

Age and Intraocular Pressure: How are they Correlated?

Pages with reference to book, From 150 To 152

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Abstract

Background: The relationship between intraocular pressure and age is not fully understood, Intraocular pressure may increase or decrease with age.

Purpose: Study was planned to determine the effect of aging on intraocular pressure of an apparently healthy population of Karachi.

Subjects and Methods: Depending upon age, 8036 subjects were divided into seven groups. All were examined according to standard protocols. Measurements were taken by Goldmann applanation tonometer, after a complete rest for atleast 15 minutes and always first in the right eye.

Results: Mean intraocular pressure increases progressively with age until 60 yeais. When one age group is compared with its preceding, the increase is non-significant until 40 years but highly significant (P

Conclusion: This study supports the conclusion that as age increases, intraocular pressure also increases, with an average of 0.28 mmHg per decade. Knowledge of the normal range of intraocular pressure in various age groups will help glaucoma screeners (JPMA 45:150,1995).

Introduction

With regard to the effect of age on intraocular pressure (IOP) fmdings are not consistent. Several univariate studies indicate that TOP increases with age among Eumpean and American populations¹⁻⁷. Many studies have shown that with age, the entire population develops an increase in IOP¹⁻³, such that the frequency of low readings drops and of the high readings increases significantly⁴, especially after the age of 40 years^{5,6}. Martin⁵ reported that IOP increases by 1 mmHg, while Kass et al⁷ found 0.43 mmHg per decade after the age of 40 years. Risk for glaucoma, which is the second most important cause of permanent blindness in the Asia Pacific region, increases with the age^{8,9}.

In contrast to these, in the Japanese population, TOP decreases with age, which is statistically significant after the age of 40 years^{10,11}. Because of this contrast the present study was undertaken to determine the effect of aging on IOP in the apparently healthy population of Karachi.

Subjects and Methods

The sample consisted of 8036 healthy subjects (5188 men and 2848 women) which were collected from different hospitals, colleges, universities and factories. A medical history was taken from each subject, including questions concerning previous ocular diseases, presence of diabetes mellitus and the occurrence of glaucoma in the family. The blood pressure was taken in supine position after five minutes rest. The inclusion criteria met were absence of ocular complaints including refractive errors, absence-of ally history of eye surgery and diabetes, normal body temperature and blood pressure.

Subjects were asked not to smoke or take tea and have a complete rest atleast 15 minutes before the measurement of IOP. 1 hey were asked to see the ophthalmologist for further examination, if he/she had an IOP reading above 21 mmHg, or a difference of 5 mm Hg between the two eyes also if, they had a history of haloes or attacks of blurred vision. Out of 8455 subjects, 8036 fulfilled the criteria and were divided into seven age groups (Table). After instillation of 0.25% fluorescein and 0.4%benox-mate hydrochloride (Fluress) eye drops, the IOP was measured with the Goldmann applanation to no meter

first in the right eye and then in the left. Three consecutive readings of each eye were taken and after each reading the tonometer was removed from contact and the measuring scale was returned to 10 mmHg. The average of the three readings for each eye and the mean of two averages is used as the person's IOP for the present study. The measurements were taken at a fixed time from 9 to 11 A.M. to minimize the effect of diurnal variations. Significance of the difference between two groups is calculated by applying the unpaired student's "t" test and the differences are regarded as significant when the P value is less than 0.05.

Results

IOP increases progressively with age until 60 years. When the mean IOP of one age group was compared with its preceding age group, the increase is statistically non-significant until the age of 40 years and highly significant ($P < 0.001$) in the age groups 41-50 and 51-60 years. There was non-significant decrease in the age group 61-70 years and increase in the age group above 70 years (Table).

Table. Intraocular pressure in various age groups.

Age group (Years)	Number of subjects	Percentage of total subjects	Mean age (Years)	IOP (mm Hg)#
11-20	768	9.56	16.10	13.80±0.18
21-30	1744	21.70	25.21	14.11±0.11
31-40	1900	23.64	35.13	14.38±0.13
41-50	1516	18.87	44.74	14.92±0.10*
51-60	1360	16.92	56.92	15.66±0.17**
61-70	360	4.48	64.56	15.43±0.30
Above 70	388	4.83	73.69	15.49±0.22

Values are expressed as mean ±SEM.

* indicates that value is highly significant ($P < 0.001$) as compared to age Group 31-40 years.

** indicates that value is highly significant ($P < 0.001$) as compared to age group 41-50 years.

Differences in mean IOP of one age group from its preceding age group were +0.31, +0.27, +0.54, +0.74, -0.23 and +0.06 mmHg respectively. The very small difference between the last two groups is within the limits of chance fluctuation. The average per decade increase in this study was found to be 0.28 mmHg.

