



INTRAOCCULAR PRESSURE; INTRAOCCULAR PRESSURE IN DIABETO-HYPERTENSIVE PATIENTS OF AGE-MATCHED NEWLY DIAGNOSED - A CRSSSECTIONAL STUDY

Dr. Muhammad Shahid Faruqi¹, Dr. Abdul Rehman Khokhar², Dr. Abdul Ghaffar Khan³,
Dr. Tanvir Ali Shirwany⁴

1. Associate Professor of Physiology, MBBS Medical College, Mirpur, AJ&KG
2. Assistant professor of Physiology, Ghazi Medical College, D G Khan.
3. Assistant professor of Physiology, MMDC Medical College, Multan.
4. Professor of Physiology, Rohi (CMH) Medical College, Bahawalpur.

Correspondence Address:

Dr. Muhammad Shahid Faruqi
Associate Professor of Physiology,
MBBS Medical College, Mirpur,
AJ&KG
mshahidfarooqi@yahoo.com

Article received on:

10/12/2015

Accepted for publication:

02/01/2016

Received after proof reading:

10/03/2016

ABSTRACT... Objectives: To evaluate the intraocular pressure in diabeto-hypertensive subjects and age and sex matched normal healthy adults. **Study Design:** Cross-sectional analytic study. **Methodology:** 50 subjects visiting the out-patient department (OPD) of Ophthalmology in Lahore General Hospital, Lahore, were examined. 25 were newly diagnosed diabeto-hypertensive, and 25 normal healthy were selected from the relatives of these patients. IOP was checked by Goldman Applanation Tonometer. Blood pressure was checked by mercury sphygmomanometer. Blood glucose level checked by glucometer. **Results:** The IOP was raised in both eyes of diabeto-hypertensive patients and there was a significant difference in intraocular pressure of normal healthy control and diabeto-hypertensive subjects. The differences between two groups was analyzed by paired Student's t-test. The P-value was <0.001. **Conclusion:** Intra-ocular pressure can be raised in all diabeto-hypertensive subjects, which shows that co-existence of diabetes and hypertension were important risk factor for raised intraocular pressure.

Key words: Intraocular pressure, Hypertension, Diabetes mellitus

Article Citation: Faruqi MS, Khokhar AR, Khan AG, Shirwany TA. Intraocular pressure; Intraocular pressure in diabeto-hypertensive patients of age-matched newly diagnosed - a crsssectional study Professional Med J 2016;23(3):317-323. DOI: 10.17957/TPMJ/16.3211

INTRODUCTION

Intraocular pressure (IOP) is due to presence of fluid in the anterior chamber of eye called intraocular fluid which helps maintain pressure in the eyeball to maintain its shape. It is dependent on several physiological and pathological factors including posture¹, body mass index, diet, height age, diabetes mellitus, hypertension and obesity.²⁻⁵ The IOP within the eyeball normally varies from 11-21 mmHg. Aqueous humor forms at a rate of 2-3 µl/minute during the day, the fluid volume of the anterior chamber being exchanged every 100 minutes.⁶ Essentially all of it is produced by the ciliary processes. Approximately 80% aqueous humor is produced by the non-pigmented epithelium as a result of an active metabolic process. The remaining 20% of aqueous is produced by ultrafiltration and diffusion. The vast majority (90%) of aqueous flow exits in the anterior chamber angle through the trabecular meshwork into Schlemm's canal, from where it traverses through a series of collector

channels into the network of episcleral vein.⁷

Intraocular pressure is determine by Rate of aqueous secretion, resistance encountered in outflow channels and level of episcleral venous pressure.

The relationship between these three factors can be expressed as follows:

$$Po = (F/C) + Pe \text{ or } F = C (Po - Pe)$$

Po = IOP in mmHg

F = rate of aqueous outflow (normal 2µl/min)

C=facility of aqueous outflow (normal 0.2µl/min/mmHg)

Pe = episcleral venous pressure (normal 10 mmHg).

