Surgery for COEXISTING CATARACT AND GLAUCOMA:
UNEASY RELATIONSHIP

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Course Instructors
Ahmad K Khalil
Alan Crandall
Amar Agarwal
Boris E Malyugin
Soosan Jacob
Introduction

Cataract is the foremost cause of treatable blindness in the world. Cataract and glaucoma often co-exist in the elderly, especially so with the increasing longevity of the human race. It is especially important to be able to appropriately manage this patient sub-group in whom central vision is compromised due to cataract and peripheral vision due to the glaucoma.

Surgical options

Several surgical options are available when managing a patient with co-existing cataract and glaucoma; cataract surgery alone, glaucoma surgery first followed later by cataract surgery, cataract surgery first followed later by glaucoma surgery, or same session cataract and glaucoma surgery. The decision is based on the degree of visual field damage, optic nerve head damage and retinal nerve fibre layer loss, the patient’s response to medical or laser therapy, grade of cataract, and the surgeon’s experience and personal preferences. The factors favoring a combined procedure are many. While cataract surgery with IOL implantation lowers IOP by 2 to 4 mmHg in long-term studies, a glaucoma procedure combined with cataract surgery lowers IOP more effectively (6 to 8 mmHg). Following either extracapsular cataract extraction (ECCE) or phacoemulsification, many of the glaucomatous eyes suffer an IOP spike to 30 mmHg or more, which may lead to progression of glaucomatous damage. It is essential to avoid IOP spikes in eyes with severe optic disc damage and visual field loss close to fixation. Combining drainage surgery with cataract extraction can significantly reduce the frequency of these spikes. The disadvantages for performing filtration surgery first followed by cataract surgery 3 to 6 months after a mature bleb has formed include delayed visual recovery, all attendant anesthetic as well as perioperative risks of having to undergo two intraocular surgical procedures, decreased cost efficiency and the possibility of inducing bleb failure.

In a patient who requires both cataract extraction and glaucoma surgery for IOP control, a combined surgery would be preferred. The advantages of a combined procedure (cataract extraction with IOL implantation and trabeculectomy) are avoiding the IOP rise that may occur following cataract surgery alone, rapid visual recovery, and long-term glaucoma control with a single operation. Phacoemulsification combined with glaucoma surgery results in good IOP control as well as an improvement in the visual acuity. Combined procedures, however, are technically more difficult and time consuming. On the other hand, in a patient for whom glaucoma surgery is indicated and has a co-existing borderline cataract, the decision to combine glaucoma surgery with a cataract extraction as well depends on the patient’s age, visual acuity, visual requirements, grade of cataract, associated ocular comorbidity such as subluxated lens, exfoliation syndrome etc. Glaucoma surgery can hasten the onset and progression of cataract which will
make optic nerve head and field evaluation difficult and also result in an unhappy patient who then requires a second surgery for the cataract soon after. The second step cataract surgery may also result in failure of a previously functioning bleb, all of which lead to an extremely unhappy patient and a difficult situation for the surgeon. All these factors favor a combined surgery for these patients.

Preoperative preparation:
Apart from the usual preoperative preparations, it is extremely important to control the IOP prior to surgery to avoid choroidal effusion, choroidal hemorrhage or expulsive hemorrhage. Phacoemulsification is especially advantageous here, as it is a closed chamber procedure, nevertheless, IOP may suddenly drop to values close to zero even with phaco. Pre-operative control of IOP can be done with topical medications, systemic carbonic anhydrase inhibitors, oral glycerol or intravenous mannitol.

Surgical techniques

Peripheral Iridectomy with phacoemulsification:
A simple peripheral iridectomy can be done with a vitrectomy probe at the time of phacoemulsification in some cases of angle closure glaucoma.

Single site trabeculectomy with phacoemulsification
Either a limbus based or fornix based conjunctival flap is created followed by a scleral flap which will be large enough to allow implantation of the IOL. Anterior chamber is entered under the scleral flap and phacoemulsification is performed as usual. After IOL implantation, sclerectomy and iridectomy are made and the scleral and conjunctival flaps are sutured.

