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Optical coherence tomography Angio-B mode for early detection of myopic choroidal neovascularization and treatment with Bevacizumab

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ABSTRACT

Purpose: The purpose of this case report is to outline the management of a 41-year-old female with pathological myopia and type II choroidal neovascularization (CNV) diagnosed by optical coherence tomography angiography (OCT-A) angio-B mode.

Observations: The early detection of CNV with OCT-A angio-B mode and treatment with intra-vitreous injections of Bevacizumab contributed to the amelioration of her vision to 20/20, a better visual acuity than she had prior to treatment.

Conclusions and importance: This case report suggests that an OCT-A scan may reveal the initial formation of abnormal vasculature before pathological changes are evident in structural OCT, allowing for prompt treatment and resolution in patients with myopic CNV.

1. Introduction

CNV is characterized by excessive growth of abnormal blood vessels in the eye; more specifically, the abnormal invasion of choroidal vasculature into the retinal pigment epithelium (RPE) or subretinal tissue.[1] Myopic CNV develops predominantly as type II CNV which involves the growth of vessels into the subretinal space above the RPE.[2] Individuals with any degree of myopia (near-sightedness) are at risk for developing CNV, with higher degrees of myopia associated with increased risk.[3] Myopia is the most common cause of CNV in some countries, especially in younger patients.[4] Myopia is caused by equatorial stretching and axial elongation of the eye. These changes in morphology could be associated with defects in Bruch's membrane which can lead to protrusions of choroidal vasculature and the onset of atrophic CNV.[5]

CNV secondary to pathological myopia (PM) can be devastating, leading to severe vision loss as delicate retinal tissue is damaged by leaking fluid and blood in the macula.[1] Early detection is a key component of effective treatment to prevent irreversible damage, mainly due to the rapid progression of the disease.[6] CNV consists of 3 phases; active, scar and atrophic.[3] During the active phase, changes in vascular structure can be visualized, and if treated in a timely manner, reversible.[3] Symptoms of early, active CNV include decrease in vision, distortion or waviness of central vision (metamorphosia) and a central scotoma.[2] During the second and third phases, scar tissue and fibrosis leads to permanent vision loss.[3] CNV is usually diagnosed with fluorescein angiography (FA), indocyanine green angiography (ICGA) fundoscopy, optical coherence tomography (OCT), OCT-angiography (OCT-A), or a combination of these tests.[6] OCT-A is a depth resolved technology that has shown promising results in the study of CNV pathogenesis and vascular morphology. Although FA and ICGA offer the important, advantageous feature of dye leakage, they are more invasive and provide lower resolution.[7] FA and ICGA are currently considered retinal angiographic gold standards, however OCT-A offers great advantages; it is non-invasive, it can visualize both retinal and choroidal vasculature, and can show both structural and blood flow information.[8]

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The benefits of OCT-A scans also include their ability to quantify time-related differences in erythrocyte reflectivity to create flow maps of the retinal circulation with segmentation capabilities as well as provide a detailed, depth-resolved picture of retinal and choroidal microcirculation, without the need for a contrast medium or invasive means.[9] Moreover, Querques et al. found that in the neovascular detection of myopic CNV, OCT-A sensitivity was 90.48% and specificity was 93.75%, while other studies found that the sensitivity and specificity of FA was only 47% and 80.4%, respectively.[10,11] Finally, anti-VEGF therapy is recommended as the first-line treatment for patients with myopic CNV, with dosing involving 1 to 3 monthly injections.[6] Significant and sustained improvements have been reported in myopic CNV patients with intravitreal Bevacizumab injections of 1.25mg after 6 months.[6]

Strong evidence indicates that the visual prognosis of myopic CNV without treatment is very poor as a result of chorioretinal atrophy that develops around the lesion.[12] With a clear need for accurate and early detection of CNV, determining the most effective technique to do so is important.

2. Case report

A 41-year-old female with a history of high myopia (−10D) presented to the clinic with complaints of vision loss and metamorphopsia in her right eye. Topcon swept-source Triton DRI-OCT™ was used for imaging at each clinical visit for OCT-A and structural OCT scans. This iteration provides 100,000 A-scans/s. A widefield 12 × 9mm cube scan was performed as well as a 4.5 × 4.5 mm OCT-A with an imaging depth of 2.6 mm. Each B-scan is made up of 256 A-scans.

