INTERVENTIONAL GLAUCOMA OPTIONS FOR CATARACT AND REFRACTIVE SURGEONS

An update to assist with clinical decision-making.

BY VAMSEE VEMULAPALLI, MD; KAITLYN HUNTER, BA; RIMA STEPANIAN, MD; ERIC NIESPODZANY, MD; AND BALAMURALI AMBATI, MD, PHD, MBA

Recently developed therapies for primary open-angle glaucoma (POAG) provide increased opportunities for IOP control and effective disease management but add to the complexity of clinical decision-making. This article provides a broad overview of common interventional options for POAG management.

LASER PROCEDURES

Laser surgery is often an early step or an adjunctive therapy in POAG management (Table 1). The Laser in Glaucoma and Ocular Hypertension (LIGHT) trial showed that primary therapy with selective laser trabeculoplasty (SLT) provided better long-term disease control than treatment with IOP-lowering topical drops.[1] In the trial, 70% of eyes that underwent SLT were drop-free at 6 years. Ten-year outcomes of a retrospective study showed that first-line SLT was effective for the management of early POAG, with 60% of eyes requiring retreatment for IOP control.[2]

Direct SLT (DSLT) allows 360° treatment of the trabecular meshwork. The FDA approved DSLT in 2023 after the GLAURIOUS trial demonstrated the procedure's noninferiority to SLT with regard to safety and IOP reduction at 12 months.[3] It is important to note that the trial failed to show noninferiority at 6 months. DSLT does not require gonioscopy or direct eye contact, which saves time for patients and physicians.

Other laser technologies such as titanium-sapphire laser trabeculoplasty, pattern scanning laser trabeculoplasty, and micropulse laser trabeculoplasty target the trabecular meshwork and have demonstrated safety profiles and IOP reductions comparable to those achieved with standard SLT.[4,5] The technologies generally use lower energy levels than traditional SLT to minimize scarring and coagulative damage to the trabecular meshwork. The popularity of these three technologies, however, has decreased in favor of SLT, which is more thoroughly researched and cost-effective for clinics.

Micropulse transscleral cyclophotocoagulation with the Cyclo G6 Glaucoma Laser System (Iridex) decreases aqueous production. This form of treatment has been found to reduce IOP similarly to continuous-wave transscleral cyclophotocoagulation but with a lower risk of serious ocular complications.[7]

MEDICATION IMPLANTS

The US FDA has approved two intracameral medication implants for the reduction of IOP in POAG (Table 2). The first is an injectable biodegradable sustained-release bimatoprost implant (Durysta, AbbVie). The second, approved in 2023, is an anchored encased drug delivery system with travoprost 75 µg (iDose TR, Glaukos).

In phase 3 trials, 81% of eyes that received the iDose did not require topical medications at 12 months.[8] The incidence of adverse events such as hyperemia, iritis, and dry eye was 2% to 6%. Contraindications for the implant include uveitis, Fuchs corneal dystrophy, and narrow angles. Perhaps the greatest benefit of this treatment is its duration of effect; a therapeutic drug concentration has been maintained for at least 2 years with the iDose compared to 4 to 12 months with Durysta, although more long-term data are needed.[9]

The adoption of iDose has been limited. The wholesale cost of iDose TR is $13,950, significantly higher than the annual cost of most topical medications.[14] Additionally, the implant is US FDA-approved only for one-time

TABLE 1. LASER PROCEDURES FOR PRIMARY OPEN-ANGLE GLAUCOMA[6]

Subtype	Mechanism	Pros	Cons
Laser trabeculoplasty (selective laser trabeculoplasty, direct selective laser trabeculoplasty, titanium-sapphire laser trabeculoplasty, pattern scanning laser trabeculoplasty, micropulse laser trabeculoplasty)	Enhances aqueous outflow through trabecular meshwork	Performed in office, low cost, retreatment possible	Risk of transient IOP increase, decreased efficacy with repeat treatment
Cyclodestructive procedures (endoscopic cyclophotocoagulation, micropulse transscleral cyclophotocoagulation)	Reduces aqueous production by targeting ciliary body	Effective at reducing IOP in eyes with end-stage glaucoma	High risk of hyphema, macular edema, mydriasis

