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Evaluation of Role of Optical Coherence Tomography in Diagnosis of Papilledema and Pseudopapilledema

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ABSTRACT

Background: Papilledema is a swelling of the optic nerve head, while pseudopapilledema include hyperopia and congenital disc elevations. Optical coherence tomography (OCT) is an imaging tool that provides histologic information on neural tissue. The aim of the present study was to assess the early and non- invasive diagnosis of papilledema and differentiating it from pseudopapilledema using optical coherence tomography (OCT). **Patients and methods:** this study included adult patients above 18 years old presented to the outpatient clinic of Zagazig University Hospital, diagnosed clinically to have swollen disc by funds biomicoscopy. The Eyes (n=45) had been stratified into 3 groups: Group (1) with 15 normal eyes, Group (2) with 15 eyes with papilledema and Group (3) with 15 eyes with pseudopapilledema (e.g. optic disc drusen and narrow disc due to hypermetropia). **Results:** There is statistically significant difference between the studied groups regarding horizontal elevation. There is statistically significant difference between the studied groups regarding vertical elevation. On LSD comparison, the difference is significant between papilledema and each other group. The highest value occurs in papilledema group followed by pseudo papilledema group then control group**.** The best cutoff of inferior RNFL in diagnosis of pseudo papilledema is ≥135.5 with area under curve 0.987, sensitivity 93.3%, specificity 86.7%, positive predictive value 87.5%, negative predictive value 92.9%, accuracy 90%**.** The best cutoff of superior RNFL in diagnosis of pseudo papilledema is ≥132.5 with area under curve 0.916, sensitivity 86.7%, specificity 73.3%, positive predictive value 76.5%, negative predictive value 86.4%, accuracy 80%. The best cutoff of nasal RNFL in diagnosis of pseudo papilledema is ≥78 with area under curve 0.918, sensitivity 86.7%, specificity 73.3%, positive predictive value 76.5%, negative predictive value 86.4%, accuracy 80%. **Conclusion:** Using OCT can provide a valuable measures for differentiating papilledema from pseudopapilledema.

Keywords: Papilledema; Pseudopapilledema; Optical Coherence Tomography

INTRODUCTION

Papilledema is a swelling of the optic nerve head that is caused by an increase in the intracranial pressure. Swelling of the optic nerve due to other causes such as ocular inflammatory or vascular disease is not called papilledema **(1).** Pseudopapilledema can be defined as any disc appearance that can be confused with papilledema. The most frequently encountered causes of pseudopapilledema include optic disc drusen, hyperopia, hyaloid remnants, and congenital disc elevations **(2).** Optical coherence tomography (OCT) is a non-contact, non-radiation, fast,efficient, safe, and reproducible diagnostic imaging tool that provides, histologic information on neural tissue in vivo **(3).** Fundus examination has been the traditional method to identify the structuraleffects of optic neuropathies, and include optic disc edema, optic disc pallor, andretinal nerve fiber layer (RNFL) defects. Consequently, changes in RNFLstructure, including slit or wedge defects, represent visible effects of axonal losscaused by retrograde degeneration, typically from an afferent visual pathway lesioninvolving the optic nerve, chiasm, or tracts **(4)**.

Therefore,clinically relevant changes in intracranial pressure, caused for example by shunt ailure, could possibly be best detected by evaluation of the Bruch's membrane complex morphology. This OCT feature could be particularly useful in assessing patients with pre-existing optic atrophy, among which RNFL values (and fundus examination of the optic nerve) may not be a reliable means of tracking worsening elevations in intracranial pressure **(5).** Lastly, OCT has important clinical role to detect retinal causes of vision loss from IIH and evaluate the disease severity **(6)**. Therefore, this study aimed to assess the early and non- invasive diagnosis of papilledema and differentiating it from pseudopapilledema using optical coherence tomography (OCT).

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PATIENTS AND METHODS

An observational study conducted on adult patients above 18 years old who presented to the outpatient clinic of Zagazig University Hospital, diagnosed clinically to have swollen disc by funds biomicoscopy. An informed consent form and any other written information to be given to patients will be reviewed and approved by the Ethics Committee of the Zagazig University Hospital.

