Glaucoma Surgery

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**Approach to managing glaucoma:** factors to consider include diagnosis (open-angle or angle-closure glaucoma), intraocular pressure (IOP) at baseline, goal of therapy, use and tolerability of medications, surgical risk profile, and technical skills of surgeon; surgical options include phacoemulsification, microinvasive glaucoma surgery (MIGS), blebless ab externo glaucoma surgery (BAGS), and ab externo bleb surgery

**Ab externo bleb surgeries:** external approaches to filtration surgery include trabeculotomy and placement of tube shunts (eg, Ex-Press Mini Shunt); approach typically reserved for advanced cases (eg, glaucoma uncontrolled despite maximum medication or progressing at normal IOP) with low target for IOP; clinical trials include Tube vs Trabeculectomy study, Ahmed Baerveldt Comparison (ABC) study, and Primary Tube vs Trabeculectomy (PTVT) study

**Blebless ab externo glaucoma surgeries:** external approaches to lowering IOP without forming bleb; compared with trabeculotomy procedures, BAGS associated with improved safety profile and reduced recovery time but somewhat less effective lowering of IOP; Gold Micro Shunt — suprachoroidal device; placement requires external dissection; device enhances aqueous outflow through suprachoroidal uveoscleral outflow tract; canalonplasty — procedure improves trabecular flow by tying intraluminal suture with tension to enlarge effective filtration area

**Microinvasive glaucoma surgeries:** characteristics — ab interno approach that uses microincisions; no conjunctival incisions; minimally traumatic (ie, generally physiologic in nature with minimal disruption to normal anatomy); safety and efficacy — very safe procedures, result in less reduction of IOP compared with trabeculectomy; candidates — patients with mild to moderate glaucoma and modest targets for IOP

**Outflow targets:** include Schlemm canal, suprachoroidal space, and subconjunctival space; Trabectome — procedure involves ab interno trabeculectomy, removing inner wall to enhance aqueous outflow directly into collector channels; iStent (trabecular micro-bypass stent) — L-shaped implant inserted ab interno, bypassing trabecular meshwork and placed in Schlemm canal or inner wall; also used in combined surgery for glaucoma and cataract; placement of >1 stent further reduces IOP, but obstructions in distal outflow system may limit performance; Hydrus microstent — scaffold-like device placed completely within Schlemm canal (through clear corneal incision); device maintains open channel through inner wall, increases area of filtration, and enhances aqueous flow; procedure may be combined with cataract surgery; cyclodiagnosis — device (~6 mm in length) placed within suprachoroidal space; increases communication with anterior chamber; developing technologies — AqueSys procedure uses ab interno method of bleb formation to increase aqueous outflow to subconjunctival space; soft microfistula placed on surface of sclera for communication between anterior chamber and subconjunctival space, and enhancement of posterior filtration; implant may be used in conjunction with 5-fluorouracil or mitomycin

**Balancing efficacy and risk:** safest procedures (eg, medications, selective laser trabeculoplasty [SLT]) associated with relatively modest lowering of IOP; trabeculectomy and tube shunts result in greater reduction in IOP, but associated with highest risk; newer procedures (eg, MIGS) intermediate with respect to efficacy and risk; role of MIGS expanding, especially for patients with mild glaucoma; 20% to 25% of patients who undergo MIGS later require trabeculectomy, but history of MIGS does not reduce efficacy of trabeculectomy

**Selective Laser Trabeculoplasty vs Medical Therapy**

*L. Jay Katz, MD, Professor of Ophthalmology, Jefferson Medical College of Thomas Jefferson University; Director, Glaucoma Service, Wills Eye Hospital, Philadelphia, PA*

**Management algorithms:** in patients with open-angle glaucoma, medical therapy typically maximized first; SLT used as second-line therapy; incisional surgery reserved for patients with advanced disease

