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EDITORIAL (BY INVITATION)

The heyday of optical coherence tomography angiography is just around the corner

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Since the introduction of optical coherence tomography (OCT) nearly three decades ago, this noninvasive imaging modality has dramatically changed our clinical practice. The advances in OCT technology have aimed for higher resolution and higher acquisition speed, resulting in widefield (WF)-OCT imaging and phase-variance OCT (i.e., OCT angiography: OCTA) imaging [1]. The advent of OCTA enabled noninvasive imaging of ocular blood flow and has contributed significantly to obtaining detailed information on macular disorders among others. It is well known that OCTA is inferior to conventional dye-based angiography (fluorescein angiography [FA]/indocyanine-green angiography [IA]) in that it is unable to identify dye leakage from disrupted blood-retinal barrier or dye staining to abnormal ocular tissues. However, the advantage of OCTA over FA/IA (i.e., high-resolution, noninvasive visualization of microvasculature with depth resolution) is so powerful that clinical research on the macula or optic disc using OCTA is progressing rapidly [2].

WF-OCTA retains advantage of OCTA against FA/IA and attains the assessment of far larger fundus area than non-WF-OCTA. Since diabetic retinopathy (DR) is a disease in which retinal blood vessels are mainly damaged, it is one of the important eye diseases to be evaluated by OCTA. Sun Z and associates prospectively investigated the relationship of OCTA metrics to DR progression and development of diabetic macular edema (DME) and found that some OCTA metrics can predict DR progression and DME development [3]. As the OCTA metrics used in this study were calculated from macular OCTA data only, additional data provided by WF-OCTA could further improve the prediction accuracy of OCTA in DR progression and DME onset.

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Another attempt to apply WF-OCTA to the management of DR is the assessment of changes in nonperfusion (NP) areas which potentially lead to vision threatening ocular events: vitreous hemorrhages and/or tractional retinal detachment. Couturier A and associates conducted an observational case series of severe non-proliferative DR or proliferative DR (PDR) treated with 3 initial monthly injections of anti-vascular endothelial growth factor (VEGF) drug for DME and obtained the following results: the ability of swept-source WF-OCTA to detect capillary NP areas was higher than that of ultra-WF FA, no change in capillary NP was observed, and no reperfusion of small retinal vessels in NP areas was seen on swept-source WF-OCTA after anti-VEGF therapy [4]. Although the authors did not directly mentioned, this study showed that WF-OCTA is a powerful tool to assess subtle changes in retinal vasculature and blood flow in eyes with DR.

Disadvantages of current WF-OCTA is summarized in long image acquisition time and image noise. Xephilio OCT-S1 (Canon, Tokyo, Japan), a commercially available WF-OCTA system, utilized revolutionary swept source technology and artificial intelligence (AI) technology to overcome these disadvantages. Xephilio OCT-S1 achieves a very fast scan speed of 100,000 A-scans/sec and incorporates an AI-based system called Intelligent Denoise. With its high-speed image acquisition time and excellent denoising system, Xephilio OCT-S1 can offer high-quality OCTA images without averaging multiple images within seconds (https://eu.medical.canon/products/eye-care/xephilio-oct-s1). Hirano T and associates conducted a well-designed retrospective study to investigate the power of Xephilio OCT-S1 to detect retinal neovascularization (NV) in eyes with PDR. They reported that Xephilio OCT-S1 successfully detected 166 (99%) of 168 retinal NV sites identified by conventional method combining biomicroscopy, color fundus photography, and FA), using disc-centered 23 × 20 mm WF-OCTA images [5]. Because it needs a high-quality WF-OCTA image to assess the presence/absence retinal NV, Hirano T and associates

took advantages of the characteristics of Xephilio OCT-S1. As shown by Hirano T and associates, further attempts are needed to connect advances in OCTA technology to patients' benefit, which subsequently changes our practice.

Over the past decade, OCTA has changed its position from being a research device to being a clinically useful device in the management of ocular disorders associated with vascular abnormality. This is because frequent non-invasive vascular imaging with OCTA enables close monitoring of disease progression and response to therapy. Currently, more than 100 clinical trials are ongoing to explore further clinical applications for OCTA (https://clinicaltrials.gov/). These clinical trials will surely add a new perspective on our understanding of ocular diseases including peripheral retina and provide robust evidence in best clinical use of OCTA in the near future. The clinical practice, where OCTA information is critically important, is just around the corner.

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