Inclusion Criteria:

Eyes of adult patients above 18 years old who diagnosed clinically to have swollen disc by funds biomicoscopy.

Exclusion Criteria:

Patients with other optic disc pathology (glaucoma, congenital anomaly). Patients with ocular media opacity. Patients with high myopia (> -6 D. due to presence of myopic degeneration).

Patients had been stratified into 3 groups:

1- Group (1): (Normal eyes): Eyes with normal optic disc appearance (no disc edema nor pseudo-edema or any other disc pathology) considered as control group.

2- Group (2): (Eyes with papilledema): Patients with papilledema, which was defined as bilateral disc swelling secondary to elevated intracranial pressure (ICP) which had been further divide into mild, moderate and severe according to modified Frise´n Scale **(Philiponnet et al.,2017).**

- Mild papilledema: elevated nasal edge with normal temporal disc margins and no major vessels obscuration.
- Moderate papilledema: elevated all disc margins with obscuration of at least one segment of major blood vessels.
- Severe papilledema: elevated whole nerve head including the cup with obstruction of all vessels on the disc.

3- Group (3): (Eyes with pseudopapilledema): Eyes with pseudopapilledema as in crowed disc (hypermetropia) and optic nerve head drusen had been included in this group.

Techniqual design

All patients were subjected to the full clinical history including age; complaint, ocular trauma or disease, optical correction: glasses, contact lenses and any systemic medical diseases e.g. diabetes mellitus.

Ophthalmic examination:

1- The best corrected visual acuity: after refraction, BCVA was estimated using Landolt ' s broken ring chart which was recorded as its decimal equivalent.

2- Slit-lamp bio microscopy: The cornea was examined for evidence of corneal scar, corneal edema or keratin precipitates. The anterior chamber examined for Depth, Regularity, Aqueous flare and cells. Application tonometry to record baseline intraocular pressure.

3- Fundus examination: Using auxillary lenses (+78 D lenses) to examine central and mid-peripheral retina to exclude possible pathology e.g.; cystoid macular edema, retinal breaks, macular scars…etc.

4- Optic disc photography using Kowa fundus camera.

5- Optic nerve head examination and scanning with Spectral domain OCT: Disc map to measures RNFL thickness in four quadrants (3.4 mm circle around disc) and to detect presence or absence of sub-retinal fluid around optic disc margins,disc radial map scans to measure to measure the degree of optic disc elevation (from inner retinal surface to outer RPE layer), evaluate contour of optic disc and to detect associated pathology as drusen.

Outcomes and follow up:

Spectral domain OTC to differentiate between papilledema, pseudopapilledema, and a normal disc. Nasal RNFL thickness has the highest diagnostic ability to differentiate TP from pseudopapilledema. An independent observer followed up each case. Data were recorded for the purpose of this report at the initial visit. Improvement or failure was assessed according to the criteria described above.

Statistical analysis:

Data collected and analyzed using Microsoft Excel software. Data were then imported into Statistical Package for the Social Sciences (SPSS version 20.0) software for analysis. According to the type of data qualitative represent as number and percentage, quantitative continues group represent by mean ± SD. Differences between quantitative independent multiple by ANOVA or Kruskal Wallis. ROC curves were used. P value was set at <0.05 for significant results &<0.001 for high significant result.

RESULTS

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There is statistically significant difference between the studied groups regarding morphology. Normal control group had normal morphology. All patients with pseudo papilledema had pseudo swelling. Concerning papilledema, 40% had elevated disc while 60% of patients had markedly elevated **(Table 1).**

There is statistically significant difference between the studied groups regarding horizontal elevation. On LSD comparison, the difference is significant between papilledema and each other group The highest value occurs in papilledema group followed by pseudo papilledema group then control group. There is statistically significant difference between the studied groups regarding vertical elevation. On LSD comparison, the difference is significant between papilledema and each other group. The highest value occurs in papilledema group followed by pseudo papilledema group then control group **(Table 2).**

The best cutoff of inferior RNFL in diagnosis of pseudo papilledema is ≥135.5 with area under curve 0.987, sensitivity 93.3%, specificity 86.7%, positive predictive value 87.5%, negative predictive value 92.9%, accuracy 90% (p<0.001) **(Table 3, Figure 1).**