The distribution of IOP within the general population has a range 11mmHg to 21 mmHg. Although there is no absolute cutoff point, 21mmHg is considered as the upper limit of normal. However, in some patient's glaucomatous damage occurs

with IOPs less than 21 mmHg (normal-tension glaucoma) whilst others may not suffer from over Open Angle Glaucoma (OAG) with IOPs up to 30 mmHg (ocular hypertension).^{8,9}

An increase in IOP with age has been found in western population, whereas IOP has been confirmed to decrease with aging among Japanese population. The relationship between IOP and age was not linear, whereas male sex, hypertension, and diabetes were positively related to changes in IOP.¹⁰

Diabetes is a known risk factor for raised IOP and primary open angle glaucoma (POAG). The prevalence of diabetes for all age groups was estimated to 2.8% in the year 2000 and 4.4% in 2030. According to World Health Organization (WHO), at least 171 million peoples worldwide have diabetes.^{11,12}

Diabetes mellitus (DM) is a complex metabolic disorder manifesting as hyperglycemia. Later results from defects in insulin secretion, insulin sensitivity or, most commonly, both. Metabolic dysregulation in diabetes is accompanied by characteristic long term complications.^{5,13}

Hypertension is one of mankind's most common disease and a major health problem affecting as much as 50% of the adult population in some areas of the world. The prevalence of hypertension continues to increase worldwide. National Health and Nutrition Examination Survey (NHANES) data indicate that prevalence has increased among U.S. adults, from approximately 50 million in the period from 1988 through 1994 to 65 million in the period from 1999 through 2004.¹⁴ The prevalence of hypertension worldwide is to increase to 1.5 billion by 2025. Both sexes having the prevalence of hypertension increases with age. Hypertension has several associated complications, which cause major morbidity and mortality, such as coronary artery disease, cerebrovascular disease and renal failure. Hypertension and history of diabetes are significantly associated with higher IOP.¹⁵

Present study therefore was designed to evaluate

and compare the intraocular pressure in age-matched diabeto-hypertensive subjects with healthy population.

METHODOLOGY

It was a cross-sectional analytic study. The study protocol was approved by the Advanced Studies and Research board committee of University of Health Sciences Lahore and Ethical committee of Postgraduate Medical Institute Lahore. A written informed consent was obtained from the participant before enrolling them in the study. 50 subjects (25 healthy, 25 diabeto-hypertensive) with age range of 30-50 years and either sex fulfilling the inclusion were selected from Department of Ophthalmology of Lahore General Hospital. Lahore.

Inclusion criteria

Normal healthy control was selected from the relatives accompanying the patients aged 30 to 50 years of either sex were included in the study. Subjects with diabetes mellitus according to World Health Organization (WHO) criteria.¹³ Hypertension according to Joint National Committee (JNC) 7 criteria.¹⁶

Exclusion criteria

Patients suffering from any other disease besides hypertension and diabetes mellitus. Those hypertensive patients with acute illness or with recent myocardial infarction, unstable angina or shock. Patients suffering from other diseases of eye like glaucoma, cataract and retinopathy (diabetic or hypertensive). Age below 30 and above 50year.

IOP

IOP measurements were taken by the same examiner and with the same Goldman's applanation tonometer (Goldman Topcon Germany). After instillation of 0.25% Fluorescein sodium and 0.4% Benoxinate hydrochloride (FLURESS) eye drops, the I.O.P. was first measured in the right eye and then in the left eye. Three consecutive readings in each subject were recorded and the mean was calculated.¹⁷

Blood pressure

(B.P) was measured with mercury sphygmomanometer in the sitting position. Subjects were required to be calm and quiet for 10 to 20 minutes before taking the readings. Inflated the cuff slowly by pumping the bulb with the other hand and note the pressure reading when the radial pulse is first lost. Increased the pressure to around 20 mmHg above the point where the radial pulse was first lost. Palpated the brachial artery on the medial side of the cubital fossa. Placed the diaphragm of stethoscope below the cuff and over the brachial artery. Reduced the pressure in the cuff by turning the valve counter clockwise slowly. As the pressure decreased we heard the “sound changes” (Korotkoff sounds). Recorded the pressure when the sound first reappear as systolic pressure. When the sounds became muffled and reduced in intensity, the pressure was recorded as diastolic pressure. Took three readings and calculated the mean. According to the JNC7 systolic blood pressure >140mmHg and diastolic blood pressure >90mmHg were taken as hypertension.¹⁶

Blood sugar

Was randomly measured in every patient and control by glucose oxidation method, using Accu-Chek. Active blood glucose monitor (Glucometer) The result appeared in display in mg/dl.

