Special Focus: Glaucoma and the Aging Eye

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Core Concepts
- Glaucoma is the leading cause of irreversible and preventable visual disability worldwide (accounting for 12% of global blindness)
- As the population ages, the coexistence of cataract and glaucoma is common
- Management options of POAG in the context of coexisting cataract include cataract surgery, trabeculectomy or combined surgery
- Choice of surgical algorithm is dictated by the severity of the glaucoma and pre-operative IOP control, as well as individual patient factors
- For POAG patients with well-controlled IOP and early to moderate disease, it may be reasonable to perform cataract surgery alone, as this may reduce IOP by 2–4 mmHg (mostly not sustainable over longer term).
- In patients with uncontrolled moderate to severe glaucoma on maximal tolerable medical therapy, trabeculectomy alone may be reasonable.
- In patients with uncontrolled glaucoma and visually significant cataract, combined surgery and trabeculectomy should be considered. However visual recovery and post-operative course are usually longer.
- In patients with mild to moderate glaucoma and a desire to decrease medications, one of the newer techniques (trabecome, stents, ECP or canaloplasty) combined with cataract surgery may be appropriate. However, long-term outcomes data is not yet available.

Epidemiology of the Aging Eye

In the last 30 years much progress has been made to understand the epidemiology, risk factors, natural history, and treatment of age-related eye diseases such as glaucoma, cataract, and age-related macular degeneration (AMD). Glaucoma is the leading cause of irreversible and preventable visual disability worldwide, accounting for 12% of global blindness, with age as a major risk factor. In the United States, prevalence of glaucoma is 1–2% in persons of European ancestry, 4% in African-Americans, and 2–5% in Mexican-Americans. When national data is pooled, the overall prevalence of glaucoma is 1.86% in patients over 40 years of age. The epidemiologic data worldwide offers a glimpse of the heterogeneity of glaucoma frequency across different populations as well as within populations. For example, prevalence estimates vary from 1% in Nigeria to 7–9% in African-Caribbeans, whose ancestry is mainly from West Africa.

The leading cause of blindness worldwide, age-related cataract affects more than 20 million people.

Management of coexisting glaucoma and cataract

As the population ages, the coexistence of cataract and glaucoma is common. When visually significant cataract and glaucoma are both present, the clinician is faced with several management options. Here we consider the management of primary open-angle glaucoma (POAG) in the context of coexisting cataract. Options include cataract surgery alone, trabeculectomy alone, or combined surgery.

To limit the scope of this discussion, we will not consider the option of tube shunt surgery alone or combined cataract and tube shunt surgery. Which surgical algorithm to consider often is dictated by the severity of the glaucoma and pre-operative IOP control, as well as individual patient factors.

Cataract surgery alone

For POAG patients with well-controlled intraocular pressure (IOP) and early to moderate disease, it may be reasonable to perform cataract surgery alone. However, if there is a surgical indication to lower IOP, such as inadequate IOP control or poor adherence or intolerance to medications, cataract surgery alone may not reduce IOP sufficiently over time. While there have been numerous studies examining IOP reduction after cataract extraction in glaucoma patients, the magnitude and duration of the effect needs further study. In a Cochrane meta-analysis of 5000 patients with various types of glaucoma and cataract undergoing cataract and/or incisional glaucoma surgery, an estimated 2–4 mmHg IOP reduction was achieved by cataract surgery alone, but sustained long-term IOP reduction was reported only for patients who underwent combined surgery. The magnitude of IOP reduction following cataract surgery is proportional to the level of preoperative IOP, such that patients with higher preoperative IOP had greater IOP reductions postoperatively. Therefore, in the treated POAG patient, the effect of cataract surgery alone on IOP may be small (1–2 mmHg of IOP reduction). It is also unclear whether the effect is sustained in POAG patients, with IOP trending towards baseline over time. Therefore, if IOP control may be questionable, cataract surgery alone may be insufficient to achieve long-term IOP reduction.

Trabeculectomy alone

In patients with uncontrolled moderate to severe glaucoma on maximal tolerable medications, trabeculectomy alone may be reasonable. After lowering IOP, cataract surgery can be performed. Particularly prior to small incision and clear corneal phacoemulsification techniques, cataract extraction frequently caused bleb failure; patients then required ad-
surgery.12–14 Useful adjuncts to avert this post-operative inflammation or conjunctival manipulation during the cataract surgery. Even with improved phacoemulsification techniques, cataract surgery can adversely affect a well-functioning bleb by stimulating fibrosis, either through post-operative inflammation or conjunctival manipulation during the cataract surgery.12–14 Useful adjuncts to avert this complication and maintain an adequate bleb include the use of antimetabolites such as 5-fluorouracil at the time of cataract surgery and/or post-operatively.15

Trabeculectomy alone was thought to achieve better outcomes than combined procedures, but with improved surgical technique, small incision cataract surgery, and the use of antimetabolites, combined cataract surgery and trabeculectomy may be a more appropriate choice for a patient with cataract and uncontrolled moderate to severe glaucoma.

