OCT effective in detecting retinal thickness changes in cataract patients

Aldina Reis

Cheryl Guttman in Paris

OPTICAL coherence tomography using the OCT2 (Humphrey) is effective in detecting subclinically significant changes in retinal thickness in the eyes of cataract surgery patients, Aldina Reis MSc, University of Coimbra, Portugal told the XXII Congress of the ESCRS in Paris.

In a prospective study, Dr Reis and her associates used the OCT2 device to evaluate 173 eyes of 173 patients before and six weeks after they underwent phacoemulsification and implantation of a foldable IOL. The results showed that cataract surgery tended to cause an increase in retinal thickness.

The investigators performed OCT examinations after pupillary dilation using six radial lines, each with a length of 3.45 mm, centred at the fovea. They measured retinal thickness of the central (1.0 mm), inferior, nasal, superior, and temporal areas.

Values were increased significantly postoperatively compared with baseline in all five measured areas. At six weeks follow-up, mean central retinal thickness had increased from 185 microns at baseline to 207 microns, and it was greater than two standard deviations away from the department's normal mean in 42% of eyes, said Dr Reis.

Furthermore, while there was no significant correlation between the preoperatively measured Snellen best-corrected visual acuity and central retinal thickness, postoperatively, visual acuity worsened with increasing central retinal thickness.

Further analyses showed that postoperative increases in central retinal thickness were statistically associated with visual acuity. In the operated eyes, mean pre-operative best-corrected acuity was 0.28, improving to 0.81 at week six, with 74% of eyes achieving a best-corrected acuity of 0.8 or higher.

"The goal of cataract surgery is to obtain optimal visual acuity. While macular oedema is a frequent finding after cataract surgery, it usually has minimal effect on visual acuity. Various quantitative methods based on measurement of leakage or retinal thickness have been used to study this pathology. OCT has been used to quantify changes in a variety of other pathologies and our study shows this non-invasive, non-contact technology can also be used to measure the effects of cataract surgery," said Dr Reis.

> "While macular oedema is a frequent finding after cataract surgery, it usually has minimal effect on visual acuity."

Comparisons between the operated and non-operated eyes showed they were identical with respect to mean central thickness at baseline (185 microns) whereas best-corrected acuity was significantly worse in the operated versus non-operated eye (0.28 vs. 0.55).

Are the data reliable?

To study the validity of OCT measurements in the presence of cataract and to investigate the effect of cataract surgery on retinal thickness the Coimbra researchers also evaluated data from 152 of those eyes to determine the reliability of OCT2 measurements in eyes with cataract. OCT measurements were also obtained in the fellow, non-operated eyes that did not have so dense cataracts or being pseudophakic eyes.

Central retinal thickness and best-corrected acuity remained stable in the non-operated eyes. However, postoperatively, central thickness was significantly higher in the operated versus non-operated eyes (207 microns vs 192 microns) while the operated eyes had significantly better best-corrected acuity (0.81 vs. 0.55).

In addition, the foveal standard deviation (standard deviation of the point of intersection of the six radial lines) was significantly higher in the operated eye versus the non-operated eye at baseline. Moreover, this measure decreased significantly by six weeks after surgery in the operated eye so that there was no longer any statistically significant difference between foveal standard values in the two eyes.

A review of the global OCT data showed a correlation between high foveal standard deviation at baseline and heterogeneity of the values from the five measured areas. However, that correlation was no longer present in the operated eyes at week six when foveal standard had decreased.

Using the baseline data, the researchers then translated the range of OCT values for each eye (maximum _ minimum) into an amplitude value. Finding a close correlation between amplitude and foveal standard deviation, they established a "fidelity limit" for foveal standard deviation above which amplitude (thickness value heterogeneity) seemed to increase.

Less effective for eyes with dense cataracts

When they compared the preoperative foveal standard deviation with preoperative VA and found a significant inverse correlation between the two values. Using mathematical analysis and the established fidelity limit, they determined that the reliability of OCT may be reduced in cataractous eyes with visual acuities of 0.3 or less.

"While OCT has been used widely in the diagnosis of a variety of disease of the macula and optic nerve, our experience with that technology suggested the presence of lens opacity might induce some difficulty in scanning and interpretation of the results. This investigation indicates that transparent media is not an absolute requirement for using OCT, although reliability of the data may be lower in the case of more advanced lens opacity," said Dr Reis.

Analyses of the amplitude values revealed that patients with a high foveal standard deviation at baseline had more heterogeneous values in the five measured areas and significantly higher amplitude compared with the unoperated eyes.

Comparing pre- and post-operative data from the operated eyes showed a decrease in heterogeneity of the retinal thickness values and a significant reduction in the amplitude. Amplitude was unchanged over time in the non-operated eyes and not significantly different compared with the operated eyes at week six.

Correlation testing was then performed and showed a highly statistically significant relationship between foveal standard deviation and the amplitude of values for the operated eye at baseline.

A plot of foveal standard vs. amplitude was used to empirically identify a foveal standard cut-off value (the so-called "fidelity limit") above which amplitude seemed to increase, representing greater heterogeneity of the retinal thickness values. Further analyses then focused on determining any relationship between the fidelity limit and visual acuity.

> "These data indicate it may not be possible to measure retinal thickness with OCT when the visual acuity is 0.25 or less."

Comparison of the baseline VA and foveal standard in the operated eyes showed those two variables were significantly inversely correlated with each other. Therefore, a linear regression equation defining the relationship between foveal standard deviation and visual acuity was developed. Substituting into that equation the fidelity limit (70 microns) for the foveal standard value showed that the fidelity limit was reached at a visual acuity of 0.31.

"In fact, in a plot of foveal standard on the Y-axis and visual acuity on the X-axis, if we project a vertical line at the point where visual acuity is 0.31, it is clearly seen that there is higher variability for the foveal standard values to the left of that line in the region of poorer visual acuity," Dr Reis said.

It was not possible to obtain OCT measurements at baseline in 11 of the patients enrolled in the study. Review of their visual acuity values showed a very low mean of 0.09 with a range from 0.01 to 0.25.

"These data indicate it may not be possible to measure retinal thickness with OCT when the visual acuity is 0.25 or less. In our study, we could not obtain OCT measurements in 14% of the population with visual acuity equal to 0.25 or less," Dr Reis observed.

Aldina Reis MSc
aldinareis@mail.pt