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Diurnal Variation of Intraocular Pressure

Short Term Study

Thesis

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﴿وَقُل رَّبِّ زِدْنِي عِلْماً﴾

سورة طـــه الآيـــــه رقم ١١٤

To the Soul of My brother

Also I would like to thank ***my mother and my father*** who stood by me throughout my life.

I also thank my wife for her support and help.

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Mohamed Mesbah Mohamed Ibrahim

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List of Abbreviations

Abbreviation	Full name
24H	24 hours.
ANF	Atrial Natriuretic Factor.
Ant.seg.	Anterior segment.
BCVA	best corrected visual acuity.
C/D	Cup to Disc ratio.
CCT	Central Corneal Thickness.
EVP	Episcleral venous pressure.
Fig	Fig..
GAT	Goldmann applanation tonometry.
IOP	Intraocular pressure.
ISGEO	International Society for Geographic and Epidemiological Ophthalmology.
LASIK	Laser In Situ Keratomielusis.
mm Hg	Millimeter mercury.
OCT	Optical coherence tomography.
OD	Oculus Dexter (right eye).
OS	Oculus Sinister (left eye).
PACG	Primary angle closure Glaucoma.
POAG	Primary Open angle glaucoma.
Post.seg.	Posterior segment.
SD	Standard Deviation.
VCDR	vertical cup-disc ratio.

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Abstract

Glaucoma is the second leading cause of blindness globally, after cataract. There are several risk factors for develpment of glaucoma, like increasing age, myopia, family history, but intraocular pressure still the most important and only treatable risk factor of glaucoma.

Intraocular pressure is not a constant value, it undergoes a pattern of diurnal variation .Such variations are of particular interest in glaucoma, where elevated IOP is assumed to be associated with glaucoma progression and the main option currently available for the treatment of glaucoma is the reduction of IOP, accurate determination of the IOP and the effects of therapy on it are of utmost concern not only for the management of patients with glaucoma but also for early diagnosis of patients whose randomly sampled IOP appears normal.

The evaluation of IOP is usually based on measurements performed during office hours. As IOP is considered a major risk factor for glaucoma, an undetected IOP spike could be the missing link that has not been taken into account

Our study carried out assessment of diurnal variation of IOP acting on two groups of eyes,normal and POAG .the results are shown as follows:

Regarding the normal group: the peak IOP for the normal group was reached most often at 7 pm (mean IOP □16.6 mmHg± SD□ 1.82 mmHg), then at 4 pm (16.4 mmHg ± 2.07mmHg).followed by 10 am,10 pm,7 am and 1 pm, with their mean IOP±SD (15.40mmHg ±1.82mmHg),(15.2mmHg ±1.3mmHg), (15.00 mmHg ±2.24 mmHg) and(13.80 mmHg ± 2.28 mmHg) respectively.

Regarding the POAG group: the peak IOP for the POAG group was reached most often at 7 am (mean IOP =18.40 mmHg± SD= 2.41 mmHg), then at 4 pm (17.8mmHg ± 1.92mmHg).followed by 10 am,7 pm,1 pm and 10pm, with their mean IOP±SD (16.80mmHg ±2.59mmHg), (16.8mmHg ±1.92mmHg), (16.60 mmHg ±1.14 mmHg) and (15.40 mmHg ± 1.82 mmHg) respectively.

Keywords: GAT: Goldmann applanation tonometry, **IOP:** Intraocular pressure.

Introduction

Werther manifesting as primary Open angle glaucoma (POAG), primary angle-closure glaucoma (PACG), or congenital disease, glaucoma is among the leading causes of blindness in the developing world and a major health problem in the developed world with the basic medical resources available in the developed world, nearly all cases of blindness from glaucoma are preventable if the disease is detected early and proper treatment is implemented (***Thylefors B and Negrel AD.,1994).***

A definition of glaucoma for use in epidemiologic studies was agreed on in 1998, and that definition is still in use. Glaucoma is defined as an optic neuropathy that is characterized by specific structural findings in the optic disc and specific functional deficits detected by automated visual field testing. raised intraocular pressure (IOP) is still recognized as an important risk factor, but it is not a defining characteristic of the disease ***(Foster PJ, Buhrmann R. et al.,2002)***.

