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Advanced Glaucoma Surgery

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Advanced Glaucoma Surgery

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Rohit Varma, M.D., M.P.H. graduated from Maulana Azad Medical College, University of Delhi, India, and completed fellowships in the Glaucoma Services of Wills Eye Hospital, Philadelphia, and the Doheny Eye Institute, University of Southern California School of Medicine. In 2005, he was appointed Professor (tenured) at the Department of Ophthalmology and Preventive Medicine, University of Southern California, Keck School of Medicine, Los Angeles. Since 2014, Dr. Varma has been Professor and Chairman, Department of Ophthalmology, USC Eye Institute, Keck School of Medicine, Los Angeles. During his distinguished career he has been the recipient of various honors, including the American Academy of Ophthalmology Honor Award (1998) and Senior Achievement Award (2006) and the President's Award from the Glaucoma Research Foundation (2009). Dr. Varma served on the Editorial Advisory Board of *Ophthalmology* from 1999 until 2013 and since 2010 has been an Examiner for the American Board of Ophthalmology Oral Examinations. He has published approximately 220 articles in peer-reviewed journals and edited/co-edited two books: *Essentials of Eye Care: The Johns Hopkins Wilmer Handbook* (Lippincott Raven, 1997) and *The Optic Nerve in Glaucoma* (Lippincott 1992).

Advanced Glaucoma Surgery: An Overview

1

Ahmad A. Aref and Rohit Varma

The current era has been described as a "Renaissance Period" in glaucoma surgical care. Our care has been revolutionized with innovative techniques and devices designed to enhance physiologic aqueous outflow pathways in patients with mild stages of glaucomatous optic neuropathy. Although these techniques in this specific patient population have deservedly taken the spotlight with regard to advancing glaucoma treatment paradigms, it is important to note similarly transformative treatment strategies for patients with late stages of the disease as well as those experiencing persistent complications in the postoperative period. This textbook aims to shed light on these strategies for a host of complex entities that may present to the glaucoma surgical consultant.

Drs. Hu and Moster describe use of a novel trabecular micro-bypass stent to access and enhance physiologic aqueous outflow pathways for the treatment of mild glaucomatous optic neuropathy (Chap. 2). In its current iteration, a single micro-bypass stent (iStent, Glaukos Corp.) is attached to a disposable inserter. The device is currently approved for insertion in conjunction with cataract surgery. Upgrades in stent design are currently under study and will allow for multiple stents to be placed with a single inserter. Current evidence supports multiple stent insertion for enhanced aqueous outflow [1]. In addition, targeted stenting may increase rates of success by increasing chances of accessing functioning trabecular collector systems.

Drs. Kaplowitz and Loewen describe the use of the trabectome procedure (Neomedix, Inc.) for the treatment of complex angle-closure glaucomas (Chap. 3). Although typically categorized as a microinvasive procedure with typical indications, the authors describe a technique with encouraging results for the reversal of peripheral anterior synechiae. In addition, the authors describe the use of the device after failed conventional glaucoma filtering procedures [2]. Supplemental video of the technique as performed by Dr. Nils Loewen provides invaluable instruction.

The conventional treatment paradigm for angle-closure glaucomas is currently under investigation, with lens extraction becoming a prime consideration in earlier stages of the disease. Drs. Trikha, Perera, Husain, and Aung provide convincing evidence from anterior segment imaging studies to support this approach (Chap. 4) [3]. Indeed, the high-quality pre- and postoperative figures in this chapter reveal a marked improvement

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in angle crowding with presumed enhancement in trabecular outflow. The authors provide guidance for the performance safe cataract removal under challenging preexisting conditions of a shallow anterior chamber with angle closure.

Drs. Grover and Fellman describe a truly innovative technique, Gonioscopy-Assisted Transluminal Trabeculotomy (GATT) (Chap. 5). The technique involves use of the iTrack microcatheter for performance of ab-interno trabeculotomy for the treatment of adult and developmental glaucomas. Advantages of this technique include sparing of the conjunctiva and the ability to visualize safe cannulation of Schlemm's canal. The group recently reported a 39.8 and 52.7 % decrease in IOP with this technique in primary and secondary open angle glaucomas, respectively, after 12 months of follow-up [4].

Drs. Reznik and Varma describe a novel microinvasive procedure for bypass of physiologic outflow pathways (Chap. 6). The procedure is performed via an ab-interno approach, utilizing a porcine gelatin tube (XEN Gel Stent) to access the subconjunctival space. Three lumen sizes are available, with the degree of aqueous flow determined by the Hagen–Poiseuille equation. A multicentered randomized controlled clinical trial investigating the safety and efficacy of the device is currently underway.

Drs. Khoueir and Shaarawy describe nonpenetrating glaucoma surgical procedures (Chap. 7). The authors note a relatively long learning curve with these techniques when compared to conventional glaucoma filtering surgeries. This learning curve may have slowed the adoption of these techniques which offer a superior safety profile when compared to trabeculectomy surgery [5]. Step-by-step instruction and supplemental video provided by the authors help to soften this learning curve for the novice while providing invaluable pearls for the experienced surgeon.

Dr. Noecker describes the use of endoscopic cyclophotocoagulation for the treatment of plateau iris and angle-closure glaucomas (Chap. 8). In a modification of the technique typically employed for open angle glaucomas, Dr. Noecker describes treatment of the posterior aspect of the ciliary processes. This allows for pulling of the anterior processes away from the iris with subsequent angle opening. This technique, termed endocycloplasty, represents an important advance as angle-closure associated with plateau iris may persist after laser iridoplasty and/or lens extraction [6, 7].

