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Comparison of intraocular pressure variance in moderate and high myopia

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Abstract: Purpose: Intraocular pressure changes have been, and still is, a topic of discussion. Increasing myopia has been constantly associated with increasing intraocular pressure. Myopia has long been identified as a risk factor for open angle glaucoma because of the changes in optic disc and pressure. Thus, repeated evaluation of all the factors that are related to changes in IOP levels is important. This can help to figure out the risk factors for open angle glaucoma in the form of variables that can be proved to be associated with IOP level changes.

In this study, we will evaluate the intraocular pressure levels between moderate and high myopia, also taking age and gender in to account

Methods: This is an Observational, hospital-based study conducted on 35 patients presented in the HAH centenary hospital in the period of 2 months at Delhi. Data confidentiality was maintained. The detailed demographic details along with ocular findings, systemic health findings, were collected for analysis. The test used for statistical analysis were Un-paired, 2-tailed, T-test, Two way ANOVA test. The software MS EXCEL was used.

Results: The hospital-based study conducted at HAH centenary hospital evaluated 35 myopic patients (70 eyes) in the period of 2 months. Out of 35 patients, 20(57%) were moderate myopic (-3.00D to <-6.00D) and 15(42%) were highly myopic (-6.00D and more). Range of the age being 11- 55years. 20(57%) females and 15(42%) males were present in the sample. Only one patient had IOP level more than 21mmhg and was further examined for glaucoma tests which came out negative. All the evaluated patients had a C/D ratio less than 0.5

Conclusion: No significant association was found between IOP and myopia along with other factors such as age and gender. Small sample size and avoiding various others factors such as ocular biomechanics, corneal thickness, curvature etc. can be the reason for it. Overcoming these limitations can help confirming a conclusion and give results that would be different and convincing. The study needs further research time and evaluation.

Keywords: Hakeem Abdul Hameed Centenary Hospital, Intraocular Pressure, Myopia.

Introduction

Intraocular pressure changes have been, and still is, a topic of discussion. There have been various health related variables which have been associated with intraocular pressure changes such as refractive error, hypertension, obesity, age, gender etc. Increasing myopia has been constantly associated with increasing intraocular pressure. Myopia has long been identified as a risk factor for open angle glaucoma because of

the changes in optic disc and pressure. A previous population based study by Mitchell (8) concluded in their research that intraocular pressure increases with increasing myopia. Similarly, another study by Perkins and Phelps (22) stated that myopic eyes are more susceptible to elevated intraocular pressure levels. Even though the reason is unknown or not clearly understood, it is being said that pathological changes in the increasing myopic eyes may lead to changes in the intraocular pressure. An Israeli study (6) of 2043 subjects found an association of increasing intraocular pressure, particularly in North African or Asian people. However, no such relationship was found in a United Kingdom study. Similarly, in another study by Daubs and Crick (14), they found no direct association between intraocular pressure and refractive error after controlling for several other confounding variables like age, gender and birthplace. However, not considering central corneal thickness in his study, his research conclusion is not valid. . According to some studies (27, 28) thin corneal thickness underestimates IOP whereas, thick corneal thickness, overestimates IOP. Corneal curvature and ocular rigidity also influence IOP. Study by SP Gupta (20), states that hormonal changes in females, especially after menopause might be the reason of higher IOP levels in females. Such contradictions have been found in many other studies associating IOP with such variables.

Thus, repeated evaluation of all the factors that are related to changes in IOP levels is important. This can help to figure out the risk factors for open angle glaucoma in the form of variables that can be proved to be associated with IOP level changes.

In this study, we will evaluate the intraocular pressure levels between moderate and high myopia, also taking age and gender in to account.

Aim and Objective

To assess the changes of intraocular pressure changes with increasing myopia. To detect the accompanying ocular defects i.e. Glaucoma.

