Prevalence of increased intraocular pressure and optic disc cupping in Egyptian population

Thesis

Submitted for partial fulfillment of master's degree in Ophthalmology

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2018

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List of Abbreviations

Abb.	Meaning
BCVA	Best corrected visual acuity
BDNF	Brain derived neurotrophic factor
CAT	Correction applanation tonometry
C/D ratio	Cup to disc ratio
CCT	Central corneal thickness
CSF	Cerebrospinal fluid
D	Diopter
DM	Diabetes mellitus
ET-1	Endothelin-1
GAT	Goldmann applanation tonometry
GFAP	Glial fibrillary acidic protein
GON	Glaucomatous optic neuropathy
HLA	Human leukocyte antigen
HSP	Heat shock protein
HTN	Hypertension
ICT	Intracranial tension
IOP	Intraocular pressure
LC	Lamina cribrosa
Log MAR	Logarithm of minimum angle of resolution
MAP	Mitogen activated protein
MHC	Major histocompatibility complex
mm	Millimeter
mmHg	Millimeter mercury
MMP's	Matrix metalloproteinases
NCAM	Neural cell adhesion molecule

List of Abbreviations (Cont..)

Abb.	Meaning
NFL	Nerve fiber layer
NMDA	N-methyl-D-aspartate
NO	Nitric oxide
NTG	Normotensive glaucoma
OD	Right eye
ON	Optic nerve
ONH	Optic nerve head
OS	Left eye
PAS	Peripheral anterior synechia
PCAs	Posterior ciliary arteries
PCNA	Proliferating cell nuclear antigen
POG	Primary open angle glaucoma
RA	Rheumatoid arthritis
RGC	Retinal ganglion cells
ROS	Reactive oxygen species
SD	Standard deviation
SLE	Systemic lupus erythromatosis
TGF	Tumor growth factor
TNF	Tumor necrosis factor
TrKB	Tyrosin kinase B receptor
VF	Visual field

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Abstract

PURPOSE: this study aimed to determine the prevalence of increased intraocular pressure (IOP) and optic disc cupping in the Egyptian population.

METHODS: this was a cross sectional study included 200 subjects. All subjects underwent full medical and ocular history taking, full ocular examination with IOP measurement by Goldman Aplanation Tonometry (GAT) and fundus examination for estimation of optic nerve cupping.

RESULTS: the present study found that the mean IOP was 18.00 mmHg ± 4.00 and about 28% of the studied group their IOP was > 21 mmHg. While, the mean C⁄D ratio of the studied group was 0.41 ± 0.41 and about 43.5 % of the studied group their C⁄D was ≤ 0.3, about 49 % their C⁄D was 0.4 - ≤ 0.6 and about 7.5 % their C⁄D was ≥ 0.7.

According to results of present the study, there was a positive and highly statistically significant correlation between IOP and C ⁄ D ratio (P-value ≤ 0.001), also there was about 11.25 % of the studied group their IOP > 21 (mmHg) and C ⁄ D ratio > 0.5. There was no statistically significant difference between male and female according to IOP and C ⁄D ratio (P-value >0.05) but, there was positive and significant correlation between IOP and C ⁄D ratio with age (P- value < 0.001). The study also showed highly statistically significant difference between urban (17.03 ± 2.94 mmHg) and rural (19.84 ± 3.84mmHg) according to IOP (P-value < 0.001) and highly statistically significant difference between urban (0.37 ± 0.10) and rural (0.48 ± 0.17) according to C ⁄D ratio Pvalue ≤ 0.001. Positive medical history has positive and highly statistically significant correlation with IOP and C ⁄D ratio (Pvalue ≤ 0.001).

CONCLUSION: the mean IOP of this study group was 18.00 mmHg ± 4.00 and about 28% their IOP was > 21 mmHg. While, the mean C⁄D ratio of the studied group was 0.41 ± 0.41 and about 7.5 % their C⁄D was ≥ 0.7. There was a positive and highly statistically significant correlation between IOP and C ⁄ D ratio (P-value ≤ 0.001).

KEY WORDS: intraocular pressure, optic disc cupping, glaucoma, lamina cribrosa, optic nerve head.

