Minimally Invasive Glaucoma Surgery in India: Is it time?

Minimally Invasive Glaucoma Surgery or “MIGS”[1,2] is a term applied to a wide range of implants, devices, and techniques, that lower IOP with less surgical risk than the more established bleb-forming sub-conjunctival drainage procedures—trabeculectomy (trab) as well as glaucoma drainage devices (GDDs).

MIGS procedures and devices have the following characteristics: minimally-or-atraumatic to the conjunctiva, usually “ab interno,” usually bleb-independent, usually combined with cataract surgery with reduced surgical time along with rapid visual recovery, lesser post-operative visits, and high safety profile. These latter characteristics along with the fact that they are cosmetically more acceptable make these procedures very patient friendly.

MIGS devices and procedures utilize the trabecular meshwork (TM), suprachoroidal space, and also targets the seat of aqueous production—the ciliary body (CB) itself [Table 1]. The procedures and devices that target the TM outnumber the others—as one can stent it, dilate it, or also cut through it (trabectolotomy). There are a few devices (XEN, PreserFlo) that are not strictly MIGS, as they do create a sub-conjunctival bleb and so are called MIGS-Plus. By and large, MIGS are minimally invasive as they utilize the eye’s natural physiologic pathways of aqueous production and drainage, hitherto largely untapped surgically, versus creation of an artificial sub-conjunctival drainage in the established filtration procedures. It is this latter type of drainage modality that is not only plagued by short- and long-term fibrosis and failure but also hypotony, early and late bleb leak, blebitis, bleb-associated endophthalmitis, bleb-dysaesthesia, etc. These are all avoided with MIGS, though some of it may occur with MIGS-Plus procedures.

The indications for MIGS devices and procedures have evolved and are now rather better defined—mild-to-moderate open angle glaucoma—primary or secondary, that requires two or more anti-glaucoma medications (AGM) especially when undergoing cataract surgery. Intolerance to and other barriers for continued usage of AGM, for example, allergy, poor compliance and adherence, concerns about lifelong cost of therapy, and so on, are also indications for MIGS procedures.

At the turn of the millennium, when MIGS procedures and devices first emerged, there were more than the usual nay-sayers predicting its doom even before it was allowed to establish its credentials. The apprehension appears unfounded, as in the past 20-odd years, these procedures and devices have established an IOP lowering efficacy to the tune of approximately 25% to 40%, sometimes more, in the presence of increased safety with about 50% or more reduction in medications.[3-10] Furthermore, complications associated with MIGS are usually infrequent and mostly transient compared with trab and GDD surgery.[11]

The main disadvantage of these MIGS procedures is its modest ability to reduce IOP, yet it is perfectly stationed to fill the void between medical therapy and the leap to an incisional bleb-forming one. In other words, it may be offered much earlier in the disease spectrum, rather than wait till the glaucoma gets advanced. When seen from the perspective of the patient, it not only improves their quality of life with none or fewer AGMs but also faster visual rehabilitation, post-surgery. Furthermore, being atraumatic to the conjunctiva, trabeculectomy can still be performed, should it be a requirement in the future.

MIGS has made very small but definitive inroads in India in the last few years, albeit a little slow and a bit late. Of course, the number of procedures and devices that are available are still extremely limited in type and number. Several procedures being done are actually cost-effective alternatives rather than their expensive western counterparts (prolene suture GATT vs OMNI, Bent needle ab-interno Goniotomy or BANG vs KDB etc) [Table 1]. The Trabectome and the cycloablative diode procedures—endoscopic (ECP) or micropulse transscleral diode cyclophotocoagulation (MP-TSCPC)—are available in some centers and requires capital expenditure for acquisition of the machines. Furthermore, the electrocautery probe of the Trabectome as well as the probe used for MP-TSCPC are disposable in nature and incur a recurring cost, whereas the probe of the ECP can be reused for dozens of procedures.

ECP cyclodiode can be considered to be the “original” MIGS, as it was first described by Uram[12] in the early 1990s.

### Table 1: Some MIGS devices and procedures classified according to function (cost-effective options/alternatives in italics)

| I. Increasing Trabecular outflow—target Schlemm’s canal | II. Suprachoroidal shunts—target uveo-scleral outflow | III. Reduction of aqueous production | IV. Sub-conjunctival filtration—MIGS “PLUS” |
|---------------------------------------------|---------------------------------------------|---------------------------------|-------------------------------------|
| Stenting devices: iStent® Supra | iStent® inject | MINInj ect | XEN |
| iStent® inject W | Hydrus | Micropulse diode laser | PreserFlo |
| Trabeculotomy procedures and devices: Gonioscopy-assisted Transluminal Trabeculotomy (GATT) —OMNI. | Endocyclo-photocoagulation | Micropulse diode laser cyclophotocoagulation |
| Suture GATT | | |
| Trabectome | | |
| Kahook Dual Blade (KDB). | | |
| Bent needle ab interno Goniotomy (BANG). | | |
| Dilate: OMNI | | |
It is the most versatile of all MIGS, as it can be delivered irrespective of angle status. Hence, its value seems to be in primary angle closure disease, the real scourge of our country, where it may prove to be a game changer.[13-19] Micro-pulse diode may also prove beneficial,[20,21] but there is a need to build up more evidence in primary glaucomas. The newest entrant in the world of MIGS (in India) is the iStent® and iStent® Inject (Glaukos Corp, CA, USA)—these are trabecular micro-bypass and the smallest devices known to mankind. All round, there is a serious dearth of data related to MIGS procedures in Indian eyes, other than a few available reports in cycloablaative reports.[17,22]