### Combined cataract surgery and trabeculectomy

In patients with uncontrolled glaucoma and visually significant cataract, combined cataract surgery and trabeculectomy should be considered. There are many potential benefits of combined surgery, including prevention of visually devastating post-operative IOP elevations in patients with advanced glaucoma, elimination of glaucoma medications, and removal of cataracts that may worsen with glaucoma surgery (Table 1). However, visual recovery and the post-operative course are usually longer with combined procedures than with cataract surgery alone. In addition, there are significant risks with combined procedures when compared with cataract surgery alone, including hypotony, choroidal effusions, suprachoroidal hemorrhages, and a long-term risk of endophthalmitis.

There is no definitive consensus as to whether trabeculectomy followed by cataract surgery versus combined surgery achieves better outcomes. A meta-analysis that examined combined versus staged procedures concluded that there was insufficient evidence in the literature as to which type of procedure resulted in better outcomes.16

When comparing trabeculectomy alone with combined surgery, trabeculectomy alone results in better IOP control than combined surgery.10 However, some recent evidence suggests the two procedures have similar IOP lowering effects. In one study in which intraoperative mitomycin C was used, the phacotrabeculectomy and trabeculectomy alone groups achieved similar post-operative mean IOP at 2 years.17

Although it is still controversial as to whether combined surgery is less successful than trabeculectomy alone, compared with cataract surgery alone it offers some advantages. For example, combined surgery may avoid postoperative IOP spikes in patients with advanced glaucoma undergoing cataract surgery. In addition, cataract surgery performed after a successful trabeculectomy may compromise a well-functioning bleb, as discussed above. In summary, when contemplating combined surgery, the clinician should consider the longer visual rehabilitation for patients undergoing combined surgery, as well as the severity of the glaucoma, the visual potential after cataract removal, and the desired target IOP.

### Newer techniques for combined cataract and glaucoma surgery

With the advent of newer technologies, there are more options at the ophthalmic surgeon’s disposal to treat concurrent cataract and glaucoma. Some of these techniques, such as ab interno trabeculotomy (Trabectome) and trabecular meshwork bypass stents (e.g., iStent), are designed to improve outflow by bypassing the trabecular meshwork. Other approaches that have been paired with cataract surgery are the Ex-PRESS shunts, endoscopic cyclophotocoagulation (ECP), and canaloplasty. We will discuss several of these techniques in further detail below.

**Ab interno trabeculotomy (Trabectome)**, trabecular meshwork bypass stents, and ECP can be performed immediately before or after cataract extraction through the phacoemulsification wound, thus preserving conjunctiva for possible future glaucoma surgery such as a trabeculectomy. The Trabectome consists of a handpiece with a 19.5-gauge instrument and electrocautery tip with irrigation and aspiration ports. Using the Trabectome under direct visualization with a goniosurgical lens, the trabecular meshwork and inner wall of Schlemm canal are ablated. The cataract is then removed by phacoemulsification using the same clear corneal wound. Short-term data has demonstrated the efficacy of the Trabectome combined with cataract surgery in lowering IOP approximately 4 mmHg and reducing the number of glaucoma medications at one year.18 Further studies are needed to assess the long-term efficacy of this procedure for glaucoma patients as compared with cataract surgery alone, standard trabeculectomy or combined cataract and trabeculectomy surgery.

ECP selectively ablates ciliary processes under direct visualization and can be combined with cataract surgery by using the same clear corneal incision. In a randomized prospective study comparing combined cataract surgery/ECP with combined cataract/trabeculectomy, both techniques were shown to reduce IOP and decrease medication burden.19 In this small study, the cataract/ECP group had more immediate post-operative IOP spikes although less inflammation. A study comparing ECP/cataract surgery with cataract surgery alone has been conducted, but this data has not
been published in the peer-reviewed literature. Further studies are required to evaluate long-term IOP control and complication rates of this type of combined procedure as compared with both trabeculectomy alone and cataract surgery alone.

Canaloplasty is a nonpenetrating technique that uses a flexible microcatheter (iScience) to dilate Schlemm’s canal 360 degrees via an ab externo approach. During canaloplasty, viscoelastic is injected into Schlemm’s canal and a tensioning suture is inserted after catheterization to hold open Schlemm’s canal long-term with tension on the trabecular meshwork; the goal is to restore natural aqueous outflow. One advantage of canaloplasty over trabeculectomy is the absence of a bleb. Two-year interim results of a multicenter prospective case series showed that canaloplasty alone and canaloplasty combined with cataract surgery both resulted in sustained IOP reduction. The combined surgery group had lower IOP and decreased use of glaucoma medications as compared with the canaloplasty alone group.

Conclusions

Cataract and glaucoma commonly occur concurrently in elderly patients: these comorbidities are a management challenge for the ophthalmologist since there are no uniform recommendations. While combined cataract surgery and trabeculectomy remains the most commonly performed and traditional option for the treatment of coexisting cataract and glaucoma, there are various clinical situations that may dictate alternative approaches. In a patient with severe glaucoma and an aggressively low target IOP, trabeculectomy alone may be indicated. For patients with well-controlled mild glaucoma, a desire for quick visual rehabilitation and with no aversion to glaucoma medications, cataract surgery alone may be reasonable. In patients with mild to moderate glaucoma and a desire to decrease medication usage, one of the newer techniques combined with cataract surgery may be appropriate, although data on long-term outcomes and complications is needed. As with all treatments, consideration of the patient’s individual situation is paramount to successful management.

REFERENCES