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Laser-induced choroidal neovascularization detected on optical coherence tomography angiography in patients with diabetic retinopathy

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ABSTRACT

Purpose: To report two cases of laser-induced choroidal neovascularization (CNV) using swept source optical coherence tomography (SS-OCTA) imaging in patients with proliferative diabetic retinopathy.

Observations: Two patients developed CNV adjacent to laser scars, and these neovascular lesions were detected on SS-OCTA imaging. Historically, both patients had subretinal fluid associated with these lesions. Visual acuity for both patients was 20/25 in the affected eyes. Both patients were observed over multiple years with stable CNV and visual acuity.

Conclusions and importance: SS-OCTA was able to detect laser-induced CNV in a rapid and non-invasive manner. When there is no foveal involvement and excellent visual acuity, we recommend close observation since the CNV may not progress.

1. Introduction

Photocoagulation therapy is a common treatment for diabetic retinopathy. The Diabetic Retinopathy Study (DRS) reported the beneficial outcomes of treatment in proliferative diabetic retinopathy.[1] Early Treatment Diabetic Retinopathy Study (ETDRS) and other collaborative prospective clinical trials have demonstrated focal photocoagulation therapy to be effective in treating diabetic macular edema. Complications include epiretinal membrane, visual field defects, retinal hemorrhage, and choroidal neovascularization.[2,3] Many animal studies as well as a few case series have described secondary choroidal neovascularization (CNV) from argon or xenon laser therapy. With the advent of swept source optical coherence tomography angiography (SS-OCTA – PLEX Elite 9000, Carl Zeiss Meditec, Dublin, CA), the detection of a type 1 CNV can be obtained in a rapid and non-invasive method. We report two patients with CNV secondary laser photocoagulation using SS-OCTA.

2. Cases

2.1. Case 1

54-year old man with a history of proliferative diabetic retinopathy (PDR) presented for evaluation after treatment by an outside provider. His left eye had extensive tractional retinal detachment with silicone oil tampenade after vitrectomy and a visual acuity of counting fingers. His right eye underwent dense panretinal photocoagulation (PRP) close to the macula 20 years ago with visual acuity of 20/25 (Fig. 1A). *En face* SS-OCTA imaging using a slab with boundaries between the retinal pigment epithelium (RPE) and Bruch's membrane revealed a neovascular network arising from the pigmented scar lesion. This lesion corresponds to a double layer sign (DLS) with flow identified on the corresponding B-scan as a pigment epithelial detachment (PED) (Fig. 1B–C). The *en face* structural slab shows a darker area corresponding to the CNV due to the increased scattering of light caused by the PED and CNV (Fig. 1D). Previously, the patient did have a trace amount of subretinal fluid surrounding the PED that spontaneously resolved. This patient was observed over a 5-year period and no change occurred in his visual acuity or the SS-OCTA appearance of the CNV.

2.2. Case 2

59-year old woman presented after treatment from an outside provider. She had a history of PRP 25 years ago in the right eye for PDR with visual acuity of 20/25 in both eyes. Additional focal laser had been applied temporal to the fovea secondary to diabetic macular edema in the right eye (Fig. 2A). *En face* SS-OCTA imaging revealed CNV and the corresponding B-scans showed subretinal fluid as well as flow under the

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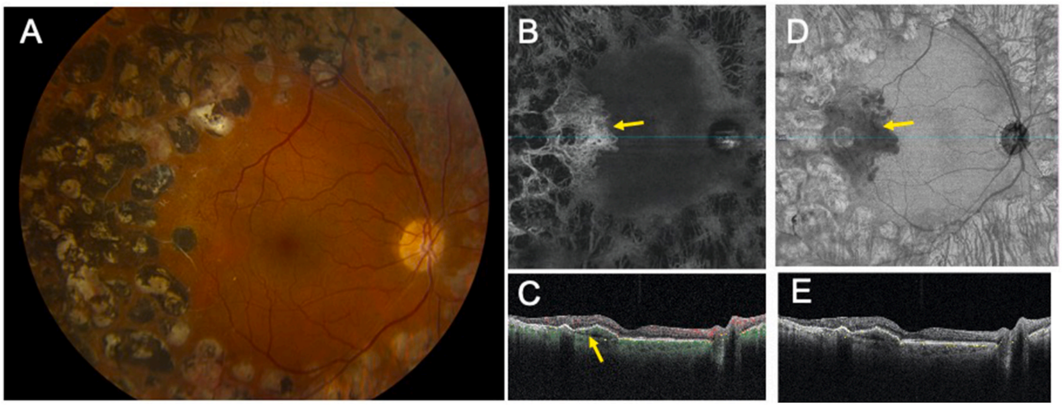

