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Editorial

Defining the Role of OCT Angiography in Clinical Practice

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Optical coherence tomography angiography (OCTA) represents a potentially exciting and significant advance in ophthalmic imaging technology.[1] Optical coherence tomography angiography relies on motion contrast to identify flow (in blood vessels) in the eye by looking for differences in signal between repeated scans obtained at the same location. As with many new technologies, the availability of OCTA on commercial instruments has been associated with a wave of enthusiasm and numerous reports and studies describing OCTA-based findings in various disorders. Diseases that have been evaluated include retinal vascular disorders (e.g., diabetic retinopathy,[2,3] retinal vascular occlusions,[4,5] and macular telangiectasia[6,7]), choroidal vascular disorders (e.g., choroidal neovascularization,[8,9] inflammatory diseases, and macular degeneration[10]), and optic neuropathies (e.g., glaucoma, hereditary optic neuropathies, and ischemic optic neuropathies).[11–13] Optical coherence tomography angiography also has been used to characterize the normal retinal and choroidal circulation better and to describe more completely its 3-dimensional morphologic features.[14]

However, these early studies have highlighted the fact that OCTA is still a nascent technology that is very much still in evolution. Commercial OCTA manufacturers are deploying updated algorithms on a regular basis, and OCTA devices continue to appear on the market with new capabilities and novel approaches to processing the flow and motion information. Early studies also have highlighted various limitations of the technology, including the absence of dynamic information (flow, leakage) and the presence of numerous artifacts (motion, segmentation, signal attenuation, and projection) that can confound the accurate interpretation of these images.[15,16] However, even in the absence of artifact, OCTA may pose challenges for interpretation because most ophthalmologists still need to become familiar with the appearance of these images, particularly for the deeper circulations. The most significant limitation of OCTA, however, is the paucity of large clinical studies to define how the technology should best be used in clinical practice. This limitation is of course intrinsic to all new technologies, and thus, well-designed studies such as the one reported in this issue, by Faridi et al,[17] are of critical importance. Such studies are crucial to establish whether OCTA is truly helpful for clinical management or simply an optional tool for research investigation.

The assessment of choroidal neovascularization, including its detection, morphologic characterization, and quantification, has been suggested as an important application of OCTA. Several reports have been published reporting the sensitivity and specificity of OCTA in identifying choroidal neovascularization (CNV) in the setting of age-macular degeneration (AMD),[10] pachychoroidal disorders,[18,19] and myopia.[20] Sensitivity is defined as the ability of the diagnostic test to identify correctly eyes with CNV (true-positive rate), whereas specificity is the ability of the test to identify correctly those without CNV (true-negative rate). Varying levels of sensitivity have been reported, ranging from 50% to 100%, with specificity levels varying from 60% to 100%.[10,17] This wide variation in values reflects an inherent limitation in all of these studies, which is the definition of the gold standard, or reference standard, for the sensitivity and specificity computation. Most of these studies, including that by Faridi et al,[17] have defined the gold standard to be a combination of structural OCT and fluorescein angiography (FA). This would seem to be a reasonable choice because many clinicians use structural OCT and FA to diagnose CNV in their clinical practices. However, others may argue this is insufficient as a true reference standard, and indocyanine green angiography should also be obtained to exclude the presence of a plaque or branching vascular network. Indeed, some early studies establishing the sensitivity and specificity of structural OCT alone used a combination of FA and indocyanine green angiography as the reference standard.[21]

Even if one were to accept the combination of FA and structural OCT is sufficient, defining the gold standard is still not a simple task. For example, what OCT scan acquisition protocol should be used, that is, how many B-scans, and at what spacing? Previous studies have shown that detection of fluid on OCT is highly dependent on B-scan density,[22] and clinicians use varying acquisition protocols in clinical practice. Another challenge in establishing the gold standard is in the definition used for CNV. In Faridi et al's study,[17] one of the definitions used for evidence of CNV on structural OCT alone was the presence of pigment epithelial detachment distinct from drusen. However, degenerating drusen[23] can have a varied appearance, and inclusion of such atypical drusen in the definition of CNV may be problematic. Finally, reliable identification of CNV on FA itself may be a challenge and also may be affected by the acquisition protocol: Were stereoscopic images obtained? Were all phases of the angiogram captured? These questions plague all studies attempting to compare a new imaging technology with a previous imaging technology or technologies. The ultimate gold standard of course is histologic examination, but this is obviously not a feasible alternative. Also, it is possible there is no need to detect all CNV, but only active CNV or CNV that over time will alter vision or function.

In the absence of a clear-cut gold standard, one may ask instead other clinically practical questions. Because many

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clinicians rely heavily on structural OCT alone to assess the status of CNV lesions, one might suggest that structural OCT alone may be sufficient for standard clinical practice. This is of practical relevance because OCTA represents an additional economic investment over structural OCT alone. If structural OCT is sufficient, perhaps OCTA is not necessary for this clinical scenario of CNV diagnosis. Faridi et al[17] should be congratulated for specifically evaluating this question. Their findings, although requiring replication in larger prospective clinical studies, seem to suggest that although structural OCT (using their scanning protocols and CNV definitions) is highly sensitive for detecting CNV (100%), it may fall a bit short (85%–97%) in terms of specificity. In their study, OCTA seemed to enhance the specificity of structural OCT, suggesting the possibility that FA may not be necessary for CNV diagnosis if both structural OCT and OCTA are available.

Studies such as these will be very helpful in defining better the optimal clinical use of new technologies such as OCTA. However, the best and most critical studies will be large prospective clinical trials with standardized acquisition and analysis protocols that evaluate the impact of OCTA based on findings regarding clinical decision making and management outcomes in specific clinical use cases. Fortunately, such studies are already underway. As findings from these new studies become available and OCTA technology continues to mature and stabilize, the opportunity should arise to define precisely the optimal use of OCTA in clinical practice.

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