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LETTER TO EDITOR

Recent Advances in Glaucoma Diagnostics

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Glaucoma, a leading cause of blindness worldwide refers to a group of conditions, characterized by typical changes to the retinal nerve fibre layer, and the optic nerve head, resulting in reduced visual field sensitivity, with IOP (intraocular pressure), being the only modifiable risk factor. Recent scientific research in glaucoma diagnostics is attempting to reduce the enormous socio-economic impact of the disease, through improve methods of disease detection, thereby aiding in its early diagnosis.

As glaucoma causes irreversible damage to the eye, early disease detection is of prime importance, which may be achieved by assessing the intraocular pressure, optic nerve structure, and function, using optic nerve imaging and perimetry, respectively.

Heidelberg Retina Tomograph (HRT), a method for measurement of optic disk parameters, detects subtle changes in optic nerve head configuration and hence contributes to early detection of glaucoma progression. Another new investigative method in the form of Optical coherence tomography (OCT) and OCTA measures the peripapillary retinal nerve fibre layer with macular thickness and vascularity/blood flow to the optic nerve head, retina, and choroid respectively. Both these tests are objective and require less patient cooperation than visual field analysis.

However, these devices have their own limitations. Although we have been using these devices for several decades, both imaging and perimetric techniques have improved considerably. New strategies are emerging to complement these already established techniques.

Despite these recent advances, the role of IOP measurement and IOP control remains of prime importance in managing glaucoma. The newer advances in Glaucoma diagnosis are as follows-

1) Triggerfish CLS

It is a new device that helps in continuous IOP monitoring. It is a non-invasive, soft, disposable contact lens embedded with a miniaturized telemetric sensor for continuous 24-hours Intraocular pressure (IOP) monitoring (figure 1). The contact lens is of 14.1 mm in diameter and 585 micro meter in thickness in its centre with a base curve of 8.4, 8.7, and 9 mm. Embedded within the contact lens are two strain gauges, a microprocessor, and an antenna. The device detects the circumferential

changes in the area of the cornea-scleral junction, and the corresponding IOP value is transmitted wirelessly via a flexible adhesive antenna worn around the eye to a portable recorder worn on the body (Figure 2).

The device was approved by the FDA in 2016 to detect the variation in IOP over a period of 24 hours. It is a useful device to detect nocturnal or non-clinic hours IOP peak in glaucoma patients.

2) Home Tonometry (iCare Tonometer)

It is an FDA-approved (2017) self-IOP monitoring device, based on the principle of rebound tonometer (figure 3). The iCare tonometer device has a 40 mm metal probe with a 1.7 mm diameter plastic end-tip which is accelerated through a solenoid chamber towards the corneal surface, and the speed of the rebounding probe is recorded to give the IOP. The procedure does not require anesthesia (figure 4).

Studies have shown a strong correlation between the iCare HOME and Applanation tonometry measured IOP with inter-device variation within 5 mmHg.

The major disadvantage of this device is the inability of patients to accurately use the device. About 16 to 25% of patients have difficulties in completing training of Self IOP monitoring. This device is not useful in picking up nocturnal IOP spikes.

3) Virtual and Home Perimetry

It is a head-mounted eye-tracking perimeter, that does the equivalent of a full threshold 24–2 visual field (Figure 5). In addition to manual patient response with a click, it can also track changes in gaze while detecting stimulus (visual grasp). It has the advantage of being portable, affordable, and convenient to use in bedridden or wheelchair patients. (Figure 5). However, it is not as sensitive as Standard automated, perimetry and may miss early glaucoma. It is uncomfortable for claustrophobic patients.

The normative database in this device is still being validated.

4) OCT-A (OCT Angiography)

OCT angiography is a new, non-invasive diagnostic method through which the vascular structures of the retina and choroid may be visualized in three dimensions without the need for contrast agent injection. Through acquisition software and more advanced hardware, OCTA enables imaging of the retinal vascular flow easily (Figure 6).

OCT-Angiography is based on the principle of diffractive particle movement detection, such as red blood cells, on sequential OCT B- scans performed repeatedly at the same retina location, therefore, showing the presence of blood vessels. This method is based on differences between the B-scans to generate a movement-related contrast, especially a contrast related to erythrocyte movement In the vascular system. This new investigation also has the potential to enhance our understanding of the disease mechanism since microvascular changes can now be easily correlated to structural features. Currently, OCTA is widely used in the clinical setting to guide Glaucoma treatment and diagnostic decisions.