Editorial

New Horizons in Glaucoma

[1]Syril Dorairaj MD
[2]Marcos Pereira Vianello MD

[1]Mayo Clinic, Department of Ophthalmology
Jacksonville, Florida. USA
[2]Medical Sciences Eye Institute
(Instituto de Olhos Ciências Médicas)
Belo Horizonte, Brazil

Glaucoma is the leading cause of irreversible blindness. Current estimates point to 65 million people over 40 years affected by glaucoma. Projections are 76 and 111 million for 2020 and 2040, respectively[1]. We will have a 74% increase in prevalence over the next 27 years, of this cases, approximately 13% will be bilaterally blinded. In the US, more than half of glaucoma sufferers are undiagnosed[2]. In Latin America, studies show rates of 70% to 90%, as found in the south of Brazil[3].

In recent years we had many important advances in the diagnosis, monitoring and treatment of glaucoma. The optical coherence tomography (OCT), combined drugs, drainage implants and new insights into the pathophysiology of the disease are good example of it. We believe we have excellent prospects ahead. In this editorial we will highlight some of them.

Visual function:

More than doing traditional perimetry, researchers are looking for quality of vision and its consequence in life of patients. Glaucoma patients have a three times higher risk of falls in the first year and six times more likely to have a motor vehicle collision in the previous five years compared with normal subjects as revealed by a Canadian study[4]. As so, physicians should warn and orientate their patients. Another study[5] of University of California San Diego (UCSD) reveals similar results

Imaging:

Now OCTs are in full evolution, both in terms of acquisition and evaluation of data[6]. The current machines reach 25,000 to 75.000 scans/second but there are experimental models that reach up to 20 million scans/second[7]. Closer to our reality we have three new technologies. The first one is the swept-source optical coherence tomography (SS-OCT) that uses a faster scan sweep with a broader band of the spectrum. This allows 400,000 scans/second and the observation of deeper structures such as choroid and the lamina cribosa[8,9] The defects of the lamina cribrosa like narrower pores and thicker beams are associated with severe glaucoma[10]. The evaluation of anterior segment structures is also more precise and studies show a good ability to identify anterior synechia and angle closure, even surpassing the gonioscopy[11,12]. There is already two SS-OCT on the market called CASSIA SS-1000 (Tomey, Japan) for anterior segment and DRI OCT-1 (Topcon Corporation, Itabashi-KU, Japan) for complete eye scans.

Another technology under development is the Adaptive Optics Spectral Domain Optical Coherence Tomography (AO-SDOCT), which greatly increases the transverse resolution of the OCT image by reducing optical aberrations caused by the laser beam on the surface of the retina. With this, you can now visualize photoreceptor, microstructures within the RNFL , retinal microvasculature and lamina cribosa[13,14]. For the first time, change in the outer layers of the retina in glaucomatous eyes were detected, associated with the expected changes in the internal layers[13]. It is an impressive breakthrough. In the near future this technology will quantify the ganglion cell changes consistently in glaucoma evaluation. Today we can only have good estimates of them.

A third technology that is under evaluation is polarization-sensitive OCT (PS-OCT) that utilizes detection of polarized light changes in RNFL even before cell death occurs in glaucoma[15,16,17]. It has shown good results in early detection of glaucoma compared to current OCT technology[18]. Another promising anterior segment utility of PS-OCT is its ability to identify fibrosis earlier in the capsular trabeculectomy blebs[19], which would allow better monitoring of the healing postoperatively, increasing survival of glaucoma surgeries.

Other technologies are still in development[6] at early stages. The photo-acoustic ophthalmoscopy allows identification of retinal blood volume and oxygen saturation and the vertical-cavity surface emitting laser technology allows visualization of the entire thickness of the eye wall.

Given these advances in imaging technology, we have better prospects of understanding the pathophysiology of glaucoma and its progression. Much is been focused on the study of the lamina cribrosa, which is thought to be the site of initial damage to the axons of the ganglion cells. Spectral OCTs currently in

the market do not allow the entire imaging of lamina cribrosa and even the new technologies described above have significant limitations on the visualization of the entire length of it. To confirm the collected data, histological comparative studies must be done. Although promising and under spotlight, the analysis of the cribriform plate is not recommended in our routine glaucoma practice at this time [20].