Literature Review

Blue Mountains Eye Study

This was a large, cross-sectional, population-based study of 3654 whites aged 49 to 97 years from a door-to-door census of 4433 Australians in an urban setting. Myopia was tested through standardized subjective refraction and defined as low myopia (– 1.0 D to – 3.0 D) or moderate-to-high myopia (over – 3.0 D). Open angle glaucoma was identified though Humphrey visual field testing and optic nerve examination with the diagnosis confirmed by the presence of matching optic disc cupping with rim thinning (cup-disc ratio >0.7 or cup-disc asymmetry >0.3) and characteristic visual field loss on auto-mated perimetry, after excluding secondary causes by gonioscopy. Glaucoma was found in 108 patients (3%), for a total of 126 eyes after non phakic eyes were excluded. Low myopia and moderate-to-high myopia were present in 524 eyes (7.6%) and in 342 eyes (4.9%), respectively. Among these phakic eyes, glaucoma was more than twice as common in eyes with low myopia (4.2%) than in eyes without myopia (1.5%) after adjusting for age and sex [odds ratio (OR), 2.1; confidence interval (CI), 1.2-3.8]. The correlation remained even after adjusting for other known glaucoma risk factors such as family history. An even stronger relationship was discovered between glaucoma and moderate-to-high myopia (4.4%) than in eyes without myopia (1.5%) (OR, 3.3; CI, 1.7-6.4). There was no association between myopia and ocular hypertension without optic nerve abnormality. The investigators acknowledged that over or under classification of glaucoma could have confounded the results, particularly if non glaucomatous field defects from tilted discs or difficulties in grading cup-to-disc

ratios occurred in myopic eyes. Another possible issue could be myopic shift in older eyes due to early cataract formation as AL was not measured and most of the patients with glaucoma were over the age of 60 years.

The Barbados Eye Study

A similar population-based random sample of 4036 black participants aged 40 to 84 years, found the same association between myopia and glaucoma, although slightly weaker than Blue Mountains with an OR of 1.48 (95% CI, 1.12-1.95). Their study defined myopia as the spherical equivalent over – 1 D and glaucoma as the presence of a visual field defect and corresponding optic nerve damage. Perhaps the lower cutoff of myopia reduced the OR in the Barbados study because the mean myopic refraction among blacks might be lower than the white Blue Mountain population, but it is difficult to know if aging and cataract could be affecting the outcome.

Method

The study was a hospital based observational study where subjects were selected from patients attending the ophthalmic OPD. Only Patients having moderate myopia, defined by a refractive error of -3.00D to <-6.00D and high myopia defined by a refractive error of -6.00 and more were included. Demographic details and history was recorded. Patients having glaucoma, family history of glaucoma, cataract, hypertension, previous eye injury and eye surgery were excluded.

Complete ocular examination was performed after. Visual acuity and refraction under dilatation was done. Refractive corrections of the patients were taken and their spherical equivalent was calculated as the final number. Patients coming in the category of moderate and high as defined above were then selected and their intraocular pressure was taken with goldmann applanation tonometry mounted on a Haag-streit slit lamp 900 with surface anaesthetic and fluorescein (0.25%) strip, before dilated fundus examination. To avoid interexaminer variances, all IOP measurements were taken by the same optometrist. Three consecutive readings were taken for each eye, starting with the right eye first. Normal Range for the IOP was considered as 10-21mmHg. Normal Cup disc ratio was taken as 0.3. Any patient with IOP level exceeding 21mmHg for and/or having C/D ratio hen 0.5 was further evaluated for glaucoma.

Result

The hospital based study conducted at HAH cenetary hospital evaluated 35 myopic patients (70 eyes) in the period of 2 months. Out of 35 patients, 20(57%) were moderate myopic (-3.00D to <-6.00D) and 15(42%) were highly myopic (-6.00D and more). Range of the age being 11- 55years. 20(57%) females and 15(42%) males were present in the sample. Only one patient had IOP level more than 21mmhg and was further examined for glaucoma tests which came out negative. All the evaluated patients had a C/D ratio less than 0.5. Out of 35 patients, simple and compound Anisometropic patients having one eye in the category of moderate myopia and one eye in the category of high myopia were 4(11.4%). Intraocular pressure was taken for these patients and was included in their respective refractive groups. Out of 35 patients unilaterally moderate myopic patients were 8(22%) unilaterally high myopic patients were 3(8.6%). Demographic subject details are given in table 1.

variables	N (%)

Moderate myopia	20(57%)
High myopia	15(42)
Age	
11-20yrs	12(52%)
21-30yrs	18(35%)
31-40yrs	4(13%)
0ver 40yrs	1(2.8%)
Gender	
Male	15(42%)
Female	20(57%)

Table 1. Demographic variables details.

During applanation tonometry, three consecutive readings were taken for each eye, starting from the right eye first and their mean was calculated for each eye.

Mean of the IOP was taken from the both right and left eye in each patient as the final reading of their IOP.students Ttest was used for analysis of refractive and gender analysis and ANOVA one way test was used for age analysis of IOP. Mean IOP for moderate myopia was found to be 16.5±2.40mmHg and for high myopia, mean IOP was found to be 17.6±2.96mmHg. The difference was not significant (p=0.231 >0.05). The mean IOP for females was 16.96±3.4 which was slightly higher than males with mean IOP of 16.75±2.04mmHg with non significant difference (p=0.84 >0.05). In case of IOP changes with increasing age, the change was inconsistent with non significant difference (p=0.670 >0.05). The results are shown in table2 below.