INTRODUCTION

Glaucoma is the foremost cause of irreversible blindness, affecting more than 70 million people around the globe. Accumulating evidence reveals that glaucoma is a multifactorial neurodegenerative disease resulting from the loss of retinal ganglion cells (RGC) and from damage to the optic nerve (ON). Both defects ultimately result in progressive permanent vision loss ***(Jia et al., 2016).***

The main pathological factor of most glaucoma is elevated intraocular pressure (IOP), and reducing IOP continuously and effectively remains the only proven method for preventing and delaying the progression of glaucomatous visual impairment. However, normotensive glaucoma (NTG) also exists and there are significant number of patients with classical glaucoma who have statistically normal levels of IOPs. In these patients, irreversible sustained injury of the ON, gradual narrowing of the visual field (VF) and progressive loss of visual function persist even though the IOP is normal or below normal levels. These findings suggest that biomechanical factor involved in the pathogenesis of glaucoma cannot be neglected. In depth knowledge to the biomechanics mechanism contributing to glaucomatous damage may ultimately lead to early detection, early diagnosis and better treatment. There has been ongoing research investigating the mechanical properties of pupillary blocking force, the involvement of the iris, and mechanisms of the aqueous humor flow, as well as studies evaluating morphological changes in the anterior chamber. In recent years, research has suggested that the biomechanical properties of the sclera and scleral lamina cribrosa (LC) determine biomechanical changes of the optic nerve head (ONH), thus playing an important role in the pathologic process of the loss of RGC and contributing to ON damage ***(Jia et al., 2016).***

The LC, where retinal nerve fiber bundles exit from the eye, plays a prominent role in the pathogenesis of glaucoma according to the biomechanical theory. The LC deformations caused by increased IOP, in particular, deformations involving posterior bowing of the LC and posterior displacement of the laminar insertion, have been widely studied in experimental animal eyes as well as ex-vivo human eyes. With the advent of enhanced depth imaging (EDI) spectral domain optical coherence tomography (SD-OCT) and swept-source OCT (SS-OCT), in vivo evaluation of the LC deformation in glaucoma eyes has generated considerable interest ***(Kim et al., 2016)***.

Glaucomatous ONHs typically present with a deeper but thinner LC compared to healthy controls. It is well documented that the LC depth decreases and the LC thickness increases with IOP-lowering treatments ***(Kim et al., 2016)***.

Posterior bowing of the LC may be related to mechanical or vascular damage to the ONH, including the ganglion cell axons. It may be reasonably hypothesized that the greater the posterior bowing of the LC, the greater the burden to RGC ***(Kim et al., 2016)***.

So, The LC is the primary site of glaucomatous ON damage. Histologic studies have demonstrated that compression and posterior displacement of the LC underlies glaucomatous cupping ***(Oh et al., 2016)***.

Several studies have tried to identify possible systemic risk factors which include vascular abnormalities like migraine, Raynaud's phenomenon, cardiovascular insufficiency and female gender. Local ocular factors like differential pressures across the ON, now termed a translaminar pressure gradient and low cerebrospinal fluid pressure are now increasingly recognised as predominant risk factors for ON damage at "normal" IOP. Presumably, ONH response to different pressure differentials across the LC may partly explain presence of VF defects which are deeper and closer to fixation in NTG as compared to high pressure glaucoma or primary open angle glaucoma (POAG) eyes ***(Rao and Mukherjee, 2014)***.

Studies have also reported difference in area of peripappilary atrophy among NTG eyes with IOP<15 or >15 mm Hg, suggesting IOP dependent mechanisms also actively playing a role in glaucomatous cupping ***(Rao and Mukherjee, 2014)***.

AIM OF THE WORK

To determine the prevalence of increased IOP and optic disc cupping in Egyptian population.

Chapter (1)

NORMAL OPTIC NERVE HEAD ANATOMY AND HISTOLOGY

The ONH is defined as the intraocular portion of the ON. The borders of the ONH include the vitreous anteriorly, retina and sclera peripherally; and the posterior borders include the surrounding pial, arachnoid and dural meninges with cerebral spinal fluid (CSF) located between the arachnoid and dural meninges ***(Agapova et al., 2001)*** **(Figure 1)**.

