Original Article

Estimation of Range of Intraocular Pressure in Normal Individuals by Air Puff Tonometer

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Purpose: To estimate the range of IOP among normal individuals of different age groups.

Material and Methods: This cross sectional descriptive study was conducted in Department of Ophthalmology, Bahawal Victoria hospital, Bahawalpur for a period of six months from 1st Feb 2010 to 31st July 2010. Data was collected from 300 normal individuals. The IOP was measured with air puff tonometer and Results were recorded on specially designed structured proforma. As the variable was quantitative in nature simple descriptive analysis was performed to calculate mean and range of intraocular pressure.

Results: Mean IOP was found to be 15.368 ± 3.37 mm Hg giving a range of 5 to 25 mm Hg. No significant difference was found in the range of IOP between individuals of both sexes of various age groups. It also revealed that IOP in both eyes of the same individual was almost the same.

Conclusion: In different age groups IOP was similar. Similarly, mean IOP was found to be same in two sexes. No difference was found in the IOP of two eyes.

Key words: Intraocular pressure, air puff tonometer, glaucoma.

Human eye is a spherical structure with flexible and elastic walls. Maintenance of spherical shape is essential for the optical properties of eye. Tissue pressure of the intraocular contents is called intraocular pressure that is maintained by a balance between aqueous humor production and its outflow through the drainage pathways[1].

Intraocular pressure is found to vary depending on the gender, the presence of Diabetes Mellitus and refractive error in different population of the world.. IOP in children is much lower than the adults and it is noted to increase with age[2]. Intraocular pressure is known to differ in various racial groups and even within various regions of the same country.[3-5] IOP varies with time of the day, changes in body posture, and changes in eye movements[6]. In population based studies the mean IOP is 16 mm Hg. Two standard deviation of 2.5 on either side gives a range from 11 to 21 mm of Hg. There is a significant number of population whose IOP is found to exceed normal IOP of 21 mm Hg on several consecutive occasions but are without any visual damage. Similarly in few people, glaucomatous damage is found despite very low IOP[7].

So the rationale of our study is to estimate the range of IOP in normal individuals of various age groups of either sex presenting in our settings as this can vary in various setups. Consequently this range of IOP will act as a tool to early detect and to refer all the cases outside this range to glaucoma clinic for more complex and time consuming tests like assessment of cup disc ratio, automated visual fields and optical coherence tomography to complete the diagnosis and management.

MATERIAL AND METHODS

In this cross sectional descriptive study 300 individuals (600 eyes) were included. Study subjects were divided into three groups according to age. First group included individuals between 25 to 40 years of

age; second group included 41 to 60 years and third was comprised of individuals older than 60 years. Convenient sampling technique was employed to carry out the study.

Individuals of either sex above 25 years of age with normal vitals including pulse rate, respiratory rate and blood pressure were included in the study while following individuals were excluded from the study.

1. Individuals with systemic disease like diabetes mellitus, hypertension.
2. Individuals using drugs affecting IOP.
3. Individuals with history of ocular trauma or surgery.
4. Individuals with high astigmatism that could affect IOP measurements.
5. Individuals with conditions causing difficulty in taking IOP like blepharospasm and lid abnormalities.
6. Individuals with abnormal cup disc ratio on fundus examination.
7. Individuals with visual field defects.

The healthy relatives of the patients presenting to outpatient department and admitted in our ward were explained the purpose of study and requested to participate in the study. Each individual underwent a thorough ophthalmic examination including visual acuity, visual field analysis by Humphrey field analyzer, slit lamp examination and dilated fundus examination to rule out conditions affecting the IOP. Those who fulfilled our criteria were included in the study. Study was approved by ethical and research committee of our hospital. Informed consent was taken from study subjects and their demographics like name, age, sex were noted. Intraocular pressure of both eyes was taken by air puff tonometer which was Shin Nippon Non-contact tonometer NCT-10. Average of three IOP readings with air puff tonomeret was recorded. IOP measurement was performed during the morning hours from 8 am to 11 am. Data was collected on specially designed structured proforma.

Mean outcome measures include

1. Range of IOP
2. IOP according to various age groups.
3. IOP in both sexes separately.

Data were analysed using SPSS version 10. Mean and range of intraocular pressure was calculated in each group.

RESULTS

In our study, a total of 300 subjects (600 eyes) were studied. Mean IOP was found to be 15.368 ± 3.37 mm Hg giving a range of 5 to 25 mm Hg. Table 1 shows IOP in both sexes at different age groups. No significant difference was found in the range of IOP between individuals of both sexes of various age groups. Similarly table 2 shows mean IOP and standard deviation of both right and left eye of the same individual under study. It also revealed that IOP in both eyes of the same individual was almost same. In Table 3 the range of IOP in different age groups is shown which reveals that range of IOP in middle age group is wider than younger and elder age groups.

