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Co-relation between Intraocular Pressure, Refractive Errors and Blood Pressure

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ABSTRACT

Purpose: To evaluate the co-relation between Intraocular pressure, Refractive errors and Blood pressure.

Method: A total of 360 eyes of 180 patients (36 simple myopic, 68 simple hyperopic, 75 simple astigmatic, 117 compound astigmatic and 48 mixed astigmatic) age between 18 to 60 years diagnosed to have refractive errors were enrolled in this study of which16 emmetropic eyes were excluded. All patients underwent baseline examination to rule out any abnormality in the eyes. Measurement of intraocular pressure was taken between specific intervals of time 10:00 AM to 3:00 PM to avoid any diurnal variation. Systolic and diastolic blood pressure was measured using a standard mercury sphygmomanometer concurrently. Statistical analysis was made to find out co-relation between intraocular pressure, refractive errors and blood pressure.

Results: By using ANNOVA test there was statistically significant positive co-relation found between systolic blood pressure and refractive errors like simple myopia, simple hyperopia, simple astigmatism, compound astigmatism and mixed astigmatism (P=0.003) but no significant co-relation found between diastolic blood pressure and refractive errors. There was also no statistically significant co-relation found between intraocular pressure and refractive errors (P=0.301). Pearson co-relation coefficient test, showed no relation between intraocular pressure and systolic blood pressure in patients with refractive errors but poor positive co-relation found between diastolic blood pressure and intraocular pressure in patients with mixed astigmatism (P=0.023).

Conclusion: This study had shown weak co-relation between refractive errors, blood pressure and intraocular pressure which did not show any clinical significance.

Keywords: Refractive errors, Blood pressure, Intraocular pressure

INTRODUCTION

Intraocular Pressure (IOP) is the pressure exerted by intraocular fluids on the coats of the eyeball. IOP is a function of the rate at which aqueous humor enters the eye and the rate at which it leaves the eye. The distribution of IOP within the general population is in a range of 11-21 mm of Hg [1]. This pressure is required to maintain the proper shape and optical properties of the globe. Homeostatic mechanisms normally preserve this balance, but the factors like heredity, age, sex, race and refractive errors can cause significant changes in intraocular pressure [2].

The relationship between refractive errors and intraocular pressure is an area of discrepancy. Some studies have suggested that myopia or short-sightedness may be associated with risk of primary open angle glaucoma responsible for optic nerve damage [3-5]. Elevated intraocular pressure is hypothesized to impose scleral stress and creep, resulting in axial elongation with scleral stretch [3]. One hypothesis is that sustained accommodation in myopia causes an increase in intraocular pressure which in turn leads to a stretching of the posterior segment of the eye and axial elongation [3]. Hypermetropia or far-sightedness is accompanied by short axial length and shallow anterior chamber depth is also a risk factor for angle-closure

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glaucoma and ocular hypertension [6]. Astigmatism is a type of refractive error where rays of light form line focus image at different meridians instead of point focus. A previous study found that patients with with-the-rule astigmatism having purely corneal astigmatism over 4D resulted in an under estimate of intraocular pressure and against the rule astigmatism, an overestimated of intraocular pressure by 1 mm of Hg, but the etiology was still unknown [7].

Furthermore, blood pressure and its co-relation with intraocular pressure in patients with refractive errors are of clinical interest. Blood pressure is the pressure of circulating blood on the walls of blood vessels. It is expressed in terms of the systolic pressure over diastolic pressure and is measured in millimeters of mercury (mm Hg). Normal resting blood pressure in an adult is approximately 120 mm of mercury systolic and 80 mm of mercury diastolic abbreviated as "120/80 mm Hg". There is correlative not necessarily causal, relationship between glaucoma and systemic hypertension and the risk of developing systemic hypertension in hypermetropic patients is higher compared to myopia [8]. Long standing hypertension may cause micro vascular damage whereas low systemic blood pressure may reduce local perfusion, particularly in the present of existing intraocular pressure elevation or poor auto regulation [9].

Therefore, this study would help us to know whether the change in refractive status of eye may have any co-relation between IOP and blood pressure or not.

MATERIALS AND METHODOLOGY

The experimental design of this study was hospital-based, observational prospective and crosses-sectional. The study sample consisted of patients, between 18 to 60 years of age. Permission was obtained from ethical committee of the institute. An informed consent was obtained from patients willing to participate in the study. Patients with ocular diseases, systemic diseases like Diabetes, asthma, COPD, pathological myoipa >-10.00 D, pathological hypermetropia >+10.00 D and those under any medications except for controlled hypertension were excluded.

