Optical coherence tomography angiography of circumscribed choroidal hemangioma treated with photodynamic therapy

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We describe features of a circumscribed choroidal hemangioma (CCH) treated with photodynamic therapy (PDT) by means of optical coherence tomography angiography (OCT-A).

A 40-year-old man had a complaint of decreasing visual acuity in his left eye for 10 days. A diagnosis of CCH was confirmed by fundus examination, fluorescein angiography, and indocyanine green angiography. An OCT-A study of choroidal lesion before and after PDT was carried out. Segmented en face OCT-A of CCH showed multiple irregular connected vascular channels with hyperflow and a capillary-like lesion. Absent and/or reduced intrachannel flow in most of the intratumoral vessels was shown by OCT-A soon after treatment (2 days), with normalization of vascular flow 7 days and 1 month after PDT. OCT-A was able to noninvasively visualize intrinsic vasculature of CCH showing vascular remodeling after PDT.

Keywords: Choroidal hemangioma, optical coherence tomography angiography, photodynamic therapy

Circumscribed choroidal hemangioma (CCH) is a benign vascular hamartoma that occurs as an orange-red, round or oval discrete, unilateral smooth mass. Due to subfoveal location, it may lead to severe visual loss secondary to associated exudative retinal detachment, cystoid macular edema, or subretinal fibrosis. Optical coherence tomography angiography (OCT-A) is a recently developed technique that allows structural imaging of retinal circulation and in vivo analysis of microvascular alterations induced by physiologic and pathologic changes without intravenous dye injection. In this case, photodynamic therapy (PDT) effects on the vascular pattern of the CCH were described by means of OCT-A. This study adhered to the tenets of the Declaration of Helsinki, and written informed consent was obtained after a detailed description of the study and its goals.

Case Report

A 40-year-old male was referred to San Paolo Ophthalmic Retina Center, Padua, because of decreasing visual acuity in his left eye for 10 days. Best-corrected visual acuity was 20/30 oculus sinister (OS) and 20/20 oculus dexter. Fundus examination showed a well-delineated, red-orange mass inferiorly to the optic disc in his left eye. Diagnosis of CCH was carried out by fluorescein angiography (FA) and indocyanine green angiography (ICG) examinations. OCT-A (OCT RTVue XR AVANTI; Optovue Inc., Fremont, CA) was carried out. This device employs a new analytical algorithm, “split-spectrum amplitude-decorrelation angiography with OCT” (SSADA), to improve the signal-to-noise ratio of flow detection using spectral bands separately and then averaged, showing the microvascular network and allowing the automated removal of motion errors. The images observed with the SSADA with OCT represent the blood flow. Automated segmentation was used to identify the anatomic and pathological plane. To obtain a better visualization, we chose the deep choroid capillary (CC) slab on OCT-A. High-quality OCT-A of the intraretinal vascular pattern has been obtained by manually segmenting a CC slab (from 30 to 70 µm) below Bruch’s membrane in the AngioVue software (OCRTVue XR AVANTI; Optovue Inc., Fremont, CA). A 3 mm × 3 mm field of view was the preferred size for better visualization of the intraretinal vasculature. Large-field en face OCT-A (~3 mm × 8.5 mm) was produced by stitching together three 3 mm × 3 mm scans.

On OCT-A, tumor was surrounded by a richly branched and voluminous capillary pattern with a high flow signal centrally. CCH was wrapped by rarefied leaf-like vessel peripherally. OCT-A also showed large blood-filled vascular channels with high flow capillary network separated by intervascular septa where flow was not detected. At the periphery, numerous radially projecting vessel ends were also observed. The slab segmentation also showed extensive coalescent spaces hyporeflective on OCT-A at the inner retinal layers and corresponding to intraretinal cystic changes overlying the lesion. Visual acuity loss in OS was due to serous macular detachment. The patient underwent standard fluence PDT (Visulas 6905, Carl Zeiss-Meditec AG, Jena Germany). The greatest linear dimension was calculated on the basis of ICG features of the lesion. The spot size was diameter. A single nonoverlapped 4.7 mm laser spot was applied at a distance of 200 µ from the optic disc edge, covering the entire area of the lesion and also taking care to avoid additional exposures of surrounding normal choroid. Two days after PDT, large intraretinal vascular channels appeared dark on OCT-A. Large intraretinal vascular channels appeared dark on OCT-A due to vaso-occlusive effects of PDT and corresponding to an extensive thrombosis of the angiomatous channels. Those features involved the entire lesion.

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Figure 1: Circumscribed choroidal hemangioma. Fluorescein angiography showing late leakage (a). On indocyanine, green angiography tumor shows a complete filling of the tumor with a superimposed hyper- and hypo-fluorescent spots during venous phase (b).

Figure 2: En face 3 mm x 3 mm optical coherence tomography angiography stitched scan revealing tumor surrounded by a richly branched and voluminous capillary pattern with a high flow signal (arrows). Centrally, optical coherence tomography angiography shows a high flow capillary network composed of large blood-filled vascular channels and separated by intervascular septa where flow was not detected (arrowheads), while more the peripheral lesion was wrapped by rarefied vessels.

Figure 3: Optical coherence tomography angiography scan centered at the apex of the tumor, showing dark large intralesional vascular channels due to vaso-occlusive effects of photodynamic therapy and corresponding to an extensive thrombosis of the angiomatous channels.

Discussion

This study was aimed at detecting the ability of OCT-A, a noninvasive imaging modality, to image the vascular pattern within CCH before and after PDT. OCT-A was valuable in imaging intratumoral vessels in CCH since the vascularization was successfully identified. CCH appeared characterized by a...
richly branched and voluminous vascular pattern and wrapped by rarefied vessels peripherally. OCT-A generates functional images based on the contrast between blood vessels and static tissue by assessing the change in the OCT signal caused by flowing blood cells. This offered the advantage of allowing the visualization of the vasculature over the area of the scan, with no masking effect. In our case, the vaso-occlusive mechanism of PDT was well shown by OCT-A with thrombosis of the angiomatous channels. PDT induced changes from progressive nonperfusion of the angiomatous network even though complete disappearance of the angioma was not related to resolution of intraretinal pooling overlying the lesion. OCT-A also showed an irregular but complete recanalization of the lesion after PDT. This event occurred rapidly within 7 days of treatment. To the best of our knowledge, this is the first report on visualization of the intralesional vessels in cases of CCH using a commercially available OCT-A system.

Our case report had several limitations. It was a retrospective single case report describing features of CCH by means of OCT-A. No comparison gold standard diagnostic examinatios (FA and ICG) or with study of effects of different PDT parameter has been done, as a larger number of patients id needed. In our case, we used a 3 × 3 scan box that allowed us the visualization of a very limited area but perhaps allowed for better scanning density. Although the field of view can be expanded, doing so would mean lower scanning density and therefore loss of resolution for a given scan time. Projection artifacts were sometimes observed on the cross-sectional angiograms. The flow signal fadeout in large vessels with very fast blood flow can induce fringe washout of OCT signals. This means that some large vessels in the deeper parts of the tumor could not be visualized using SSADA. Finally, the decorrelation (flow signal) signal in OCT-A must be interpreted with care.

**Conclusion**

In conclusion, OCT-A is a noninvasive imaging tool able to detect blood flow pattern in CHs. Vascular pattern has been shown and blood flow signal inside the CHs showed a precise and well-delineated capillary-like pattern before and after PDT. Close monitoring of choroidal perfusion using OCT-A might be an excellent base for retreatment decisions.

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**Conflicts of interest**

There are no conflicts of interest.

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