REFERENCES

1. Gooch N, Molokhia SA, Condie R, et al. Ocular drug delivery for glaucoma management. *Pharmaceutics* 2012;4:197-211.
2. Nordstrom BL, Friedman DS, Mogaffari E, et al. Persistence and adherence with topical glaucoma therapy. *Am J Ophthalmol* 2005;140:598-606.
3. Tsai T, Robin AL, Smith JP. An evaluation of how glaucoma patients use topical medications: a pilot study. *Trans Am Ophthalmol Soc* 2007;105:29-33.
4. Schwartz GF and Quigley HA. Adherence and persistence with glaucoma therapy. *Surv Ophthalmol* 2008;53 (Suppl 1): S57-S68.
5. Kwon YH, Kim YI, Pereira ML, et al. Rate of optic disc cup progression in treated primary open-angle glaucoma. *J Glaucoma* 2003;12:409-416.
6. Quigley HA, Tielsch JM, Katz J, Sommer A. Rate of progression in open-angle glaucoma estimated from cross-sectional prevalence of visual field damage. *Am J Ophthalmol* 1996;122:355-363.
7. Nordmann JP, Auzanneau N, Ricard S, Berdeaux G. Vision-related quality of life and topical glaucoma treatment side effects. *Health Qual Life Outcomes* 2003;1:75.
8. Lavik E, Kuehn MH, Kwon YH. Novel drug delivery systems for glaucoma. *Eye* 2011;25:578-586.
9. The AGIS Investigators. The Advanced Glaucoma Intervention Study (AGIS): 7. The relationship between control of intraocular pressure and visual field deterioration. *Am J Ophthalmol* 2000;130:420-440.
10. Nouri-Mahdavi K, Hoffman D, Coleman AL, et al. Predictive factors for glaucomatous visual field deterioration in the Advanced Glaucoma Intervention Study. *Ophthalmology* 2004;111:1627-1635.
11. Saettone MF, Salminen L. Ocular inserts for topical delivery. *Adv Drug Deliv Rev* 1995;16:95-106.
12. Misha GP, Bagui M, Tamboli V, Mitra AK. Recent applications of liposomes in ophthalmic drug delivery. *J Drug Delivery* 2011;2011:863734.
13. Natarajan JV, Ang M, Darwitan A, et al. Nanomedicine for glaucoma: liposomes provide sustained release of latanoprost in the eye. Int J Nanomed 2012;7:123-131.
14. Natarajan JV, Darwitan A, Barathi V, et al. Sustained drug release in nanomedicine: a long-acting nanocarrier-based formulation for glaucoma. *Am Chem* Soc 2014;1:419-429. 419-429.

Will Minimally Invasive Glaucoma Surgery (MIGS) Gain Acceptance and be Adopted in the Asia-Pacific Region?

Discussion by Norman M. Aquino, MD

The options for surgical control of intraocular pressure (IOP) in open-angle glaucoma (OAG) patients are expanding. In the last few years, traditional glaucoma filtration surgery is being challenged with the introduction of new surgical approaches and implants that offer innovative solutions to safely lower IOP in OAG eyes. These new procedures and devises are collectively termed as Minimally Invasive Glaucoma Surgery or MIGS. They involve an ab interno approach and are oftentimes done in conjunction with cataract surgery.

The following techniques and devices fall under the category of MIGS[1]:

1. Ab interno trabeculotomy

The Trabectome (NeoMedix, Tustin, CA, USA) is inserted through a small sideport incision under gonioscopic view. High-frequency electrocautery is used to ablate 90 to 120 circumferential degrees of the trabecular meshwork and the inner wall of Schlemm's canal, areas that are associated with the greatest resistance to aqueous outflow.

2. Drainage into Schlemm's canal

   a. The iStent (Glaukos, Laguna Hills, CA, USA) a trabecular microbypass stent is a device implanted using a disposable insertion instrument through an ab interno gonioscopy-guided approach. It is designed to bypass the trabecular meshwork and create a communication between the anterior chamber and the Schlemm's canal.

   b. The Hydrus (Ivantis Inc., Irvine, CA, USA) is an 8-mm long non-luminal open-design device that is implanted within the Schlemm's canal, oftentimes in conjunction with cataract surgery. It is an intracanalicular scaffold that increases outflow by allowing aqueous to bypass the trabecular meshwork and dilating the lumen of the canal.

3. Drainage into the suprachoroidal space

   a. The iStent Supra (Glaukos, Laguna Hills, CA, USA) is designed to create a patent lumen between the anterior chamber and the

suprachoroidal space. It attempts to harness the potentially vacuum-like effect of the suprachoroidal space by shunting aqueous to the area. It is made of polyethersulfone, has a titanium sleeve, and is heparin-coated. The stent is slightly curved to match the suprachoroidal space and is introduced ab interno and implanted right below the scleral spur. It is advanced into the suprachoroidal space until approximately 0.5 mm of the sleeve is left in the anterior chamber.

b. The CyPass (Transcend Medical, Menlo Park, CA, USA) is a 6.35-mm polyamide tube with an outer diameter of 0.51 mm implanted into the supraciliary space to establish a conduit for aqueous filtration via the uveoscleral pathway. A small guide-wire with a special tip that separates the iris from the scleral spur creates a cleft where the devise is inserted. Once in place, openings along the length of the tube allow aqueous to flow out.

