The role of optical coherence tomography angiography in diagnosis of central serous chorioretinopathy

Alaa Atia  
*Memorial Institute for Ophthalmic Research (MIOR)*

Ghada Samir  
*Memorial Institute for Ophthalmic Research (MIOR)*, ghada24sam@yahoo.com

Hussam E. O Elrashidy  
*Memorial Institute for Ophthalmic Research (MIOR)*

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The role of optical coherence tomography angiography in diagnosis of central serous chorioretinopathy

Ghada Samir, Hussam E.O Elrashidy, Alaa Atia
Department of Ophthalmology, Memorial Institute for Ophthalmic Research (MIOR), Giza, Egypt

Abstract

Purpose
To detect the findings of optical coherence tomography angiography (OCTA) in eyes with central serous chorioretinopathy (CSCR), in comparison with conventional multimodal imaging.

Patients and methods
In the current case series, 80 eyes of 80 patients were diagnosed to have CSCR, and they underwent spectral domain optical coherence tomography (SD-OCT), fluorescein angiography (FA), and OCTA. OCTA images are performed at two main depth intervals: automatically segmented outer retina and automatically segmented choriocapillaris.

Results
In 40 of 80 eyes, OCTA images showed detached retina adjacent to the leakage point, compared with 40 of 80 eyes using FA, and 80 of 80 eyes using SD-OCT. In 44 of 80 eyes, irregular flow patterns were observed on OCTA images through the choriocapillaris. OCTA images could not identify leakage points in any of the included eyes, compared with 68 of 80 eyes on FA, and 56 of 80 eyes on SD-OCT. In 12 of 80 eyes, abnormal vessels (associated choroidal neovascularization) were observed on OCTA images, compared with eight of 80 eyes in SD-OCT and four of 80 eyes in FA.

Conclusion
OCTA images of the superficial and deep retinal plexus, outer retina, and choriocapillaris did not reveal altered flow patterns directly associated with the leakage point in acute CSCR. However, OCTA was able to visualize altered choroidal flow in some of the included eyes and was the best between all other modalities in detection of choroidal neovascularization in eyes with chronic CSCR.

Keywords: Central serous chorioretinopathy, Optical coherence tomography angiography, Spectral domain optical coherence tomography, fundus fluorescein angiography

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The role of OCTA in diagnosis of CSCR

Samir, et al.

Optical coherence tomography angiography (OCTA) is a noninvasive imaging modality that allows for detection of blood flow and three-dimensional reconstruction of blood vessels using signal decorrelation between consecutive transverse cross-sectional OCT scans, that is, the concept of OCTA is the detection of changes in blood flow in the vessels in a static eye without dye injection. An OCTA image is computed by comparing, on a pixel-by-pixel basis, repeated B-scans acquired at the same retinal location in rapid succession. The rationale behind OCTA imaging is that in nonmobile tissue the reflected signal will be stationary, and thus the repeated B-scans will be identical. In contrast, moving erythrocytes cause a time-dependent backscattering of the OCT signal, which manifests as differences among the repeated B-scans.

Basically, OCTA of the posterior pole can be obtained by using one or a combination of two methodologies: amplitude decorrelation and phase-variance. Amplitude decorrelation analyzes amplitude changes in the OCT signal. Split-spectrum amplitude decorrelation divides the spectrum into smaller spectra and performs the repeated B-scan decorrelation separately for each subspectrum, which improves the signal-to-noise ratio. It is considered that OCTA reveals more information about the choriocapillaris that might be beneficial for better understanding of the pathophysiology of CSCR.

Although previous studies compared between FA/ICGA and OCTA, especially the B-scan images on OCTA, the clinical value of OCTA has not yet been evaluated accurately. So, the aim of this study was to further analyze the OCTA findings in greater number of eyes with CSCR either in acute or chronic stages and to compare them with those obtained through multimodal imaging including SD-OCT and fundus autofluorescence.

**Patients and methods**

**Study population**

A series of consecutive patients diagnosed with CSCR at Giza Memorial Institute of Ophthalmic Researches was examined. Our study has included patients either with acute CSCR or chronic CSCR with persistent neurosensory detachment more than 3 months and did not receive any treatment. Patients with history of any chorioretinal diseases or any other ophthalmological condition that could influence the interpretation of clinical and imaging findings for diagnosis of CSCR were excluded. Our study has been approved by the scientific and ethical committee at MIOR.

**Study protocol**

The patients provided a written consent after informing them that all the procedures conform to the guidelines in the statement for use of patients in ophthalmic and vision research. All patients’ demographic data were recorded (sex, age, and race). All patients underwent a complete ophthalmological examination, including best-corrected visual acuity measurement with Snellen chart that was transferred to logMAR, slit-lamp examination, dilated-fundus biomicroscopy, and standardized imaging protocol, using three-dimensional OCT-2000 series (Tokyo 174-8580, Japan), which included FA and SD-OCT. All patients also were subjected to OCTA using a commercially available RTVue XR Avanti with AngioVue (Optovue, Fremont, California, USA). Three-dimensional en-face angiograms are generated by an incorporated software algorithm through decorrelation of two merged consecutive orthogonal registration volumes that centered automatically at the macula or manually centered at the lesion. Each acquired OCTA volume (3 × 3 mm) consisted of 304 × 304 A-scan in 2.6 s, and 6 × 6-mm OCT en-face images (OCTA) were obtained for each patient. Both orthogonal volume scans are combined with a motion correction technology to create a three-dimensional image of retinal and choroidal blood flow. A coregistered OCT B-scan allows the visualization of the retinal structure. RTVue XR Avanti has an automated segmentation at the superficial retinal capillary plexus, deep retinal capillary plexus, outer retina, and choriocapillaris. The OCTA software was used to manually adjust the automated segmentation and its relative depth in the retina and choroid.

