patients reduced the incidence of this glaucoma.

The main cause for late post-PK glaucoma is a synechial angle closure; a floppy atrophic iris may lead to a higher incidence of PAS formation; which can be prevented by iris suturing or iridoplasty.

Diagnostic difficulty arises due to errors in tonometry readings of a thick and astigmatic corneal graft.

High resolution non-invasive ultrasound technique of in-vivo imaging of anterior segment i.e. Ultrasound BioMicroscopy evaluates the extent of irido-corneal adhesions, location and status of natural as well as artificial lens ,anterior chamber depth, angle width and corneal thickness; which aids the surgeon in preoperative evaluation, planning and its prognostication (6)

In our study, we had done proper slit lamp examination and in hazy cornea Ultrasound BioMicroscopy was done to find out high risk patients, who had more chances of developing secondary glaucoma post keratoplasty surgery.UBM was done pre operatively in 50(51.02%) patients in whom details of anterior segment were not appreciated by slit lamp and thus peripheral anterior synechiae was identified in 16
(32%) patients on UBM. Pre operative finding of PAS were significantly associated with development of glaucoma post operatively in this study (P value-0.005) and similar findings also found by Nguyen NX et al (17). During surgery we had taken proper measures to avoid risk factors as described previously.

The major indications of Penetrating Keratoplasty in developing countries are corneal scarring and adherent leucoma (8),which was 41.84% and 23.47% respectively in our study, followed by PBK (20.41%),corneal dystrophy (10.20%) and ABK (4.08%).Post PK glaucoma was seen in ABK (75 %) and 34.78% of adherent leucoma patients.

CONCLUSION
Association of modifiable risk factor for graft failure with certain categories of pt. are identified in our study, these could be looked for and treated aggressively to reduce the risk of graft failure and visual loss and prevention of blindness. In this prospective study, Out of 98 patients, the most common age group of 30-45 years include 33(33.67%) patients, males (69, 70.41%) were more than females (29, 29.59%).The UBM was done in 50 patients-suggestive of 16(32%) had PAS(Peripheral Anterior Synechia); 18(36%) had adherent leucoma;28(56%) had phakic, 13(26%) had PCIOL;3(6%) had ACIOL; 6(12%) had aphakia. The 70(71.43%) were done PK, while 28(28.57%) were done triple surgery (PK, Cataract removal, IOL implantation). The post PK glaucoma was developed in 11 (11.2%) patients by the end of 3rd month, while 24(24.4%) patients by end of 6th month postoperatively. Out of 24 patients, 20(83.4%) were treated medically, 3(12.5%) surgically while cyclocryotherapy was done in 1(4.1%) patient. The preoperative risk factors- ACIOL, Aphakia(21,23), PAS, were found statistically significantly associated with post PK glaucoma with P-value -0.01333,0.04666,0.005 respectively.

Limitations of our study are: IOP measurement is not precise with Tonopen due to K oedema and increased intraocular pressure was due to steroid responsiveness was not clarified.

ACKNOWLEDGEMENT
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Conflict of interest: None declared.

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