**Efficacy of SLT:** most studies of SLT evaluate efficacy in setting of secondary therapy (ie, disease progression despite medical therapy); Glaucoma Laser Trial compared argon laser trabeculoplasty with medication (timolol) as primary therapy; participants had one eye treated with timolol and one eye treated with laser; follow-up at 2 yr and 7 yr showed comparable rates of control, but study
disclose relevant financial relationships within the past 12 months that might create any personal conflicts of interest. Any identified conflicts were resolved to ensure that this educational activity promotes quality in health care and not a proprietary business or commercial interest. For this program, the following has been disclosed: Dr. Ahmed is a consultant for ACE Vision Group, AdeTherapeutics, Alcon, Allergan, AqueSys, Carl Zeiss Meditec, Clarity Medical Systems, Endo Optiks, Eyelight, Glaukos Corporation, iScience Interventional, Ivantis, Ono Pharmaceutical Co Ltd, Pfizer, SOLX, Strôma Medical Corporation, and Transcend Medical; receives grant/research support from Alcon, Allergan, AqueSys, Carl Zeiss Meditec, Ivantis, Science Interventional, and Transcend Medical; and is on the Speakers’ Bureaus for Abbott Medical Optics (part of Abbott Laboratories), Alcon, Allergan, Carl Zeiss Meditec, Clarity Medical Systems, iScience, and New World Medical. Dr. Katz receives grant/research support from and is on the Speakers’ Bureau for Lumenis. Dr. Iwach is a consultant for AcuMEMs, Carl Zeiss Meditec, Clarity Medical Systems, and IRIDEX Corporation; and is on the Speakers’ Bureaus for Alcon, Ellex, and Merck & Co. Drs. Radhakrishnan, Williams, and Ou and the planning committee reported nothing to disclose.

**Educational Objectives**

The goal of this program is to improve the management of primary angle closure and glaucoma. After hearing and assimilating this program, the clinician will be better able to:

1. Individualize management of glaucoma based on patient characteristics, baseline intraocular pressure, and goals of therapy.
2. Select patients most likely to benefit from newer surgical procedures, such as blebless ab externo glaucoma surgery and microinvasive glaucoma surgery.
3. Discuss the role of selective laser trabeculoplasty in the initial management of glaucoma.
4. Identify patients with glaucoma who may be at increased risk for loss of visual field as a consequence of aggressive antihypertensive therapy.
5. Recognize abnormalities of the optic nerve associated with increased risk for dementia.

**Faculty Disclosure**

In adherence to ACCME Standards for Commercial Support, Audio-Digest requires all faculty and members of the planning committee to
widely criticized; more recent studies compared SLT (considered gentler than argon laser trabeculoplasty) with prostaglandin therapy; decrease in IOP similar between SLT and medical groups; one study showed greater improvements in IOP as treated area increased from 90° to 360°; at 1 yr, 90% of patients treated with SLT maintained 20% decrease from baseline IOP (results comparable to those seen with latanoprost); in study by Katz et al (2012), IOP targets determined by baseline IOP and severity of visual field loss; decreases in IOP similar between SLT and medical groups, but more participants in medical arm required step-up therapy

Safety: SLT—spike in IOP occurs after SLT, but typically transient; sustained elevation of IOP may occur in eyes with heavily pigmented angles (eg, pigmentary glaucoma, pigmentary dispersion syndrome); relatively rare complications include uveitis, hyphema, hyperopic shift, and corneal haze; medications—adverse effects include hyperemia (with prostaglandin therapy), blepharoconjunctivitis (with bromonidine), and cardiopulmonary effects (timolol)

Adherence: medical therapy—studies estimate rates as low as 50%; study in which patients used single medication (provided for free) reported adherence rate <75%; SLT—100%

Cost: several models have suggested superior cost-efficacy of SLT over medications (generics included) as first-line therapy

Iridotomy in Patients with Narrow Angles

Sunita Radhakrishnan, MD, Ophthalmologist, Glaucoma Center of San Francisco, Research Director, Glaucoma Research and Education Group, San Francisco, CA

Stages of angle-closures glaucoma: 1) primary angle closure (PAC) suspect—angles narrow (ie, anatomically narrow and occludable); IOP and optic disc normal; 2) PAC—demonstrated dysfunction of trabecular meshwork, which may be acute (typical acute attack of angle closure) or chronic and asymptomatic (evidence includes peripheral anterior synechiæ [PAS] and elevated IOP); 3) glaucoma—defined by glaucomatous cupping of optic nerve

Goals of treatment: in early stages, modification of anatomy of anterior segment may prevent damage to trabecular meshwork and disc; in setting of glaucoma, important to lower IOP; patients with extensive PAS and advanced cupping require more aggressive management

