

Comparison of Efficacy of Optical Coherence Tomography, Angiography in patients suffering from true or Pseudo-Optic Disc Swelling

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ABSTRACT

Background: Optical Coherence Tomography Angiography (OCTA) is a non-invasive, detailed visualization of the retinal and choroidal vascular layers, allowing for accurate detection of abnormalities.

Objective: To compare the efficacy of optical coherence tomography angiography in patients suffering from true or pseudo optic disc swelling.

Study Design: Comparative study

Place and Duration of Study: Department of Ophthalmology, Shalamar Medical & Dental College Lahore from 1st January 2023 to 31st October 2023.

Methodology: There were total 60 (80 eyes) cases compared with 50 (50 eyes) as controls. In the control group one healthy eye of each participant was enrolled in the study for comparison. Patients suffering from ONHD eyes, papilledema or with NAION were included in this study. All patients underwent a detailed ophthalmological examination involving measurement of best corrected visual-acuity (BCVA), light sensitivity pupillary reaction of pupillary defect identification. Photographic images of the dilated fundus were taken through Topcon fundus camera. The patients suffering from the ODS were further divided into three sub groups where in G1A was those patients suffering from papilledema (n=20) while G1B were ONHD (n=20) and G1 C were NAION (n=20). A three-dimensional artifact eliminator (PAR) algorithm was installed in the software, for improving the image quality. Pupillary dilation was achieved in each patient followed by peripapillary RNFL imaging. Disc boundaries were categorized, and false identifications were corrected by adjusting disc marginal-points and RNFL was recalculated/analyzed.

Results: In the mean age of the patients was 35.54±12.5 years and controls was 42.5 ± 15.5 years. There were more females than males in the study except in NAION patients. The NAION has the highest values of mean peripapillary-RNFL thickness in eyes. Papilledema had second highest values while control eyes had lowest mean peripapillary RNFL thickness. The sectoral mean thickness of peripapillary RNFL were also high in all patient group except in the healthy controls with a p value as <0.001. The densities of the vessels were measured post exclusion of large vessels. The maximum value for vessel density of peripapillary was observed in ONHD followed by healthy controls and NAION respectively. There was no variance in mean density of peripapillary of ONHD and healthy controls (p value 0.332). Within peripapillary sectors the values of vessel density in nasal region presented no significant difference than other groups while in comparison to healthy controls a significant decrease in vessel density of eyes with the papilledema at temporal and supertemporal regions.

Conclusion: Radial peripapillary capillary (RPC) density is predisposed during ONHD condition as well as in NAION and papilledema. There is a reduction in density of vessel parameters in true disc-edema with emphasis of future more detail study required to analyses

Keywords: Efficacy, Optical coherence tomography, Angiography Pseudo-optic disc swelling

INTRODUCTION

Optic disc swelling (ODS) is a condition which can lead into increased cranial pressure. It can be formed due to various conditions as papilledema, non-arthritis-anterior ischemic optic-neuropathy (NAION).^{1,2} In the cases of papilledema as the intracranial pressure increases swelling is axonal stasis is presented. Whereas in cases of NAION there is edema in retina-nerve fiber layer (RNFL) results from the hypoperfusion as well as ischemia from disrupted vascular-circulation in optic-nerve head (ONH).³ Conditions like pseudo papilledema can mimic swelling of optic disc. Bulb like bodies can be formed and imitate true optic disc inflammation.⁴

There are several methods of identifying the true or pseudo-optic disc inflammation. The most recommended techniques involve imaging protocols which can differ between the true and pseudo ODS. A few of such imaging procedure is through ONH B scan USG and auto-fluorescence of the fundus or fluorescence-angiography as well as optic-coherence tomography are recommended globally.⁵⁻⁹ The ocular B scan at minimal gain settings of USG in patients suffering from ONHD have proven to identify hyperechoic INH bodies.⁵ The fluorescence angiography has timely been able to detect non calcified as well as buried

ONHD.⁹ The fluorescence angiography has also assisted in revealing drusen staining exclusive of dye leakage and in distinction to the conditions where actual optic swelling is presented.⁷⁻¹⁰

In the OCT imaging drusen are observed as hypo reflective signal masses which are surrounded by hyper reflective margins. This imaging technique provides a deep understanding of the drusen/buried drusen morphology and its interactions with the structures present in the surroundings.¹¹ A new more advanced and sensitive ONHD detecting method has recently been introduced termed as enhanced depth-imaging (EDI) OCT. Optical coherence tomography angiography (OCTA) being a non invasive procedure has been considered as an effective method due to its beneficial results in differentiating the optic disc edema.¹³⁻¹⁷

The present study was performed for comparing the efficacy of optical coherence tomography angiography in patients suffering from true or pseudo-optic disc swelling. The results of this study have provided a substantial data on the effectiveness and benefits of the OCTA procedure and henceforth facilitated the patients suffering from ODS.