STATISTICAL ANALYSIS

Calculation was carried out with the Statistical Package of Social Sciences version 16.0 (SPSS, Inc Chicago, IL, USA). The significance of differences among the two groups was analyzed by paired Student’s t-test. Arithmetic mean and

standard deviation (SD) of each parameter was determined. P-value <0.05 was considered statistically significant.

RESULTS

Present study was conducted in 50 subjects aged 30-50 years. These were divided into 02 groups of 25 each. Since the outcomes of study were quantitative variable, ANOVA was applied to test the differences between the 4 groups. (Table-I). It shows p-value <0.05.

Table-I and figure-1 shows comparison of IOPs in normal and diabeto-hypertensive subjects. The mean ± SD intraocular pressure (mmHg) in right eye was 11.04 ± 2.53 in normal and 18.63 ± 2.68 in diabeto-hypertensive. Mean ± SD intraocular pressure (mmHg) in left eye was 11.80 ± 2.87 in normal and 18.45 ± 1.91 in diabeto-hypertensive. Differences in IOP in both eyes between the two groups are statistically significant. Table-II and figure-2 shows comparison of mean ± SD intraocular pressure (mmHg) in both eyes in normal subjects only. IOP in right was 11.05 ± 2.53 and in left eye was 11.8 ± 2.87. The difference in IOP is not statistically significant (p >0.05). Table-III and figure-3 shows comparison of mean ± SD intraocular pressure (mmHg) in both eyes in diabeto-hypertensive alone. IOP in right eye was 18.6 ± 2.68 and in left eye was 18.5 ± 1.91. The difference in IOP is not statistically significant (p >0.05). Figure-4 shows correlation between intraocular pressure of right and left eye with age in diabeto-hypertensive subjects. It shows no significance. Figure-4 shows that intraocular ressure of left eye were more decreases as compared to right eye as the age increases.

	Normal	Diabeto-Hypertensive	p-value
	Mean ± SD	Mean ± SD	
IOP Right Eye(mmHg)	11.04 ± 2.53	18.63 ± 2.68	0.000
IOP Left Eye(mmHg)	11.80 ± 2.87	18.45 ± 1.91	0.000

Table-I. Comparison of mean ± SD intra-ocular pressure (mmHg) in normal and diabeto-hypertensive subjects

	Normal	p-value
	Mean ± SD	
IOP Right Eye(mmHg)	11.05 ± 2.53	0.126
IOP Left Eye(mmHg)	11.8 ± 2.87	

Table-II. Comparison of mean ± SD intra-ocular (mmHg) pressure of right eye and left eye in normal subjects

	Diabeto-Hypertensive	p-value
	Mean ± SD	
IOP Right Eye(mmHg)	18.6 ± 2.68	0.695
IOP Left Eye(mmHg)	18.5 ± 1.91	

Table-III. Comparison of mean ± SD intra-ocular pressure (mmHg) of right eye and left eye in diabeto-hypertensive subjects

	Age	p-value
IOP Right Eye	(r)= -0.412*	0.041
IOP Left Eye	(r)= -0.156	0.456

Table-IV. Correlation between Intra-ocular pressure of right and left eye with age in normal subjects

	Age	p-value
IOP Right Eye	(r)= -0.123	0.559
IOP Left Eye	(r)= -0.279	0.178

Table-V. Correlation between Intra-ocular pressure of right and left eye with age in diabeto-hypertensive subjects