Table 1: IOP in two sexes in different age groups

Gender	Mean IOP ± Standard Deviation (n = 300)		
	25-40 Years	41-60 Years	> 60 Years
Male	15.063 ± 3.017 mm Hg	15.017 ± 3.469 mm Hg	14.53 ± 3.341 mm Hg
Female	16.20 ± 2.596 mm Hg	14.841 ± 3.685 mm Hg	16.5 ±4.012 mm Hg

Table 2: Mean IOP and standard deviation in two eyes (n = 260)

	Mean IOP	±	Standard Deviation
Right Eye	15.336	±	3.471
Left Eye	15.4	±	3.282

Table 3: Table showing range of IOP in different age groups (n = 300)

Age Groups	Range of IOP mm Hg
25 - 40 years	9 - 25
41 - 60 years	5 - 25
Older than 60 years	7 - 22

DISCUSSION

In this study of healthy individuals, mean IOP is found to be 15.368 ± 3.37 mm Hg while range of IOP is 5–25 mm Hg. In another study conducted in Pakistan[8] previously mean IOP was found to be 14.3 ± 0.17 mm Hg. Elevated IOP is a major risk factor for open angle

glaucoma. Similarly there are several other factors that affect IOP. One of these is relationship of increasing age with IOP. So it is very difficult to accurately define a level of IOP which is likely to cause glaucomatous damage. In our study, no age related increase in IOP was found. This finding is similar to a study, conducted on a large number of individuals in United States[9] that stated there was no evidence found of an independent age effect on IOP.

In our study effort was made to include only healthy subjects. All those using any kind of medicine were excluded from the study. This excluded a large number of older individuals from the study. Accordingly this result may not be representative of general older population as this study was conducted on a limited scale. All the patients with ocular diseases or history of ocular trauma were also excluded from the study.

Mean value of IOP was found to be 13.6 ± 2.6 mm Hg in men and 13.3 ± 2.6 mm Hg in women in Japanese population[10]. The IOP was found to be decreasing with age in Japanese population. Central corneal thickness is one of the most important factors affecting corneal rigidity which is a major source of error in applanation tonometry[11]. An extremely thick or thin cornea can respectively cause overestimation or underestimation of IOP[12]. Since CCT and applanation tonometeric estimates of IOP correlate positively, monitoring of the former parameter has served as the basis for adjusting readings pertaining to the latter, with the consequence that many patients have had to be reclassified[13]. Study of this variable was beyond the scope of my study. Furthermore in my study, all measurements were taken with puff tonometer.

The variation in IOP was also studied in two sexes and no significant difference was found as in other studies conducted in Pakistan previously[14].

IOP undergoes fluctuation with the time of the day[15] and with seasonal variation[16]. In our study no diurnal variation and seasonal variation in IOP was noted.

There is ocular hypotensive effect of pregnancy[17] and higher IOP is found in postmenopausal women than in those who are still menstruating[18]. This factor should be considered while assessing for IOP variations. In our study this factor was not considered and this is our limitation.

IOP is also altered by changing the subject's gravity dependent body position[19]. So while taking IOP values this factor should be kept in mind. Since my study was conducted in OPD and IOP measurements was done in sitting position in all subjects, so bias due to this factor is eliminated.

IOP readings can be altered by many factors including instrumental, anatomical, physiological, examiner induced and patient induced sources of error[20]. All these factors should be considered while taking IOP readings. So far the most accurate instrument to take IOP is Goldmann applanation tonometer whereas in my study, all measurements were made by puff tonometer. The readings taken with it are found to be higher than those measured with Goldmann applanation tonometer[21] so actual range of IOP might be lower than that found in my study. This is another limitation of our study.

Sample size in our study was 300 normal individuals. Sample size should be in thousands as it is reflective of big population. Small sample size is a limitation of our work.

Our study estimated the range of IOP in normal individuals of various age groups of either sex presenting in our settings. All cases having IOP outside this range can be further examined and investigated to rule out glaucoma.

CONCLUSION

The mean IOP in normal individuals is found to be 15.368 ± 3.37 mmHg. No difference was found in two sexes. Also insignificant relationship was found between age and IOP. Consequently this range of IOP will act as a tool to early detect and to refer all the cases outside this range to glaucoma clinic for more complex and time consuming tests like assessment of cup disc ratio and automated visual fields to complete the diagnosis and start early management.

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