Intra Ocular Pressure (IOP):

Intra ocular pressure is the only risk factor that we can currently modify to decrease glaucoma progression. Many efforts are been made for a most accurate and continuous method to evaluate IOP in the home settings by temporary and permanent methods [21 22].

As a permanent option, there are intraocular implants that could be placed during cataract surgery behind the iris, like the EyeMate (Implandata Ophthalmic Products GmbH, Hannover, Germany). Some patients have received the implant and are accompanied with good results so far. As a temporary option, available in the European market, we have the Triggerfish contact lens (Sensimed AG, Lausanne, Switzerland). Its principle is that small changes in perilimbic curvature correspond to changes in IOP. The reproducibility of the data is good according to studies[23]. The key issue now is to discover the correlation between the data collected and the value of IOP in mm Hg, which has not yet been possible.

Medications:

Topical treatment with eye drops is still considered and ideal first option to manage majority of glaucoma patients. The low adherence or compliance to treatment is still a crucial point in managing glaucoma [24].

Although no new drug class has been developed in the last 19 years, the pharmaceutical industry is currently working on to develop medications that act on the trabecular meshwork, increasing the aqueous outflow and enhancing the action of current drugs. There are several drugs with this profile in research as the rho kinase inhibitors[25], adenosine agonists[26], angiotensine type 1 antagonist, actin polymerization inhibitor and a serotonin receptor antagonist. The inhibitors of Rho class have a neuroptrotection effect. The Rhopressa (Aerie Pharmaceuticals, Durham, NC), an inhibitor of Rho kinase, is in Phase 3 of tests and shows very promising results in reducing IOP, either by increasing the aqueous outflow through the trabecular meshwork or by decreased its production[27,28]. There is emphasis on innovations in drug delivery to the point of interest or by sustained drug delivery. Contact lens[29], punctal plugs and floating devices in the fornix and anterior chamber have been tested. Excessive mobility with consequent discomfort, irritation and loss of the device are the main limitations. Biodegradable implants with injectable prostaglandins from Pfizer and pSivida (Watertown, Mass) are already being tested in clinical trials. Although presenting the risk of a surgical procedure, they have longer lasting effect (6 months to 1 year) with a much lower concentration of drug. Increase compliance is crucial goal in the current conjecture of glaucoma management.

Surgical Treatment:

To overcome the limitations of trabeculectomy and drainage implants,

currently we have a group of minimally invasive glaucoma surgeries (MIGS) that focusses on new technologies and techniques. Most of these procedures are suitable especially for early to moderate glaucoma and still have modest results in reducing IOP. In principle, these procedures cause less eye inflammation due to lower tissue damage. We can separate them as ab interno and as ab externo MIGS (Table). Currently FDA approved iStent and Trabectome (Neomedix) are widely used to manage mild to moderate glaucoma patients undergoing cataract surgery.

Trabecular Micro-Bypass (iStent, Glaukos, Laguna Hills, Calif.), which when deployed in trabecular meshwork (TM), promotes an aqueous direct passage to Schlemm's canal, thereby reducing resistance and IOP. When combined with cataract surgery, experienced an average reduction of 15-20% in IOP, with low rates of complication[30,31,32,33 34].

Trabectome removes the TM with high-frequency electrocautery via ab interno, creating a pathway for aqueous directly to Schlemm's canal. There is no thermal damage and consequently, a minor harm for surrounding tissues. Trabectome spares the conjunctiva and there's no bleb formation. Trabectome is a more used device with more publications showing good initial results[35].

Conclusion: With the advances in technology there is paradigm change in diagnosing and managing our glaucoma patients in the last decade. It is not only important for us to stay tuned regarding the changes that are happening in our field but is also crucial to educate our patients and keep them updated, since medical and surgical management of glaucoma is going to be more individualized. Glaucoma soon will be a curable blindness and we believe that we have already started the journey to accomplish it.