The patient received a comprehensive ophthalmologic examination, including measurement of best-corrected visual acuity (BCVA), at each clinical visit. At the first visit, her BCVA was 20/40. Additionally, at baseline, the OCT-A identified an area suspicious of CNV with increased flow signature on Angio-B mode, as well as an adjacent hyporeflective portion compatible with a small collection of sub-retinal fluid (SRF, Fig. 1A, Panel A). The En Face OCT-A revealed a white circle in the center of the fovea (Fig. 1A, Panel B, highlighted in a yellow circle), demonstrating growth of vasculature. No gross findings suggestive of CNV were seen in the structural OCT-B scan (Fig. 2A).

The patient was diagnosed with early myopic CNV treated with an intravitreal Bevacizumab injection (1.25 mg/0.05 ml) during her first visit, and a second injection 4 weeks later.

Two weeks after the first Bevacizumab injection, the BCVA was 20/30. The finding suggestive of CNV in the macula receded, and no discontinuity of the ellipsoid zone and external limiting membrane (ELM) was appreciated by OCT-A (Fig. 1B, Panel A). The En Face OCT-A illustrates the disappearance of the white circle in the center of the fovea that was previously present (Fig. 1B, Panel B). The structural OCT-B scan obtained at the same time showed little difference between the first and second clinic visits (Fig. 2B).

At the final visit, 10 months after the last Bevacizumab injection, there was no evidence of activity of CNV in both OCT-A and En Face scans (Fig. 1C, Panels A and B). Nevertheless, there was a hyporeflective finding underneath the ellipsoid zone and ELM with hypertransmission of the subjacent choroid without any adjacent flow signature visualized using the OCT-A and structural OCT-B scans (Fig. 1C, Panel A, and Fig. 2C, highlighted by a yellow circle). The ellipsoid zone and ELM were seen as continuous, linear layers without interruption by structural OCT B-scan (Fig. 2C). There was no evidence of intraretinal fluid or SRF (Fig. 1C, Panel A). The En Face OCT-A reveals the persistence of a clear foveal area (Fig. 1C, Panel B). The BCVA was 20/20 with no metamorphopsia.

3. Discussion

In this report, we present a case of a 41-year-old female patient with myopic CNV diagnosed using OCT-Angiography Angio-B mode and successfully treated with two injections of Bevacizumab. The morphological features of myopic CNV have been described in the literature as eyes with relatively thicker sclera and a thinner choroid when compared to myopic eyes without CNV.[13] In our case, the patient had a thicker choroid than usually seen in myopia. Thus, pachychoroid spectrum could not be ruled out. Other biological indicators include an axial length greater than 26.5mm or refractive error greater than −6 D, posterior staphyloma, lacquer cracks, tessellated fundus, tilted optic disc, and straightened and attenuated vessels.[3] The vascular network pattern in myopic CNV is described as “tangled” or “interlacing” when visualized with an OCT-A scan.[9]

A key diagnostic feature of myopic CNV is a flow signature, which can be appreciated using the Angio-B mode in an OCT-A scan.[14] The Angio-B mode of the OCT-A scan is a specialized imaging tool used to visualize blood flow within vessels.[15] Angio-B mode contains both structural and flow information, serving to localize the exact depth of vascular abnormalities which can be used in conjunction with En Face OCT-A that provides a top-down view of vascular layers to diagnose CNV.[16] Additionally, OCT-A is better at detecting CNV than structural OCT which cannot delineate vascular structure.[17] In the initial stages of CNV, there may be no leakage present on FA or ICGA while the initial growing vascular network of CNV can be visualized using OCT-A.[18] The authors hypothesize that in the present case, contrast modalities would not demonstrate leakage and they were not performed. The OCT-A scans also allowed for the visualization of appreciable changes to the CNV lesion at each clinical visit while structural OCT scans did not, suggesting that OCT-A is not only an effective diagnostic tool, but beneficial throughout treatment to track progress.

The remaining hyporeflective segment underneath the ellipsoid zone and ELM is of potential concern and demands close follow-up and caution. A study found that approximately 30% of choroidal clefts eventually regress with favourable visual outcomes, while other cases can lead to neovascular age-related macular degeneration and polypoidal choroidal vasculopathy.[19]

4. Conclusion

OCT-A Angio-B mode allowed for the early detection of CNV in a myopic patient, and the prompt initiation of anti-VEGF therapy that improved the patient’s visual acuity to 20/20 from 20/40. Overlooking the positive flow-signature and adjacent area of fluid accumulation would have probably led to the progression of the disease, potentially a late diagnosis, and treatment that would not have been as timely or effective. Patients with high myopia and visual complaints and/or findings on the fundus examination of the macula would benefit greatly from OCT-A tests to detect CNV and follow-up on changes to vascular tissue in the macular region.

