EXCELLENT PUBLISHERS

International Journal of Current Research and Academic Review

ISSN: 2347-3215 Volume 3 Number 4 (April-2015) pp. 320-327

www.ijcrar.com

A study on association of intraocular pressure changes with refractive errors in Bidar population

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KEYWORDS

Intraocular pressure, refractive errors, glaucoma

A B S T R A C T

Blindness is one of the major health hazards in developing countries. Top causes of blindness in India are cataract & glaucoma. 80% of blindness is potentially preventable or treatable. Elevated Intraocular pressure (IOP) is an important risk factor for development of glaucoma. The present study is taken up with the following: Objective-To study the relation between intraocular pressure and refractive errors. .Methodology- This study was conducted on total 300 subjects, out of which 100 were controls, 140 were myopics and 60 were hyperopics. Results- Total of 300 subjects were taken for the study. 100 controls, 140 myopics and 60 hyperopics in the range of age <15 to 60 years. IOP of all these 3 groups was measured and compared with eachother on the basis of refractive errors.IOP was higher in myopics when compared to controls and when compared to hyperopics. IOP rises as the age advances. Conclusion-IOP was higher in subjects with refractive errors (myopia) when compared to normal subjects in resting condition,there was a positive correlation between refractive error & IOP,advancing age is associated with elevated IOP.

Introduction

Blindness is one of the major health hazards in developing countries. There are nearly 180 million people worldwide who are visually disabled, of whom nearly 45 million are blind. About 80% of them are living in developing countries. However, among them 80% of blindness is potentially preventable or treatable. In India, among the top causes of blindness; cataract stands first position, closely followed by glaucoma. Glaucoma is one of the world's leading causes of acquired blindness. An estimated 67 million people have this disease. About 3 million of them are in United States, of which roughly

half are undiagnosed. A survey of adults in India above the age of 50 years showed that 5.8% of blindness was due to glaucoma. Glaucoma is defined as disturbance in structural or functional integrity of optic nerve, leading to visual field defects over time. The development of glaucoma is more likely to be associated with high intraocular pressure[1]

IOP is defined as the difference between the pressure inside the eye and the extraocular surrounding space. It is measured as the transcorneal pressure difference[2].

IOP is an essential entity in maintaining structural and functional integrity of the eye ball. Normal IOP varies between 10 to 20 mm Hg. The average being 15.5mmHg with fluctuations of about 2.75mmHg. IOP varies throughtout the day. IOP is influenced by various factors like exercise, heart rate, respiration, fluid intake, systemic medication, topical drugs, alcohol, smoking, axial length of the eye ball etc.[3]

A number of studies have attempted to identify the risk factors associated with development of elevated IOP. Previous studies have shown conflicting correlation between IOP and refractive errors. Association between refractive errors and IOP was stronger among few populations. There is a positive association between moderate myopia and increasing axial length of eye ball and suggested that moderate to high myopia is associated with the risk of Primary open angle glaucoma[4]. Myopia is one of the several risk factors for increased IOP thus resulting in glaucoma[5]. while correlating sex with IOP, it was found that both sexes showed an increase of IOP as the refractive status changed from hyperopia to myopia. In correlating age with IOP, each age group showed an increase in IOP as the refractive status changed from hyperopia to myopia[6]

Considering that raised IOP could produce glaucoma, this study attempts to establish the relationship refractive errors and IOP and the influence of age and gender on IOP.

The present study has been undertaken with following objectives- To study the relation between intraocular pressure and refractive errors.

Methodology

Materials and Methods

Source of collection of data: The study was conducted in the Department of Ophthalmology, Bidar Institute of Medical sciences, Bidar.

Methods and diagnostic criteria: The subjects were explained the study protocol. A written informed consent was obtained from the participating subjectsThe study protocol was approved by institutional scientific & ethical committee.

This study was conducted on total 300 subjects for a period of 8 months, out of which 100 were controls, 140 were myopics and 60 were hyperopics and subjects were selected depending upon the following inclusion and exclusion criteria.

Inclusion criteria for controls: Normal subjects with normal refraction and normal IOP**,** Age <15 years to 60 years

Exclusion criteria for controls

- Alcoholics
- Smokers
- Diabetics
- Hypertensive
- Vitamin A deficiency

- Patients with previous eye surgeries
- Patients on eye medications other diseases
- Any other eye diseases

Inclusion criteria for cases: Subjects with refractive errors- myopia and hyperopia**,**Age <15 years to 60 years

Exclusion criteria for cases

- Alcoholics
- Smokers
- Diabetics
- Hypertensive
- Vitamin A deficiency
- Patients with previous eye surgeries
- Patients on eye medications other diseases
- Any other eye diseases

Study design

A detailed history was taken as per the proforma (enclosed). During history taking details of present illness, smoking, consumption of alcohol & family history of glaucoma, hypertension & diabetes were noted.

