Minimally Invasive Glaucoma Surgery(MIGS)

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Glaucoma surgery has been challenged by the advent of innovative techniques and new implants in the past few years. There is an increasing demand for safer glaucoma surgery offering patients a timely surgical solution in reducing intraocular pressure (IOP) and improving their quality of life. These new procedures and devices aim to lower IOP with a higher safety profile than fistulating surgery (trabeculectomy/drainage tubes) and are collectively termed "minimally invasive glaucoma surgery (MIGS).

MIGS can be classified into 2 types by their surgical approach as ab interno and ab externo.

Ab interno procedures are performed under gonioscopic view usually through a small side port incision. The techniques can be divided by their way of principle, that is, by removing tissue or by implanting a shunt device.

1) Ab Interno Trabeculotomy (Trabectome)- It was introduced in 2004 that allows a trabeculotomy to be performed via an internal approach.Uses a high frequency bipolar electrocautery to ablate the trabecular meshwork (TM) and inner wall of Schlemm's canal (SC). It consists of a disposable hand piece connected to a console with irrigation and aspiration controlled via a 3-stage Foot Pedal Control that initiates irrigation, aspiration and electrocautery in sequence. Continuous irrigation and aspiration allows for removal of debris and regulation of temperature. Additionally, the tip of the Trabectome is bent at a 90° angle to create a protective triangular footplate and allow for easier insertion into Schlemm's canal. Tissue of up to 90 or 120 circumferential degrees can be removed. The potential advantages for this angle surgery are the removal of the area of greatest resistance to aqueous outflow and tissue debris which may reduce the inflammatory stimuli and consequently potential scarring.

2) Excimer Laser Trabeculotomy- Ab interno excimer laser trabeculotomy utilizes the energy of a xenon chloride pulsed excimer laser connected to a quartz fiber optic probe. The procedure intends to enhance outflow facility by creating microperforations in the TM and inner wall of SC. The probe tip is beveled at 65 degrees to aid the placement against the angle via gonioscopic or endoscopic guidance .Eight to ten laser punctures are spaced over 90 degrees, each pulse delivering a mean energy of 1.2?mJ over 80?ns duration .Presence of blood reflux following the laser ablation means that SC has been accessed. It is simple,quick and requires only topical anesthesia and can be combined with phacoemulsification . The advantage is that there is no interference with future fistulating surgery if needed.

3) Trabecular Microbypass Stent(istent) - The device is a heparin-coated, non-ferromagnetic titanium stent measuring at 0.3mm in height and 1mm in length ,with a snorkel shape to facilitate implantation. It is the smallest FDA approved device .The device is placed using a sterile inserter through a 1.5mm corneal incision. The pointed tip allows penetration of the trabecular meshwork and insertion into Schlemm's canal and three retention arches ensure that the device will be held in place.

4) Suprachoroidal Microstent (CyPass)-The CyPass is a supraciliary tube designed to create a controlled outflow from the anterior chamber to the suprachoroidal space. It is made from polyamide and has a length of 6.35mm and a diameter of largest 0.51mm. Currently, the device is still under clinical trials.

5.) Subconjunctival Implant (Aquesys)- This implant consists of a soft collagen tube with an inner diameter of 65 microns. It is placed via the anterior chamber (ab interno) into the subconjunctival space (AqueSys Inc.). The idea is to create subconjunctival filtration (bleb formation) without opening the conjunctiva.

Ab Externo Procedures

Ab externo procedures are characterized by using external approach to reach the surgical site, namely, SC or suprachoroidal space, either to remove or modify tissue or to implant a device.

1)Canaloplasty-Canaloplasty is a nonpenetrating and bleb-independent procedure which combines 360 degree viscocanalostomy with a circumferential distention of the canal . The aim of canaloplasty is to restore the physiologic drainage system of eye. Like in viscocanalostomy, parabolic superficial and deep scleral flaps are formed. The deep flap is dissected to the plane of SC which is unroofed. A flexible microcatheter is inserted into SC and advanced 360 degree to dilate stepwise the lumen by injecting microvolumes of sodium hyaluronidate 1.4%. The microcatheter has a 200??m diameter shaft and incorporates an optical fiber to provide an illuminated beacon tip to assist in guidance. The illuminated tip is observed through the sclera during the catheterization at all times to identify the location of the distal tip of the catheter in the canal .Following viscodilation of the full length of canal, a 10-0 polypropylene suture is sutured to the distal tip of the microcatheter and looped through the canal. The suture is tightened to an extent that it stretches the SC and TM circumferentially .

2) Stegmann Canal Expander (SCE) -The Stegmann Canal Expander (SCE) is an implant that is made of polyimide and placed into SC to create a permanent distension of the TM. Due to its fenestrations, SCE is patent to aqueous humor. SCE is implanted as follows: SC is deroofed by preparing a superficial and a deep scleral flap, creating a Descemet window like in viscocanalostomy and canaloplasty. After dilation of the surgical ostia of SC, the microcatheter is inserted in the canal to dilate it circumferentially with highly viscous sodium hyaluronate . After completed dilation, the catheter is withdrawn, and the SCE implant is placed inside both ostia of SC in order to create a permanent distension of the TM. The rationale behind SCE is to maintain increased permeability of the TM. The superficial scleral flap is sutured watertight as in canaloplasty to prevent bleb formation and to force the aqueous humour leaving through the physiological drainage system. Clinical trials are still on.

3) Gold Microshunt - The nonvalved flat plate drainage device made of 24-karat medical-grade gold is 3.2?mm wide, 5.2?mm long, and 44??m thick. It includes several channels for aqueous to percolate which can be opened more with laser energy after surgery, if a further IOP decrease is necessary. The surgeon positions the device through a fornix-based conjunctival flap and under a 4?mm full-thickness scleral dissection into the created suprachoroidal space.

Conclusion

Like any other procedure MIGS too has its own advantages & disadvantages

Advantages - 1) less time consuming

2) less number of complications

3) faster visual recovery compared to fistulating surgery

4) can be combined with cataract surgeries

5) reduction in number of drugs being used for IOP control

6) trabeculectomy can be done in later stages , if needed

Disadvantages - 1) it is an expensive procedure

2) limited clinical experience and evidence

3) produce a limited IOP reduction compared to trabeculectomy

With advantages having an upper hand compared to disadvantages , these new procedures when performed on suitable patients can deliver satisfactory results . And also Understanding the different principles of the new devices and techniques, proper surgical training, and careful patient selection are important requirements for a successful implementation of MIGS. However, as there is limited clinical experience and evidence with many of the new devices whereof some are still under investigation today, more studies are needed before MIGS can be fully recommended for a widespread use in the near future.

References :

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