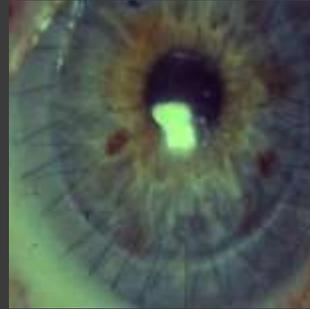


INTRA OCULAR PRESSURE ELEVATION FOLLOWING PENETRATING KERATOPLASTY

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- Glaucoma can occur as a complication of virtually any anterior segment surgery, including glaucoma surgery.

- ◉ Glaucoma remains a leading cause of graft failure following penetrating keratoplasty (PKP)



- ◉ The management of penetrating keratoplasty and glaucoma (PKPG) remains controversial mainly because of the high risk of graft failure associated with the treatment

Incidence

- ◉ The incidence of PKPG varies from **9-31%** in the early postoperative period (*Wilson, 1990*) and from **18-35%** in the late postoperative period (*Chien, 1993*).

Etiology

I. Important risk factors for glaucoma in PKP patients include:

- Aphakic bullous keratopathy
- Combined PKP and cataract surgery
- Pre-existing glaucoma
- Wound gaping
- Repeated keratoplasty

(Wilson, 1990; and Chien, 1993;).

II. Causes for elevated IOP in the early postoperative period :

- Postoperative inflammation
- Viscoelastic substances
- Wound leak with angle closure
- Hyphema
- Operative technique
 - Tight suturing and long bites compressing the angle
 - Larger recipient bed
 - Increased peripheral corneal thickness
- Pupillary block glaucoma
- Preexisting glaucoma

III. Causes for elevated IOP in the late postoperative period:

- PKP in aphakic eyes
- PKP combined with cataract extraction
- Chronic angle-closure glaucoma
- Preexisting glaucoma
- Steroid-induced glaucoma
- Graft rejection with glaucoma
- Ghost cell glaucoma
- Ciliary block (malignant) glaucoma

Pathophysiology

- The pathophysiology of PKPG is multifactorial and may be related to distortion of the angle with collapse of the trabecular meshwork, suturing technique, postoperative inflammation, and peripheral anterior synechiae.
- Factors contributing to angle distortion include:
 - tight suturing
 - long bites (more compressed tissue)
 - larger trephine sizes
 - smaller recipient corneal diameter
 - increased peripheral corneal thickness.

Histopathological changes

- ◉ The degree and duration of elevated IOP has been shown to result in significant **endothelial cell loss**.
- ◉ Following an acute attack of angle-closure glaucoma, endothelial cell loss is **10-33%** and rising to **77%** in eyes with ACG lasting more than 12 days.
- ◉ Morphologic changes in the endothelial cells, such as vacuolization, loosening of cell junctions, blebbing, disruption of the plasma membrane and loss of whole cells, have been observed in experimentally induced models.

Diagnosis

- ◉ Accurate measurement of IOP in patients with keratoplasty can be difficult.
- ◉ IOP in the early postoperative period, when the corneal surface is irregular, can be measured with the **Mackay-Marg** electronic applanation tonometer, the **Pneumatic applanation tonometer**, or the **Tono-Pen**.
- ◉ If the graft surface is smooth, the epithelium is intact, and the mires are regular, then **Goldmann applanation** can be used .

- The accuracy of applanation tonometry is reduced in any condition that thickens or alters the cornea.
- Thin corneas result in underestimation, and thick corneas result in overestimation.

Pneumatic Tonometer

- Applanates only a small area of the cornea
- Can measure the IOP in the presence of corneal scars, corneal edema, or when only a small portion of the cornea is visible (large tarsorrhaphy)
- In patients with neurotrophic keratopathy it is possible to measure the IOP with minimal disturbance of the epithelium.

Follow up:

- Optic disc changes should be monitored in all cases of elevated IOP.
- Visual fields: difficult, especially in the early postoperative period. In patients with reasonable vision, Humphrey visual fields or Goldmann visual fields should be performed.