MATERIALS AND METHODS

This comparative study was conducted at Department of Ophthalmology, Shalamar Medical & Dental College Lahore from 1st January 2023 to 31st October 2023. The study was ethically

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approved through the ethical clearance and initiated after obtaining written informed consent from each participant of the study. In the control group one healthy eye of each participant was enrolled in the study for comparison. There were total 60 (80 eyes) cases compared against 50 controls (50 eyes). Patients suffering from ONHD eyes, papilledema or with NAION were included in this study. The sample size was generated using the incidence of 13 per 100,000 of the ODS. The other parameters which were kept under consideration for sample size generation included 95% Confidence of interval, 80% power of test and 5% margin of error. The age of the patients and controls was between 20-44 years. Patients under grade 4/5 papilledema having chronic papilledema, disc pallor (diagnosed >6 months of ODS) were excluded from the study. Further cases of optic disc-leakage were also excluded. Patients having clinical history of ocular disease or intraocular operations other than the simple cataract operation were also excluded. All patients underwent a detailed ophthalmological examination involving measurement of best corrected visual-acuity (BCVA), light sensitivity pupillary reaction of papillary defect identification. Photographic images of the dilated fundus were taken through Topcon fundus camera. The patients suffering from the ODS were further divided into three sub groups where in G1A was those patients suffering from papilledema (n=20) while G1B were ONHD (n=20) and G1 C were NAION (n=20). The G1 A had previously untreated idiopathic intracranial hypertension with added lumbar-cerebrospinal pressure greater than 25 cm H₂O. These patients had normal MRI. EDI-OCT (Heidelberg Engineering, Heidelberg, Germany) and B scan USG was used for imaging of G1 B. Within this group patients with giant-cell arteritis signals, including raised ESR, CRP levels, were additionally excluded. The control participants presented with BCVA of higher or equal to 20/25, a spherical equivalent within -2.00 - +2.00 diopters, with a normal appearance of their optic disc, intraocular pressure greater or equal to 21 mm Hg. A three-dimensional artifact eliminator (PAR) algorithm was installed in the software, for improving the image quality. Pupillary dilation was achieved in

each patient followed by peripapillary RNFL imaging. Disc boundaries were categorized, and false identifications were corrected by adjusting disc marginal-points and RNFL was recalculated. Post placement of 2 concentric-circles within the diameter of 3.45- as well as 1.95-mm large vessel signal removal was performed with calculation of capillary density including complete imaging in the inner disc. The data was analyzed using SPSS version 26.0 through applying 't' test and Chi square test with p value <0.001 as significant.

RESULTS

The mean age of the patients and controls was 35.54±12.5 and 42.5±15.5 years. There were more females than males in the study except in NAION patients. The youngest patients were observed in the cases with ONHD (Table 1).

The NAION has the highest values of mean peripapillary-RNFL thickness in eyes. Papilledema had second highest values while control eyes had lowest mean peripapillary RNFL thickness. The sectoral mean thickness of peripapillary RNFL were also high in all patient group except in the healthy controls with a p value as <0.001. However temporal sector was not found to be statistically variant between patient and healthy participants (p value 0.514). There was no significant variance within the groups of optic disc swelling (Fig. 1).

The densities of the vessels were measured post exclusion of large vessels. The maximum value for vessel density of peripapillary was observed in ONHD followed by healthy controls and NAION respectively. There was no variance in mean density of peripapillary of ONHD and healthy controls (p value 0.332). Within peripapillary sectors the values of vessel density in nasal region presented no significant difference than other groups while in comparison to healthy controls a significant decrease in vessel density of eyes with the papilledema at temporal and supertemporal regions (Table 2).