Even though MIGS procedures are desirable bleb-independent safe procedures, on the face of it, its use in our population may appear to be limited due to factors like poor and variable availability of specialized healthcare, late presentation, greater incidence of angle closure, cost, and so on. However, a significant proportion of ocular hypertensives or early glaucoma patients, who are on multiple AGM and are due to undergo cataract surgery, may be offered MIGS along with it to eliminate or reduce the burden of AGM. Patients intolerant to AGM will also benefit from conjunctiva-sparing procedures, as risk of bleb failure is high in such eyes.

Successful implantation of a MIGS device or execution of a MIGS procedure demands a new set of skills, hitherto not taught or extremely sparingly imparted in our training programs. The single most important aspect is the practice of intra-operative gonioscopy with a direct gonioscopic lens and the familiarization of the angle structures under extreme high magnification. For this purpose and for best visualization of the angle intra-operatively, a few other adjustments are important which are different from those practiced for gold-standard filtration surgery—the surgeon seated temporally, the tilt of the microscope 35° toward the surgeon, and that of the head of the patient 35° away from the surgeon. Therefore, this requires a period of retraining and adaptation as this constitutes a significant change from the current norm.

Challenging the status quo is difficult and abhorrent to many. The single biggest barrier for the uptake of any new procedure/s is our reluctance for change, but cost is conveniently cited as the most important factor. Desire for change is what aided and abetted the evolution of modern day medicine; be it the cardiac stent in ischemic heart disease or the neuro-radiological coiling for an aneurysm in the brain, or even the laparoscopic abdominal procedures. All these changes have a price-tag but increased safety, better outcomes, and early patient rehabilitation have been very potent forces propelling this transformation with wide acceptability and adoption of these procedures. Open surgery in these conditions continue to be performed for specific indications and training routinely imparted—as they comprise a safety net too, in case of failure of these minimally invasive procedures. There are several precedents in ophthalmology too—for example, the great cataract revolution; a journey that commenced with the rather mutilating large-incision multiple-suture intra-capsular procedure to the innovation of the intra-ocular lens implant (IOL) and transition to the extracapsular procedure. It is the IOL technology that has fuelled and transformed modern-day cataract surgery—it is now not only being inserted through sub-3 mm wounds but also has the capability of correcting presbyopia and astigmatism too. Furthermore, lens extraction is being achieved via the expensive phacoemulsification (phaco) technology in most cases and the ultra expensive femto-laser assisted in some. These procedures and IOLs come at a cost—yet are widely preferred and adopted because of the improved safety, better overall outcomes, and early visual rehabilitation. Extracapsular extraction continues to serve as a fall-back should a complication occur during phaco. Yet another example on a smaller scale—the capability of replacing the Descemet’s membrane with DSEK and DMEK—have made a difference in the outcomes of the management of specific causes of corneal blindness. However, the cost of procuring such tissue/s and the skill required for such a surgery is not a deterrent, when a penetrating keratoplasty is still a feasible surrogate, should complications occur. Hence, we cannot afford to continue deluding ourselves where management of glaucoma is concerned. Ophthalmologists providing glaucoma care will need to revamp current practices in the management of the disease and invest time and effort in the learning of intra-operative gonioscopy-based MIGS procedures. None of these are proclaimed as a substitute for trab but are poised to bridge the gap between medical therapy and the surge toward bleb-forming incisional surgery. Therefore, it is time. Better late than never.

Vanita Pathak-Ray
Department of Glaucoma, Centre for Sight, Hyderabad, Telangana, India.
E-mail: vpathakray@gmail.com