The best cutoff of superior RNFL in diagnosis of pseudo papilledema is ≥132.5 with area under curve 0.916, sensitivity 86.7%, specificity 73.3%, positive predictive value 76.5%, negative predictive value 86.4%, accuracy 80% (p<0.001) **(Table 4, Figure 2).** The best cutoff of nasal RNFL in diagnosis of pseudo papilledema is ≥78 with area under curve 0.918, sensitivity 86.7%, specificity 73.3%, positive predictive value 76.5%, negative predictive value 86.4%, accuracy 80% (p<0.001) **(Table 5, Figure 3).**

Table (1): Comparison between the studied groups regarding morphology

Parameter	Groups			Test	
	Normal group	Papilledema group	Pseudo papilledema group	χ^2	p
	N=15(%)	N=15(%)	N=15(%)		
Morphology **Normal**	15 (100)	0 (0)	0 (0)	MC	<0.001**
Pseudoswelling	0 (0)	0 (0)	15 (100)		
Elevated Markedly	0 (0)	9 (60)	0 (0)		
elevated	0 (0)	6 (40)	0 (0)		
Morphological changes: **SRF**	0 (0)	15 (100)	0 (0)	MC	<0.001**
Humpled shape	0 (0)	9 (60)	3 (20)	MC	<0.001**
Crowded disc	0 (0)	0 (0)	11 (73.3)	MC	<0.001**
Buried optic disc drusen	0 (0)	0 (0)	4 (26.7)	MC	0.027*

χ^2 Chi square test, MC Monte Carlo test, **p≤0.001 is statistically highly significant

Table (2): Comparison between the studied groups regarding elevation of Buch's membrane

Parameter	Groups			Test	
	Normal group	Papilledema group	Pseudo papilledema group	F	p
	N=15(%)	N=15(%)	N=15(%)		
Horizontal:					
Mean ± SD	364.97±15.75	817.2±332.15	425.6 ± 111.42	22.048	<0.001**
Range	335 – 388	240 – 1210	269 – 613		
LSD	P_1<0.001**	P_2 0.023*	P_3 0.417		
Vertical:					
Mean ± SD	389.57 ± 70.3	888.1 ±359.9	498.7 ± 82.17	21.88	<0.001**
Range	174 – 484	290 – 1362	404.5 – 661		
LSD	P_1<0.001**	P_2 0.023*	P_3 0.176		

**p≤0.001 is statistically highly significant , F One way ANOVA test

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p1 the difference between normal group and papilledema groups
p2 the difference between papilledema and pseudo papilledema groups
p3 the difference between normal group and pseudo papilledema group

Table (3): Performance of inferior RNFL in diagnosis of pseudo papilledema among the studied patients

Cutoff	AUC	Sensitivity	Specificity	PPV	NPV	Accuracy	p
≥135.5	0.987	93.3	86.7	87.5	92.9	90	<0.001**

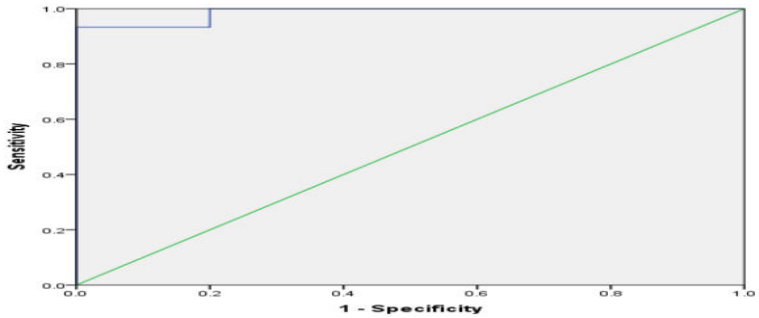

Figure (1): ROC curve showing Performance of inferior RNFL in diagnosis of pseudo papilledema among the studied patients

Table (4) Performance of superior RNFL in diagnosis of pseudo papilledema among the studied patients

Cutoff	AUC	Sensitivity	Specificity	PPV	NPV	Accuracy	p
≥132.5	0.916	86.7	73.3	76.5	86.4	80	<0.001**