Trabeculectomy or Trabeculotomy with phacoemulsification, two site:
In trabeculectomy, a direct communication is created between the anterior chamber and the sub-conjunctival space and, while in trabeculotomy, this communication is accomplished with the Schlemm’s canal. Following is description of surgical technique of separate site phaco-lectomy (combined phaco and trabeculectomy) and phaco-lotomy (combined phaco and trabeculotomy)

Planning sites of phaco incisions and filtration
For primary cases, 12 o’clock position is used as the glaucoma surgery site. Clear cornea phaco incision is done between 10 and 11 o’clock (for right handed surgeons) or 1 and 2 o’clock (for left handed surgeons). The side stab incision is made 90 degrees away for convenience of the non-dominant hand

Traction sutures
A 1 or 2 bite corneal traction suture is taken using 7-0 thread with a semi-cutting needle

Conjunctival incision for the glaucoma surgery

The choice of fornix-based versus limbal-based incisions are discussed extensively in literature. We prefer a limbal based conjunctival incision for the following advantages;

- It carries the potential of conjunctival scarring in the incision area back and away from the precious filtration area (figs 1, 2).
- Leaving the limbal conjunctiva intact, nullifying the incidence of bleb overhanging the upper cornea occasionally seen with fornix-based incisors.
- Its tight closure together with its location away from the filtration outflow renders it extremely rare to have leaks.

Figure 1 fornix-based conjunctival incision and ensuing scarring overlying filtration ostium
The incision is made 6-8 mm from the limbus depending on palpebral fissure size. It has to be posterior enough not to lie directly over the filtration area, yet surgically accessible for proper closure at the conclusion of the surgery. Length of the incision is fashioned to provide adequate exposure of planned filtration site. Incision is carried out respecting layers, and subconjunctival space is cleared forward to the limbus. Conjunctival retraction sutures are taken using 2 8-0 vicryl.

_Scleral flap_ is then done by using a blade or a scleral pocket knife. The sides of the flap are stopped short of reaching the limbus to encourage posterior outflow, while the central dissection is carried out well into the clear cornea. Recently, I have changed from the rectangular flap to a pentagonal one (fig 3). These angles in the flap help better repositioning of the flap in its original location and minimize flap displacement during suturing, and subsequent astigmatism.

**Figure 3 pentagonal scleral flap**

**The Cataract Procedure**
Conjunctival and corneal traction sutures are released back to make exposure for the cataract surgery. According to individual surgeon’s phaco technique, clear cornea cataract stabs are made with filling of anterior chamber with visco-elastic material. The role of _phaconit_ (fig 4) and other micro-incisional techniques where a 0.7 mm gauge phaco probe, irrigating chopper and I/A instruments instruments are used for performing bimanual micro incision cataract surgery come to good help here, as they can better keep the integrity of the eye in the subsequent glaucoma surgery maneuvers.
Continuous curvilinear capsulorhexis, hydrodissection and/or hydrodelineation, nucleus emulsification and irrigation aspiration of cortical lens material are carried out.

Figure 4

**Lens implantation** is then performed through the smallest possible incision (fig5). This usually entails using lens injectors at the lip of the wound. If widening the incision is needed to implant the lens, a closure 10/0 suture will be needed more often than not to prevent anterior chamber shallowing on subsequent corneal traction for completion of filtration surgery. Corneal and conjunctival traction sutures are then gently pulled to the 6 o’clock position taking care to avoid corneal wrinkles. Conjunctival traction assists in minimizing traction on the cornea.

Figure 5

**The trabeculectomy** (figs 6-8): the superficial sclera flap is pulled to the corneal side to help expose the limbic area, a deep sclera-limbus-peripheral cornea, overlying the trabecular area is then delineated with a knife scratch, the anterior chamber is then entered by the tip of a 15° super-blade, and the delineated tissue is removed by a Vannas micro-scissors. A full thickness peripheral iridectomy is then performed.
The trabeculotomy: The superficial sclera flap is pulled to the corneal side to help expose the limbus area. A radial incision about 1 mm is then started over the limbus and deepened very gradually and cautiously till the canal of Schlemm is exposed and its
outer wall incised. The canal is located at the level of the innermost sclera lamellae, its antero-posterior diameter variable but usually just behind the clear cornea in adult eyes. Entry into Schlemm’s canal is recognized by one of the following signs:

- gentle egress of aqueous; a gush or an efflux of aqueous (fig 9) denotes opening the anterior chamber rather than the canal.
- direct (dry) visualization of the canal (fig 10); most commonly in stretched out eyes. This is usually associated afterwards by the exudation of aqueous.
- rarely; in congested eyes, egress of blood from the canal site can be the main sign of its opening.