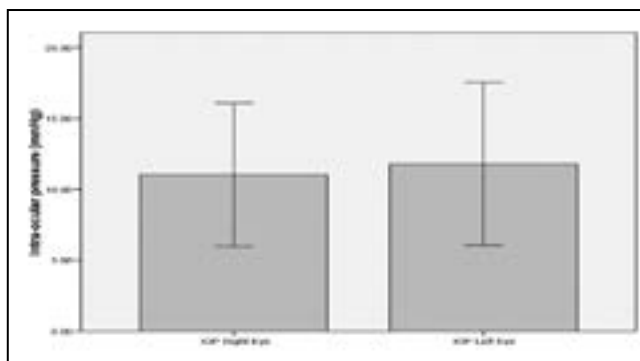


Figure-2. Comparison of mean ± SD intra-ocular pressure (mmHg) of right eye and left eye in normal subjects

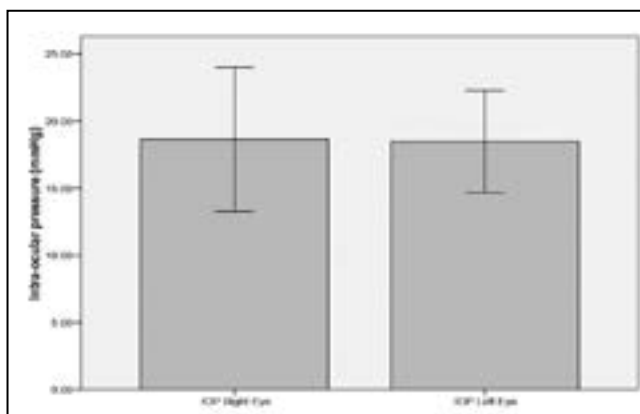


Figure-3. Comparison of mean ± SD intra-ocular pressure (mmHg) of right eye and left eye in diabeto-hypertensive subjects

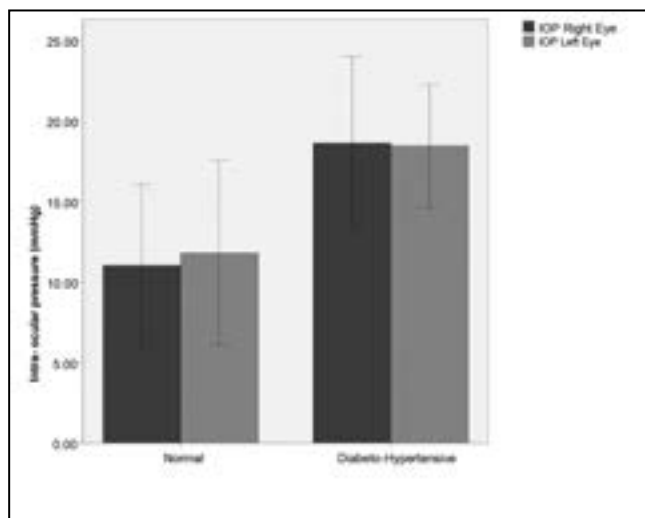


Figure-3. Comparison of mean ± SD intra-ocular pressure (mmHg) of right eye and left eye in diabeto-hypertensive subjects

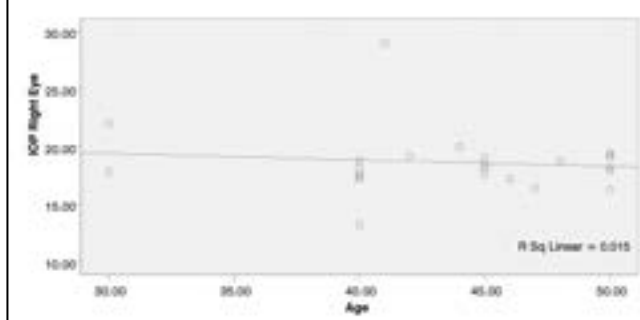
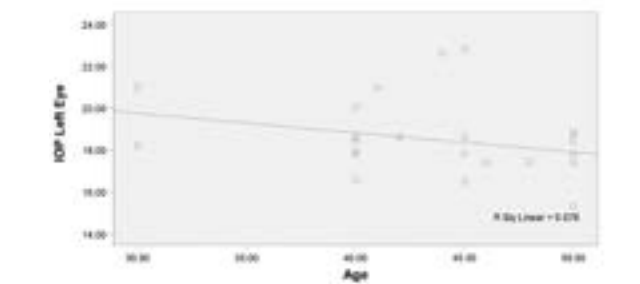


