IOP changes and risk factors for post corneal grafting glaucoma

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Corneal grafting

• Penetrating keratoplasty

• Lamellar keratoplasty
  • DALK
  • DSAEK
  • DMEK
Post keratoplasty glaucoma

- 2nd most common cause of graft failure
  - Endothelial cell loss
- Visual field defects
Glaucoma

- Optic nerve damage
- Disc changes (Cupping)
- Visual field defects
- Increased IOP

! IOP measurement

! Definition of glaucoma in published studies
Incidence of glaucoma post PKP

- Huber et al., Graefes Arch Clin Exp Ophth, 2013, 8.7%
- Sihota, Austr & NZ J Ophthalmology 1998, 10.6%
- Kirkner, Ficker, Cornea 1992, 14%
- Karadag et al., Cornea 2010, 16.6%
- Foulks GN. Ophthalmology 1987, 18%
- Ing JJ, Ophthalmology 1998, 21%
- França, Cornea 2002, 21.5%
- Geerling Ophthalmologe 2010, 25%
- Yıldırım, Journal of Ophthalmology 2011, 34%
Penetrating keratoplasty

- 1848 penetrating keratoplasties
- Incidence: 8.7%
- 1st occurrence: 138 days post graft
- IOP: 29.3 +/- 6 mmHg
- IOP Max: 35.3 +/- 8.3 mmHg
- @ 1st year: 89.4%

- IOP ≥22 needing medication or surgical intervention, +/- VF loss or optic nerve changes
- In pre-existing glaucoma, worsening of the glaucomatous control, which required additional medication or surgery

Penetrating keratoplasty

- 749 eyes
- 16.6% chronically elevated IOP
- 5.5% IOP immediate postop period
- 5 months (Average time to presentation)
- Mean IOP: 27.9 +/- 5.8 mmHg
- The incidence of post-PKP glaucoma was 59.4% in eyes with pre-existing glaucoma vs 14.6% in cases without

O. Karadag et al, “Incidence of and risk factors for increased intraocular pressure after penetrating keratoplasty”
OHT after PKP

- One episode of OHT: 47.9%
- Mean IOP: 25.15 +/- 5.66
- Time after surgery: 70.3 +/- 15.8

Incidence depends on indication for PKP

- Foulks 1987 - 502 patients, 18% glaucoma
  - 39% aphakic bullous keratopathy
- Kirkness and Ficker (1992) - 1122 patients, 14% developed elevated IOP following PKP
  - 1% keratoconus
  - 3% corneal dystrophies
  - 29% bullous keratopathy
- Ing 1998 - 394 patients, 21% glaucoma
  - 1% keratoconus
  - up to 44% in patients with PBK
Escalation of glaucoma therapy after PKP

715 PKs in 32.2 months of f/u

- 12.4 % of eyes
- 82 % - Medical escalation
- 18 % - Surgical escalation

## Risk factors

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Overall No.</th>
<th>No. With Increased Intraocular Pressure</th>
<th>Relative Risk</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bullous keratopathy*</td>
<td>109</td>
<td>38 (30.6%)</td>
<td>2.59</td>
<td>1.87–3.58</td>
</tr>
<tr>
<td>Graft Rejection</td>
<td>69</td>
<td>27 (21.7%)</td>
<td>2.61</td>
<td>0.83–2.72</td>
</tr>
<tr>
<td>Corneal scar</td>
<td>83</td>
<td>14 (11.2%)</td>
<td>0.93</td>
<td>0.55–1.59</td>
</tr>
<tr>
<td>Vascularized scar</td>
<td>69</td>
<td>9 (7.2%)</td>
<td>0.86</td>
<td>0.47–1.57</td>
</tr>
<tr>
<td>Keratoconus</td>
<td>232</td>
<td>9 (7.2%)</td>
<td>0.15</td>
<td>0.07–0.30</td>
</tr>
<tr>
<td>Traumatic scar</td>
<td>14</td>
<td>5 (4%)</td>
<td>2.66</td>
<td>1.42–4.99</td>
</tr>
<tr>
<td>Dystrophy</td>
<td>67</td>
<td>5 (4%)</td>
<td>0.42</td>
<td>0.18–1.01</td>
</tr>
<tr>
<td>Corneal abscess</td>
<td>16</td>
<td>4 (3.2%)</td>
<td>1.52</td>
<td>0.64–3.62</td>
</tr>
<tr>
<td>Graft thinning</td>
<td>5</td>
<td>4 (3.2%)</td>
<td>4.96</td>
<td>3.1–7.92</td>
</tr>
<tr>
<td>Graft abscess</td>
<td>7</td>
<td>3 (2.4%)</td>
<td>2.62</td>
<td>1.1–6.27</td>
</tr>
<tr>
<td>Descemocoele</td>
<td>20</td>
<td>3 (2.4%)</td>
<td>0.90</td>
<td>0.31–2.59</td>
</tr>
<tr>
<td>Herpetic keratitis</td>
<td>18</td>
<td>2 (1.6%)</td>
<td>0.66</td>
<td>0.17–2.48</td>
</tr>
<tr>
<td>Band keratopathy</td>
<td>8</td>
<td>1 (0.8%)</td>
<td>0.75</td>
<td>0.11–4.74</td>
</tr>
<tr>
<td>Corneal perforation</td>
<td>13</td>
<td>0</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Corneal ectasia</td>
<td>4</td>
<td>0</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Fuchs endothelial dystrophy</td>
<td>5</td>
<td>0</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Corneal degeneration</td>
<td>3</td>
<td>0</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Corneal ulcer</td>
<td>6</td>
<td>0</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Alkali burn</td>
<td>1</td>
<td>0</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>749</strong></td>
<td><strong>124</strong></td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