The images were acquired by three well-trained OCTA users (Ghada Samir, Alaa Atia and Hussam Omar) who performed a qualitative analysis to determine CSCR features and assess the microvasculature. Our analysis included descriptive statistics (using Microsoft Office Excel software, 2010) for demographics and main clinical data, as well as qualitative descriptions of the imaging findings.

A total of 80 eyes of 80 patients (51 males and 29 females; mean age: 34.5 ± 10 years), diagnosed with CSCR were included in this study. Mean best-corrected visual acuity was 0.23 ± 0.25 logMAR (range: 0–0.8 logMAR, corresponding to 20/20 to 20/125). Overall, 50 (62.5%) eyes had newly diagnosed CSCR, whereas 30 (37.5%) eyes had chronic CSCR with persistent neurosensory detachment more than 3 months. In 12 (15%) eyes, CSCR was associated with type 1 CNV. Tables 1 and 2 show patient demographics and clinical characteristics. The whole population was analyzed, with description of images obtained at different levels. The eyes with abnormal choroidal vessel patterns were described with more details, with an attempt of classification according to the pattern.

**Results**

In 40 of 80 eyes, it was possible to detect detached retina adjacent to the leakage point in OCTA images, compared with 40 of 80 eyes using FA, and 80 of 80 eyes using SD-OCT. In 44 of 80 eyes, irregular flow patterns were observed on OCTA images through the choriocapillaris. OCTA images...
could identify leakage points in only two of the included eyes, compared with 68 of 80 eyes on FA, and 56 of 80 eyes on SD-OCT. In 12 of 80 eyes, abnormal vessels (associated CNV) were observed on OCTA images, mainly of patients with chronic CSCR, compared with eight out of 80 eyes in SD-OCT and four out of 80 eyes in FA.

At the beginning, analysis of the whole population with description of images obtained at different levels was performed. Then, eyes with abnormal pattern of choroidal vasculature were described with more details.

Analysis of optical coherence tomography angiography images

Outer retina
Automatically segmented outer retina OCTA images detected the presence of an abnormal flow in 44 (55%) eyes, whereas no remarkable abnormality in 36 (45%) eyes.

Choriocapillaries
The automated segmentation of choriocapillaris was obtained for all patients. It showed three types of findings: (a) dark areas: they corresponded to diffuse or focal ill delineated areas of low flow in the choriocapillaris layer. This was coregistered with OCT B-scan that revealed a high correspondence between the presence of dark areas and neurosensory detachment, which was observed in 40 (50%) out of 80 eyes (Figs. 1 and 2).

(b) Dark spots: they corresponded to black, single or multiple, well-delineated areas of no flow at the choriocapillaris. These dark spots could be seen alone or in association with dark areas. Coregistration with B-scan revealed a high correspondence with areas of RPE detachment (Figs. 3–5).

(c) Abnormal choroidal vessels: they corresponded to areas of well-defined, high-flow, tangled pattern in the choriocapillaris layer (Fig. 6), as well as an abnormal dilation of choroidal vessels. Coregistered OCT B-scan showed a hyperdense signal that corresponded to the tangled lesion with a typical neovascular network.

Discussion
In our study, we showed OCTA findings in consecutive cases of CSCR in comparison with FA and SD-OCT. Although OCTA
has a big advantage as it can show the changes in blood flow without injecting the dye, but it cannot completely replace FA and SD-OCT in case of CSCR, as through OCTA images, we could not localize the leaking points in all eyes included in the study. On the contrary, the leaking points could be detected by FA in all eyes; this is explained by velocity of the blood cells in the leaking points [10]. OCTA showed irregular choriocapillary blood flow in some cases but not in all of them, as Min et al. [11] noticed that the combination between PED and the height of SRF may act as a shield masking the flow signals of chorionicapillaries on OCTA B-scan, especially if the height is more than 485 μm. This study disclosed dark areas and dark spots at the chorionicapillaris, which previously were reported by Costanzo et al. [12]. These were explained by changes in honeycomb-like microvasculature at the central fovea. These findings could be owing to attenuation of light by the serous retinal detachment, PED, or elongation of outer segment photoreceptor or all of them. We detected the presence of secondary CNV in some cases of chronic CSCR and detected its position in relation to the RPE and Bruch membrane using OCTA, which gave us information about flow (OCTA) and structure (OCT B-scans). OCTA provides high sensitivity and specificity of detection of CNV associated with CSCR, as it is rarely associated with the excessive subretinal hemorrhage that may limit OCT signal penetration.

CONCLUSION

OCTA images of the superficial and deep retinal plexus, outer retina, and chorionicapillaris did not reveal altered flow patterns directly associated with the leakage point in acute CSCR. However, OCTA was able to visualize altered choroidal flow in some of the included eyes and was the best between all other modalities in detection of CNV in eyes with chronic CSCR.

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Ethical clearance

Our study has been approved by the scientific and ethical committee at MIOR.

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Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

3. Kitzmann AS, Pulido JS, Diehl NN, Hodge DO, Burke JP. The incidence