Evaluation of Retinal Vascular Changes Seen on Optical Coherence Tomography Angiography (Octa) In Patients with Clinically Insignificant Diabetic Retinopathy (CIDR) At Pns Shifa, Karachi

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ABSTRACT

Objective: To compare superficial retinal plexus (SCP) of the foveal avascular zone (FAZ) in patients of diabetes who have clinically insignificant diabetic retinopathy (CIDR) with Optical Coherence Tomography Angiography (OCTA) at Pakistan Navy Station (PNS) Shifa, Karachi.

Study Design: Quasi-experimental study

Place and Duration of Study: Department of Opthalmology, PNS Shifa, Karachi, Pakistan, from Jan 2022 to Jan 2024.

Methodology: Our study included a total of 100 eyes at PNS Shifa, Karachi, where 50 eyes were included in diseased group (Group I), who had diabetes but without any clinical findings, and 50 eyes in the age-matched control group (Group II). Retinal vascular density of SRP and size of FAZ in both groups was noted using SS-OCTA after doing Best Corrected Visual Acuity (BCVA) and detailed fundal examination and compared on data analysis.

Results: This study comprised a total of 50 patients, with 100 eyes, mean age being 46.20±7.17 years, ranging from 33.00 to 67.00 years, of which, 43(86.00%) were male and 7(14.00%) were females. Superficial vessel density of FAZ was found to be significantly increased in the Diabetic Retinopathy group as compared to the Non-Diabetic Retinopathy (p value < 0.001).

Conclusion: Our results showed that OCTA is an efficient tool for early detection of diabetic retinopathy in patients with clinically insignificant diabetic retinopathy.

Keywords: Clinically insignificant diabetic retinopathy (CIDR), Diabetic retinopathy, Foveal avascular zone (FAZ), Optical coherence tomography angiography (OCTA)

INTRODUCTION

Diabetic retinopathy is a serious complication of diabetes which occurs when high blood sugar levels damage the blood vessels in the retina, leading to vision problems and potential blindness if left untreated, as in the early stages, it may cause no symptoms, but as it progresses, symptoms like blurred vision, floaters, and even complete vision loss may occur, due to which, optical coherence tomography angiography (OCTA) is a must, particularly in the context of diabetes.[1] This non-invasive imaging method compares the decorrelation signal across successive OCT B-scans, which allows for the creation of OCT angiograms using motion contrast.[2,3] The foveal avascular zone (FAZ) and vascular density are two of the factors that may be quantitatively evaluated using this method.[4,5] While retinography and fundus examination both lack quantitative and qualitative information, recent studies have shown that OCTA can show early diabetic vascular alterations, making it

a potentially useful tool for diabetic retinopathy (DR) screening.[6,7] This study aims to investigate the superficial retinal plexus (SRP) within the foveal avascular zone (FAZ) using Optical Coherence Tomography Angiography (OCTA) in diabetic patients with clinically insignificant diabetic retinopathy (CIDR). By comparing the FAZ characteristics in this specific subgroup, we seek to report early microvascular alterations that may precede clinically significant changes. Understanding the subtle changes in the retinal microvasculature in CIDR patients could potentially aid in earlier detection and intervention strategies, ultimately contributing to improved management and prevention of vision-threatening complications.

METHODOLOGY

The quasi-experimental study was done at PNS Shifa, Karachi, Pakistan, after gaining approval from the Ethics Committee Review Board of PNS Shifa, vide ERC/2022/EYE/01. Sample size was computed using World Health Organization (WHO) sample size calculator, taking mean FAZ within 3- and 3-mm area of non-diabetic retinopathy patients at 0.37 ± 0.12 and

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Diabetic retinopathy patients at 0.53±0.32[8]. The estimated sample size came out to be 72 eyes; however, we recruited 100 eyes (50 in each group) using non-probability consecutive sampling.

Inclusion Criteria: Patients aged ≥ 18 years, of either gender, diagnosed with Type 1 or 2 Diabetes Mellitus, with no other medical comorbidity and good quality OCT images.

Exclusion Criteria: Patients with optic nerve disease (glaucoma, optic neuropathy), diseases of the vitreoretinal interface, high myopia, age-related macular degeneration, central serous chorioretinopathy, hypertensive retinopathy, surgery, and retinal photocoagulation.

Patients were divided into two groups, Group-I included patients who had Diabetes (type 1 or 2) but without any clinical findings of diabetic retinopathy while Group-II included aged-matched controls as shown in Figure-1. Images were captured by means of the RTVue XR spectral-domain OCT device's AngioVue OCTA software.
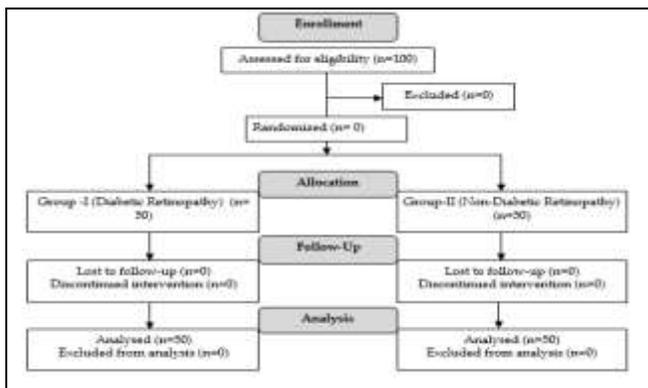