Table 1: Demographic details of patients and controls

Parameters	Controls n=50 with 50 eyes	ONHD n=20 with 25 eyes	Papilledeman n=20 with 30 eyes	NAION n=20 with 25 eyes	P value
Age (years)	42.5±15.5	25.71±9.52	33.12±14.95	47.8±13.1	<0.001
Gender					
Female	32 (64%)	11 (55%)	15 (75%)	8 (40%)	0.311
Males	18 (36%)	9 (45%)	5 (25%)	12 (60%)	
BCVA (Log MAR)	0.00±0.01	0.06±0.05	0.02±0.03	0.77±0.65	<0.001

Table 2: Comparative measurements of RPC vessel-density within groups

Parameters	Controls n=50 with 50 eyes	ONHD n=20 with 25 eyes	Papilledeman n=20 with 30 eyes	NAION n=20 with 25 eyes	P value
Overall imaging measures	49.71±1.83	49.69±2.22	47.32±5.1	45.01±4.96	0.001
Peripapillary	52.06±2.07	52.46±2.36	48.90±4.19	46.4±6.03	0.006
Nasal	48.91±2.85	49.99±2.50	48.97±6.04	46.37±6.45	0.06
Inferonasal	50.34±3.67	52.35±4.12	47.40±7.12	45.76±7.01	0.023
Inferotemporal	55.42±4.35	57.35±4.31	52.09±8.01	48.88±10.19	0.015
Super-temporal	54.88±3.12	54.48±4.54	49.08±9.72	45.05±9.77	<0.001
Super-nasal	49.68±3.80	48.95±7.32	46.28±7.06	42.48±8.32	0.003
Temporal	55.12±2.33	54.62±3.35	49.67±7.54	48.30±5.01	0.001

DISCUSSION

Optical Coherence Tomography Angiography (OCTA) is a game-changer for diagnosing and monitoring optic disc swelling. The application is useful in high-resolution imaging and enabling clinicians to distinguish between true and pseudo optic disc swelling. It eliminates the need for invasive procedures, reducing patient discomfort and risk and allows for precise measurement of blood flow and vessel density. The diagnostic usage includes variations between optic disc swelling causes: OCTA helps identify underlying conditions, such as glaucoma, optic neuritis, or papilledema.¹⁸

The regular OCTA scans enable clinicians to track changes in optic disc swelling and adjust treatment accordingly. The OCTA imaging can reveal characteristic patterns of vascular changes in patients with optic disc swelling, such as reduced blood flow or

Fig. 1: Comparison of the peripapillary-RNFL thickness within various groups (P<0.001)

vessel density.¹⁹ The swept-source OCTA can detect subtle changes in the retinal and choroidal layers, aiding in early diagnosis. Overall, OCTA has revolutionized the diagnosis and management of optic disc swelling, offering a valuable tool for clinicians to provide timely and effective treatment.^{20,21}

Literature supports that in true or pseudo cases of ODS there is an alteration observed in the flow of blood which can be identified as perfusion delay during early stages of the disease.²²⁻²⁵ Similar results were noticed in the current study results. A dry leakage may make the vessel of optic disc incomprehensible for proper evaluation of the ONH as true disc swelling.²⁵ Contradictory if the blood flow has slow but detectable flow the OCTA will secure detection motion-contrast between the B scan making it difficult to estimate the densities of vessels.²⁶⁻²⁹

The present study assessed the measurements of OCTA in ONH papillary regions in control subjects. The OCTA was also measured in ONH, ONHD, NAION and papilledema. The measurements of the RNFL thickness within groups was performed and a reduction in the papillary vessels density was observed only between the NAION and controls while no such reduction was noticed within ONHD group. There was an increase in the RNFL thickness with true ODS in cases of papilledema and NAION at acute stages. In various groups of ODS a decreased flow of blood may result in hypothetical alterations in the OCTA scan quality. The resolution can be done through usage of novel scanning machine of OCTA which has higher speed and can have selective modes for various time frames within the B scans for improving image-quality.³⁰⁻³³

CONCLUSION

Radial peripapillary capillary (RPC) density is predisposed during ONHD condition as well as in NAION and papilledema. There is a reduction in density of vessel parameters in true disc-edema with emphasis of future more detail study required to analyses. OCTA for differentiating between true and pseudo optic disc swelling.

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