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Research Article

Correlation Between Changes in Peripapillary Capillaries in Primary Open Angle Glaucoma by OCT Angiography and RNFL Thickness Measured by OCT

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Abstract

Background: Optical Coherence Tomography Angiography (OCTA) is a revolutionary imaging technology that enables the blood flow into the retina and optic nerve head without intravenous injection of dye. The objective of this study was to connect changes between OCT and retinal nerve fiber layer (RNFL) thickness with peripapillary capillaries in primary open-angle glaucoma (POAG) by OCT Angio.

Methods: This sectional cross-pilot study was carried out in 30 patients age between 20 to 60, patients with POAG and to correlate between localized RNFL defect and peripapillary capillary by OCT angiography.

Results: Statistically significant positive correlation between RNFL thickness and vascularity in superior sector, RNFL thickness and vascularity in inferior sector, RNFL thickness and vascularity in nasal sector. significant positive correlation between RNFL thickness measured for nasal, superior and inferior sectors. significant positive correlation between pericapillary changes measured for nasal, superior, temporal and inferior aspect.

Conclusion: The detection of reduced vessel density in POAG perimetrically shows that OCT-A can identify a significant risk of microvascular alterations in the eyes before visual area impairment is detected.

Keywords: Peripapillary capillaries; Primary open angle glaucoma; OCT angiography; RNFL

Introduction

Glaucoma is one of the world's major irreversible blindness [1]. Glaucoma's pathogenesis is complicated and unclear. Mechanically, the damage caused by the retinal ganglion is caused by increasing intraocular pressure (IOP), compared with additional elements like as blood flow in glaucoma aetiology in "vascular" hypothesis [2].

The outcome was comprehensive investigation of microvascular infusion and flow of blood to the head of the optic nerve (ONH). A variety of different diagnostic instruments are utilised in clinical practise to quantify and evaluate the course of OAG. These include the examination of the visual field and the determination of stereometric parameters using Heidelberg retina tomography by employing OCT images to examine the RNFLT thickening (HRT). OCT is extensively used to diagnose and manage retinal disorders and glaucoma, as it provides retinal thickness measurements [3].

A newly designed OCT angiography (OCTA) has proved the capacity to quickly and correctly assess retinal and disc flow [4].

It is a non-invasive technology that requires no exogenous dye or contrast agent and quantities of disc infusion close automatically.

OCTA is a revolutionary imaging technology that enables the blood flow into the retina and optic nerve head without intravenous injection of the Dye in normal and pathological vascularization. The measurement of blood flow is an interesting component of this non-invasive approach. In normal people and in diverse disorders, the reproducibility and repeatability of the flow density data were demonstrated to be high [5].

Further research in patients with glaucoma compared to healthy tests have shown a decrease disc infusion [6].

The objective of this study was to connect changes between OCT and RNFL thickness and peripapillary capillaries of primary open-angle glaucoma by using OCTA.

Patients and Methods

This sectional cross-pilot study in 30 patients aged between 20 to 60, patients with POAG and localized RNFL defect, both males and females with OCT angiography and OCT thickness evaluated in POAG correlating alterations in peripapillary capillaries in primary open angle glaucoma. The study was done at Ophthalmology department clinic at Beni-suef university hospital from 1st July 2020 to 30 of March 2021.

Exclusion criteria were patients with History of ocular or systemic diseases causing ONH damage, thinning of circum papillary retinal nerve fibre layer, visual field defects, patients with refractive error > -6 or > +3D spherical equivalent, media opacities preventing high quality imaging, vitreoretinal disease previous retinal surgery, any other diseases that could potentially cause visual field loss or optic disc abnormalities and angle closure glaucoma or neurological disease.

Cases will be chosen randomly according to inclusion and exclusion criteria.

Statistical Analysis

IBM SPSS® (version 22.0) Software was used to alter, modify and analyse the data. Average, standard deviation, minimum and maximum values have been reported in descriptive statistics for the continuous variables. As frequency and proportion, categorical variables were described. Postoperative differences were shown as a median difference, 95% confidence intervals, and the acceptable margin of Error was set at 5%. The p-value was therefore considered important: The differences were tested for statistical significance using paired t-test. The comparison between groups regarding qualitative data was done by using chi-square test. A two tailed P value <0.05 was considered significant.

