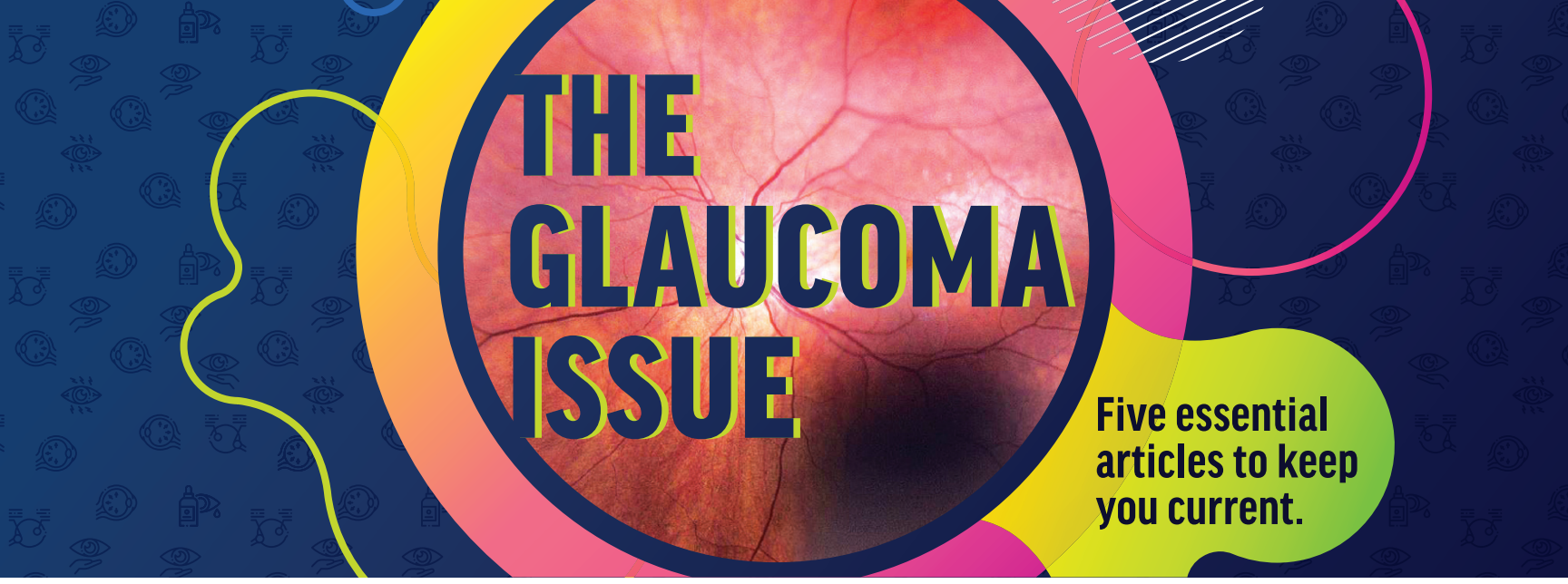

A SURVEY OF TODAY'S GLAUCOMA LANDSCAPE

What's new and what's coming in the diagnosis and treatment of this serious disease.

BY PATRICIA FULMER, OD, FAAO

Glaucoma has become a regular aspect of care in most optometry practices, so it's no surprise that companies and organizations have been dedicating so much time to research and development in the diagnosis and treatment of the disease.

This article reviews some of the most recent and upcoming developments in glaucoma diagnostic testing and therapy options, and briefly discusses an important trending topic for the profession.

DEVELOPMENTS IN DIAGNOSTIC TESTING

Recently, we have seen new technologies in tonometry and visual field testing, as well as advancements in OCT with the addition of angiography. Although not yet mainstream, artificial intelligence (AI) is also showing promise for future use (more about that in *Advances in Artificial Intelligence*).

Tonometry

New devices have been introduced that allow testing in a patient's home, opening the door for more frequent evaluation and practical serial tonometry, as well as the ability to test at any time of day without the restriction of a practice's business hours. The two most recognized options for home-based IOP measurement are iCare Home (iCare USA) and the Triggerfish contact lens sensor (Sensimed).

Clinicians should remember that it is possible to bill for a patient's home IOP measurements using CPT code 92100, serial tonometry, as long as multiple measurements are taken on the same day over an extended period of time. CPT code 0329T is also available for measurements monitored over 24 hours, but it is not as widely accepted by payors as serial tonometry. Reimbursement amounts for each code will vary by state.

iCare Home is a rebound tonometer that patients operate themselves.[1] There is no need for anesthesia, and the device has the ability to upload measurements to the Cloud for a managing physician to review. iCare Home can store up to 1,000 measurements, detect which eye is being measured, and guide the patient through the test with audio instruction and a positioning light. Some practices are renting the iCare Home to patients for a predetermined period of time in order to gain more frequent IOP measurements.