Figure-4. Correlation between intra-ocular pressure (mmHg) of right eye and left eye in diabeto-hypertensive with age



DISCUSSION

Intra-ocular pressure has been a subject of extensive research in the West, and its changes in hypertensives and diabetics have also been investigated there. In this study, the intra-ocular pressure was measured in diabeto-hypertensive group of subjects and was compared with the intra-ocular pressure in the healthy normal group. The Beaver Dam eye study while investigating the relationship between changes in systemic blood pressure and changes in intra-ocular pressure discovered significant direct correlation between the two. It was concluded that reduced systemic blood pressure was associated with reduced IOP.¹⁷ In an experimental study in hypertensive rats, a positive relationship between blood pressure and intra-ocular pressure in hypertensive rats was suggested. The base-line IOP was found to be higher in hypertensive rats versus their normotensive control.¹⁸ Numerous other studies have also reported a positive association between intra-ocular pressure and systolic blood pressure^{8,10,19} and are in agreement with the findings of this study. However, our findings do establish a positive relationship between hypertension and raised IOP.

Diabetes mellitus affects 100 million persons worldwide, 90-95% of them have type 2 diabetes. It is likely that incidence of type 2 diabetes will rise as a consequence of life-style pattern.¹² The micro-vascular change, a complication of diabetes, causes retinopathy which is a major cause of blindness. Diabetes, besides its other ocular manifestations, also affects the intra-ocular pressure. The incidence of raised IOP in diabetics is higher than in the general population.^{20,21} When we compared the intra-ocular pressure of normal subjects with diabeto-hypertensive in our study, there was an increase of IOP in both eyes of diabeto-hypertensive subjects in comparison to normal subjects. However, Oshitari et al²² concluded that chronic hyperglycemia was associated with increase in IOP in patients with diabetes. In the Los Angeles Latino eye study, it was found that higher systolic blood pressure, higher diastolic blood pressure, and overt diabetes mellitus were major factors associated

with an elevated IOP.²³

Dielemans et al reported a raised in newly diagnosed diabeto-hypertensive with an overall rise in mean IOP of both eyes.²⁴ Similarly, the Barbados eye study, conducted in a black population, concluded that the high intra-ocular pressure in that population may be linked to the high prevalence of hypertension and diabetes.²⁵ Another population-based study highlighted the increased risk of elevated IOP in Population with high prevalence of diabetes and hypertension.²⁶ Most of the studies have reported a direct correlation between rising IOP and increasing duration of diabetes and poor glycemic control. As against our findings, Lakshmi et al report a low incidence of raised IOP in newly diagnosed diabetics.²⁷ Oh et al²⁸ also arrived at the conclusion that raised intra-ocular pressure was associated with hypertension plus diabetes and obesity.

Interestingly, the intra-ocular pressure was found to be statistically significantly higher in both the eyes in hypertensive patients with co-existing diabetes when compared with normal subject.

The comparison of intra-ocular pressure in the right eye and left eye in the normal controls and in the study groups (diabeto-hypertensive) in our study did not show any statistically significant differences, which is indicative of equal distribution of IOP in the two eyes in healthy or in disease state.

We also looked at the correlation between intra-ocular pressure in both eyes with age in normal and diabeto-hypertensive subjects. No significant correlation was detected. Few studies in Pakistan, Europe, and America have provided evidence showing that IOP increases with age. However, some Japanese studies have shown that IOP had a definite tendency to decrease with age, especially after 40 years of age.^{17,29}

In Pakistani population different prevailing factors can influence the development of raised IOP. Studies on larger cohorts of newly diagnosed diabeto-hypertensive should be undertaken to

substantiate our findings.

CONCLUSION

In the present study intra-ocular pressure in both eyes was raised in all newly diagnosed diabeto-hypertensives as compared to normal group. The rise in IOP was statistically significant.

Copyright© 02 Jan, 2016.