All patients underwent baseline examination to rule out any abnormality in the eyes. A detailed history was taken as per the proforma. Unaided, aided and pinhole visual acuity was recorded for distance at 6 m and near at 33 cm with Snellen's distance and near visual acuity chart. Refraction was performed objectively and subjectively with undilated and dilated state using GR100 Grand Seiko Autorefractometer (Japan). Refractive error was stratified into three categories: Low myopia (≤ -3.00 D), moderate myopia (-3.00D to -6.00D), high myopia (>-6.00 D), low hypermetropia (≤ +2.00 D), moderate hypermetropia (+2.00 D to +5.00 D), high hypermetropia (>+5.00 D). Astigmatism was defined by cylinder at least +/−0.50 DC.

Slit lamp evaluation was done to rule out any anterior segment abnormality. Non-contact tonometry by using Keeler's non-contact tonometer was performed on both eyes, with the right eye measured first, between 10.00 AM to 3.00 PM. Measurements adhered to protocols; the patient was seated, with eyes in the primary position, eyelashes or eyelids did not obscure the applanation circle and the alignment spot was centered and focused in the alignment circle before applanation. Detailed examination of the posterior segment was carried out with direct ophthalmoscope by using +20.00 D lens. Then, systolic and diastolic blood pressure was measured using a standard mercury sphygmomanometer after 5 min of rest in the sitting position.

RESULTS

In this study, 344 eyes of 180 patients (36 simple myopic, 68 simple hyperopic, 75 simple astigmatic, 117 compound astigmatic and 48 myopic astigmatic) were examined of which 91 (51%) were male and 89 (49%) were female. Following assessments were performed to find out the co-relation between IOP, refractive errors and blood pressure. **Tables 1 and 2** showed comparison between refractive errors and blood pressure. By using ANOVA test, *P*-value was <0.05 therefore there was statistically significant co-relationship found between systolic blood pressure and refractive errors and no co-relation found between refractive errors and diastolic blood pressure. Compound astigmatism group of patients were likely to have lesser systolic blood pressure **(Figure 1)** compared to other types of refractive errors.

Table 1. Correlation between refractive errors and systolic blood pressure.

Refractive Error Group	Number of eyes	Systolic Blood Pressure		*P*-value
		Mean	SD	
Myopia	36	120.00	15.31	0.003
Hyperopia	68	123.24	14.50	
Simple Astigmatism	75	120.53	14.69	
Compound Astigmatism	117	117.18	11.44	
Mixed Astigmatism	48	125.21	11.67	

Table 2. Correlation between refractive errors and diastolic blood pressure.

Refractive Error Group	Number of eyes	Diastolic Blood Pressure		*P*-value
		Mean	SD	
Myopia	36	85.83	13.55	0.283
Hyperopia	68	84.97	10.65	
Simple Astigmatism	75	85.60	12.38	
Compound Astigmatism	117	82.99	9.63	
Mixed Astigmatism	48	86.46	9.34	

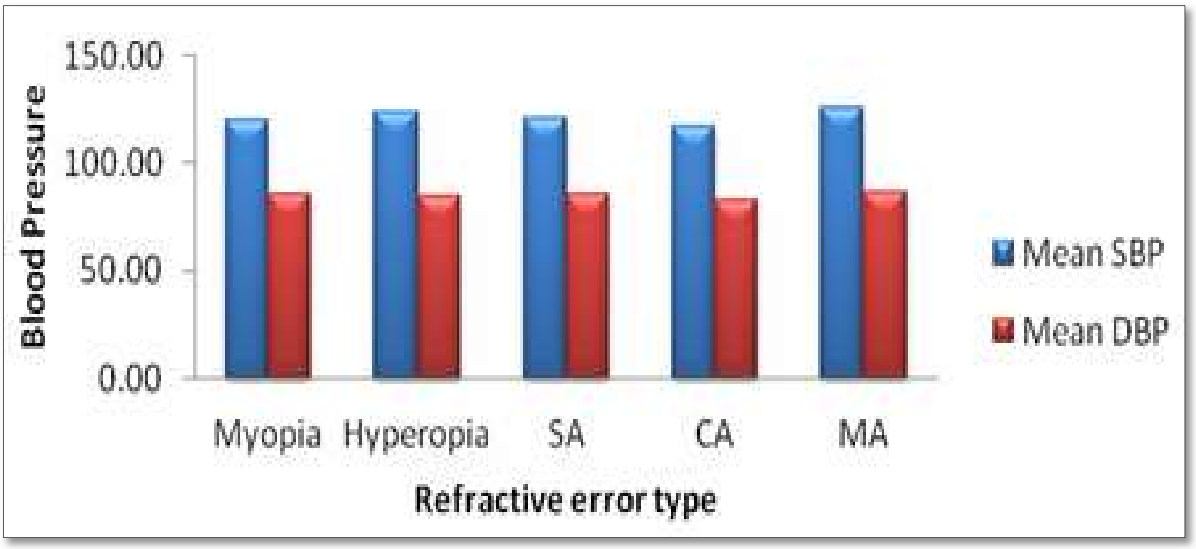

Figure 1. Mean systolic blood pressure and diastolic blood pressure with refractive error type.