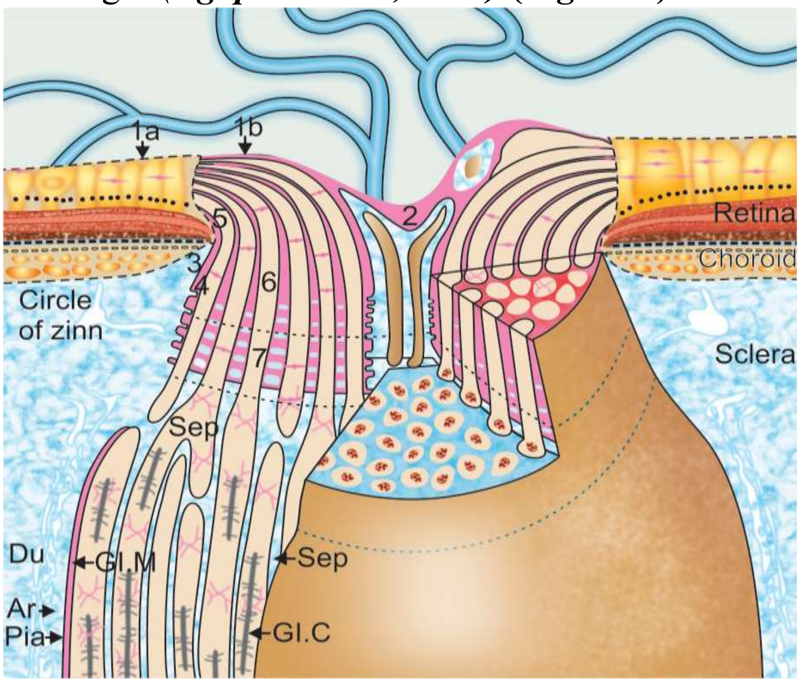

Figure (1): 1 ON within and adjoining eyeball. Numbered regions: 1a, inner limiting membrane of retina; 1b, inner limiting membrane of Elschnig; 2, central meniscusof Kuhnt; 3, border tissue of Elschnig; 4, border tissue of Jacoby; 5, intermediary tissue oKuhnt; 6, anterior portion of lamina cribrosa; and 7, posterior portion of lamina cribrosa Du = Dura; Ar = Arachnoid; Sep = Septa ***(Anderson, 1969)***

Recent use of histomorphometric reconstruction compared to disc photography has suggested that Bruch's membrane correlates to the clinically observed disc margin. The whitish rim that occasionally is observed at the edge of the optic disc by ophthalmoscopy is exposed sclera. ***(Figure 2)*** There is variation in the size of the ONH between individuals and its measurement further varies depending on the instrument used to make the measurements and software used to analyze it. Ethnic background has been shown to affect optic disc size, although gender and age do not. The role of refractive error and axial length in relation to optic disc size is controversial ***(Berdahl et al., 2008).***

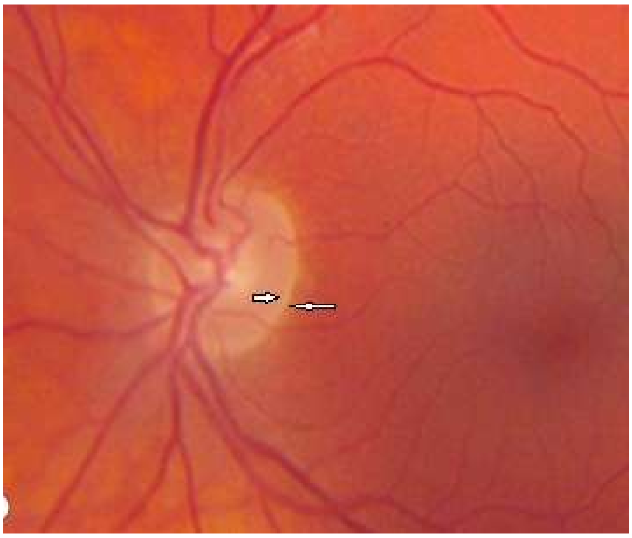

Figure (2): Normal optic disc with whitish scleral rim between the 2 arrowes ***(Lisa et al., 2008).***