Introduction:

The goal of glaucoma surgery is to prevent further loss of visual field or visual acuity. Glaucoma surgery (with the exception of combined cataract surgery) is not intended to improve either visual field or visual acuity. Obviously this expectation must the clearly explained to patient. Conversely, glaucoma surgery ideally should not result in loss of visual acuity. However, alterations to the ocular structures in the visual axis during or following surgery can lead to decreased visual acuity. This can be troublesome for advanced glaucoma patients with constricted visual fields who are very dependent on the remaining central island of vision, as well as those with less severe glaucoma in whom the post-surgical loss of acuity may be their first symptom related to their glaucoma.

Cataract

Cataract is the most common cause of decreased visual acuity after filtering surgery. The 5 year risk of developing a visually significant cataract increases by 78%. The reason for cataract formation following trabeculectomy is not clear. The most accepted hypothesis is that aqueous humor dynamics are altered by trabeculectomy surgery. A surgical peripheral iridectomy is typically performed in trabeculectomy allowing aqueous to directly pass from the posterior chamber into the anterior chamber bypassing the typical trans-pupillary route which bathes the anterior lens. Because the lens receives nourishment from the aqueous, the anterior central portion of the lens may not be supplied with its metabolic needs. This theory is consistent with the observation cataracts are more common after laser peripheral iridotomy. Another proposed mechanism of cataract formation is post-operative inflammation. Although certainly plausible, convincing evidence is lacking. Increased cataract formation has been observed with the use of Mitomycin-c (MMC) and may be due either to increased aqueous of flow bypassing the lens, or direct toxicity to the lens. Certainly, surgical complications such a flat anterior chamber with lens cornea touch increase the risk of cataract formation. Additionally postoperative medications, especially corticosteroids, are known to be associated with cataract formation. The risk of cataract formation from topical ocular steroids is difficult to determine because of the many confounding variables. However, the odds ratio of cataract formation from systemic and inhaled chronic corticosteroid use is approximately 1.5-2.0. The surgeon should bear this in mind during the post-operative period in phakic patients.
Cataract surgery after trabeculectomy is generally similar to standard cataract surgery with a few additional considerations. First, it is important to avoid the bleb when creating the main incision and any paracenteses. This is easily accomplished by altering the incision location and/or performing clear corneal incisions. We advocate clear cornea incisions to preserved as much conjunctiva as possible should the need for further glaucoma surgery be necessary. We do routinely suture clear corneal cataract wounds in eyes with prior trabeculectomy and high flow filters to ensure a watertight seal. Second, the anterior chamber is occasionally less stable in post trabeculectomy eyes, due fluid flow through the trabeculectomy. This can be minimized by strategically placing viscoelastic at the sclerotomy site to prevent excessive flow through the trabeculectomy although in general, this extra step is rarely necessary. Third, glaucoma patients often have small pupils. Typical strategies can be employed as needed including viscodilation, lysis of posterior synechiae, intracameral epinephrine, gentle bimanual pupil stretching techniques, iris hooks, or other surgical devices such as the Malyugin ring. Fourth, care should be taken to remove all viscoelastic from the eye to prevent a post-operative IOP spike in an already glaucomatous eye. Finally, post-operative inflammation should be aggressively managed to prevent fibrosis of the bleb. We typically give corticosteroid eye drops every 2 hours for the first week followed by a taper over the next 6 weeks. If cataract surgery should lead to fibrosis of the filter, a bleb needling procedure with Mitomycin C or 5-fluorouracil can be very effective at preserving filter function.16, 17

Pupillary Membrane

Pupillary membranes can occur after filtering surgery and are usually the result of excessive inflammation, fibrin formation and subsequent organization following glaucoma surgery.18 Typically pupillary membranes decrease during the perioperative period with aggressive topical corticosteroid treatment. However, pupillary membranes can persist after the perioperative inflammation has subsided. Dense pupillary membranes may require surgical removal typically with an anterior vitrector. However, most pupillary membranes can be lysed with a YAG laser.19, 20 The surgeon must keep in mind that the reason for the membrane formation was excessive perioperative inflammation. Thus, we recommend aggressive topical corticosteroid treatment for at least 3 days prior to membrane removal and continued aggressive corticosteroid treatment in the immediate post-operative period and a slow taper over a couple months.

Opacities of the IOL in pseudophakic eyes.

Early generation silicone IOLs and acrylic IOLs are more likely to have a proliferation of cellular debris comprised of residual lenticular epithelial cells or aggregations of inflammatory giant cells across the anterior IOL surface when compared to recent generation silicone IOLs.21 This thin sheet of epithelial cells can give a smudged appearance to the lens. No conclusive studies have shown that an actual decrease in visual acuity or contrast sensitivity results from this anterior membrane.22 The Yag laser can be used to remove the cells on the anterior lens surface if they are causing visual compromise.