Discussion

The effect of age on mean applanation pressure reported here is similar to that reported in Western population studies¹⁻⁷, while reverse is true for Japanese population^{10,11}. All these studies found that IOP increases with age and this effect was lost or at least weakened at the oldest ages. In contradiction to these results, in the Japanese population the age dependent decrease of IOP has been consistently

observed in both sexes but more markedly in men^{10,11}. Because of this contrast, it is suspected that some other factors might be equally or more important than age in determining IOP.

The associations between IOP, age and blood pressure (BP) have previously been described^{1,12-14} but inconsistencies are present. Klein et al¹ reported that both age and BP are independently and significantly associated with TOP level, but others observed that systolic BP is positively correlated with the age, while IOP is significantly negatively correlated with systolic BP; any apparent association between IOP and age was fully accounted for through the correlation between systolic BP and age¹². The age effect on IOP is merely mediated by an increase in systolic BP and that age itself does not have an independent effect on IOP¹³. IOP is positively and independently related to systolic BP and obesity index¹⁴. A series of Japanese studies repeatedly confirmed that obesity index, systolic BP and age are three primary factors affecting IOP^{10,11}. Multiple regression analysis of data in the Japanese, shows that TOP is physiologically maintained by a balance between the value decreasing effect of aging and value increasing effect of obesity and hypertension¹¹. Based on this observation, the discrepancy can be explained, as among Pakistani, European and American populations, the ocular hypertensive effect of hypertension and obesity overwhelms the hypotensive effect of aging and TOP therefore, increases with age. However, in the Japanese population the hypotensive effect of aging has the dominant effect and lowering of IOP is the net result.

Alternatively, change in aqueous dynamics with age is a more likely explanation for this discrepancy. The tendency for IOP to decrease with age in Japanese may be due to decrease in the production of aqueous humour, because some studies have reported significant decrease in aqueous humour production with the increase in age¹⁵. On the other hand the tendency for IOP to increase with age in the Pakistani population may be due to decreased outflow facility, as it has also been reported for the elderly¹⁶. IOP levels among blacks are higher than whites⁷. These findings suggest that a genetic factor may play a role in determining TOP level.

TOP decreases as the pregnancy advances because changes in circulating progesterone and relaxin levels increase the outflow facility by reducing corneal rigidity^{17,18}. Besides sex hormones, there is some evidence that vasopressin, thyroxin, insulin, glucocorticoids and mineralocorticoids may also affect the physiological regulation of IOP¹⁹. The characteristics of ocular tissue and thus IOP, may change with changes in serum hormonal levels. Thus with advancing age, especially after the age of 40 years, the hormonal influence on IOP may adopt different paths in different races, determined by their genetic background. The suggested difference in hormonal influence on IOP could take the form of increased or decreased level, tissue sensitivity, or effectiveness of one or another hormone with age. The logical choices for target tissues in the eye are the ciliary epithelia, the sub-epithelial vascular plexus, the trabecular meshwork, outflow channels and the episcleral venous plexus. There is a possibility that hormones may alter IOP by affecting the rate of aqueous inflow or the facility of the outflow. At this time, collection of well documented clinical data of TOP change in endocrine conditions is desirable. It would appear that there is a hormonal component in the physiologic regulation of IOP. Whether this is one of the keys to understanding the differences in IOP with age, sex and racial groups and causes of glaucoma must be left to future investigators.

Among the many systemic factors, ages cannot be discussed in the same dimension as other variables. This is because all biological phenomena show age dependent changes. While there are individual variations, the phenomenon of aging becomes definitely apparent in those over 40 years, accompanied by increase in the incidence of various adult diseases, for example, diabetes mellitus. Diabetics have a higher mean IOP than non-diabetic persons²⁰. Stoupe et al²¹ showed that environmental conditions also have a significant influence on IOP. Due to differences in inherent constitution, diet and environmental conditions, there may be some qualitative differences in important systemic and ocular characteristics in the Pakistani and Japanese populations, with particular reference to blood pressure.

body mass index, height, haematocrit, serum glucose, glycohaemoglobin, cholesterol level, episcleral vein and corneal thicknesses. There is a possibility that with advancing age, changes in these factors may affect IOP differently in the two races. No comparable data is available between these two populations. These characteristics should be considered in further research on IOP, particularly when comparing IOP in different populations. Among these, haemoglobin looks theoretically important, as resistance in the episcleral veins can be increased by rises in blood viscosity. TOP measurements in polycythaemia and in severe anaemia can also help. What is needed is one or more population based studies in Pakistan and Japan in which TOP, hormonal levels and other important parameters are measured by the same investigators using uniform methods of measurement and subject selection.

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