Patient Consent

Consent to publish the case report was not obtained. This report does not contain any personal information that could lead to the identification of the patient.

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Authorship

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CRediT authorship contribution statement

Stephanie Rico: Writing – review & editing, Writing – original draft,

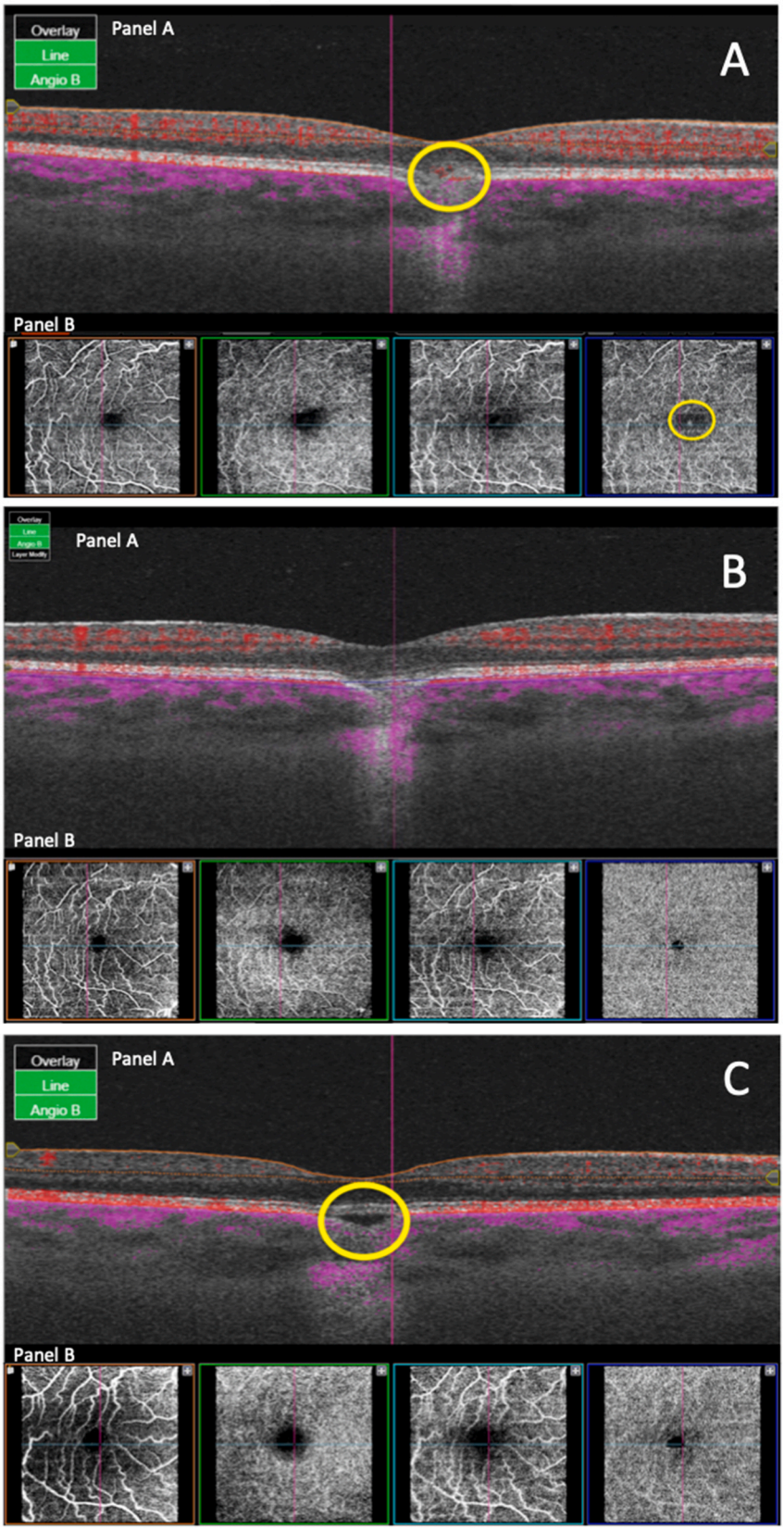

Fig. 1. OCT-A Angio B mode and En Face of patient's right eye at A) baseline shows flow signature on the B-scan and an adjacent small hyporeflectivity suggesting fluid (upper yellow circle). The lower yellow circle shows a small area on the En Face suggestive of the small CNV B) 2 week visit C) 10 month visit shows absence of CNV and no evidence of sub-retinal fluid.