Efficacy of iridotomy: iridotomy corrects pupillary block; efficacy depends on mechanism of angle closure and stage of disease; PAC suspect—studies show good efficacy, even when nonpupillary block mechanisms coexist; 2 studies showed no progression ≤4 yr after iridotomy; other studies reported no acute attacks, elevations of IOP, or need for additional therapy during follow-up; acute PAC—20% to 60% of patients have persistent elevation in IOP after iridotomy; patients usually require medications to lower IOP, and some patients progress to angle-closure glaucoma; risk for progression decreases when iridotomy performed within 24 hr of acute attack; glaucoma—additional therapy typically required after iridotomy, especially in patients with previous attacks of angle closure; IOP well controlled with medications in most patients, but ≥30% require surgery

Other management options for PAC and glaucoma: medications—used in management of open-angle and angle-closure glaucoma; prostaglandin analogs effective even in patients with extensive synechiæ; iridotomy—addresses nonpupillary block mechanisms, but long-term efficacy unknown; does not appear to add benefit when combined with laser peripheral iridotomy; surgery—filtration surgery (with or without cataract extraction) primary approach for managing angle-closure glaucoma; removal of lens (often thick and with high anterior lens wall) beneficially alters course of disease, and emerging evidence shows benefit of cataract surgery alone; although early phacoemulsification of cataract associated with improved long-term control of IOP after acute attack of angle closure, surgeons may prefer to wait ≥1 mo after iridotomy or iridectomy to allow inflammation to resolve; role of clear lens extraction for managing angle closure not yet determined (clinical trial in progress)

Managing Risk in Treatment of Glaucoma

Andrew G. Iwach, MD, Associate Clinical Professor of Ophthalmology, University of California, San Francisco, School of Medicine; Executive Director, Glaucoma Center of San Francisco, San Francisco

Estimating risk for progression: various risk calculators available; important to consider overall trend in progression over time, as well as patient characteristics to individualize decisions about management; patient’s age, health, level and types of activity, symptoms, treatment goals, and risk for adverse events must inform management decisions

Choice of procedures: newer technologies (eg, iStent, Ex-Press Mini Shunt) increase options for management; newer devices may not lower IOP as much as traditional filtration surgery, but often safer, with lower risk for complications and shorter recovery time

Medication issues: trends in use—prostaglandin analogs most commonly used; β-blockers and other agents still used but have diminishing roles; adherence—factors include cost and tolerability; sensitivity to preservatives may develop over time; available options include drops without benzalkonium chloride and some preservative-free formulas; delivery systems—emerging implantable technologies allow delivery for 3 to 6 mo; use may improve adherence and decrease risk for adverse effects; generic options—widely available, but variability in packaging and access to reliable customer service may cause problems; recalls—Mobius Therapeutics recalled Mitosol (prepackaged mitomycin often used during surgery) because of presumed contamination

Informed consent: all therapies associated with risk; updated forms for informed consent available online (www.omic.com/risk-management/consent-forms/)

Surgical trends: based on Medicare coding and billing, use of newer technologies has correlated with reduction in filtering procedures

Cardiology vs Ophthalmology

Ruth D. Williams, MD, President and Chief Executive Officer, Wheaton Eye Clinic, Naperville, IL

Similarities between systemic hypertension and glaucoma: both conditions chronic and often difficult to control; combination medical therapy often required to achieve control of IOP and systemic blood pressure (BP); medications associated with adverse effects that potentially reduce adherence; treatment targets often poorly defined and difficult to achieve

Systemic hypotension and loss of visual field: questions about whether hypotension (from aggressive management of BP) may increase risk for loss of visual field; IOP tends to increase at night; emerging data suggest that, in patients with normal-tension glaucoma, low BP during sleep predicts progression of visual field loss; risk increases with longer duration and greater severity of nocturnal hypotension relative to daytime mean arterial pressure

Take-home messages: ask patients about BP and occurrence of systemic hypotension; loss of visual field may indicate poor perfusion of end organs (eg, optic nerve, brain); address potential concerns about systemic hypotension and risk for progression of visual field with prescribing physician; discuss possibility of changing dosing schedule of BP medications to daytime rather than nighttime dosing

Glaucoma and Dementia

Yvonne Ou, MD, Assistant Professor of Ophthalmology, University of California, San Francisco, School of Medicine

Case: 56-yr-old man reports decreased field of vision; referred to ophthalmologist after examination showed increased clipping
of optic nerve; visual acuity 20/25 in both eyes; further evaluation shows open angles and no afferent papillary defect; IOP and central corneal thickness within normal limits; cupping of optic nerve (more severe in left eye) confirmed; other findings include rim thinning (superior and nasal) and peripapillary atrophy in left eye; evaluation of visual field shows minor deficits; analysis of retinal nerve fibers shows modest thinning of vertical rim, especially in superior quadrants, in both eyes; additional history — patient reports visuospatial deficits and problems with memory; magnetic resonance imaging of brain shows temporoparietal and occipital atrophy (more severe in left hemisphere); patient referred to neurologist for cognitive testing and evaluation; diagnosis — early-onset Alzheimer disease (AD).