REFERENCES

- Karim S, Khan MN, Hussain Z. **Mohammad S, Analysis of intraocular pressure with changes in body position.** J Postgrad Med Inst 2012; 26(2):218-20.
- Durrani K, Choudhry HA, Younas SA, Tahir M, Ahmad S. **The significance of Type2 Diabetes as Risk Factor for Elevated Intraocular pressure in Pakistani Adults.** Invest Ophthalmol Vis Sci 2005;46:E-Abst 3659.
- Baig MSA, Burney JA, Ali SS, Sheikh ZA. **Association of diabetes mellitus with primary open angle glaucoma (POAG), the study of 1000 selected cases.** PJSurg 2009; 25:171-5.
- Lin HY, Hsu WM, Chou P, Liu CJ, Chou JC, Tsai SY et al. **Intraocular pressure measured with a noncontact tonometer in an elderly Chinese population.** Arch Ophthalmol 2005; 123.
- Nemesure B, Wu SY, Hennis A, Leske MC. **Factors related to the 4-year risk of high intraocular pressure.** Arch Ophthalmol 2003; 121: 856-62.
- Spalton DJ, Hitchings RA, Hunter RA, Tan JCH, Harry J. **Atlas of clinical ophthalmology.** 2nd ed. Philadelphia; Mosby Elsevier;2005:181-91.
- Murgatroyd H, Bembridge J, **Intraocular pressure.** Cont Educ Anes Crit Care Pain2008;(3):100-3.
- Carel RS, Korezyn AD, Rock M, Goya I. **Association between ocular pressure and certain parameters.** Ophthalmology1984; 91:311-4.
- Rochthina E, Mitchell P, Wang JJ. **Relationship between age and intraocular pressure: the Blue Mountains Eye Study.** Clin Experiment Ophthalmol.2002; 30:173-5.
- Klein BE, Klein R. **Intraocular pressure and cardiovascular risk variables Arch Ophthalmol**1981;99:837-9
- World Health Organization.** [online]. Available at URL: <http://www.who.int/dietphysicalactivity/publications/facts/diabetes/en>.
- Wild S, Roglic G, Green A, Sicree R, King H. **Global prevalence of diabetes.** Estimate for the year 2000 and projections for 2030. Available at URL: <http://care.diabetesjournals.org/contents/27/5/1047>.
- Hussain F, Arif M, Ahmad M. **The prevalence of diabetic retinopathy in Faisalabad, Pakistan: A population-based study.** Turk J Med Sci2011;41:735-42.
- Kawase K, Tomidokoro A, Araie M, Yamamoto T. **Ocular and systemic factors related to intraocular pressure in Japanese adult.** The Tajimi Study. Br J Ophthalmol2008; Sep; 92(9):1175-9.
- Wu SY, Nemesure B, Hennis A, Leske MC. **Nine-year changes in intraocular pressure.** Arch Ophthalmol 2006; 124: 1631-6.
- Medical Encyclopedia Hypertension.** Available at URL://www.answer.com/topic/hypertension.
- Shiose Y, Kawase Y. **A new approach to stratified normal intraocular pressure in a general population.** Am J Ophthalmol 1986; 101: 714-21.
- Vaajanen A, Mervaala E, Okasa O, Vapaatalo H. **Is there a relationship between blood pressure and intraocular pressure? An experimental study in hypertensive rats.** Curr Eye Res 2008 Apr; 33(4): 325-32.
- Bulpitt CJ, Hodes C, Everitt MG. **Intraocular pressure and systemic blood pressure in the elderly.** Br.J.Ophthalmol 1975; 59: 717-20.
- Krueger RR, Ramos-Esteban JC. **How might corneal elasticity help us understand diabetes and intraocular pressure?** J Refract Surg. 2007 Jan;23(1): 85-8.
- Jeganathanvse, Wang JJ, Wong TY. **Ocular association of diabetes other than diabetic retinopathy.** Diabetes Care2008;31(9):1905-12.
- Oshitari T, Fujimoto N, Hanawa K, Adachi-Usami E, Roy s. **Effect of chronic hyperglycemia on intraocular pressure in patients with diabetes.** Am J Ophthalmol.2007 Feb; 143(2): 363-5.
- Memarzadeh f, Ying-Lai M, Azen SP, Varma R. **Association with intraocular pressure in Latinos: The Los Angeles Latino eye study.** Am J Ophthalmol. 2008 Jul; 146(1): 69-76.
- Dielemans I, De Jong PT, Stolk R, Vingerling JR, Groobe DE, Hofman A, **Primary open angle glaucoma, intraocular pressure and diabetes mellitus in the general population.** The Rotterdam study. Ophthalmology1996; 103(8):1271-5.

