Advances in ultrasound bring choroid imaging into greater focus

Dermot McGrath
in Sao Paulo

WHILE optical techniques can reveal much about the structure of the retina, recent advances in high-resolution ultrasound techniques mean that detailed images of the choroid and deeper tissues can now be obtained. These images are beneficial in diagnosing and tracking pathologies such as diabetic retinopathy and age-related macular degeneration as well as assessing the effectiveness of a variety of treatments in these patients, according to D Jackson Coleman MD, FACS.

"There were limitations as to what we could achieve using the old 10 MHz scan as it did not give a great deal of definition to the retina. We could use it to detect a retinal detachment and certain other structural changes, but it is only at 20 MHz that we begin to see the definition of the choroid and the sclera," he told a session of the World Congress of Ophthalmology.

Dr Coleman, professor and chairman of the Department of Ophthalmology at Weill Medical College of Cornell University, New York, said that new advanced digital processing techniques, developed in collaboration with Ronald Silverman PhD and Mark Rondeau, can provide better resolution for enhanced screening.

"With harmonic imaging, we can actually go from 20 MHz to 40 MHz. However, the reason we can’t go higher than this frequency is that there is a drop-off in penetration to the back of the eye once we go over 30 MHz."

A clinical trial currently under way at Cornell, for instance, is using ultrasound studies in conjunction with optical coherence tomography (OCT) imaging in a series of patients and age-matched control subjects to determine if choroidal thickness and/or perfusion might be used as an early indicator of AMD and thus aid in patient management.

Dr Coleman said better results and a wealth of valuable clinical information can now be obtained using a combination of advanced techniques such as wavelet transform, harmonic imaging and swept imaging.

He said wavelet transform provides increased boundary enhancement and enhanced imaging detail. Such an approach can also provide composite colour images as well, although Dr Coleman said he personally prefers grey scale images for their higher definition. To illustrate the high level of detail possible with wavelet transform, Dr Coleman showed how the images could be used for patients with drusen and age-related macular degeneration to monitor changes in the choroid and retina over time.

Turning to swept mode imaging, Dr Coleman said this technique provides integrated imaging to accurately measure blood flow in the choroid. It is useful for examining patients prior to and following photodynamic therapy, as well as other treatments involving a variety of pharmacologic agents in the back of the eye, he said.

Another benefit of swept mode imaging is its ability to differentiate small melanomas of the choroid or ciliary body and enable the clinician to determine which patients should be followed more closely.

"We can do this using choroidal replacement in tumour cavities as a way of differentiating a more lethal type of melanoma or one we should follow more rapidly from one that is slower growing or a dormant tumour," said Dr Coleman.

Dr Coleman said that these advances in ultrasound imaging allow for better assessment and stratification of architectural changes in the back of the eye, and provide an improved method for diagnosis, treatment planning and follow-up evaluations for surgical procedures to preserve and correct vision.

"These imaging techniques have been designed to help stratify patients both in terms of architectural changes that we see in pathologies such as macular degeneration, diabetic retinopathy, or tumours. We can then use these stratified areas to reduce the size of the cohorts necessary for evaluating different findings of treatment. For choroidal evaluation, both in terms of its properties and in terms of blood flow, I believe that these techniques will prove to be a very useful adjunct, particularly in assessing the use of pharmacologic agents," he said.

Djcolema@mail.med.cornell.edu

-Ultrasoundogram of the posterior pole with digital deconvolution to emphasise boundary planes of retina, choroid and sclera. (a) Inner surface of retina; (b) posterior surface of retina; (c) posterior surface of choroid; (d) Tenon’s capsule

(U) wavelet image of normal choroid; (b) wavelet image of choroid with age-related macular degeneration with drusen and change in choroidal microarchitecture. (a) ch, choroid; sd, sub-retinal fluid

"Using this approach we are also able to demonstrate important developments such as protein lipid deposition and thickening of Bruch’s membrane, as well as changes in the choriocapillaris," he said.

Harmonic imaging is another approach that can provide an increased amount of detail of the anatomical structures at the back of the eye, noted Dr Coleman. He said it is particularly useful for viewing inflammation and may be beneficial for examining patients with diabetic retinopathy, as well as for examining the effectiveness of a variety of pharmacological treatments in these patients.

"With harmonic imaging, we can actually go from 20 MHz to 40 MHz. However, the reason we can’t go higher than this frequency is that there is a drop-off in penetration to the back of the eye once we go over 30 MHz. But this technique is very useful to track inflammation, which we are discovering plays an important role in diabetic and macular degenerative changes, and certainly in the treatment of different pharmacologic agents of macular degeneration," he said.