Multimodal Guidance for Macular Laser Photocoagulation

Different diagnostic modalities lead to differences in laser treatments for DME.

BY IGOR KOZAK, MD, PhD, AND J. FERNANDO AREVALO, MD, FACS

Diabetic macular edema (DME) is a common cause of visual loss in diabetic patients of working age.[1] Evidence-based treatment options include focal/grid laser photocoagulation and intravitreal antiangiogenic agents and steroids. Sustained glycemic control is also effective in controlling disease progression.

Due to the high efficacy of intravitreal pharmacotherapy for DME, the role of laser to the macula has shifted in recent years. Once considered first-line treatment, laser is now frequently used to stabilize structural and functional improvements after initial antiangiogenic pharmacotherapy and to decrease the number of subsequent intravitreal injections.[2-6]

During photocoagulation, ophthalmologists have several options to guide their placement of laser spots. For grid laser, some prefer a stereo fundus view to apply laser only where macular thickening is obvious with no need of additional imaging studies. Others like to guide their grid laser application based on optical coherence tomography (OCT) thickness maps that detect macular edema, in case it is not apparent or clear from clinical examination. Focal laser treatments are usually guided by fluorescein angiography (FA), which shows the numerous microaneurysms and areas of diffuse dye leakage that are to be targeted. This variety of options results in tremendous variation in the treatment of macular diseases with laser.

In a recently published study, we and our coauthors from the King Khaled Eye Specialist Hospital in Saudi Arabia and the University of California, San Diego, looked into how different preoperative imaging modalities can influence treatment decisions for macular laser photocoagulation.[7] We performed a prospective randomized study of 14 eyes of 10 patients with symptomatic DME undergoing laser photocoagulation using navigated laser (Navilas Laser System; OD-OS GmbH). This photocoagulator also incorporates the ability to perform FA and to take color fundus photographs, and for this study, each patient's FA was superimposed onto that patient's color fundus photograph taken with the same system.[8] Before treatment, a retinal thickness map was acquired for each eye with spectral-domain OCT using the Spectralis (Heidelberg Engineering). These images were then imported to the laser photocoagulator unit and also superimposed and aligned onto the fundus image of the same eye.

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A treatment plan was then devised by 3 retina specialists on the Navilas laser screen for each study eye. This process consisted of placing laser spot marks separately on FA and OCT images in a masked fashion. For the most part, treatment decisions were based on the modified ETDRS method, targeting all leaking microaneurysms with spot treatment and delivering grid laser to areas of edema. Areas of dye leakage on FA and increased retinal thickness on OCT in the same eye were also delineated using Image J software (US National Institutes of Health). The study authors compared the number of spots placed by each physician using FA and OCT, and the differences among physicians were assessed with appropriate statistical tests.