Their refractive error was objectively assessed by streak retinoscopy & the exact error was determined by trail lens set. Goldmann tonometer consists of a double prism mounted on a standard slit-lamp. The prism applanates the cornea in an area of 3.06mm diameter. Applanation tonometry was done after anaesthetizing the cornea with a drop of 2% xylocaine and staining the tear film with fluorescein. Patient was made to sit in front of slit lamp, tonometer was swung into place. The beam width opened to its fullest height. The beam angle was about 45–60 degrees to the side of the tonometer. The cornea and biprisms were illuminated with cobalt blue light from the slit lamp and Biprism was then advanced until it just touched the apex of cornea. At this point, two fluorescent semicircles were viewed through the prism. Then, applanation force against cornea was adjusted until the inner edges of two semicircles just touched. This was the endpoint for measurement. The IOP was determined by multiplying the dial reading with ten.

Statistical analysis

The following methods of statistical analysis have been used in this study. Continuous data was expressed as mean ± standard deviation & presented in tables and figures 1) Student 't' test , 2) One way Analysis of Variance (ANOVA) **,** 3) Pearson correlation coefficients.

Result and Discussion

Comparison of IOP between myopics and hyperopics:RE

Glaucoma is the commonest cause of irreversible blindness worldwide and the second most common cause of blindness overall after cataract. It affects approximately 70 million people among them 7 million are blind[7] The World Health Organization has estimated that India has 1% prevalence of blindness. Of the estimated 8.9 million blind in India, 12.8% are due to glaucoma. The problem is expected to reach alarming proportions by the turn of the century[8]. World population projection for 2010 and 2020 derived that by 2020, India will become second in number with glaucoma, surpassing Europe. From 2010 to 2020, the most detectable change in glaucoma worldwide will be its increase in India. As the proportion of those above 40 years of age increases, the proportional increase in glaucoma will challenge our resources and ingenuity[9].

Refractive errors is one of the leading causes of blindness in the developing countries. As seen myopia affects nearly 1.6 billion people world-wide, with its proportions accelerating to 2.5 billion by 2020[10]. The relationship between refractive errors, IOP & glaucoma is uncertain[80]. Earlier studies have reported myopes are at a increased risk of developing glaucoma when compared to emmetropic subjects. Some studies have found that there is no relationship between the refractive error & glaucoma. Finding out their relationship to potential ocular morbidity will be an important goal in research field. Since there are contradicting results from various studies we have made an effort to find out the relationship between the intraocular pressure & the refractive errors & we also studied the effect of Valsalva maneuver on intraocular pressure in subjects with & without refractive errors. Blindness arising out of glaucoma is preventable if people who are prone to developing glaucoma are identified & screened periodically**.**

Relation between IOP and Refractive errors

In our study, IOP is positively correlated with the refractive errors. Myopes have higher IOP than the controls and the IOP of hyperopes is less compared to controls. In myopes, there is anatomic weakness of the disc manifested as increase in cup size, unusually large or skewed canal shape, thin sclera & lamina in the periphery of the disc. The cup-to-disc ratio is high in myopes which predispose more of the nerve fibres to damage at any IOP level. Shearing forces in lamina cribrosa & connective tissue changes have been noted to be exaggerated in eyes with longer axial length than with the eyes with shorter axial length with the same IOP[11]. There is a reduced blood flow & low ocular pulse amplitude in the myopic eyes. And the optic disc in myopic patients is subjected to ischemia or damage at any level of IOP. Glaucoma & myopia share a common pathway. Both the conditions show changes in ocular connective tissue. The changes in sclera in myopes & in lamina cribrosa & trabecular meshwork in subjects with glaucoma. They have a strong familial basis & may also share common genetic links[12]. Therefore, the relationship between the refractive errors, IOP & glaucoma may revolve around a concept that, an increase in the IOP can cause scleral stress & axial elongation leading to development of myopia & there is high glaucoma susceptibility in myopes. And also raised IOP is the only modifiable risk factor for the development of glaucoma. Few of the recent studies have tried to explain the inheritance and manifestation of glaucoma on specific gene expression. The gene coding for trabecular meshwork-induced glucocorticoid response protein in the GLC1A locus on chromosome 1q21-q31 was identified & found in 3.9% of glaucoma population compared to 0.3% of general population81. Therefore, in myopes may have the glaucoma genes more frequently than the other subjects. A neurosignaling substance known as tumor necrosis factor-alpha was recently found to mediate pathology related to glaucoma. Blocking its presence reduced optic nerve damage in animal models of elevated IOP. It is also suggested that increased intraocular pressure may prevent retinal ganglion cells (RGCs) from receiving brain-derived neurotrophic factor (BDNF), a protein that is crucial to RGC survival, from neighboring cells in the optic nerve[13].The earlier studies has suggested that higher resting IOP in hyperopes could be due to shallower anterior chamber. But majority of the other studies have remained silent about the possible mechanism[14]. We have tried to look at the relationship between refractive error & the IOP. In our study we have noted

that there was a positive correaltion between the refractive error & IOP in both myopes & hypermetropes. There is conflicting reports about the relationship between refractive error & IOP. A study with a large sample size have reported that high myopes are more susceptible to glaucomatous optic nerve damage[15].