By using Pearson co-relation coefficient test, **Tables 3 and 4** showed no statistically co-relation between intraocular pressure and systolic blood pressure in patients with simple myopia, simple hyperopia, simple astigmatism and compound astigmatism but poor positive co-relation found between diastolic blood pressure and intraocular pressure in patients with mixed astigmatism (*P*=0.023). Slight increase in systolic blood pressure was observed in patients with mixed astigmatism compared to other refractive errors. Likewise slight increase in diastolic pressure was observed in patients with mixed astigmatism which did not show any clinical significance **(Figure 2)**.

Table 3. Co-relation between refractive errors and intraocular pressure.

Refractive Error Group	Number of eyes	IOP		*P*-value
		Mean	SD	
Myopia	36	16.22	3.18	0.301
Hyperopia	68	16.06	3.50	
Simple Astigmatism	75	15.23	3.27	
Compound Astigmatism	117	15.68	3.05	
Mixed Astigmatism	48	16.38	3.72	

Table 4. Co-relation between intraocular pressure and blood pressure with respect to refractive errors.

	Number of patients	Pearson correlation coefficient (r) between	
		SBP vs. IOP	DBP vs. IOP
Myopia	36	0.065	-0.12
P-value		0.708	0.404
Hyperopia	68	-0.033	0.006
P-value		0.788	0.958
SA	75	0.009	0.02
P-value		0.941	0.865
CA	117	0.162	0.108
P-value		0.082	0.245
MA	48	0.047	0.327
P-value		0.75	0.023*

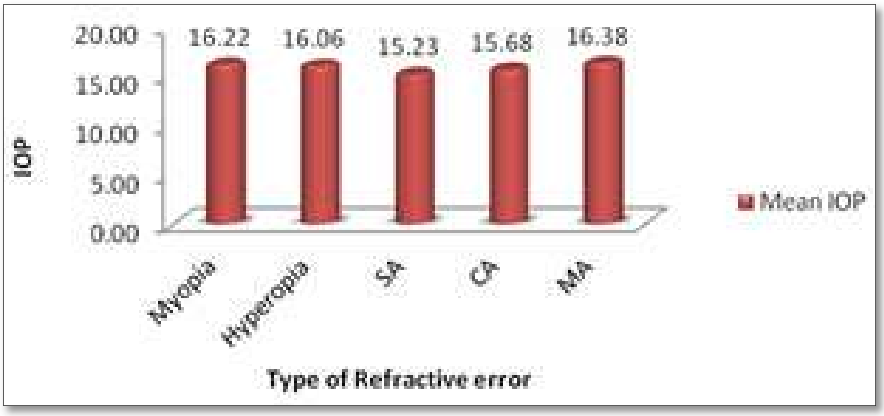

Figure 2. Mean IOP with refractive error type.

DISCUSSION

In this report we presented a detailed study of intraocular pressure, refractive errors and blood pressure in an 18 to 60 years old population. We took this age group as the period between these ages is one of the refractive stability. Additionally, we studied correlation between refractive errors and blood pressure which has not been discussed in any study.

Refractive errors are very common ocular problems in the population worldwide. Myopia is one of the risk factors for glaucoma that is commonly mentioned in various studies [10,11]. Study done by Abdalla et al. [10] showed high IOP in myopic individuals compared to non-myopic individuals suggesting that relationship between glaucoma and myopia may be pressure mediated. The possible mechanism for raised intraocular pressure in myopic is the shearing forces exerted by scleral tension across the lamina cribriosa and may be important in pathogenesis of pressure damage [10].

However study done by Lee et al. [12] in Singapore, assessed association between intraocular pressure and refractive errors in children of age group 9-11 years. Refractive errors were categorized into 4 groups: hypermetropia, low myopia, emmetropia and high myopia. The result of this study showed no significant intraocular pressure differences between different types of refractive errors. They said that elevated intraocular pressure and myopia might not be linked in these children. Our study also did not provide sufficient evidence to conclude that intraocular pressure was related to refractive errors, but slight increase in intraocular pressure was observed in mixed astigmatic patients compared to other types of refractive errors in older age groups. Different methods and samples may be the reason for the inconsistent result with different studies.

Our results compared to Keihanian et al. study [13], by showing significant correlation between changes of systolic

blood pressure and intraocular pressure (P=0.005), while the relationship between diastolic blood pressure and intraocular pressure changes were not seen (P>0.005). But result of our study indicated a direct relation between systolic blood pressure and refractive errors, as the systolic blood pressure showed a statistically significant result but no clinically significant result in those patients and only weak or poor positive co-relation found between diastolic blood pressure and intraocular pressure with respect to mixed astigmatism [14].

No significant correlation was found in the measured parameters with age or sex. A large sample size, high refractive error group and measurement of corneal biomechanical parameters would have added to the study's strengths.

CONCLUSION

In summary, our study had shown weak co-relation between refractive errors, blood pressure and intraocular pressure which did not show any clinical significance. The observations need confirmation by study with age matched emmetropes as controls.

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