Not commonly used in daily practice, *Triggerfish* is an FDA-approved device that uses a microsensor embedded in a soft contact lens to provide insight into the ocular volume changes that occur throughout the day.[2] These changes are thought to correlate to changes in IOP. The contact lens transmits data to an adhered periocular antenna, which in turn transmits to a recorder worn around the patient's neck. The device takes measurements in any patient position, so it can be worn throughout the day, including overnight.

Visual Field Testing

There have been two main signs of progress within visual field testing in the past few years, one addressing test design and the other introducing new equipment.

ADVANCES IN ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI) has not made its way into clinical practice as of yet, but it is being researched as a glaucoma management tool for the future. There are three main areas in which AI is thought to be useful in this regard: identifying at-risk patients, interpreting data sets, and forecasting disease outcomes.

NO. 1: IDENTIFYING AT-RISK PATIENTS

AI is able to evaluate images or tests to determine which patients are likely to develop or have already developed a condition, such as glaucoma. This sorting method quickly flags those at risk and increases the chances of initiating care.

NO. 2: INTERPRETING DATA SETS

Compared with clinicians, AI has the ability to interpret data sets over time with more accuracy. Systems are able to utilize "poor data" to extract repeatability or progression, while practitioners would more likely need to retest the patient or discard data deemed unreliable. This is particularly evident in visual field testing. AI can also be set to a more customized normative data, which allows for the patient's testing to form a personalized baseline, increasing the chances of accurately identifying progression.

NO. 3: FORECASTING DISEASE OUTCOMES

AI can utilize interpretation of a patient's data to predict that patient's likelihood of blindness and current level of risk. It is also able to set an individualized IOP goal that is updated based upon new testing data as time progresses. This may be significantly useful in tailoring treatment modalities and follow-up frequency for patients in the future.

AI is being applied to multiple forms of glaucoma testing, including OCT, visual fields, and fundus photography.

Source: Mayro EL, Wang M, Elze T, Pasquale LR. The impact of artificial intelligence in the diagnosis and management of glaucoma. *Eye (Lond)*. 2020;34(1):1-11

The latest update in the visual field test itself has come through the introduction of the 24-2c test design layout.[3] In a study published in 2013, Donald C. Hood, PhD, concluded that glaucomatous changes exist in the macular areas of glaucoma suspects and those with all stages of glaucoma. However, because of the spacing between the 12 points in the macular area that are tested in a traditional 24-2 visual field, this early vision loss has often been missed.

Perimetric studies have shown that, in patients with mild glaucoma, 15% of "normal" 24-2 fields showed damage on a 10-2. In response to these new findings, the 24-2c modality has been introduced. This modality adds 10 additional points within the 10˚ macular area, making it less likely for early vision loss to be missed clinically. The 24-2c protocol is being incorporated into the newest models of visual field devices and is already available on both the *VisuALL* VR visual field perimeter (Olleyes) and *Humphrey Field Analyzer 3* (Zeiss) devices.

Virtual reality (VR) has become commonplace in many areas of daily life. In eye care, this technology has been embraced through the invention of VR visual field devices that provide reliable testing comparable to that of a Humphrey Field Analyzer with a much different patient experience.[4] Unlike traditional visual field units, patients using VR headsets can be tested in any chair or position. Gyroscopes within the machine interpret the patient's head position, allowing accurate testing and data point distribution, regardless of the patient's posture. This is particularly remarkable for handicap patients or those with neck or back problems who have struggled with traditional machines. Additionally, these headsets allow adjustable fixation using gaze tracking and are self-monitoring, eliminating the need for staff to supervise the test. Built-in instructions and feedback throughout the test minimize patient error, and the immersive environment increases patient engagement. Despite eliminating the need for monocular occlusion, VR visual field tests are able to test each eye individually and can be performed in any room in a practice or at the patient's home. Combined, these benefits increase the chances of a reliable, repeatable visual field result and help the patient have a more comfortable experience.

Several companies are developing VR visual field headsets, including Olleyes, Virtual Field, M&S Technologies, and Heru. Although the basic concepts of these devices are similar, there are some variations in test types offered and exact specifications of the unit. Many have added features, such as the ability to test color vision or stereopsis, take visual acuity, and perform ptosis screenings. Pricing and purchase structure vary by company, although all units are less expensive than a traditional machine.

WHAT'S NEW IN GLAUCOMA TREATMENT?

Two topical medications have been approved recently. The FDA in September approved omidenepag isopropyl ophthalmic solution 0.002% eye drops (*Omlonti*, Santen

Pharmaceuticals) for the reduction of elevated IOP in patients with primary open-angle glaucoma or hypertension. Omidenepag isopropyl, the active pharmaceutical ingredient in Omlonti, is a relatively selective prostaglandin EP2 receptor agonist, which increases aqueous humor drainage through the trabecular and uveoscleral outflow pathways.

Théa Pharma received FDA approval in December for latanoprost ophthalmic solution 0.005% (*Iyuzeh*), a preservative-free formulation of latanoprost, for the reduction of elevated IOP in patients with open-angle glaucoma or ocular hypertension.