Lowering intraocular pressure is still the only practical form of medical treatment in glaucoma and in neuroprotection.

To diagnose, follow glaucoma and maintain optic nerve function, understanding the physiology of intraocular pressure is an important tool. ***(Coleman AL,2002).***

Prevalence of blindness from glaucoma

Glaucoma is the second leading cause of blindness globally, after cataract. The 2010 global estimates are that 4.5 million people are blind due to open-angle glaucoma and 3.9million are blind due to angle-closure glaucoma. These numbers are set to rise to 5.9 and 5.3 million, respectively, by 2020. Angle-closure glaucoma causes agreat proportion of blindness than open-angle glaucoma ***(Quigley HA and Broman AT.,2006).***

Some surveys of glaucoma prevalence report the proportions of people with glaucoma who are blind. These numbers vary from none in Sweden 23 to 22% in South Africa. Data from blindness-prevalence surveys for which cause-specific data are given offer similar numbers of people bilaterally blind as the result of glaucoma ***(Rotchford AP and Johnson GJ.,2002).***

Incidence of glaucoma and glaucoma blindness

In a predominantly white population in Melbourne, Australia, the 5-year incidence of definite open-angle glaucoma was 0.5% and of probable and definite open-angle glaucoma was 1.1%. ***(Mukesh BN, McCarty CA, et al,2002)***

In a predominantly black population in Barbados, the 9-year incidence of definite open-angle glaucoma was 4.4%, or 0.5% per year. ***(Leske MC, Wu SY, et al.,2007).***

In both studies, the incidence rose with increasing age. Estimates of incidence can be calculated from prevalence data by using mathematical models. Based on a mathematical model, in the United States, the cumulative probability of open-angle glaucoma in white persons is 4.2% and in black persons is 10.3%. ***(Schoff EO, Hattenhauer MG,.et al.,2001)***

It would be useful to know the incidence of blindness resulting from glaucoma, but these data are not available. In a study in Uganda, the annual incidence of visual loss resulting from glaucoma was 0.04% ***(Mbulaiteye SM, Reeves BC, et al.,2003).***

Basic Science of intra Ocular Pressure (IOP)

The tissue pressure of the intraocular contents is called the intraocular pressure (IOP). The normal range for IOP is 10-20 mm Hg and is maintained at this level throughout life and between the sexes, though there is some diurnal variation. Control of IOP within the correct physiological range is necessary to maintain the anatomical conditions necessary for optimal refraction and thus vision. ***(Raw D and Mostafa SM,2001).***

Goldmann equation states: Po = (F/C) + Pv.

Where **Po** is the IOP in millimeters of mercury (mmHg), **F** is the rate of aqueous formation, **C** is the facility of outflow, and **Pv** is the episcleral venous pressure**.** ***(George A. Cioffi, F. Jane Durcan, et al,2008).***

The aqueous humor is a transparent, colorless solution continuously formed from plasma by the epithelial cells of the ciliary processes. It is secreted into the posterior chamber from where it passes through the pupil into the anterior chamber and is drained at the anterior chamber angle. Most of the aqueous drains into the venous circulation via the trabecular meshwork, Schlemm's canal, scleral collector

channels, and aqueous and episcleral veins, the remainder drains into the orbit via the interstices of the ciliary muscle, the suprachoroidal space, and the sclera. ***(Fig.. 1).***

Functions of Aqueous humor:

Aqueous delivers oxygen and nutrients to, and removes waste products, macrophages, inflammatory products, or other debris from, the posterior cornea, crystalline lens, and perhaps the anterior vitreous, structures which are necessarily a vascular. Continuous formation and drainage of the aqueous helps maintain the intraocular pressure (IOP), necessary for maintaining the shape and internal alignment of the ocular structures and, consequently, optimal optical properties.

The aqueous maintains a transparent and colorless medium of lower refractive index between the posterior cornea and the lens, and thus constitutes an important component of the eye's optical system. These functions are essential to maintaining the eye's structural integrity. In addition, because the aqueous humor is devoid of blood cells and of more than 99% of the plasma proteins, it provides an optically clear medium for the transmission of light along the visual path. ***(Davson H,1990).***