New macular function tests aid AMD treatment

Marie-Jose Tassignon

New macular function tests are becoming available which can provide useful insights into retinal pathology and which may provide a more accurate assessment of visual function than visual acuity testing in patients with retinal disease, reported researchers at the 6th EURETINA Congress.

"Visual acuity is not enough to quantify human visual function and its impairment in relation to daily life activities. It is unreliable in poor vision patients and the functional point of view is really the patient's point of view, said Edoardo Midena MD, Padua, Italy. Patients with retinal disease frequently experience a degree of retinal dysfunction that will not be detected by visual acuity testing, he noted. Moreover, structural changes detected by fluorescein angiography and OCT have an exact quantification of the visual function of the retina, he said.

Up until recently SLO microperimetry (formerly Rodenstock, now Confocal Technologies) was the gold standard in macular function testing. It is now being largely replaced by Nidek's new MP1 microperimeter, a system that has several advantages over SLO microperimetry, he noted.

While SLO microperimetry provides a means of mapping the functionality of the photoreceptors of the fundus, it does not do so in a fully automatic way. Moreover, it cannot reliably perform follow-up examination of the points of the retina tested initially, as it depends on a patient's fixation characteristics, which can change over time. In contrast, the MP 1 device performs automatic perimeter independent of fixation characteristics. Furthermore, the system's automated eye tracking ensures that follow-up examinations will quantify retinal thresholds exactly on the same retinal points that are tested during baseline examination.

The system also allows the creation of differential maps that can be superimposed on high-quality colour retinal photographs, as opposed to the black-and-white infrared image of the fundus provided by SLO microperimetry.

**Clinical applications of MP 1**

Microperimetry with the MP 1 system has a range of potential applications in a number of retinal pathologies, including diabetic macular oedema, AMD, vitreomacular interface diseases and glaucoma, Dr Midena noted.

In eyes with diabetic macular oedema, the technology may supplement the predictive value of OCT and visual acuity in patients with diabetic macular oedema, Dr Midena noted.

A study by Dr Midena and colleagues that appeared in the July 2006 issue of the Journal Investigative Ophthalmology and Visual Science, indicated that macular function as determined by microperimetry appeared to provide a more sensitive determination of disease status than visual acuity testing or OCT.

The study involved 61 eyes of 32 diabetic patients. It showed that the difference in macular thickness between those without macular oedema and those with clinically significant macular oedema was paralled by a sharp decrease in macular sensitivity.

In addition, linear regression analysis showed that there was a decrease of 0.83 dB (P < 0.0001) of fundus sensitivity for every 10 per cent of deviation of retinal thickness from normal values.

"We have seen that there is a relationship between OCT, microperimetry, and probably microperimetry data are a little bit more sensitive as they determine the function of the eye rather than just the thickness of the retina." He noted.

While visual acuity correlated significantly with central macular sensitivity in eyes with non-clinically significant macular oedema, it did not correlate significantly with macular sensitivity in eyes without macular oedema or those with clinically significant macular oedema, Dr Midena said.

**Microperimetry in AMD**

In AMD patients, the technology can determine fixation characteristics, the presence of scotoma, which can be useful in quantifying the disease's impact on visual function and optimising patient selection and the timing for treatment, Dr Midena suggested.

"People with central field loss use a single area of the retina with which to fixate; the pseudo-fovea or preferred retinal locus. To identify this site there is no other technique than fundus perimetry." He noted.

It is also important to determine the stability of fixation as it will reflect the patient's ability to read, he added. In a study involving 118 eyes of 98 patients AMD patients with subfoveal CNV (E Midena et al, Sem Ophthalmol, 2004), microperimetry indicated that the location of the preferred retinal locus of fixation and the stability of fixation were not mutually dependent. For example fixation was central in 22 per cent but stable in 26 per cent, while it was eccentric in 63 per cent but unstable in only 45 per cent.

In addition, occult and classic CNV had similar impacts on fixation characteristics. In eyes with classic CNV, fixation was central in 15 per cent, poor central in 15 per cent, and predominantly eccentric in 70 per cent, while corresponding values for eyes with occult CNV were 30 per cent, 17 per cent and 53.3 per cent, respectively.

Similarly, fixation in eyes with classic CNV was stable in 20 per cent, relatively unstable in 37.5 per cent and unstable in 42 per cent, while corresponding values for eyes with occult CNV were 33.3 per cent, 36.7 per cent and 30 per cent, respectively.

Dr Midena added that a previous study using SLO microperimetry (GY Fuji et al, AO, 2003) has demonstrated that the retinal function varied significantly in lesions of the same size.

**Early AMD project**

Dr Midena and his associates have recently initiated a long-term prospective study in which they are analysing the evolution of AMD using MP1 microperimetry and autofluorescence maps. Their findings thus far indicate that features such as drusen can influence visual function in ways that are not detectable with ordinary visual acuity testing, he said.