4. Drainage to the subconjunctival space

The Aquesys implant (AqueSys Inc., Aliso Viejo, CA, USA)) consists of a small soft collagen-gelatin implant with an inner diameter of 65 microns. It is positioned into the subconjunctival space using an inserter via an ab interno approach. The objective is to create subconjunctival filtration and subsequent bleb formation without the creation of a conjunctival opening.

Yes, MIGS will be accepted and adopted in the Asia-Pacific region.

MIGS offers the potential to address and avoid most, if not all, the serious and potentially devastating complications associated with the more invasive procedures, like trabeculectomy and glaucoma tube surgery. MIGS procedures are fast to perform, involve much less tissue manipulation, and may have faster visual recovery compared to fistulizing and tube shunt surgery. They are, likewise, antimetabolite-free procedures. As such, MIGS is suitable to be combined with cataract surgery. Studies are currently ongoing to compare the IOP lowering effects of MIGS combined with phacoemulsification surgery versus phacoemulsification surgery alone.

Current available data, though limited and lacking in long-term follow-up, show that MIGS lowers IOP in patients with OAG, but to an extent that is less than that seen with traditional glaucoma surgery. It has also been shown to lower the need for postoperative pressure lowering medications.[2,3,4,5,6,7] Thus, MIGS is often performed to postpone more invasive surgical intervention in cases of early to moderate glaucoma, to prolong the patient's adherence to treatment, and to improve the quality of life.

In the Asia-Pacific region, because of issues related to cost and sustainability of prolonged medical treatment, early glaucoma surgery has become a viable option. MIGS can be adopted to address this concern.

No, MIGS will not be accepted and adopted in the Asia-Pacific region.

The epidemiology of glaucoma in the Asia-Pacific region greatly varies and is different from those in the West.[8] Although MIGS offers great potential in improving treatment outcomes, there is still no available evidence of its applicability and usefulness in patients with angle closure glaucoma, which is the prevalent type of glaucoma in the Asia-Pacific region. The burden of cost and the issue of devise availability will likely make its adaptation difficult and limited. Limited surgical expertise will also be an issue against its widespread use in the region.

CONCLUSION

Although there is a palpable need to develop newer, safer, simpler, and more effective approaches to improve glaucoma surgical outcomes, we should be very critical and circumspect in adopting these new techniques and devises. The key question is whether MIGS adds any further clinical value to currently existing and accepted surgical modalities of treatment. Furthermore, in certain areas of the world, like the Asia-Pacific region, adaptation of these new modalities of treatment will need further consideration as the prevalent type of glaucoma might not be appropriate, and the existing healthcare structure might not be amenable to these new technologies and approaches.

REFERENCES:

1. Brandão LM, Grieshaber MC. Update on Minimally Invasive Glaucoma Surgery (MIGS) and new implants. *J Ophthalmol* 2013;2013:705915.
2. Francis BA. Trabectome combined with phacoemulsification

vs phacoemulsification alone: A prospective non-randomized controlled surgical trial. *Clin Surg J Ophthalmol* 2010;28:1-7.
3. Craven ER, Katz LJ, Wells JM, et al. Cataract surgery with trabecular micro-bypass stent implantation in patients with mild to moderate OAG and cataract: 2-year follow up. *J Cataract Refract Surg* 2012;38:1339-1345.
4. Samuelson TW, Lorenz K, Pfeiffer N, et al. Six-month results from a prospective multicenter study of nickel-titanium Schlemm's canal scaffold for IOP reduction after cataract surgery in OAG. Poster presented at AGS Meeting, March 2012, NY, NY.
5. Hoeh H, Rau M, Reitshamer H, et al. Clinical outcomes of combined cataract surgery and implantation of the CyPass Microstent for the treatment of OAG. Paper presented at the ESCRS Meeting, Sept 2012, Milan, Italy.
6. Hoeh H, Ahmed II, Grisanti S, et al. Early postoperative safety and surgical outcomes after implantation of a suprachoroidal microstent for the treatment of OAG concomitant with cataract surgery. *J Cataract Refract Surg* 2013;39;431-437.
7. Palmberg PF. One-year results with the Aquecentesis procedure. Presented at the 6th International Congress on Glaucoma Surgery, September 2012, Glasgow, Scotland.
8. South East Asia Glaucoma Interest Group. Asia-Pacific Glaucoma Guidelines, 2nd ed. Hong Kong: Asia-Pacific Glaucoma Society, 2008.