Drs. Allan and Sarkisian describe surgical pearls for Ex-Press Mini-Glaucoma Device (Alcon Laboratories, Inc.) implantation for the treatment of complex glaucomas, including uveitic glaucoma (Chap. 9). The device may offer an advantage over conventional trabeculectomy in uveitic diseases as it is typically associated with less postoperative inflammation and anterior chamber shallowing. Supplemental surgical video by Dr. Sarkisian demonstrates key steps of the procedure.

Normal-tension glaucoma represents a challenging entity as it is often difficult to achieve significant intraocular pressure lowering from apparently moderate baseline levels. Drs. Khodadadeh and Tsai describe trabeculectomy pearls for safe achievement of these target levels (Chap. 10). The surgeons also describe their preferred topical anesthetic technique so as to reduce the risks for retrobulbar anesthesia.

The Boston Keratoprosthesis represents a landmark achievement in the treatment of corneal blindness. Unfortunately, postoperative glaucoma represents an important and vision-threatening complication after KPro implantation. Drs. Vajaranant and Aref describe a technique for combined glaucoma, pars plana vitrectomy, and KPro surgery (Chap. 11). The technique allows for posterior placement of the glaucoma implant tube in order to allow for optimal contact lens fitting and decreased risk of tube erosion. Addressing the preexisting (and likely future) glaucoma at the time of KPro implantation minimizes the risk of irreversible glaucomatous visual field loss. A recent report by the authors supports this strategy with a relatively low risk of postoperative complications [8].

Postoperative glaucoma may also develop after retinal detachment surgery. The presence of a scleral buckle makes surgical management of the condition somewhat challenging. Drs.

Vazquez and Gedde describe the Modified Schocket Procedure to manage this condition (Chap. 12). A supplemental surgical video by Dr. Aref demonstrates the procedure in an infant suffering traumatic glaucoma after prior scleral buckling surgery.

Dr. Palmberg describes an ab-interno technique for trabeculectomy revision once episcleral fibrosis has limited aqueous outflow (Chap. 13). The technique offers logistical, financial, and psychological advantages over conventional transconjunctival bleb needling. Preliminary results of the technique, as performed by Dr. Palmberg, are encouraging.

Ms. Teramoto and Dr. Tanji describe complex pathophysiology of choroidal effusions and hemorrhage (Chap. 14). The development of a postoperative choroidal hemorrhage may represent a devastating complication of ophthalmic surgery. However, appropriate management, as outlined by the authors, may allow for a successful outcome.

Drs. Varma and Ahmed describe the pathophysiology and management of malignant glaucoma (Chap. 15). Surgical techniques offer definitive therapy and include anterior or posterior iridozonulohyaloidotomy and anterior chamber reformation with intraocular lens pushback. It is important to note that core vitrectomy is not an effective stand-alone treatment. Exceptional figures in this chapter guide the reader through the appropriate surgical techniques.

Each section of the current text may serve as a stand-alone chapter for rapid reference by the practitioner during stages of surgical planning. In that regard, the text is meant to guide and assist the clinician in important surgical decision-making for complex ophthalmic conditions. At the same time, the text offers concise, clear explanations of these conditions while addressing advantages and disadvantages to various treatment strategies. In this regard, the text serves as a valuable reference for experienced and novice ophthalmic surgeons alike.

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2 Trabecular Micro-Bypass Stent for the Treatment of Coexistent Cataract and Mild Open-Angle Glaucomas

Wanda D. Hu and Marlene R. Moster

2.1 Introduction

In the past few years, there has been an increasing interest in microinvasive glaucoma surgery (MIGS) procedures as they may play a novel role in the glaucoma treatment algorithm. More traditional ab externo glaucoma procedures such as trabeculectomies and glaucoma drainage devices are known to very effectively reduce intraocular pressure (IOP), but are also associated with numerous sight-threatening complications that may occur even years after surgery (e.g., bleb leak, bleb-related endophthalmitis, hypotony) [1,2]. Because of the relatively high complication rates associated with filtration procedures, practitioners often turn to medications and/or laser trabeculoplasty as first-line therapies to reduce IOP [3]. However, many patients struggle with compliance and ocular surface issues with medications [4,5], and laser trabeculoplasty may only have a limited and modest effect [6,7]. The hope is that MIGS procedures will bridge the gap between medications and more invasive procedures for patients with mild to moderate glaucoma.

MIGS procedures utilize an ab interno approach, sparing the conjunctiva to allow for future glaucoma surgical procedures if necessary, and offer a much higher safety profile with smaller incisions and less distortion of the normal anatomy [8]. Compared to traditional filtering procedures, these procedures are often easier to adopt with fewer postoperative complications and therefore, can be utilized by both glaucoma specialists and comprehensive ophthalmologists in their armamentarium against this potentially blinding disease. Currently, there are several MIGS devices/procedures that may decrease IOP through either (1) improving trabecular outflow to Schlemms' canal (trabectome, Neomedix, Inc.; iStent, Glaukos, Corp.; Hydrus microstent, Ivantis, Inc.), (2) improving outflow through the suprachoroidal space (Cypass, Transcend Medical, Inc.; iStent Supra, Glaukos, Corp.), or (3) creating an alternative outflow pathway through the subconjunctival space (Xen Gel Stent; Aquesys, Inc.).

It is thought that the primary site of outflow resistance in primary open angle glaucoma (POAG) occurs at the juxtacanalicular component of the trabecular meshwork and the endothelial lining of the inner wall of Schlemm's canal [9–11]. A trabecular bypass stent bypasses the region of highest outflow resistance and creates a

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