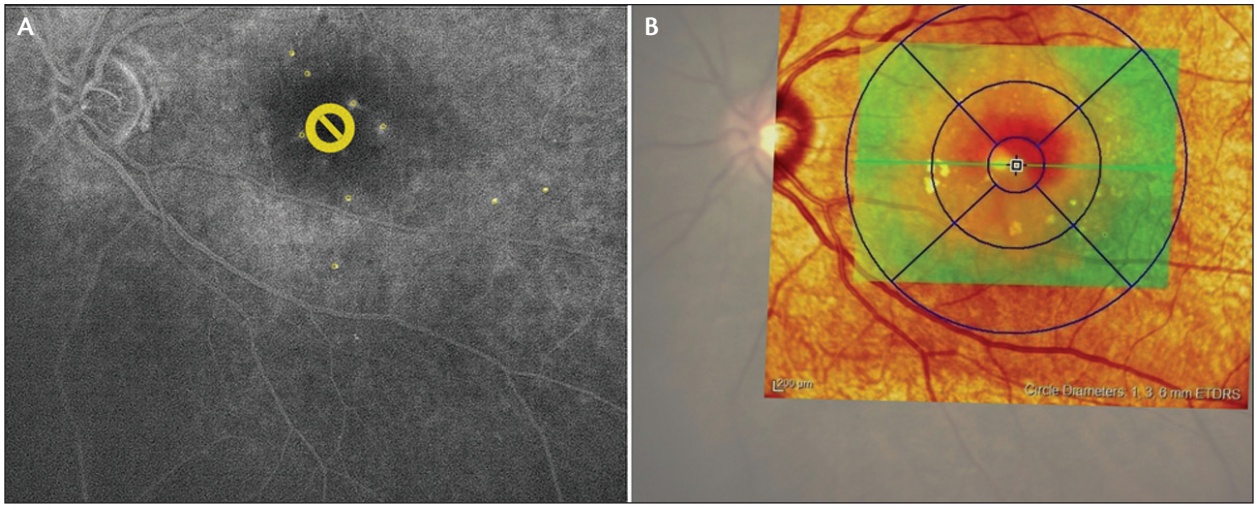

Figure 1. Late-phase FA (A) showing minor perifoveal leaks and a resulting treatment plan targeting microaneurysms (9 spots). The central yellow circle represents a no-treatment zone. An OCT thickness map overlayed on the fundus photograph of the same eye (B) demonstrates central macular thickening. The treatment plan included 3, 6, and 4 (n = 13) spots in the nasal, superior, and temporal middle ETDRS rings, respectively.

The study included 6 men and 4 women with DME; mean age was 64±8.5 years. The average numbers of planned spots using FA and OCT templates were 36.6 and 40.6, respectively (P = .0201; Figure 1). The average area of dye leakage on FA was 7.45 mm^2, whereas the average area of increased retinal thickness on OCT superimposed on the fundus image of the same eye was 10.92 mm^2 (P = .013). There were no statistically significant differences among the 3 physicians in the numbers of laser spots placed on OCT maps or FA images.

COMPLEMENTARY MODALITIES

In the ETDRS, laser photocoagulation treatment was directed at all "treatable lesions" identified by biomicroscopy and/or FA, which localized leaking microaneurysms and thus improved the accuracy of photocoagulation treatment.[9] OCT offers additional anatomic information for characterizing DME, and, due to its noninvasive character, use of OCT has surpassed that of invasive FA in retina clinics. OCT thickness maps have been widely used to guide macular laser therapy for DME, and many physicians use them instead of angiograms, especially those preferring grid photocoagulation as their treatment approach.[10,11] FA and OCT, however, are complementary in diagnosing the type and extent of DME.

As shown by our study, there is a wide variability in macular photocoagulation among physicians when they base their treatment plan decisions solely on 1 of these modalities. The 3 physicians placed different numbers of laser spots for the same DME pathology when they were guided by different imaging templates. They tended to treat more when the treatment was guided by OCT than FA. This could be because the pathologic area measured larger on OCT compared with FA. Discrepancies between FA and OCT in detection of macular edema have previously been described.[12-14]

Studies have also shown variations in macular photocoagulation treatment.[15] Van Dijk and colleagues found differences in the assessment of DME with OCT or stereoscopic biomicroscopy, which then led to differences in photocoagulation treatments. In that study, retinal specialists differed markedly in the number and placement of planned laser spots when given identical information concerning the presence and location of DME and treatable lesions. Thus, there seems to be a natural variation in treatment decisions even with the same baseline information, but the difference is magnified if the baseline information is somewhat different.

CONCLUSION

Our study expands recent observations by other authors that the treatment threshold and the number of laser spots differ depending on whether macular edema is diagnosed by biomicroscopy, OCT, or FA. This is of utmost importance in ongoing and future clinical trials comparing macular laser photocoagulation with intravitreal pharmacotherapy. The designs of clinical trials for intravitreal injections include well-defined pharmacokinetics and dosing regimens for the pharmaceutical arms, but this is not the case for the laser arms of these trials. Most clinical trials employ strict criteria for rescue

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therapy or retreatment in the laser arms, but execution depends on the study investigators, the imaging modalities they use to diagnose the extent of DME, their training, and their personal experience.

Our study shows that, even in the hands of experienced retina specialists, there is variation in laser treatment. As such, it may be that clinical trials are finding variable treatment results with laser and comparing these to very standardized pharmacotherapy protocols. Therefore, the information used to guide macular laser photocoagulation may have an impact on what and how much we treat and potentially influence the treatment outcomes. ■

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