Lens pits are a common occurrence after Yag capsulotomy.23 Although often bothersome to ophthalmologist examining the patient, rarely does the patient notice any visual disturbance
whatsoever.24, 25 Although, patients rarely experience symptoms from lens pits, we recommend diligent efforts to avoid them in glaucoma patients especially those with a constricted visual field.

Posterior Capsular Opacification

Posterior capsular opacification (PCO) is quite common after cataract surgery. No clear evidence exists that trabeculectomy or combined phacoemulsification combined with trabeculectomy increases or decreases the risk of PCO.22, 26 Recent animal studies have shown that Mitomycin C (MMC) decreases the rate of PCO in rabbits.25 However, when performing trabeculectomy great care is taken to prevent MMC from entering the anterior chamber, and MMC may or may not influence the rate of PCO formation.27 If PCO is present prior to performing a trabeculectomy or aqueous drainage device, we recommend waiting to perform capsulotomy until after the trabeculectomy has been completed to decrease the possibility of vitreous incarceration in the sclerotomy. Aggressive control of inflammation after capsulotomy is important to prevent bleb fibrosis.

Endothelial Cell Loss

Endothelial cell loss occurs at low levels after trabeculectomy.28, 29 The adjunctive use of MMC or 5-fluorouracil (5-fu) postoperatively may contribute to a slightly increased endothelial cell loss, although the data are conflicting.30-32 In patients with compromised endothelial function trabeculectomy can lead to corneal edema and decreased vision. Additionally, postoperative hypotony can lead to descemet folds and endothelial cell loss. Conversely, a spike in intraocular pressure after trabeculectomy can overwhelm the ability of the endothelial cell to pump fluid out of the corneal stroma. Penetrating keratoplasty and endothelial keratoplasty have lower success rates in patients with prior glaucoma surgery. For these reasons, we recommend special attention to be made to surgical technique in patients with Fuchs endothelial dystrophy or other causes of low endothelial cell count to prevent persistent corneal edema.

Dellen

A dellen is a focal area of corneal thinning, adjacent to a local elevation of the cornea or peri-limbal tissue, due to discontinuity of the tear film. A dellen may be painful or irritating and result in irregular astigmatism, corneal scarring, or in severe cases corneal perforation. Following trabeculectomy an elevated filtering bleb can lead to an adjacent dellen.33 This is particularly true if the bleb is highly elevated. A fornix based conjunctival flap may decrease the likelihood of a dellen formation by creating a lower lying bleb with posteriorly directed aqueous outflow.28 If the bleb is too elevated resulting in chronic corneal pathology, bleb reduction surgery can be performed.34

Dry Eye Syndrome:

Ocular surface dryness affects many patients.35 Patients with glaucoma may be particularly vulnerable because the ocular surface has typically been altered by chronic use of ocular hypotensive drops.35 Adjunctive use of 5-fu and MMC can also contribute to ocular surface irregularity.30 Dryness typically
does not result in scarring or significant visual decline, however in severe cases visual disability can occur. Treatment is directed at the underlying cause, removal of the offending drop, control of blepharitis, artificial tear replacement, or use of anti-inflammatory medications such as topical cyclosporine or oral doxycycline.

Decemet Membrane Tear:

Descemet membrane tears are an uncommon complication of glaucoma surgery. Small localized tears rarely cause symptoms, however a large tear can result in persistent corneal edema directly over the tear or throughout the cornea. Treatment can include hypertonic saline, injection of intraocular air to reposition the tear, observation to let the tear settle on its own, or ultimately endothelial or penetrating keratoplasty.

Band Keratopathy:

Band keratopathy is the accumulation of calcium deposits in Bowmans membrane of the cornea. Band keratopathy can occur after glaucoma surgery and is likely caused by a chronic inflammatory process. Band keratopathy can range from mild and innocuous to quite severe, causing pain and decreased vision. Treatment of band keratopathy is guided by symptoms. Treatment is typically performed in the office or a minor procedure room. The corneal epithelium is debrided. A 0.05 to 0.2 molar concentration of ethylenediaminetetraacetic acid (EDTA) is applied to the cornea with Weck-cel sponges. After the area of band keratopathy has dissolved a bandage contact lens is placed and the epithelium is allowed to heal.

Summary:

Although numerous visual axis opacities can limit visual function after trabeculectomy, cataracts are the most common. Glaucoma surgeons should take visual axis opacities into consideration prior to surgery and make efforts to avoid them. Should visual axis opacities develop after glaucoma surgery, the surgeon should make every effort to minimize them, since nearly all are treatable-at least to a degree.