VARIABLES	N (%)	meanIOP± STDEV	P VALUE
Moderate myopia	20(57%)	16.5±2.40	0.670 (>0.05)
High myopia	15(42%)	17.7±2.96	
Gender			
Male	15(42%)	16.7±3.49	0.846(>0.05)
Female	20(57%)	16.9±2.04	
Age			

11-20yrs	12(52%)	17±3.10	0.67(>0.05)
21-30yrs	18(35%)	16.2±2.23	
31-40yrs	4(13%)	17.4±2.27	
Over 40 yrs	1(2.8%)	15.9±0	

As these 3 variables age, gender, and refractive error can be affecting each other's result, other calculations with adjusting age and gender are as shown in table 3 below.

	Moderate myopia Mean IOP+STDEV(mmHg)	High myopia Mean IOP+STDEV(mmHg)	
Age	Female	Female	Pvalue
11-21yrs	17.5±1.47	17.4±3.02	0.979(>0.05)
21-30yrs	16.3±2.35	16.6±2.03	0.816(>0.05)
31-40yrs	18.9 ±0	-	-
Above40yrs	-	15.995±0	-
	Male	Male	Pvalue
Age			
11-20yrs	16±2.87	17.59±4.83	0.552(>0.05)
21-30yrs	14.0±0	-	-
31-40yrs	15.9±3.77	19.665±0	-
Over 40yrs	-	-	-

Table3. Mean IOP by moderate and high myopia adjusted for gender and age.

Because of a small sample size, some of the group's variances could not be calculated. In both males and females, majority of the groups in higher myopic side has more IOP levels than the groups on the moderate myopic side. However the differences are still not significant (0.979>0.05 0.816>0.05 0.552>0.05)

Relationship of IOP changes with gender was calculated after adjusting refractive groups and age groups. The results are given in the table4 below.

MODERATE MYOPIA

AGE	MALE MEAN IOP+STDEV	FEMALE MEAN IOP+STDEV	P VALUE
11-20yrs	16.0±52.87	17.5±1.47	0.330(>0.05)
21-30yrs	14±0	16.3±2.35	-
31-40yrs	18.6±0	18.9±0	-
Above40yrs	-	-	-
HIGH MYOPIA			
AGE	MALE MEAN IOP+STDEV	FEMALE MEAN IOP+STDEV	PVALUE
11-20yrs	17.5±4.83	17.6±2.64	0.98(>0.05)
21-30yrs	-	16.6±2.27	-
31-40yrs	-	19.6±0	-
Above 40yrs	-	15.9950	-

Table 4. Mean IOP by gender adjusted for refractive group and age group.

Because of small sample size some of the group's IOP variances could not be calculated. All of the females in both refractive and all age groups show higher IOP levels than males, though again, the difference is not significant (0.330>0.05) (0.98>0.05)

Relationship of IOP changes by increasing age groups were calculated after adjusting refractive group and gender. The results are given in table 5 below.

MODERATE MYOPIA		
AGE	FEMALE MEAN IOP+STDEV	MALE MEAN IOP+STDEV
11-20yrs	17.49±1.47	16.52±2.90
21-30yrs	16.32±2.35	14±0
31-40yrs	18.995±0	18.66±50
Over40yrs	-	-
P VALUE	0.41(>0.05)	-
HIGH MYOPIA		
AGE	FEMALE MEAN	MALE MEAN

	IOP+STDEV	IOP+STDEV
11-20yrs	17.66±2.64	17.59±4.83
21-30yrs	16.66±2.27	-
31-40yrs	-	19.665±0
Over40yrs	15.995±0	-
P VALUE	0.590(>0.05)	-

Table5. Mean IOP by different age groups adjusted for refractive group and gender.

Because of small sample size, some of the group's IOP variances could not be calculated. According to the table, the IOP levels in different groups are still inconsistent, and the difference is not significant (0.590>0.05)