In the present study, IOP was positively correlated with age in both men and women. Increase in IOP with age was statistically significant. Older age has been reported as a risk factor for the development ofglaucoma in patient with ocular hypertension in multiple progression studies[16]. Several population based studies have found that the incidence of open angle glaucoma increases with older age groups[17]. In a study there is strong evidence that older age is an independent risk factor for the progression of ocular hypertension and glaucoma[17]. In many cross sectional and follow-up studies incidence of raised IOP, ocular hypertension and glaucoma showed a sharp increase with age[18,19,20]. In elderly individuals the onset of structural changes in trabecular meshwork results in reduction in trabecular outflow facility and uveoscleral outflow and hence elevated IOP in older age group[21,22]. Aging is associated with modest elevation of IOP and is also linked to progressive decline in cerebral and ocular perfusion.99 Older patients with glaucoma may have dysfunction of ocular blood flow auto regulation or have elevated IOP which corresponds to damage of the optic nerve[23]. Other possible risk factors for development of ocular hypertension or glaucoma in older age are : low intracranial pressure, local vasospasm, autoimmune disorder, sleep apnea, inherited or acquired abnormalities of the connective tissue of the lamina cribrosa, primary ganglion cell degeneration, systemic hypertension and atherosclerosis[23]. Increased age may reflect the cumulative effects of some other factors that cause the aging optic nerve head to be more vulnerable to elevated IOP and even sometimes to normal range of IOP[24]. Follow-up studies for five years have shown that cumulative probability of untreated patients developing glaucoma was calculated to be greater than twice the rate of that in treated patients[16].

	GROUP	**N**	**Mean**	**Std. Deviation**
RE IOP	Control	100	14.62	1.52
	Hyperopia	60	13.20	2.00
LE IOP	Control	100	14.34	1.37
	Hyperopia	60	13.60	2.10

t	**df**	**p**	**Inference**
5.05	158	.0001 <0.001	Highly Significant
2.69	158	.008	Significant

Comparison of iop betwwen controls and myopic

	GROUP	N	Mean	Std. Deviation
RE IOP	Hyperopia	60	13.2	2.00
	Myopia	140	16.99	2.26
LE IOP	Hyperopia	60	13.6	2.10
	Myopia	140	16.86	2.37

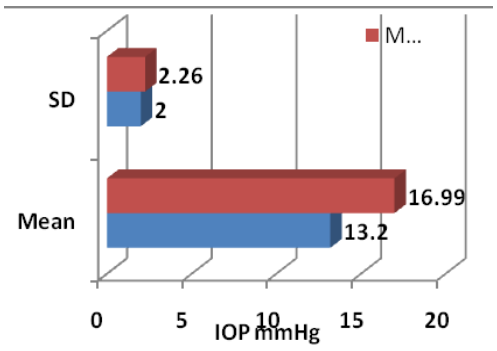
t	Df	P	Inference
-11.20	198	.0001 <0.001	Highly Significant
-9.21	198	.0001 <0.001	Highly Significant

Comparison of iop between controls and hyperopics

	GROUP	N	Mean	Std. Deviation
RE IOP	Control	100	14.62	1.52
	Myopia	140	16.99	2.26
LE IOP	Control	100	14.34	1.37
	Myopia	140	16.86	2.37

t	df	p	Inference
-9.08	238	.0001 <0.001	Highly Significant
-9.55	238	.0001 <0.001	Highly Significant

Comparison of iop between myopics and hyperopics



Conclusion

Elevated IOP is the major risk factor for developing glaucoma or glaucomatous optic neuropathy. Glaucoma is the second commonest cause of irreversible blindness and visual impairment. Glaucoma is a chronic disease with insidious onset. If it is diagnosed early and treated appropriately its progression can be arrested. IOP which is a major risk factor for glaucoma is influenced by other systemic parameters. From this study it is evident that,

1**.** IOP was higher in subjects with refractive errors (myopia) when compared to normal subjects in resting condition. 2**.** There was a positive correlation between refractive error & IOP. 3.Advancing age is associated with elevated IOP.

A positive correlation was found between refractive error & IOP and IOP & advancing age. It could be concluded that subjects with refractive error are at greater risk of developing glaucoma. In these subjects regular monitoring is required to prevent ocular pathology & blindness. Study with a larger population size could be undertaken to find out its predictive value in detecting the potential candidates at risk of developing glaucoma.

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