Results

Table 1 showed that seventy percent of the studied patients were males and 53.3% of the studied eyes were right sided. Age ranged from 42 to 55 years with mean 47.9 years. IOP ranged from 13.5 to 16.5 mmHg with mean 15.167 mmHg. C/D ratio ranged from 0.1 To 0.8 with mean 0.563. Rim area ranged from 0.43 to 2.1 with mean 1.087. Disc area ranged from 1.2 to 2.83 with mean 1.939.

Table 2 shows that Mean RNFL thickness measured by OCT in different direction were measured by RNFL thikness and were found to be (84.47 in superior sector), (83.2 in inferior Sector), (73.8 in nasal sector) and (63.8 in temporal sector). Mean vascularity in different direction were measured by OCTA and were found to be (41.5 in superior sector), (40.47 in inferior sector), (41 in nasal sector) and (45.3 in temporal sector).

Table 3 shows that there is statistically significant positive correlation between RNFL thickness and vascularity in superior sector, RNFL thickness and vascularity in inferior sector, RNFL thickness and vascularity in nasal sector. there is statistically non-significant between RNFL thickness and vascularity in temporal sector.

Table 4 shows that there is no significant correlation between

Table 1: Distribution of the studied patients according to baseline data and IOP and disc measurements.

	N=30	%
Gender:		
Female	9	30
Male	21	70
Age (year):		
Mean ± SD	47.9 ± 2.784	
Min – Max	42 – 55	
Side:		
OD	16	53.3
OS	14	46.7
IOP (mmHg):		
Mean ± SD	15.167 ± 0.894	
Min – Max	13.5 – 16.5	
CD ratio		
Mean ± SD	0.563 ± 0.15	
Min – Max	0.4 – 0.8	
Rim area:		
Mean ± SD	1.087 ± 0.383	
Min – Max	0.43 – 2.1	
Disc area:		
Mean ± SD	1.939 ± 0.428	
Min – Max	1.2 – 2.83	

Table 2: RNFL thickness of optic disc among the studied patients measured by OCT.

Thickness	Mean ± SD
Superior	84.47 ± 23.795
Inferior	83.2 ± 24.741
Nasally	73.8 ± 16.059
Temporal	63.8 ± 14.894
Superior	41.5 ± 10.957
Inferior	40.47 ± 12.105
Nasally	41.0 ± 7.395
Temporal	45.43 ± 10.044

Table 3: Correlation between thickness and vascularity of optic disc (superior aspect).

Parameter	Thickness	
	r	P
Vascularity (superior sector)	0.544	<0.001**
Vascularity (inferior sector)	0.785	<0.001**
Vascularity (nasal sector)	0.663	<0.001**
Vascularity (temporal sector)	0.344	0.062

r Pearson correlation coefficient

**p≤0.001 is statistically highly significant

Table 4: Correlation between IOP of the studied patients and RNFL thickness measured by OCT, pericapillary changes by OCT angiography and disc measurements.

RNFL thickness	IOP	
	r	p
Superior	-0.064	0.738
Inferior	0.131	0.49
Nasal	-0.005	0.98
Temporal	-0.175	0.355
Pericapillary changes (Vascularity		
Superior	-0.125	0.51
Inferior	0.107	0.573
Nasal	0.081	0.671
Temporal	-0.223	0.235
Disc measurements		
C/D ratio	-0.249	0.184
Rim area	-0.208	0.269
Disc area	-0.205	0.276

r Pearson correlation coefficient

Table 5: Correlation between RNFL thickness in different direction by OCT.