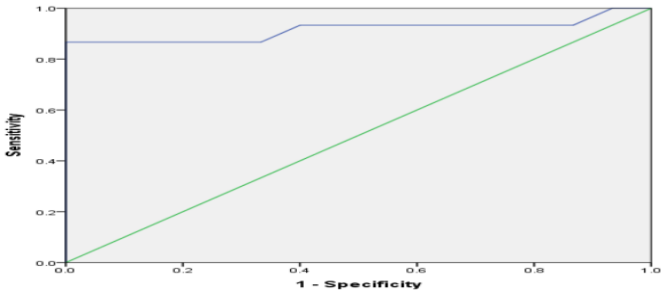

Figure (2): ROC curve showing Performance of superior RNFL in diagnosis of pseudo papilledema among the studied patients

Table (5) Performance of nasal RNFL in diagnosis of pseudo papilledema among the studied patients

Cutoff	AUC	Sensitivity	Specificity	PPV	NPV	Accuracy	p
≥78	0.918	86.7	73.3	76.5	84.6	80	<0.001**

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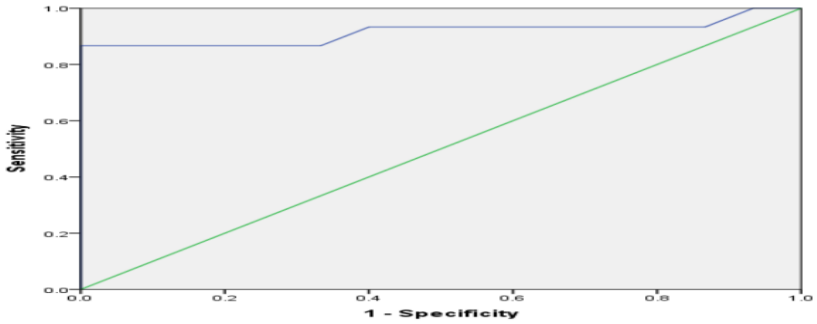

Figure (3): ROC curve showing Performance of nasal RNFL in diagnosis of pseudo papilledema among the studied patients

DISCUSSION:

Optical coherence tomography can be used in papilledema monitoring as an objective method of evaluation of disc swelling while monitoring the treatment. El-**Dairi et al. (7)** showed the use of OCT in pediatric age group. Rebolleda and Muñoz-Negrete have quantitatively correlated RNFL thickness with visual field sensitivity losses. **Rebolleda and Muñoz-Negrete (8)** showed that for every 10 μm of mean RNFL thickness increase at baseline, there was a decrease in mean deviation by 0.6-dB at the last follow-up.

Causes of papilledema can be life-threatening, however, distinguishing papilledema from pseudopapilledema is often challenging. The standard conventional optical coherence tomography (OCT) scan for assessing the optic nerve often fails to detect mild papilledema. Our study suggests that parameters derived from volumetric OCT scans can provide additional useful information for detecting papilledema **(9)**.

The main problem using OCT to assess patients with ONH swelling is the need to combine clinical examination, fundus photography, U/S, visual field, fluorescein angiography and OCT to obtain accurate diagnosis **(10)**.

Johnson et al. (11) described a qualitative criteria for differentiating papilledema and pseudopapilledema using OCT, he described the disc appearance on the OCT of papilledema as an elevated optic nerve head with smooth internal contour and subretinal hyporeflective space (SHYPS) with recumbent "lazy V" pattern whereas ONHD displayed a "lumpy-bumpy" internal optic nerve contour and a rapid decline in SHYPS thickness.

Another study by **Wester et al. (12)** studied the OCT differences between the ONHD, papilledema and small crowded discs**.** They described ONHD as typically elevated disc surface on the OCT and appeared as an optically empty cavity, sometimes with a perceptible reflection from the posterior surface whereas in papilledema, there was strong anterior reflection due to which to structures were seen behind it.

Lee et al. (13) described ONHD as a focal, hyper reflective, subretinal mass with a discrete margin on SD-OCT. This study states that the retinal nerve fiber thickness in the nasal section provides a good differential marker for optic disc edema from ONHD.

CONCLUSION:

Using Optical coherence tomography (OCT) can provide a valuable measures for differentiating papilledema from pseudopapilledema.

No Conflict of interest.

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