References
1. Saheb H, Ahmed, II. Micro-invasive glaucoma surgery: Current perspectives and future directions. Curr Opin Ophthalmol 2012;23:96‑104.
2. Pathak-Ray V. Advances in glaucoma surgery: Paradigm shift in management. Oman J Ophthalmol 2016;9:1‑2.
3. Healey PR, Clement CI, Kerr NM, Tilden D, Aghajanian L. Standalone iStent trabecular micro-bypass glaucoma surgery: A systematic review and meta-analysis. J Glaucoma 2021;30:606‑20.
4. Ventura-Abreu N, García-Feijoo J, Páez P, Biarnés M, Morales-Fernández L, Martínez-de-la-Casa JM. Twelve-month results of ab interno trabeculectomy with Kahook Dual Blade: An interventional, randomized, controlled clinical study. Graefes Arch Clin Exp Ophthalmol 2021;299:2771‑81.
5. Samuelson TW, Chang DF, Marquis R, Flowers B, Lim KS, Ahmed I, et al. HORIZON Investigators. A scleral canal microstent for intraocular pressure reduction in primary open-angle glaucoma and cataract: The HORIZON Study. Ophthalmol 2019;126:29‑37.
6. Gillmann K, Mansouri K. Minimally invasive glaucoma surgery: Where is the evidence? Asia Pac J Ophthalmol 2020;9:203‑14.
7. Guo CY, Qi XH, Qi JM. Systematic review and Meta-analysis of treating open angle glaucoma with gonioscopy-assisted transluminal trabeculotomy. Int J Ophthalmol 2020;13:317‑24.
8. Kapłowicz K, Bussel II, Honkanen K, Schuman JS, Loewen NA. Review and meta-analysis of ab-interno trabeculectomy outcomes. Br J Ophthalmol 2016;100:594‑600.
9. Lavia C, Dallorto L, Maule M, Ceccarelli M, Fea AM. Minimally-invasive glaucoma surgeries (MIGS) for open angle glaucoma: A systematic review and meta-analysis. PLoS One 2017;12:e0183142.
10. Bicket AK, Le JT, Azuara-Blanco A, Gazzard G, Wormald R,
Bunce C, et al. Minimally invasive glaucoma surgical techniques for open-angle glaucoma: An overview of cochrane systematic reviews and network meta-analysis. JAMA Ophthalmol 2021;139:983-9.

11. Yook E, Vinod K, Panarelli JF. Complications of micro-invasive glaucoma surgery. Curr Opin Ophthalmol 2018;29:147-54.

12. Uram M. Combined phacoemulsification, endoscopic ciliary process photocoagulation, and intracocular lens implantation in glaucoma management. Ophthalmic Surg 1995;26:346-52.

13. Francis BA, Berke SJ, Dustin L, Noecker RJ. Endoscopic cyclophotocoagulation combined with phacoemulsification in medically controlled glaucoma. J Cataract Refract Surg 2014;40:1313-21.

14. Francis BA, Pouw A, Jenkins D, Babic K, Vakili G, Tan J, et al. Endoscopic cycloplasty (ECPL) and lens extraction in the treatment of severe plateau iris syndrome. J Glaucoma 2016;25:e128-33.

15. Hollander DA, Pennesi ME, Alvarado JA. Management of plateau iris syndrome with cataract extraction and endoscopic cyclophotocoagulation. Exp Eye Res 2017;158:190-4.

16. LinM, RagehA, TuralbaAV, Lee H, Falkenstein, IA, Hoguet AS, et al. Differential efficacy of combined phacoemulsification and endocyclophotocoagulation in open-angle glaucoma versus angle-closure glaucoma. J Glaucoma 2019;28:473-80.

17. Pathak Ray V. Intermediate results of phaco-endocycloplasty in an exclusive cohort of angle closure glaucoma: Potential for change. Int Ophthalmol 2019;39:2257-65.

18. Pathak-Ray V, Choudhari N. Phaco-endocycloplasty versus phacotrabeculectomy in primary angle-closure glaucoma: A prospective randomized study. Ophthalmol Glaucoma 2020;3:434-42.

19. Pathak-Ray V. Protocol for titrated endocycloplasty when combined with phacoemulsification in an exclusive cohort of angle closure glaucoma. J Glaucoma 2019;28:e177-8.

20. Ariga M, Nivean PD, Madanagopalan VG, Mohan S. Micropulse trans-scleral diode laser cyclophotocoagulation in refractory glaucoma: An initial experience in Indian eyes. Int Ophthalmol 2021;41:2639-45.

21. Pathak Ray V. Micropulse transscleral cyclophotocoagulation Cyclo G6 laser at low energy levels: Initial results in Indian eyes with advanced glaucoma treated in a single session. Indian J Ophthalmol Case Rep 2021;1:292-6.

About the author

Dr Vanita Pathak-Ray

Dr Pathak-Ray graduated in medicine from the University of Calcutta, completed her basic ophthalmology training in London, higher training in Cardiff, UK and a clinical fellowship in glaucoma at the University of Toronto, Canada, under Dr. Ike Ahmed, where she gained experience in advanced glaucoma surgery. In 2005, she obtained her Certificate of Completion of Specialist Training (CCST) from UK and was appointed consultant. She is currently Director Glaucoma at Centre for Sight and Neoretina EyeCare Institute, Hyderabad. She is the first Glaucoma specialist in India to perform minimally invasive glaucoma surgery (MIGS) in POAG (iStent) and also in PACG (phaco-Endocyclophotocoagulation) and first to use Kahook Dual Blade to perform trabeculotomy in adults. She has several prize-winning presentations at International, National and Regional fora, most notably in innovative procedures - at WGC, ICGS, GSI, AIOS, TOs and HOA and AIOS has felicitated her 3-times in a row as an 'International Hero' from 2017-2019. She has a keen interest in teaching and research, has published widely in peer-reviewed journals, presented as invited faculty at numerous national and international meetings and is a reviewer for several prestigious national and international journals. She is passionate about spreading awareness in Glaucoma and hosts an annual CME event on World Glaucoma Day.