		RNFL thickness (superior)	RNFL thickness (inferior)	RNFL thickness (nasal)	RNFL thickness (temporal)
RNFL thickness (superior)	r		0.732	0.524	0.097
	p		<0.001**	0.003*	0.612
RNFL thickness (inferior)	r	0.732		.619**	0.222
	p	<0.001**		<0.001**	0.238
RNFL thickness (nasal)	r	0.524	0.619		0.160
	p	0.003*	<0.001**		0.398
RNFL thickness (temporal)	r	0.097	0.222	0.160	
	p	0.612	0.238	0.398	

r Pearson correlation coefficient *p<0.05 is statistically significant **p≤0.001 is statistically highly significant.

Table 6: Correlation between pericapillary changes in different direction by OCT angiography.

		VD (superior)	VD (inferior)	VD (nasal)	VD (temporal)
VD (superior)	r		0.855	0.813	0.793
	p		<0.001**	<0.001**	<0.001**
VD (inferior)	r	0.855		0.912	0.762
	p	<0.001**		<0.001**	<0.001**
VD (nasal)	r	0.813	0.912		0.736
	p	<0.001**	<0.001**		<0.001**
VD (temporal)	r	0.793	0.762	0.736	
	p	<0.001**	<0.001**	<0.001**	

r Pearson correlation coefficient *p<0.05 is statistically significant **p≤0.001 is tatistically highly significant

RNFL thickness (by OCT) at any sector and IOP, vascularity by OCTA at any sector and IOP, between disc measurements and IOP.

Table 5 shows that there is statistically significant positive correlation between RNFL thickness (by OCT) measured for nasal, superior and inferior sector. However, there is non-significant correlation between temporal thickness and thickness measured in any other direction.

Table 6 shows that is statistically significant positive correlation between pericapillary changes measured for nasal, superior, temporal and inferior aspect.

Discussion

OCTA can provide detailed capillary peripapillary pictures and can generate layered microvascular structure face pictures [7]. In our current study, there is a statistically significant positive correlation in the superior, inferior, and nasal aspects between RNFL thickness (by OCT) and vascularity by OCTA, while a non-significant correlation in the temporal sector between RNFL thickness (by OCT) and vascularity (by OCT angiography) is found. The reduced vascularity in the RNFL area revealed in this study is consistent with prior OCTA investigations, where associations between the retinal vessels' density and the inner retinal layer thickness or the RNFL were identified [8,9].

In the RNFL or the inner retina, capillaries seem to be affected when neuronal tissue degenerates [10,11]. In the ONH neural tissue, same discovery was likewise shown in the eyes with glaucoma. Midgett et al., showed that the capacity loss in both test and real glaucoma eyes was proportionate to the loss of neuronal tissue inside ONH [12,13].

Park et al [9] revealed a favourable link with their respective peripapillary vascular Densities of the temporal and superior and temporal RNFL thicknesses [14].

In the current investigation, however, no important link existed between vascularity in any sector and IOP, elevated IOP as risk factor might affect the RNFL thickness.
Cronemberger et al., 2021 [6]. Contrary to many prior research, the IOP revealed a negative connection in the median infero-nasal and infero-temporal fields with the peripapillary vascular density (Park et al., 2019 [9,14].

Wang et al [15] also conducted angiography of OCT in glaucoma patients, showing a strong link between ganglion-cell complex thickness and decrease in the flow index and density of the artery, indicating that blood flow in the optic disc is essential for monitoring. Moreover, a trial with Speckle Distribution OCT angiography found considerable linkage between RPC density and RNFL thickness and visual field index in the healthy persons, patients with glaucoma and those suspected of glaucoma [16]. In people with glaucoma, a link was revealed in several investigations between the findings of OCT angiography, vascular density, and peripapillary blood flow in and around the optic disc.

Our study was hampered by its cross-sectional design, it is unable to determine the difference between the effects of anti-glaucoma medication, depending upon glaucoma medicine and various phases of the POAG.

Conclusion

OCT-A identifies the decline in vessel density in the eyes of POAG patients. The reduced vascular density of the POAG eyes means that quantitative OCT-A measures indicate damage to pathophysiologically important tissues of glaucoma. The detection of reduced vessel density in POAG perimetrically shows that OCT-A can identify a significant risk of microvascular alterations in the eyes before visual area impairment is detected.

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