Figure-1: Patient Flow Diagram (n= 100)

The reader evaluated both 3 x 3 mm and 6 × 6 mm scans, which were performed with the fovea as the centre. Superficial vascular network OCT angiograms measuring 3 × 3 mm were subjected to qualitative and quantitative evaluations on the following parameters: the width of the FAZ, any changes to the FAZ that occur inside the 1 mm central zone (nonperfusion), vascular tortuosity, ruptures, and spider web-like architecture of the capillary border, capillary microaneurysms, characterised by localised dilatations or loops, waviness and density of superficial blood vessels using flow analysis, where the greater field and poorer resolution of the 6 x 6 mm OCT angiograms enables the evaluation of more distant abnormalities, such as microaneurysms,

vascular tortuosity, and nonperfusion areas, which are not always visible in the 3 x 3 mm scanning. All statistical analyses were carried out using Statistical Package for the Social Sciences (SPSS) version 25.00. The quantitative data was presented as mean ± standard deviation, while the variables were analysed using independent sample t-test where p-value ≤ 0.05 was considered as statistically significant.

RESULTS

This study comprised a total of 50 patients with 100 eyes, mean age was 46.20±7.17 years, ranging from 33.00 to 67.00 years, out of which, 43(86.00%) were male and 7(14.00%) were females, as shown in Table-I. Mean duration of Diabetes in the Diabetic Retinopathy group was 108.61±43.68 months and superficial vessel density of FAZ was significantly increased as compared to the Non-Diabetic Retinopathy group (p-value < 0.001) but no statistically significant difference was observed in the Superficial Retinal Vascular Plexus among both groups (p-value > 0.05), as shown in Table-II.

Table-I: Demographic characteristics of both groups (n=50)

Parameters		Study Groups	
		Non-Diabetic Retinopathy (n=50)	Diabetic Retinopathy(n=50)
Mean Age (years)		44.80±7.54	47.60±6.54
Gender	Male	23(92.0%)	20(80.0%)
	Female	2(8.0%)	5(20.0%)

Table-II: Comparison of FAZ Area, Superficial Retinal Vascular Plexus between groups (n=100)

Parameters	Study Groups		p-value
	Non-Diabetic Retinopathy (n=50)	Diabetic Retinopathy (n=50)	
FAZ Area 3 x 3 mm	0.36±0.12	0.48±0.20	< 0.001
Superficial Retinal Vascular Plexus	15.78±2.22	18.31±3.52	0.12

DISCUSSION

Optical Coherence Tomography Angiography (OCTA) is a non-invasive imaging technique that provides high-resolution, depth-resolved visualization of retinal and choroidal vasculature.[9] which allows for detailed assessment of microvascular structures without the need for contrast agents.[10] This advanced imaging modality enables clinicians to precisely visualize capillary networks, quantify vascular density, and analyse blood flow patterns, which has

revolutionized the management of various retinal diseases, including diabetic retinopathy, age-related macular degeneration, and retinal vascular occlusions, by facilitating early detection and treatment.[11] Microaneurysms are the first indicator of diabetic retinopathy, and OCTA can detect early retinal alterations that are invisible on biomicroscopic fundus examination as the more invasive and sensitive retinal fluorescein angiography is not a good choice for screening because of its limitations.[12] Changes to the choriocapillaris and superficial capillary retinal networks have been suggested by OCTA studies in diabetic patients who do not have clinically obvious diabetic retinopathy.[13] In the diabetic group, our investigation found that microaneurysms, vascular tortuosity, nonperfusion zones, and FAZ remodelling were all much more prominent, despite one previous study showing a reduction in vascular density and an increase in FAZ size in diabetic eyes, we did not see either of these changes.[14] As these factors differ from person to person and are age-dependent, [15] literature has demonstrated that a decrease in vascular density is a prelude to Type 1 Diabetes, which explains why there was no noticeable fall in vascular density in the superficial network.[16,17] However, microvascular problems can manifest elsewhere in the body, not only in the retina, and diabetic choroidopathy was described in the OCTA in one few investigation[18] but there was no correlation between the presence or severity of retinal microvascular changes and their symptoms, which included impaired choriocapillaris flow and noticeable microvascular density heterogeneity. By comparing the superficial retinal plexus within the foveal avascular zone using Optical Coherence Tomography Angiography (OCTA) in patients with clinically insignificant diabetic retinopathy (CIDR), we noted subtle alterations preceding clinically significant stages. Such insights could revolutionize early detection strategies, facilitating timely intervention and potentially averting vision-threatening complications.

LIMITATIONS OF STUDY

The quasi-experimental design and single-centre setting limit the generalizability of our findings to the broader population, particularly given the highly skewed gender distribution with 86% male participants. The relatively small sample size and the lack of long-term follow-up mean that the progression of retinal changes over time could not be assessed. Furthermore, the study's focus on only the superficial capillary plexus of the foveal avascular

zone means that deeper retinal layers, which might also show early diabetic changes, were not evaluated. Finally, the absence of blinding in the OCTA measurements and analysis could introduce potential observer bias in the interpretation of results.

CONCLUSION

Detection of microvascular alterations in diabetics before retinopathy develops using OCTA, could be beneficial in identification of patients who are likely to get retinopathy and, as a result, require closer supervision of their diabetes.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

FB & BS: Data acquisition, data analysis, critical review, approval of the final version to be published.

KH & FA: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

MKS & KB: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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