"We have found that fixation in these patients is central and stable and they are able to read but there is a progressive loss of sensitivity, and patients need more light to perform visual tasks. We have also seen a progressive loss of sensitivity in areas with increased autofluorescence. It is therefore likely that combining fluorescein angiography and microperimetry will provide more information about the history of these patients and help in assessing the effects of treatment," he said.

He noted that previous research has demonstrated that drusen can contribute to the degeneration of photoreceptors by displacing, deflecting or truncating the cells and by changing the retina's synaptic structure.

"Microperimetry and autofluorescence may be useful in the follow-up of patients with early AMD. Drusen and fluorescein autofluorescence probably do not represent independent measures of early AMD. Loss of sensitivity is related to neurosensorial changes over drusen and this effect is more relevant when drusen show increased autofluorescence," he added.

**SLO microperimetry a useful predictor of visual outcome**

While the technology may be headed for obsolescence, the findings of SLO microperimetry remain useful in predicting visual outcome after macular surgery, said Marie-Jose Tassignon MD, University Hospital, Antwerp, Belgium.

She noted that in a series of cases of significant macular pucker, with or without cystoid macular oedema, the findings of microperimetry were more predictive of good visual outcomes than the degree of structural change.

"Postoperatively we observed that in the cases where results are good with high and low intensity light spots pre-operatively, in fact, the patients usually end up with very good visual acuity postoperatively. So we verified our hypothesis that microperimetry pre-operatively can be of a certain predictive value of visual acuity postoperatively." She highlighted one case where an eye with an advanced macular pucker due to diabetic retinopathy was considered inoperable. However, microperimetry showed that the patient had good fixation and a significant portion of the macula was free of scotoma. Subsequent surgery improved the eye's visual acuity from 0.1 to 0.3.

Dr Tassignon noted that patients with damaged retinas would use their disease-affected eyes differently than before when performing visual tasks like reading. She suggested that visual function in patients with retinal diseases might be more precisely determined by means of a technique called Vision Monitor photo-oculography. The test measures eye movements based on the position of the corneal reflex compared to the pupillary centre.

The test shows that, when reading a portion of text, the eye of a patient affected by macular disease will have a markedly different saccadic pattern than their contralateral eye, even if surgery has returned visual acuity of their affected eye to 1.0, she noted.

"Quality of vision after macular surgery is not only defined by visual acuity, so it is very important in the future to try and combine all these technologies evaluating anatomy and function," Dr Tassignon said.

**Preferential hyperacuity perimeter**

A new device called the preferential hyperacuity perimeter (Zeiss PreView PHP) can also provide useful means to evaluate changes in visual function in patients with AMD, said E Wylegala MD, Medical University of Silesia, Katowice, Poland.

"The PHP is the first commercially available device used for qualitative evaluation of macular vision. Its measurements are based on angle resolution testing for a subtle misalignment of one object compared to another – so-called 'verner acuity' or 'hyperacuity phenomenon', he explained.

He noted that the angle resolution measured by PHP is accurate to within three to six angular seconds, which is 10 times more than that of standard Snellen visual acuity testing. Moreover, the sensitivity of
PHP measurements is two to three times higher than that achieved with an Amsler grid test. Furthermore, results of PHP tests are almost completely unaffected by a patient’s contrast sensitivity, age or optic media transparency.

A prospective study conducted by Dr Wylegala and his associates indicated that the device is more sensitive than standard visual acuity testing for monitoring subtle changes in visual function in AMD patients following treatment with verteporfin/PDT.

The study involved 40 eyes of 40 patients with subfoveal CNV, confirmed by fluorescein angiography and OCT. Their visual acuity ranged between 0.3 and 0.7 (logMAR score). The patients underwent visual acuity and PHP testing one day before, one week, and four weeks after photodynamic therapy with verteporfin/PDT.

"Dynamics of macular vision area changes after PDT treatment was evaluated on the basis of PHP macular vision area map comparison, where the metamorphopsia areas and intensity could be obtained," Dr Wylegala explained.

**Tranitory decrease in macular function**

They found that in a high proportion of patients macular function appeared to decrease one week after PDT but was improved at four weeks, while visual acuity was stable or improved in most patients from one week onward.

One week after PDT, 30 eyes (75 per cent) presented temporal progression of their condition in terms of PHP, whereas visual acuity worsened in only nine patients (22.5 per cent), remained stable in 60 per cent and improved in three patients (7.5 per cent).

However, at four weeks there was improvement in PHP results in 20 eyes (50 per cent), stabilisation in 15 eyes (37.5 per cent) and progression in five eyes (12.5 per cent). Meanwhile, visual acuity was improved in 11 eyes (27.5 per cent), stabilised in 26 eyes (65 per cent) and decreased in three eyes (7.5 per cent).

"Macular vision area testing by means of PreView PHP seems to be a useful and promising method of age-related macular degeneration dynamics evaluation and monitoring photodynamic therapy results. One week after photodynamic therapy there is often a temporary progression of changes, but improvement can be expected during longer periods of healing," he added.

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