OCT phenotyping the fundus in glaucoma care, management

How new techniques and parameters perform in clinical practice

By Lisa Stewart

Heidelberg Engineering hosted an evening workshop, OCT Phenotyping the Fundus in Glaucoma, at the 16th European Glaucoma Congress, in Prague. The three speakers, Professor Balwantray Chauhan, Professor Christian Mardin, and Dr Claude Francis Burgoyne, showcased the use of optical coherence tomography (OCT) imaging in glaucoma care and management. They described the structures relevant for glaucoma that can be identified by OCT and how new techniques and parameters perform in clinical practice.

The talks focused primarily on the Bruch's membrane opening minimum rim width (BMO-MRW) and retinal nerve fibre layer thickness (RNFLT), deterioration in both of which is important in monitoring glaucoma progression.

Segmented retinal thickness values

Professor Chauhan, from Dalhousie University, Halifax, Canada, summarised the early results of his ongoing project to build up a normative database of spectral domain OCT (SD-OCT) images and described the use of these detailed images of the macula, in particular, to investigate age-related changes in retinal layers.

The ganglion cell layer and the inner plexiform layer were found to deteriorate significantly with age, whereas the other layers do not seem to be affected by age at all. He illustrated how important it is to consider variations in fundal anatomy by showing scans of two individuals whose FoBMO angles—the angle between the fovea and the BMO centre—differed by 20°.

Both he and Dr Burgoyne emphasised how important it is when collecting and analysing retinal scans to consider variations in anatomical orientations between individuals.

BMO-MRW and RNFLT in optic atrophies

The second speaker was Professor Christian Mardin of the Friedrich-Alexander University of Erlangen-Nürnberg, Germany, who presented a series of real-life case studies looking at BMO-MRW and RNFLT in patients with optic discs that appeared suspicious on first examination; both measurements must be compared with a normative database to be meaningful.

> If BMO-MRW and RNFLT do not agree, one may need to go back to ophthalmoscopy for a careful look at the fundus and disc.

He described various different cases and showed how, in most cases of glaucoma, the MRW flags up many more sectors of deterioration than the RNFLT.

Often, however, changes in RNFLT that are not visible on initial inspection become obvious when a regression line is plotted over time: there is slight deterioration with age in patients without glaucoma but the slope is steep in patients whose glaucoma is progressing.[1]

Professor Mardin concluded by stressing that if BMO-MRW and RNFLT do not agree, one should go back to ophthalmoscopy for a careful look at the fundus and disc.

IN SHORT

- ***Presenters as a recent European industry symposium described the structures relevant for glaucoma that can be identified by optical coherence tomography (OCT) and how new techniques and parameters perform in clinical practice.***

Importantly, the information from OCT readings must be interpreted critically and in context. Examining sectoral data alongside global data can flag up subtle changes. Looking critically at the B-scans will sometimes allow detection of misalignment or other errors that can lead to misinterpretation, or indeed that might be indicative of simple optic atrophy or less-common diseases.

For example, one of his case studies had presented apparently with normal tension glaucoma and vision loss, but OCT showed a major discrepancy between almost normal BMO-MRW and pathologic RNFL thickness, which was indicative of a problem other than glaucoma. The patient was sent for an MRI scan and diagnosed with multiple sclerosis.

One must also remember that measurement of RNFLT reaches a "floor" at around 50 µm, below which no further loss will be flagged up by OCT, perhaps because of glial cells invading the nerve fibre layer and preventing further loss of thickness.

Behaviour of the neuroretinal rim and the retinal nerve fibre layer

The last speaker, Dr Claude Burgoyne of the Devers Eye Institute, Portland, OR, USA, considered whether and why the neuroretinal rim and the retinal nerve fibre layer behave differently as glaucoma progresses. A study of experimental glaucoma in monkeys in his laboratory showed that changes in the optic nerve head parameters MRW and minimum rim area (MRA)—a three-dimensional parameter that is interpolated from B-scans of the optic nerve head—consistently precede RNFLT changes.[2]

A second monkey study showed that, of the three OCT parameters, RNFL correlates most closely with axon count in the optic nerve.[3] Why this is the case, when the neuropathy clearly manifests more profoundly in the nerve head than the RNFL, is unclear: hypotheses include the effect of the different compositions of rim tissue versus RNFL, or the fact that laminar/scleral canal deformation affects the rim more than the RNFL.

> Changes in RNFLT not visible on initial exam become obvious when a regression line is plotted over time.

As was the case with Professor Mardin's multiple sclerosis patient, when the nerve fibre layer appears to change before any changes to the optic nerve head manifest, then Dr Burgoyne thinks suspicions should be raised.

However, in elderly patients who tend to have stiff connective tissues, it is more difficult to detect structural change in the nerve head, and easier to detect it in the nerve fibre layer, which means the structure function relationship shifts with age.

"The exciting fact is that we now have tools to longitudinally follow these tissues and assess whether non-axonal components of the rim are changing at different rates and whether those changes ultimately have predictive value for axonal loss in the same region. In other words, wouldn't it be a beautiful thing if the rim does change earlier and those changes are early pathophysiology of non-axonal tissues and therefore predict axonal loss?", Dr Burgoyne said.

REFERENCES

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