DISCUSSION

This was a hospital based observational study at HAH centenary hospital. 35 patients with moderate and high myopia were evaluated for intraocular pressure and their variations analysed. The mean IOP for the entire sample was found to be 16.98±2.68mmHg (normal range: 10-21mmHg). No significant difference (p=0.231) was found between the two refractive groups. After adjusting for the variables, most of the time, high myopes had more intraocular pressure compared to moderate myopes, though insignificant. Studies by Liang xu (2), Robert t Chang (6) Dinny sunny Joseph (13) concluded that IOP increases with increasing myopia. Blue Mountains study (8) concluded a 3 fold increase of IOP with increasing myopia. However according to a study by M.I Abdalla and M.hamd (3) confirmed geographical and racial association with IOP changes. They concluded that Asians and Africans have significant IOP and refractive error relationship, whereas, some studies in western countries only found a significant relationship between age and refractive error. Shukla (1968) (29) stated that the cornea is thinner in myopia than in emmetropia, and this probably applies to the sclera as well. Friedman (1966) (30) showed that an eye of large volume with thin coats will experience greater stress on its coats than a normal eye at the same intraocular pressure. This greater stress means that more force is required in using the applanation tonometer, thus giving higher tension readings. He proved that eyes of different volumes have a different stress-strain relationship in all their coats, in spite of having the same intraocular pressure, so that this stress-strain relationship will affect tonometric readings whatever method is applied.High myopes having less corneal curvature and more flat corneas compared to moderate myopes and emmetropes, may cause less volume of fluid displacement during pressure (jun liu 27). However, Schmidt (I959)(31) showed that such variations had very little effect on the results of applanation tonometry; the volumetric displacement in applanation tonometry of a cornea with a radius of curvature of 4.5 mm. was 0.995 cu.mm. While that of I5.5 mm was 0.28I cu. mm. This very small difference in volume displacement between these extreme radii of curvature of the cornea could not be compared with the large volumetric displacement that occurs in indentation tonometry. Another reason might be the inherited greater axial length of the myopic eyeball which causes an increase in the resistance to outflow of aqueous humour (perhaps mainly by flattening and attenuation of the meshwork) (Armaly, I 967a). Other studies by Bonomi (16) and Sanaa yasin (Saudi) (15) also could not find any relation between IOP changes and refractive error. Our study findings correlate with it. In our study mean IOP of females were found to be

16.96±2.04 which was none significantly (0.846) higher than the mean IOP of males, 16.75±3.491. Our study correlates with other studies that are the Framingham eye study (17), the Beaver Dam eye study (18) and an Iranian study by Hashemi.H (19). However, a study in UK reported significantly higher values for IOP for females from pre-teens to late adult life. Also a study in Saudi Arabia, hypertension was found to be more frequent in females than males, which might be affecting IOP levels Mean IOP was found to be 17.08±3.10 in the age group 11-20yrs, as light drop in the IOP mean was found in the age group 21-30 yrs that was 16.27±2.23 and again a slight rise was seen in the third age group of 31-40yrs individuals was 17.41±2.72. The last group of over 40yrs olds only had one individual. The difference however was not significant (0.670). These results are similar to some other researches that could not associate age with changes in the IOP, (Dielemans) (21), (sanah yasin) (15). Toselli (I961), studying the course and evolution of myopia in the first three decades of life, found that myopia showed a progressive phase with quiescent intervals in 96-5 per cent. of myopes aged 2 to 20 years, only 3*5 per cent. remaining stationary, whereas in those aged 20 to 30 years the myopia remained stationary in I2 per cent. the marked growth of the eye changes its volume and perhaps the stress-strain characteristics of the cornea, so affecting the applanation tonometric readings. The marked growth of the eye changes its volume and perhaps the stress-strain characteristics of the cornea, so affecting the applanation tonometric readings.But there are several other studies that suggest a positive correlation between IOP and age. A study in Japan (24) suggested a decrease in IOP with increasing age. Abdalla and Hamdi, 1970, stated that in all age groups from 11 to over 50 years, except for 21 to 30 years, myopes had significantly higher ocular tensions than emmetropes. Even though this result is comparing iop between myopes and emmetropes, the fact that iop is decreased in the age group of 21-30 does match our results, though insignificant. However, another study by Armaly suggests an increase in IOP levels with increasing age until a limit (after50-60yrs) after which, no significant increases can be seen in the IOP. Axial lengths longer in females compared to males can be the reason as well. Many other studies suggest an increase in IOP with increases in age due to changes in orbital soft tissues, corneal structure (Augsburger A)(25), lens thickness, decrease in aqueous production (Becker B)(26) and accompanying increased incidence of various adult diseases, such as diabetes mellitus and hypertension (Shiose)Y(26), (Tomoyose) (27) Mzezewa, S.(28).

Conclusion

No significant association was found between IOP and myopia along with other factors such as age and gender. Small sample size and avoiding various others factors such as ocular biomechanics, corneal thickness, curvature etc. can be the reason for it. Overcoming these limitations can help confirming a conclusion and give results that would be different and convincing. The study needs further research time and evaluation.

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