Fig. 1. 54-year old male with proliferative diabetic retinopathy with secondary choroidal neovascularization (CNV) from old laser treatment in the right eye. (A) Fundus photograph shows extensive panretinal photocoagulation (PRP) encroaching near the macula. (B) 12 × 12 mm *en face* angiographic slab with boundaries between the retinal pigment epithelium (RPE) and Bruchs' membrane. The blue line corresponds to the B-scan depicted in C. (C) Structural B-scan with flow corresponding to the blue line in B that shows a pigment epithelial detachment with increased flow (green) at the position where CNV is located. (D) *En face* structural slab corresponding to B shows an area of decreased reflectivity that corresponds to the CNV. (E) Structural B-scan without flow corresponding to the blue line in D that shows a pigment epithelial detachment at the position where CNV is located. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

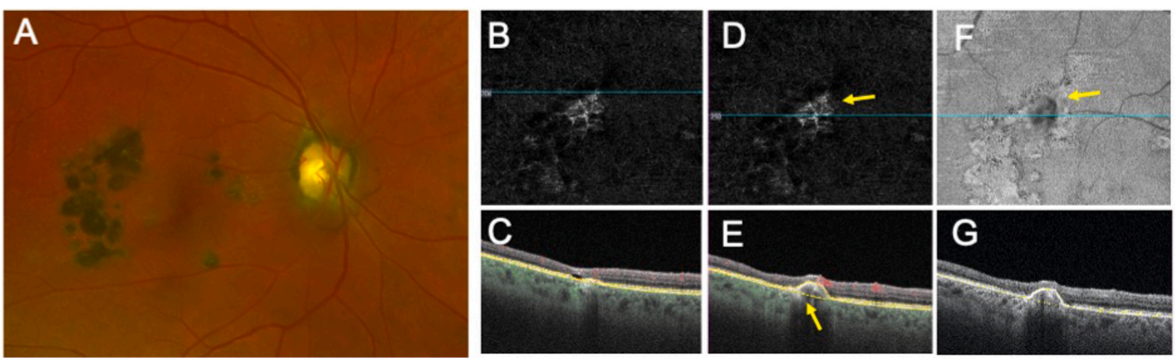

Fig. 2. 59-year old female with secondary macular neovascularization and subretinal fluid from old laser treatment in the right eye. (A) Fundus photograph shows extensive panretinal photocoagulation (PRP) and focal laser near the fovea. (B) 6 × 6 mm *en face* angiographic slab with boundaries between the RPE and Bruchs' membrane. The blue line corresponds to the B-scan depicted in C. (C) Structural B-scan demonstrates area of subretinal fluid corresponding to the blue line in B. (D) 6 × 6 mm *en face* angiographic slab with boundaries between the RPE and Bruchs' membrane, with the blue line centered at the CNV lesion (yellow arrows) corresponding to the B-scan depicted in E. (E). Structural B-scan with flow corresponding to the blue line in D that shows a pigment epithelial detachment with increased flow (green) at the position where CNV is located. (F) *En face* structural slab corresponding to D shows an area of decreased reflectivity that corresponds to the CNV (yellow arrow). (G) Structural B-scan without flow corresponding to the blue line in F that shows a pigment epithelial detachment at the position where CNV is located. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

PED, which represented a DLS (Fig. 2B–E). *En face* SS-OCTA structural imaging once again showed decreased reflectivity corresponding to the area of the CNV beneath the laser spot (Fig. 2F). Since the PDR was inactive and the subretinal fluid was minimal and outside the foveal center, we observed the patient, and for 2 years, no change in her clinical features were observed by SS-OCTA imaging.

3. Discussion

The pathogenesis of CNV from laser is thought to occur through a rupture in Bruch's membrane after photocoagulation. Animal experimentation has shown this phenomenon.[4–6] Various studies have theorized that multiple repeated, small spot size (50 μm), short duration and intense burns (power setting over 250–300 mW) are risk factors for the development of laser-induced CNV.[3,7–9] Laser-induced CNV has been reported while using either argon or xenon laser.[3,9–11] Using SS-OCTA, the figures demonstrate CNV corresponding to the laser spots.

Lewis et al. reported CNV developing in 8 patients after photocoagulation for diabetic macular edema. In this series, using fluorescein angiography, they detected that 6 patients had extrafoveal CNV, 1 patient had subfoveal lesion, and 1 patient had juxtafoveal lesions all arising from the photocoagulation scar.[8] Photocoagulation was repeated in 6 eyes targeting the CNV, with 4 of these eyes having recurrent episodes of bleeding or fluid. At the last reported follow-up, all 8 eyes had worse final visual acuity than their visual acuity at presentation.[8] Besides diabetic retinopathy, other conditions such as sickle cell retinopathy, central serous chorioretinopathy, and retinal angiomas have been associated with laser-induced CNV.[3,9–12]

In addition to traditional argon and xenon laser, Wang et al. described CNV secondary to a 750-nm Alexandrite laser used for laser hair removal that was treated with intravitreal ranibizumab.[13] Tofolean et al.[14] described the onset of CNV secondary to an accidental firing of diode laser during hair epilation. The patient was treated with one intravitreal injection of bevacizumab with improvement in visual acuity and leakage from CNV. Nehemy et al.[15] described an accidental injury with a ti:Sapphire laser pumped by an Argon laser beam that caused CNV with leakage, which remained stable with observation over time. Ying et al.[16] reported a physicist who was accidently injured by an ND:YAG laser pulse and developed CNV, which was treated successfully with photodynamic therapy (PDT).