The most recently approved non-surgical glaucoma treatment option is Durysta (bimatoprost intracameral implant, Allergan/AbbVie) 10 mcg, which was cleared by the FDA in 2020. Durysta is an intracameral implant that delivers slow-release bimatoprost through a pellet inserted into the anterior chamber. Treatment results have been shown to last several months.

Many additional therapeutic options are in various stages of the development pipeline, as you'll see below.

Topicals

NCX 470 (Nicox SA) is a second-generation nitric oxide-donating bimatoprost analog in phase 3 development for the lowering of IOP in patients with open-angle glaucoma or ocular hypertension. Mont Blanc, the first of two phase 3 trials for NCX 470, demonstrated that NCX 470 reduced IOP by 8 mm Hg to 9.7 mm Hg.[5-7]

Cromakalim prodrug 1 (CKLP1) is an adenosine triphosphate (ATP)-sensitive potassium channel opener being studied by researchers in the United States and the United Kingdom. This class of medication has a new mechanism of action: it lowers episcleral venous pressure (EVP) 1:1 with IOP lowering. Previously, this amount of EVP lowering could only be accomplished with surgery. Cromakalim prodrug 1 has not yet been tested in humans.[7]

Omidenepag isopropyl 0.002% (Omdi, Santen) is a selective, non-prostaglandin, prostanoid EP2 receptor agonist dosed every night at bedtime that is pending FDA approval for the treatment of glaucoma and ocular hypertension. Although some hyperemia has been noted in studies, no cystoid macular edema or periorbital changes similar to PGAs have been observed.[7]

QLS-101 (Qlaris Bio) is another ATP-sensitive potassium channel modulator that reduces EVP, similar to CKLP1. QLS-101 also widens outflow channels and episcleral vessels distal to the trabecular meshwork. The first phase 2 trial of QLS-101 was completed in 2022 and demonstrated a favorable safety and tolerability profile as well as positive efficacy. In contrast to PGAs, QLS-101 showed no evidence of hyperemia in the study group. Qlaris Bio plans to initiate more trials moving forward.[7,8]

Sustained-Release Options

An intracameral hydrogel-based travoprost implant to treat patients with glaucoma and ocular hypertension (*OTX-TIC*, Ocular Therapeutix) was developed to deliver travoprost for an extended duration of time to improve the issue of compliance with all topical drop therapies. Phase 1 data proved that OTX-TIC is capable of providing a clinically meaningful decrease in IOP comparable to travoprost for 6 months or longer with a single implant while preserving corneal health.[9,10]

Two other sustained-release modalities currently being researched are latanoprost microdose delivery with Optejet (Microprost, Eyenovia) and travoprost or latanoprost delivery via punctal plug (L-evolute and T-evolute, Mati Therapeutics). Mati Therapeutics has demonstrated a 92% to 96% retention rate over 12 weeks through multiple phase 2 trials and a 7 mm Hg IOP reduction, greater than topical latanoprost controls.[10-12]

Surgical Devices

iDose (Glaukos) is a biocompatible titanium implant that releases a proprietary formulation of travoprost inside the anterior chamber. This formulation bypasses the barrier of corneal permeability, allowing the iDose to release micro amounts of the active drug molecule over time. The implant consists of a scleral anchor, which affixes into the trabecular meshwork; the body of the device, which serves as the drug reservoir; and the elution membrane, which titrates travoprost release.[10]

Although not new to market, another notable change in the glaucoma treatment landscape pertains to selective laser trabeculoplasty (SLT). Differing from traditional treatment order, the 2019 report of the Laser in Glaucoma and ocular HyperTension (LiGHT) study concluded that SLT should be considered as first-line therapy for glaucoma based on the following results at 36 months.[13]

- 74.2% of patients were able to remain at target without drops.
- Eyes were within target at more visits than the drop group.
- No surgery was required to maintain target in the SLT group versus 11 required surgeries in the drop group.
- A significant probability was demonstrated of greater cost-effectiveness with SLT than drops.

Based on these conclusions, SLT should strongly be considered in practice, although access to care will likely continue to be a challenge in parts of the country.

TRENDING: SCOPE IN OPTOMETRY

Optometric scope expansion is a hot topic throughout the United States. According to the American Optometric Association, 99% of Americans have access to an optometrist,[14] making it integral that optometrists be able to diagnose and treat the more than 3 million individuals living in our country with glaucoma. Somewhat unbelievably, it was only in 2021 that Massachusetts became the 50th state to grant optometrists the ability to treat

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glaucoma topically.[15] Although we certainly celebrate with our colleagues in Massachusetts, optometry must continue to push forward if we wish to remain able to practice to the changing standard of care.

As SLT becomes more widely viewed as first-line therapy, continued scope expansion will be imperative. To date, 10 states (Alaska, Arkansas, Colorado, Indiana, Kentucky, Louisiana, Mississippi, Oklahoma, Virginia, and Wyoming) allow optometrists to perform laser treatments in-office. Other states are actively working to expand their scope and be able to deliver this important treatment. If you would like to get more involved in scope expansion, reach out to your state association or to the American Optometric Association. ■

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