OCTA in macular intraretinal microvascular abnormalities: Retinal vascular density remodeling after panretinal photocoagulation

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Abstract

Purpose: To describe a case of macular intraretinal microvascular abnormality (IRMA) detected with Optical Coherence Tomography Angiography (OCTA) and to show its remodeling and vascular density changes after panretinal photocoagulation (PRP) during an 18-month follow-up.

Methods: Case report.

Results: A 22-year-old female patient with proliferative diabetic retinopathy was found to have a small hyperreflective formation with posterior shadow cone and signal flow, located at the temporal margin of the fovea avascular zone (FAZ), identified as macular IRMA with OCTA. Her best-corrected-visual acuity was 20/20. Four months later the macular IRMA was larger and, in its context, there was also an increase in the flow area in B-scan. The patient underwent PRP and after 18 months we observed a regression of macular IRMA and an increase in the superficial capillary plexus vessel density in all sectors in comparison to baseline.

Conclusion: OCTA is a non-invasive tool that recognize macular IRMA in diabetic retinopathy patient and it could be helpful to follow their qualitative and quantitative vascular evolution over time.

Keywords

Macular IRMA, OCTA, vessel density, panretinal photocoagulation

Introduction

Diabetic Retinopathy (DR), a microvascular complication of diabetes mellitus, is among the leading causes of visual loss worldwide. Its prevalence is growing rapidly and it is expected to affect more than six million people in the US by 2030.¹ Capillary occlusion with non-perfusion areas, vascular hyperpermeability and retinal neovascularization are the effects of microangiopathic damage to the retinal vessels.² Intraretinal microvascular abnormalities (IRMAs) are tortuous intraretinal vascular segments in fields 4–7, ranging in caliber from barely visible to 31 μm according to Early Treatment of Diabetic Retinopathy Study (ETDRS).³

Spectral Domain-Optical Coherence Tomography (SD-OCT) represents a useful tool to distinguish between IRMAs and retinal neovascularization (NV).⁴ Furthermore, Optical Coherence Tomography Angiography (OCTA), a highly sensitive non-invasive technique, could detect IRMA precisely as focal area of increased intraretinal blood flow within the superficial capillary plexus.⁵

Here, we report a case of retinal vascular changes in macular IRMA with an unusual vascular pattern and its remodeling after panretinal photocoagulation (PRP) in a young female.

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Case report

A 22-year-old woman was referred to our Department for routine evaluation. The patient had suffered type 1 diabetes mellitus from the age of 10 and was taking subcutaneous insulin with a microinfusion pump reporting a blood glucose control within limits. Her general medical history was otherwise unremarkable. Her best-corrected visual acuity (BCVA) was 20/20 in the right eye (RE) and 20/32 in the left eye (LE). Fundus examination and retinography (EIDON, true-color wide-field confocal scanner imaging system, CenterVue, Padua, Italy) showed proliferative diabetic retinopathy in both eyes with macular edema in LE. Fluorescein angiography (FA) was not possible as the patient had had a previous intense allergic reaction after contrast medium. SD-OCT displayed normal macular profile and thickness in the RE, while macular edema (Central Macular Thickness: 316 µm) was observed in the LE. In the RE, OCTA (Angiovue System-Optovue RTVue XR Avanti, Optovue, Inc., Freemont, CA, USA) showed, at the superficial capillary plexus (SCP), two small hyperreflective formations with posterior shadow cone and signal flow, located at the temporal margin of the fovea avascular zone (FAZ), identified as IRMAs (Figure 1, A1). There was also capillary dropout, with rarefaction of the capillary texture with dilated and congested vessel due to macular edema were detected with OCTA. The patient refused anti vascular-endothelial-growth-factor (VEGF) intravitreal injections (IVTs) proposed in the LE. PRP was started in both eyes. Four months later, following PRP, BCVA was 20/20 in RE and 20/25 in LE. SD-OCT was unchanged in the RE, while the macular edema was slightly reduced in the LE (Central Macular Thickness: 294 µm). On OCTA examination of the RE, the superficial hyper-reflective IRMAs at the temporal edge of the FAZ were merged into one larger IRMA and in its context, there was also an increase in the flow area in B-scan which, however, does not extend significantly along the Z axis (anteroposterior) but went in a lateral direction (Figure 1, B1). The FAZ area was 0.159 mm². In LE alteration and rarefaction of the vascular texture with dilated and congested vessel due to macular edema were detected with OCTA. The patient was promptly subjected to PRP given the presence of peripheral new vessels and a retinal non-perfusion area were firstly described by Ashton in 1953.8