Given the fact that the CNV was away from the fovea in both cases reported here, we chose to observe. Both patients had excellent visual acuity with stability of the lesions on SS-OCTA imaging at follow-up visits. Previously described cases were treated with anti-vascular endothelial growth factors (anti-VEGF) drugs, corticosteroids, and PDT, but observation is still an excellent option for those lesions away from the fovea.[3,8,12,13,16] While fluorescein angiography was the method of choice for diagnosing and observing laser-induced CNV in the past, SS-OCTA has become a convenient and safe tool for close monitoring of these neovascular lesions. To the best of our knowledge, this is the first report describing laser-induced CNV imaged with OCTA.

4. Conclusions

We describe two patients with laser-induced CNV detected and monitored using SS-OCTA. Both patients had CNV away from the fovea and were observed for long periods without treatment.

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Authors

All authors attest that they meet the current ICMJE criteria for Authorship.

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References

1. The Diabetic Retinopathy Study Research Group. Preliminary report on effects of photocoagulation therapy. *Am J Ophthalmol*. 1976;81(4):383–396.
2. Early Treatment Diabetic Retinopathy Study research group 1. Photocoagulation for diabetic macular edema. Early Treatment Diabetic Retinopathy Study research group. *Arch Ophthalmol*. 1985;103(12):1796–1806.
3. Benson WE, Townsend RE, Pheasant TR. Choriovitreal and subretinal proliferations: complications of photocoagulation. *Ophthalmology*. 1979;86(2):283–289.
4. Edelman JL, Castro MR. Quantitative image analysis of laser-induced choroidal neovascularization in rat. *Exp Eye Res*. 2000;71(5):523–533.
5. Lambert V, Lecomte J, Hansen S, et al. Laser-induced choroidal neovascularization model to study age-related macular degeneration in mice. *Nat Protoc*. 2013;8(11): 2197–2211.
6. Shah RS, Soetikno BT, Lajko M, Fawzi AA. A mouse model for laser-induced choroidal neovascularization. *JoVE*. 2015;106, e53502.
7. Varley MP, Frank E, Purnell EW. Subretinal neovascularization after focal argon laser for diabetic macular edema. *Ophthalmology*. 1988;95(5):567–573.
8. Lewis H, Schachat AP, Haimann MH, et al. Choroidal neovascularization after laser photocoagulation for diabetic macular edema. *Ophthalmology*. 1990;97(4):503–510. discussion 510-501.
9. Galinos SO, Asdourian GK, Woolf MB, Goldberg MF, Busse BJ. Choroido-vitreal neovascularization after argon laser photocoagulation. *Arch Ophthalmol*. 1975;93(7): 524–530.
10. Galinos SO, McMeel JW, Trempe CL, Schepens CL. Chorioretinal anastomoses after argon laser photocoagulation. *Am J Ophthalmol*. 1976;82(2):241–245.
11. François J, Cambie E. Further vision deterioration after argon laser photocoagulation in diabetic retinopathy. *Ophthalmologica*. 1976;173(1):28–39.
12. Fekih O, Mabrouk S, Zgolli MH, Bakir K, Zghal I, Nacef L. Choroidal neovascularization following argon laser photocoagulation for central serous chorioretinopathy. *Tunis Med*. 2019;97(1):157–162.
13. Wang R, Wykoff CC, Christie L, et al. Choroidal neovascularization secondary to alexandrite laser exposure. *Retin Cases Brief Rep*. 2016;10(3):244–248.
14. Tofolean IT, Amer R. Laser-induced CNV following hair removal procedure. *Rom J Ophthalmol*. 2019;63(3):281–286.
15. Nehemy M, Torqueti-Costa L, Magalhães EP, Vasconcelos-Santos DV, Vasconcelos AJ. Choroidal neovascularization after accidental macular damage by laser. *Clin Exp Ophthalmol*. 2005;33(3):298–300.
16. Ying HS, Symons RC, Lin KL, Solomon SD, Gehlbach PL. Accidental Nd:YAG laser-induced choroidal neovascularization. *Laser Surg Med*. 2008;40(4):240–242.