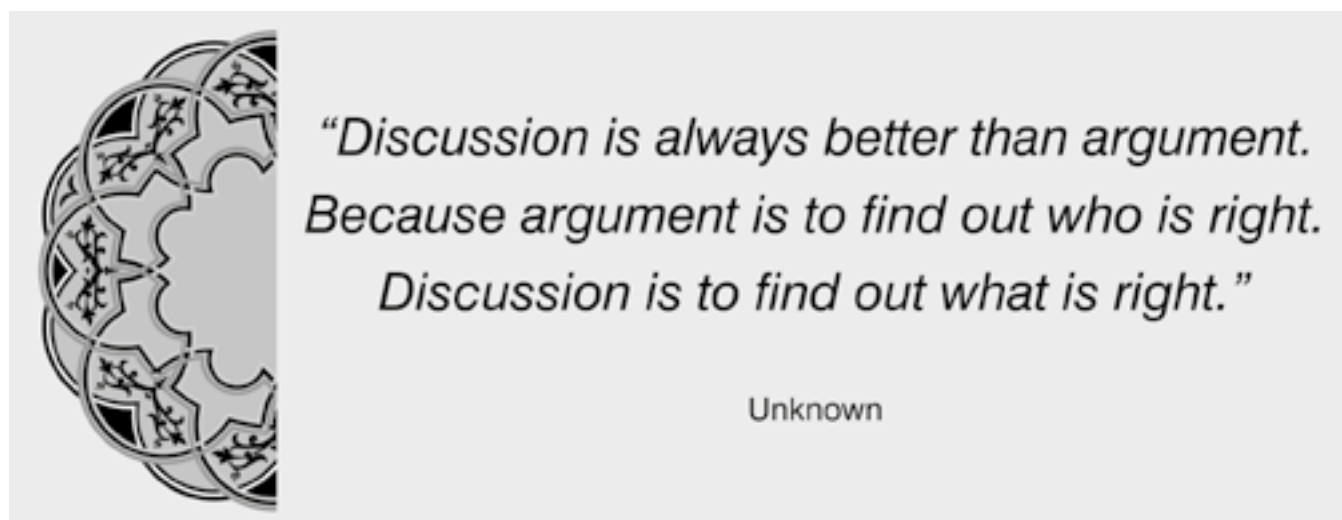
25. Leske MC, Connell AM, Wu Sy, Hyman L, Schachat AP. **Distribution of intraocular pressure.** The Barbados Eye Study. Arch Ophthalmol 1997, Aug;115(8):1051-7.

26. Hennis A, Wu SY, Nemesure B, Leske MC. **Hypertension, diabetes, and longitudinal changes in intraocular pressure.** Ophthalmology. 2003 May; 110(5): 908-14.

27. Lakshmi AS. Petricia H, Saravanan A, **Ramachandran C.** J Clin Diag Res 2011 (sup2);5:1336-8.

28. Oh SW, Lee S, Park C, Kim DJ. **Elevation intraocular pressure is associated with insulin resistance and metabolic syndrome.** Diabetes Metab Res Rev 2005 Sep-Oct; 21(5): 434-40.

29. Qureshi IA. **Intraocular pressure: a comparative analysis in two sexes.** Clinical physiology 1997; 17: 247-55.



AUTHORSHIP AND CONTRIBUTION DECLARATION

Sr. #	Author-s Full Name	Contribution to the paper	Author=s Signature
1	Dr. M. Shahid Faruqi	1st Author	
2	Dr. Abdul Rehman Khokhar	2nd Author	
3	Dr. Abdul Ghaffar Khan	3rd Author	
4	Dr. Tanvir Ali Shirwany	4th Author	