*Both aphakic and pseudophakic bullous keratopathy.

O. Karadag et al, “Incidence of and risk factors for increased intraocular pressure after penetrating keratoplasty”  
Why does in happen?

- Distortion of the angle
- Trabecular meshwork collapse
- Suturing technique
- Postoperative inflammation
- Presence of PAS
- Steroid response
Angle distortion

- Anterior loss of support from trephined Descemet Membrane
- Posterior loss of support in aphasic patients
- Results in trabecular meshwork collapse
Suturing technique

- Tight sutures
- Long bites
- Trephine size
Peripheral anterior synchiae

- Previous surgery
- Inflammation
- Narrow angle
- Previously flat AC
Retained viscoelastic

- Dispersive viscoelastic
- Obstruction of TM outflow
- Immediate postop IOP rise
Steroid response

- Common cause of post-graft IOP elevation
- Common in younger group
- Watch carefully
- Balance between safe frequency of steroids and IOP
Risk factors for post PKP glaucoma

- Pre-existing glaucoma
- PAS
- Posterior synachiae
- Pseudophakic / Aphakic bullous keratopathy
- Combined PKP and cataract extraction
- Wound leak for AC shallowing
- Retained viscoelastic
- Steroid response
- Previous graft rejection
- Previous ocular trauma
- Previous chemical injury
- Ghost cell glaucoma
- Aqueous misdirection
Summary

- Incidence of glaucoma after PKP is highly variable
  - 9 - 31 % in the early postoperative period
  - 18 - 35 % in the late postoperative period
- Depends on
  - The indication for PKP
  - the complexity of surgery
- Low incidence for KC and FED
- High incidence for bullous keratopathy and failed/rejected graft
Post DALK

- Low long term risk of glaucoma
- Increased IOP infrequent
- Easily controlled with topical agents
- Beware of pupil block from AC air
- Urrets-Zavalia syndrome

DSAEK

- AAO report 2009 (34 published articles)
- Iatrogenic glaucoma 3% (range, 0%-15%)

Post DSAEK
Short term IOP rise

- Air in AC
- Pupil block mechanism
- Management
  - Prophylactic PI
  - Dilate pupil
  - Release air
Post DSAEK
Long term IOP rise

- 28.8% IOP rise
- 11.9% glaucoma
- Steroid induced 18.6%
- Pre-existing glaucoma - Most important risk factor
- All cases responded to medical treatment

Post DSAEK de novo OHT incidence

- IOP $\geq 24$ mmHg OR IOP rise $\geq 10$mmHg baseline
- 1-year 36.1%
- 2-year 47.2%
- 3-year 47.2%
- Comparabled risk of OHT to PK
- 30% of eyes with OHT require surgery

DMEK

- 275 consecutive eyes
- Follow-up of 22 (± 13) months
- Significant IOP rise
  - IOP of ≥24 mm Hg or an elevation of ≥10 mm Hg compared to the preoperative IOP
- 6.5% elevated IOP
  - 2.5% exacerbation
  - 4% de novo

SUMMARY

- Post PKP glaucoma incidence around 10%
- Major risk factors are
  - Pre-existing glaucoma
  - PAS
  - Aphakic / pseudophakic bullous keratopathy
  - Surgical indication for PKP associated with risk of glaucoma
  - Keratoconus / FED low risk for glaucoma
- Medical & Surgical intervention may be needed
- DSAEK is associated with post-op glaucoma in 20-30%
- DMEK small incidence of glaucoma
- DALK very low risk of glaucoma
Thank you