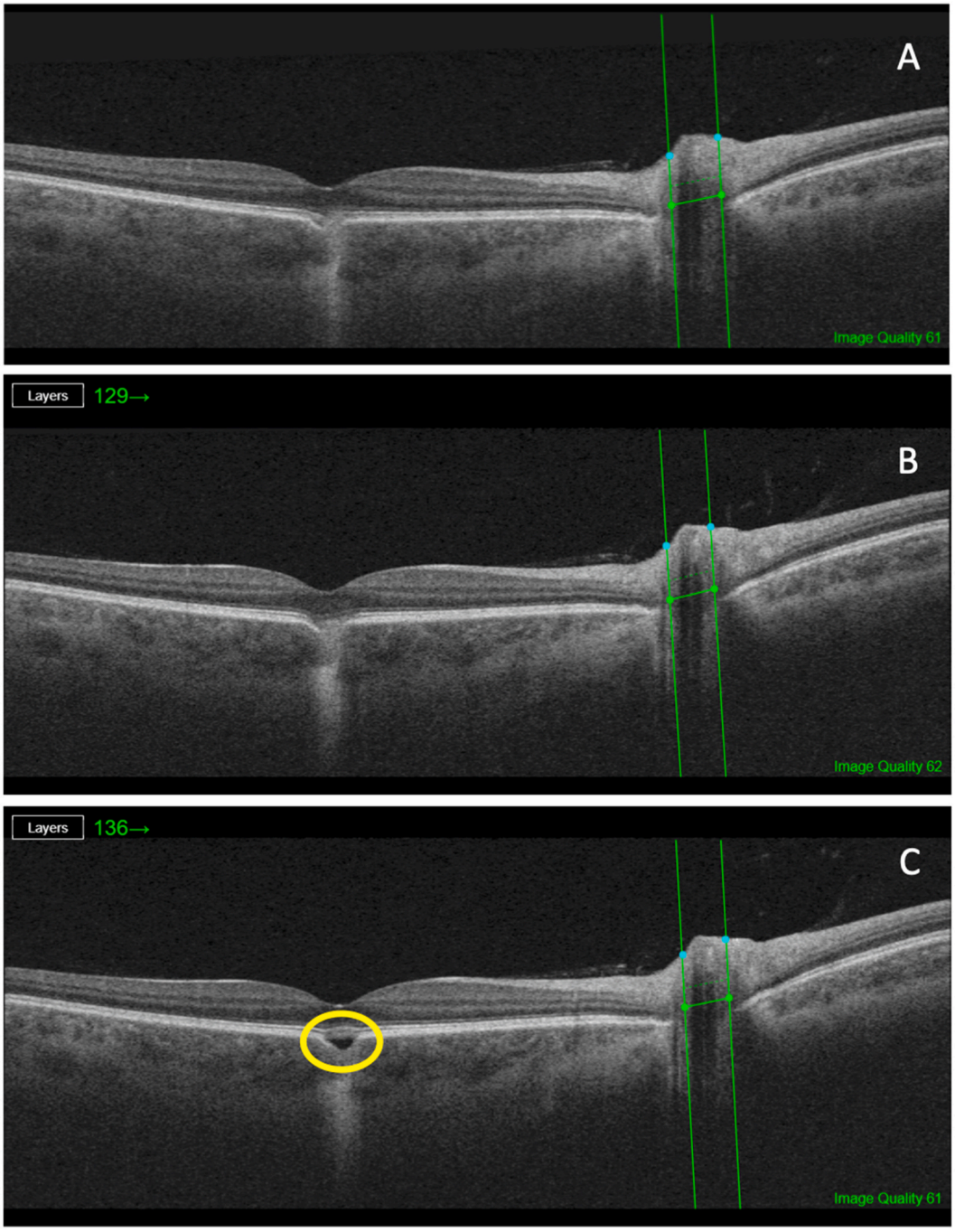

Fig. 2. Structural OCT B-scan of patient's right eye at A) baseline shows disruption of ellipsoid zone and RPE with hypertransmission underneath. B) 2 week visit and C) 10-month visit shows continuous ellipsoid zone without evidence of subretinal fluid and a hyporeflective portion at the level of the choroid with hypertransmission underneath (yellow circle).

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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