Links between glaucoma and AD: thinning of retinal nerve fiber layer (especially in superior quadrants) commonly seen in patients with AD; both diseases neurodegenerative, chronic, progressive, and lead to irreversible loss of neurons; epidemiology — studies have shown increased prevalence of glaucoma in patients with AD; prospective study (Three-City-Alienor Cohort) that adjusted for age, sex, family history of glaucoma, and other factors found that patients with open-angle glaucoma had 4-fold increase in risk for dementia; association with vertical cup-to-disc ratio and rim-to-disc ratio, but not with IOP or use of IOP-lowering medications; common neurodegenerative changes — decrease in number of retinal ganglion cells and thinning of retinal nerve fiber layer seen in glaucoma as well as in AD; in both settings, retinas have depositions of Aβ amyloid and phosphorylated tau; mechanisms of neuronal cell loss appear similar in both diseases; patients with AD have increased levels of tau in vitreous and in cerebrospinal fluid.

Potential applications: thinning of retinal nerve layer and changes in optic nerve changes may be useful as early biomarkers of AD; shared pathologic mechanisms may lead to development of new targets for treatment.

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1. Compared with trabeculectomy procedures, blebless ab externo glaucoma surgeries are associated with _______ safety profiles and _______ lowering of intraocular pressure (IOP).
   (A) Improved; less effective  (C) Similar; less effective
   (B) Improved; more effective  (D) Similar; more effective

2. Characteristics of microinvasive glaucoma surgeries (MIGS) include all the following, except:
   (A) Ab interno approach
   (B) Minimal disruption to normal anatomy
   (C) Conjunctival microincisions
   (D) Less reduction of IOP compared with trabeculectomy

3. Areas targeted for improving outflow in MIGS procedures include:
   (A) Schlemm canal
   (B) Suprachoroidal space
   (C) Subconjunctival space
   (D) All the above

4. Recent clinical trials that compared selective laser trabeculoplasty (SLT) with medical therapy as initial treatment for glaucoma have demonstrated:
   (A) Comparable decreases in IOP between the 2 groups
   (B) Unacceptably high rates of complications after SLT
   (C) Significantly better cost-efficacy associated with medical therapy
   (D) All the above

5. The spike in IOP that often occurs after SLT is typically transient, but patients with _______ are at increased risk for sustained elevation of IOP.
   (A) IOP >40 mm Hg at baseline
   (B) Heavily pigmented angles
   (C) Systemic hypertension
   (D) History of cataract surgery

6. Patients with which of the following conditions are least likely to require medications or other procedures after iridotomy?
   (A) Primary angle closure (PAC) suspect
   (B) PAC
   (C) Open-angle glaucoma
   (D) Angle-closure glaucoma

7. In patients with PAC, risk for progression to angle-closure glaucoma after iridotomy is lowest when iridotomy is performed within _______ of the acute attack.
   (A) 24 hr
   (B) 2 to 3 days
   (C) 3 to 4 days
   (D) 1 wk

8. In the management of angle-closure glaucoma, cataract surgery:
   (A) Should be avoided when possible because of increased risk for complications
   (B) Should be performed only in combination with filtration surgery
   (C) Is associated with improved outcomes when performed alone or in combination with filtration surgery
   (D) Is recommended as primary therapy for most patients

9. Emerging data suggest that, in patients with normal-tension glaucoma, low blood pressure during sleep is associated with which of the following?
   (A) Increases in IOP
   (B) Increased risk for angle closure
   (C) Increased risk for dementia
   (D) Loss of visual field

10. The prospective Three-City-Alienor Cohort study found which of the following variables to be associated with risk for dementia?
    1. Vertical cup-to-disc ratio
    2. Rim-to-disc ratio
    3. IOP
    4. Use of IOP-lowering medications
    (A) 1,2  (B) 3,4  (C) 1,2,3  (D) 1,2,3,4