TABLE 2. IMPLANTS AND SURGICAL INTERVENTIONS FOR PRIMARY OPEN-ANGLE GLAUCOMA

Description	Device/Drug	Mechanism	Pros	Cons
Medication-based devices				
Intracameral medication implants	Bimatoprost implant (Durysta, AbbVie), travoprost intracameral implant 75 µg (iDose TR, Glaukos)	Increases uveoscleral outflow[8,9]	Sustained drug delivery for months to years, avoids extraocular side effects of prostaglandin analogues[8,9]	Costly, long-term outcomes unknown[8,9]
MIGS procedures				
Trabecular meshwork bypass	iStent family of devices (Glaukos), Hydrus Microstent (Alcon)	Enhances aqueous outflow into Schlemm canal[6,10]	Commonly used in conjunction with cataract surgery, low risk of hypotony[6,10]	High risk of fibrosis, ineffective for eyes with advanced glaucoma[6,10]
Trabecular meshwork removal	iAccess Trabecular Trephine (Glaukos), iTrack (Nova Eye Medical), Kahook Dual Blade (New World Medical), Omni Surgical System and Sion Surgical Instrument (Sight Sciences), Tanito Microhook (Inami), Trabectome (MicroSurgical Technology)	Selectively removes trabecular meshwork[6,10,11]	May be used in conjunction with cataract surgery, risk of adverse events comparable to iStent[11]	Transient IOP spikes[6,10]
Subconjunctival filtration	Xen Gel Stent (AbbVie)	Creates new outflow drainage pathway into subconjunctival space[6,10]	IOP reduction comparable to that of traditional glaucoma surgery, can be performed in conjunction with cataract surgery or as standalone procedure[6,10]	Bleb-related complications, subconjunctival fibrosis[10]
Cyclodialysis with scleral allograft reinforcement	AlloFlo Uveo (Iantrek)	Enhances aqueous outflow into the suprachoroidal space[12]	Used in conjunction with cataract surgery, sustained IOP reduction and decreased risk of fibrotic closure compared to conventional cyclodialysis	Long-term outcomes unknown beyond 2 years[12]
Traditional incisional surgery				
Trabeculectomy	N/A	Creates new outflow drainage pathway through sclera[10]	Excellent IOP reduction[10]	Bleb-related complications, fibrosis[9]
Ex-Press Mini Glaucoma Shunt (Alcon)	Ex-Press Mini Glaucoma Shunt	Shunts aqueous into subconjunctival reservoir[10]	Fewer IOP fluctuations compared to trabeculectomy, recovery of postoperative visual acuity by 1 week[10,13]	Bleb-related complications[9]
Valved drainage implants	Ahmed Glaucoma Valve (models FP7 and FP8, New World Medical), pars plana placement of Ahmed Glaucoma Valve	Shunts aqueous through a valvular tube[6,10]	Immediate IOP reduction[10]	Bleb-related complications, low risk of diplopia and hypotony[9]
Nonvalved drainage implants	Ahmed ClearPath (New World Medical), Molteno3 (Nova Eye Medical), Baerveldt Glaucoma Implant (Johnson & Johnson Vision), Paul Glaucoma Implant (Advanced Ophthalmic Innovations)	Shunts aqueous through an open, unobstructed tube[6,9]	Larger plate surface area compared to valved implants may enhance IOP reduction[6,9]	Bleb-related complications, delayed IOP control, higher risk of diplopia and hypotony compared to Ahmed Glaucoma Valve[6,9]

use, and prior authorization sometimes requires the failure of at least two topical prostaglandin analogues and two additional antiglaucoma therapies.[15]

Durysta and iDose are uniquely positioned to address a common barrier to glaucoma treatment—complex dosing regimens. It is generally easier for patients to receive a sustained-release implant once than to instill topical drops daily. Additionally, although topical prostaglandin analogues are effective with daily dosing, patient adherence is often limited owing to clinical and cosmetic concerns such as upper lid ptosis, flattening of the lower eyelid bags, inferior scleral show, and eyelash changes. These extraocular side effects can be avoided with medication implants.

MIGS PROCEDURES

In POAG, the goal of MIGS is to improve physiologic aqueous outflow through small incisions, often with the implantation of a small device. MIGS is frequently combined with cataract surgery to minimize the number of trips a patient must make to the OR. The small incisions reduce tissue disturbance, postoperative recovery time, and complication rates.

The US FDA approved the Hydrus Microstent (Alcon) in 2018. This small implant made of nickel-titanium alloy is inserted into Schlemm canal during

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cataract surgery. In the HORIZON trial, patients who underwent Hydrus Microstent implantation combined with phaco cataract surgery experienced a reduction in IOP from 25.5 ±3.0 to 17.4 ±3.7 mm Hg over 2 years.[16] Although few serious adverse events were reported, clinically insignificant peripheral anterior synechiae were present in 14.9% of patients.

In 2022, the US FDA approved the iStent Infinite (Glaukos), a heparin-coated titanium stent, as a standalone procedure for uncontrolled POAG. In a study comparing this device to the Hydrus, a greater proportion of patients who received the iStent Infinite experienced no surgical complications and an unmedicated mean diurnal IOP reduction of 20% or more.[17]

The Xen Gel Stent (AbbVie), a hybrid procedure between MIGS and traditional filtration surgery, is a 6-mm implant composed of porcine gelatin that drains aqueous into the subconjunctival space.[18] The procedure has been shown to have a low complication rate and reduce IOP significantly whether performed in conjunction with phacoemulsification or as a standalone surgery.[19]

CONCLUSION

Advances in laser treatment, sustained-release drug delivery, and MIGS can offer alternatives and adjuncts to traditional pharmacologic and surgical interventions for POAG. By staying abreast of emerging technologies and treatments, ophthalmologists can improve patient care. ■

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BALAMURALI AMBATI, MD, PHD, MBA
- Professor and Director of Ophthalmology and Visual Sciences, Knight Campus for Accelerating Scientific Impact, University of Oregon, Eugene, Oregon
- Pacific ClearVision Institute, Eugene, Oregon
- bambati@pcvi.com
- Financial disclosure: None

KAITLYN HUNTER, BA
- Pacific ClearVision Institute, Eugene, Oregon
- Medical student, Oregon Health and Science University, Portland, Oregon
- hunterka@ohsu.edu
- Financial disclosure: None

ERIC NIESPODZANY, MD
- Cataract and refractive surgeon, Pacific ClearVision Institute, Eugene, Oregon
- ericn@pcvi.com
- Financial disclosure: None

RIMA STEPANIAN, MD
- Preresidency research fellow, Pacific ClearVision Institute, Eugene, Oregon
- Class of 2025, Oakland University William Beaumont School of Medicine, Rochester, Michigan
- stepanianra@gmail.com
- Financial disclosure: None

VAMSEE VEMULAPALLI, MD
- Preresidency research fellow, Pacific ClearVision Institute, Eugene, Oregon
- Class of 2025, The Ohio State University College of Medicine, Columbus, Ohio
- vamsee.vemulapalli@gmail.com
- Financial disclosure: None