Medical Treatment of PKPG

Glaucoma Medications	Potential Problems in Patients With PKPG
Beta-blockers	Superficial punctate keratitis, corneal anesthesia, dry eyes
Alpha-adrenergic drugs	Superficial punctate keratitis, dry eyes, allergic reactions
Miotics	Inflammation, graft rejection
Topical carbonic anhydrase inhibitors	Induce permanent graft failure in eyes with borderline endothelial counts (<i>Konowal, 1999</i>)
Prostaglandin analogues	Uveitis (<i>Ayyala, 1998</i>), cystoid macular edema in aphakia and pseudophakia, and recurrent herpes simplex infection in patients with previous history of herpes (<i>Wand, 1999</i>)
Adrenergic agents	Epithelial toxicity and cystoid macular edema in aphakia and pseudophakia

Medical treatment

- The benefits of pressure reduction with topical glaucoma medications should be weighed against potential adverse effects.
- **Benzalkonium chloride (BAC)**, can cause severe surface toxicity affecting the corneal epithelium.
- **The acidic pH** of some of the topical drops (eg, Cosopt, 5.8; dorzolamide, 5.6), also may be toxic to the corneal epithelium.

Surgical Treatment

Surgical options

- The lowest incidence of graft failure follows trabeculectomy (10-20%), as compared to GDD surgery (10-50%) and cyclodestructive procedure (20-50%).

I. Trabeculectomy

- Conventional trabeculectomy without antimetabolites in patients with PKPG has a high failure rate, secondary to limbal conjunctival scarring from previous surgery, extensive peripheral synechiae, aphakia, and extremely shallow anterior chamber.
- The reported success rate in IOP control with mitomycin trabeculectomy in patients with PKPG is 67-91% and that of graft failure was 12-18% (*Figueiredo, 1996 and Ayyala, 1998*).

○ Recommendations:

- Trabeculectomy with mitomycin-C can be attempted in patients with no or limited superior limbal conjunctival scarring, absence of extensive peripheral anterior synechiae, aphakia, and extremely shallow anterior chambers.
- Avoid shallow or flat anterior chamber in the postoperative period because this could compromise the graft endothelium.
- Avoid 5-FU in patients with sick epithelium and persistent epithelial defects.
- Watch for Dellen formation that can trigger thinning of the adjacent graft cornea, leaking blebs, and bleb-related infections.

II. Glaucoma drainage devices

- In 1987, *Kirkness* first reported the use of GDDs in PKPG.
- Although they control glaucoma in a high percentage of patients in all published series (71-96%, with an average of 84.8%), they are associated with a high incidence of graft failure in the range of 10-51% (average of 36.2%) (*Rapuano, 1995; Ayyala, 1998; Topouzis, 1999*).
- The etiology of graft failure probably is multifactorial. The presence of underlying chronic inflammation, extensive peripheral synechiae, and multiple previous surgeries may compromise the graft.

- Recommendations:
 - Precede or combine the GDD operation with the corneal transplantation in patients with preexisting glaucoma.
 - Use valved implants (Ahmed, Krupin) rather than Molteno or Baerveldt implants which offer no resistance to the outflow and, thus, may lead to hypotony and AC shallowing.
 - High-dose steroids for 3-6 months postoperatively

III. Cyclodestructive procedures

- Their overall success rate in controlling the IOP is **60-80%**.
- There appears to be a higher incidence of permanent visual loss and hypotony following cyclodestructive procedures Vs. GDD (*Ayyala, 2000*).
- Should be reserved for patients who have failed all other interventions.

Preexisting Glaucoma in PKP patients

- ◉ Multiple studies have documented preoperative glaucoma to be a high-risk factor for the development of PKPG (*Wilson, 1990; Chien, 1993; and Reinhard, 1997*) and higher incidence of graft failure after glaucoma operations following PKP (*Rapuan, 1995*).
- ◉ Patients with uncontrolled IOPs or with borderline IOP control on 2 or more medications may be treated with either mitomycin-C trabeculectomy or GDD surgery prior to or combined with the planned corneal transplant.

- ◉ Literature favors a combined mitomycin-C trabeculectomy with corneal graft operation in patients with preexisting glaucoma who need a corneal transplant (*Rapuan, 1995; Figueiredo, 1996; Ayyala, 1998; WuDunn, 1999; Topouzis, 1999*).
- ◉ **GDD surgery is the preferred operation** over other surgical options in patients with PKPG who have extensive **limbal conjunctival scarring**, **shallow anterior chamber**, extensive peripheral anterior **synechiae**, and **failed trabeculectomy**

Conclusion:

- ◉ During PKP, the following measures are useful in reducing the incidence of postoperative glaucoma:
 - using an oversized donor button (0.5 mm),
 - deep bites,
 - goniosynechiolysis of peripheral anterior synechiae,
 - iridoplasty of a floppy iris,
 - removal of viscoelastic material at the end of the operation
 - careful wound closure to prevent leaks

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