Lee et al. observed that through the use of SD-OCT it is possible to distinguish between IRMAs and neovascularization (NV): the former are located below the ILM, while NV start from the retina and, breaking the ILM, protrude into the vitreous.4 Furthermore, OCTA is also useful, with high sensitivity and specificity, to detect IRMAs, describing their baseline shapes such as trunk, loop, pigtail and sea-fan-shaped and could help distinguish IRMAs from NV.9 Both of them present intraretinal flow but NV, structurally characterized by a break of the ILM, typically have a denser and more concentrate vascular flow than IRMAs.9 To the best of our knowledge, this is the first description of a case of macular IRMA adjacent to the FAZ, detected using OCTA. With the aid of SD-OCT, the possibility of NV was excluded, as it was located under the ILM. The patient was promptly subjected to PRP given the presence of peripheral new vessels and a reduction of the IRMA was observed following the treatment. Shimouchi A et al.10 described, using OCTA, the trend of IRMAs after PRP, observing both unchanged and reperfusion types. The former remained stable without change, while the latter regressed, ensuring reperfusion of the ischemic area.10 Interestingly, our case showed vascular density changes in the SCP after PRP. Due to the severity of her DR, the macular IRMA at baseline progressed with time towards the FAZ, probably in order to favor revascularization of this enlarged and less-perfused area. After PRP the IRMA showed a regression with perifoveal vascular remodeling of the SCP capillaries. The VD therefore increased in the whole macular region and fovea of the SCP and only in fovea of DCP compared to baseline. These results may be the
Figure 1. Right eye of 22-year-old female patient at baseline. Optical Coherence Tomography Angiography (OCTA) image of the Superficial capillary Plexus (SCP) shows Intraretinal Microvascular Abnormalities (IRMAs) with posterior shadow cone and signal flow, located at the temporal margin of the Fovea Avascular Zone (FAZ) (A1), reduction of SCP vessel density at the level of macular IRMAs (A2). Right eye of 22-year-old female patient four months later. OCTA detects a unique and larger macular IRMA (B1) with a slight increase in SCP vessel density (B2). Right eye of 22-year-old female patient after Panretinal Photocoagulation (PRP). Regression of the macular IRMA was observed at OCTA (C1) with an increase in SCP vessel density (C2).
consequence of reperfusion of the retinal perifovea, also evident in the reduction of the FAZ area compared to baseline. We hypothesized that the changes observed in the SCP could be due to an overall redistribution of blood flow to the posterior pole following PRP. Laser photocoagulation in fact would act by bringing closer together the vessels of the SCP, which is typically characterized by a more spaced texture than DCP. This latter, on the other hand, is usually less influenced by PRP and conversely, it is more easily involved in case of pericytes loss resulting from metabolic decompensation. Further studies with a larger sample size are necessary to confirm our findings.

In conclusion, IRMAs may change after PRP, possibly with a reduction, and OCTA is helpful to recognize the presence of IRMAs in macular region in DR patient in order to detect severe DR signs and potentially opt for an earlier treatment. Moreover, OCTA, analyzing morphological and vascular changes in IRMAs before and after PRP might be useful for assessing the response to treatment and following the vascular remodeling over time.

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