![Figure 9](image)

**Figure 9**

![Figure 10](image)

**Figure 10 Direct visualization of canal of Schlemm**

Probe insertion (figs. 11, 12): The lip of the radial incision is gently held by the non-dominant hand, while the trabeculotomy probe is held by the dominant hand and gently introduced into the cut end of the canal. Depending on the depth of dissected scleral flap, the internal probe can usually be visualized in its tight path in the canal. The
The trabecular meshwork to be cut during trabeculotomy is a soft structure. Cutting it does not involve any force. On rotating the trabeculotome into the AC, the tip makes the first cut, and appearance in the AC, then follows the rest of the internal probe (fig9).
This tactile lag between appearance of only the tip first, with no limbal or corneal distortion, and then the rest of the probe (Khalil sign), is an important sign of success. The need for force, with corneal or limbal distortion simply means that the trabeculotome is not properly placed. On the other hand, if rotation meets no resistance at all, with simultaneous appearance of the whole length of the internal probe in the AC means that it was lodged in the anterior chamber angle rather than in the canal. After rotating of the full length of the probe into the AC, the probe is gently withdrawn, paying care not to touch the iris or lens. This is especially important with the second probe when the anterior chamber gets shallower. Hyphema on rotating the trabeculotome is not uncommon, but usually self limited, and absorbed by the second post-operative day. Injection of air into the AC helps to control a more active bleeding is very rarely needed. Scleral flap is closed tightly by interrupted 10/0 monofilament. The conjunctiva is then closed by running 8/0 virgin silk or vicryl.

![Figure 13](image)

**Non penetrating glaucoma surgery with phacoemulsification:**

**Viscocanalostomy, deep sclerectomy and phacoemulsification:**

Viscocanalostomy and deep sclerectomy are non-perforating techniques aimed at avoiding fibrosis related bleb failure. This is done by creating a Descemetic window which is composed of the innermost layers of the trabecular meshwork and the Descemet’s membrane. Aqueous flows out through these layers and collects in an intrasceral space, through which it flows into the cut ends of the Schlemm’s canal in viscocanalostomy or sub-tenon filtration in deep sclerectomy. Advantages of non-penetrating procedures include fewer incidences of post-operative complications such as hypotony, shallow anterior chamber, uveitis, endophthalmitis. Also the lack of external filtration avoids all bleb related complications such as bleb failure due to scarring, blebitis, discomfort etc.
**Antimetabolites:**
The use of antifibrotics (mitomycin-C and 5-fluorouracil to reduce the potential for bleb failure in combined phacotrabeculectomy is controversial. Mitomycin-C may result in lower long-term IOPs when used with combined procedures but 5-fluorouracil does not seem to. The potential vision-threatening complications of antimetabolites such as bleb-related endophthalmitis hypotonic maculopathy and late-onset bleb leaks should be considered while deciding to use these agents.

**Type of IOL:**
Friedrich et al found that foldable silicone IOLs may induce late postoperative inflammatory membranes with pigment precipitates, especially after combined surgery²⁴.

**Complications:**
Postoperative uveitis or rise in IOP can usually be tackled with appropriate medications. Hyphema, if small usually resolves by itself. If very large, it may need to be evacuated. Excessive filtration may occur leading to choroidal detachement. When associated with a flat anterior chamber or other severe complications, it may require fluid drainage and bleb revision. Shallow anterior chamber may also be due to bleb leak. Hypotonic maculopathy may rarely be seen, especially in a young myopic patient. Other postoperative complications which may occur after routine phacoemulsification may occur in this setting too. Late post-operative complications include cystoid macular edema, capsular phimosis syndrome, IOL decentration, posterior capsular opacification, bleb failure, bleb related endophthalmitis etc.