Purpose: To compare choroidal vascular density and volume in eyes with different stages of diabetic retinopathy against controls, using en face swept-source optical coherence tomography (SS-OCT).

Setting: Department of Ophthalmology, Centro Hospitalar e Universitário de Coimbra (CHUC), Coimbra, Portugal; Associação para Investigação Biomédica e Inovação em Luz e Imagem (AIBILI), Coimbra, Portugal; Faculdade de Medicina da Universidade de Coimbra (FMUC), Coimbra, Portugal; Massachusetts Eye and Ear Infirmary, Harvard Medical School, Boston, MA, United States

Methods: Multicenter, prospective, cross-sectional study. We recruited diabetic and age-matched non-diabetic subjects. Diabetic eyes were divided into 4 groups: no diabetic retinopathy (No DR), non-proliferative DR (NPDR), NPDR with macular edema (NPDR + DME), and proliferative DR (PDR). All underwent complete ophthalmologic exam and imaging using SS-OCT (3D horizontal volume, 12 mm x 9 mm). En face images of the choroidal vasculature were obtained (using Bruch’s membrane as reference for flattening) and converted to binary images on ImageJ. Choroidal vascular density was then calculated as a percentage area occupied by choroidal vessels in the central macular region (a 6-mm diameter circle centered on the fovea) as well as throughout the posterior pole (12 mm x 9 mm scan). Choroidal thickness was also obtained using SS-OCT automated software. The central macular choroidal vascular volume was calculated by multiplying the choroidal thickness by the average choroidal vascular density within this area. Multilevel mixed linear models were performed for analyses.

Results: We included 143 diabetic eyes (n = 27 no DR, n = 47 NPDR, n = 51 NPDR + DME, and n = 18 PDR), and 64 non-diabetic control eyes. Choroidal vascular densities of the central macula were significantly lower in eyes with NPDR + DME (28% ± 6.1%, β=-0.02, p=0.045) and eyes with PDR (26.4% ± 5.1%, β=-0.04, p=0.039) compared to controls (30.9% ± 7.2%), even when controlled for age. Similar statistically significant results were also observed for the wider posterior pole images (21.6% ± 3.2%, β=-0.015, p=0.009 and 20.5% ± 2.2%, β=-0.023, p=0.006 for NPDR+DME and PDR, respectively, when compared to controls (23.3% ± 3.4%). The central macular choroidal vascular volume was significantly lower in eyes with PDR (0.015 mm3 ± 0.005 mm3, β=-0.01, p=0.02) compared to control (0.023 mm3 ± 0.01 mm3).

Conclusions: Choroidal vessel density and volume is significantly reduced in more advanced stages of diabetic retinopathy. New imaging modalities should allow us to further explore the contributions of choroidal vessel disease in diabetic eye disease pathogenesis, prognosis, and response to treatment.