Visual impact of foveal ischemic changes detected by OCT angiography in type II diabetic patients without diabetic retinopathy

Esraa Ali, Mohamed E Shahin, and Moataz A. Sallam

Background: The foveal avascular zone (FAZ) is an oval capillary-free region formed by the foveal capillary network at the margin of the fovea, whose presence accounts for the fine visual acuity of the fovea. In diabetic patients, the underlying microangiopathy occurs in the form of microvascular occlusion causing ischemia, and leakage causing oedema. This diabetic macular ischemia (DMI) can cause vision loss on its own and this loss can be severe and sudden despite small progression in disease severity. In this study, we aim to detect early DMI using OCT angiography (OCTA) and show its direct impact on visual acuity (VA) of diabetic patients without diabetic retinopathy (NDR).

Methods: A cross-sectional study was conducted to compare 30 eyes of 15 type II diabetic patients with NDR and 22 eyes of 11 healthy control subjects . The study included NDR patients with 5 to 10 years disease duration, had no lens pathology and HBA1C ≤ 6.5%. Complete medical history taking, comprehensive ophthalmic examination, Objective refraction followed by assessment of best corrected distant visual acuity **(BCDVA)** were done. Dilated fundus photography, OCT and OCTA scans were taken using DRI OCT Triton plus (Topcon Co2015, Tokyo, Japan)- Swept source with implemented SMARTTrack system.

The OCTA scans were 3x3 mm centred on the fovea. The superficial capillary plexus (SCP) and the deep capillary plexus (DCP) generated by the OCT system software (IMAGEnet 6 V.1.14.8538) were included in the analysis. The central macular thickness **(CMT)** within the 1mm central diameter ring and the FAZ area were measured and assessed. Additionally, the perimeter of the superficial (sFAZ) and deep (dFAZ) FAZ were described to be regular or irregular.

The vascular density (VD) is measured as the percentage proportion of pixels containing flowing vasculature to all the pixels of the analysed area. It was calculated in the foveal and parafoveal areas. The foveal area was measured from the central avascular zone. The parafoveal area (annulus around the fovea with 1mm inner ring diameter and 3 mm outer ring diameter) was measured and divided into superior, inferior, temporal, and nasal segments using the 3D implemented software.

Results: Despite having good diabetic control (HbA1C of 6.22 ± 0.25), all patients experienced significant differences in BCDVA and CMT when compared to controls (p ≤ 0.001). the average of foveal and parafoveal vascular densities was significantly lower in diabetic than controls (p < 0.05) with a significant decrease in superior and temporal quadrants of the outer 3 mm ring. (Table 1)

NDR patient BCDVA: **0.2**

Control subject BCDVA: **0.0**

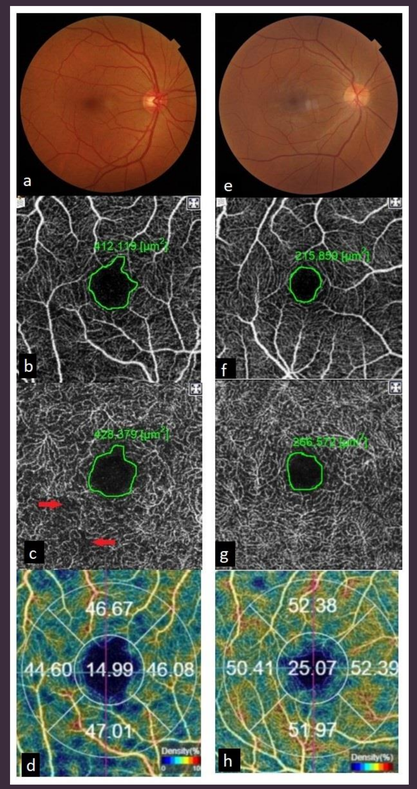


Figure 1 **a-d** Scans of NDR patient showing coloured fundus photo of the right eye, OCTA of SCP showing area of sFAZ, OCTA of DCP showing dFAZ area (red arrows pointing to capillary drop out areas), VD in foveal and parafoveal areas respectively.
e-h Scans of control subject showing coloured fundus photo of the right eye, OCTA of SCP showing sFAZ area, OCTA of DCP showing dFAZ area, VD in foveal and parafoveal areas respectively.

(Table 1)	Diabetics n=30 eyes of 15 patients	Controls n=22 eyes of 11 subjects	P value
BCDVA (LogMAR)	0.19 ± 0.17	0.00	**0.000***
CMT (µm)	247.57 ± 11.15	263.33 ± 13.98	**0.000***
Mean sFAZ area (µm²)	325.75	267.67	**0.040***
Mean dFAZ area (µm²)	375.51	327.63	0.088*
sFAZ Irregular perimeter, n	29 (96.7%)	2 (9.09%)	**0.000****
dFAZ irregular perimeter, n	26 (86.67%)	0.00	**0.000****
Mean central VD, %	18.66	19.32	0.059*
Mean inferior VD, %	47.76	50.32	0.088*
Mean nasal VD, %	46.83	47.20	0.085*
Mean superior VD, %	48.50	50.51	**0.000***
Mean temporal VD, %	47.05	49.28	**0.000***

** Mann-Whitney U test, ** Chi square test, p value <0.05*
- BCDVA: Best corrected distant visual acuity, CMT: central macular thickness,FAZ: foveal avascular zone, sFAZ: FAZ of superior capillary plexus, dFAZ: FAZ of deep capillary plexus, VD: vascular density.

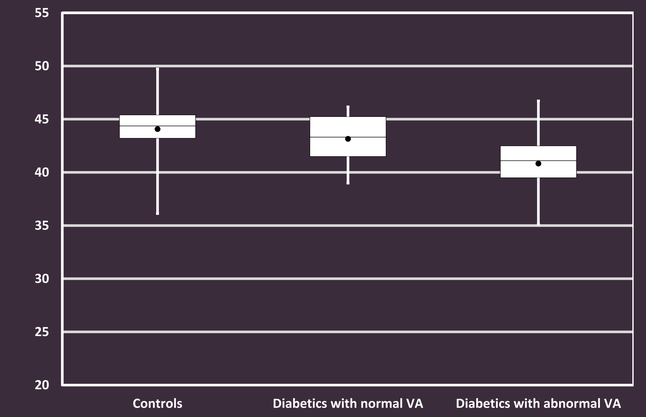


Figure 2 Average foveal and parafoveal vascular density within the central 3 mm area among diabetics and controls.

Conclusion: **Diabetic ischemic microvascular changes including decreased VD and enlarged FAZ areas precede clinically visible retinopathy and might be correlated with decreased VA in patients with NDR.**