

**INTRAOCULAR PRESSURE ASYMMETRY: AN INDICATOR FOR GLAUCOMA DIAGNOSIS**Rekha R. Khandelwal<sup>1</sup>, Jerryl Banait<sup>2</sup><sup>1</sup>Professor & HOD, Department of Ophthalmology, NKP Salve Institute of Medical Sciences & Lata Mangeshkar Hospital, Nagpur, India.<sup>2</sup>Undergraduate Student, Department of Ophthalmology, NKP Salve Institute of Medical Sciences & Lata Mangeshkar Hospital, Nagpur, India.**ABSTRACT****AIM**

To investigate the amount of intraocular pressure asymmetry between fellow eyes in patients with and without primary open angle glaucoma.

**MATERIALS AND METHODS**

This was a retrospective case control study conducted at a tertiary care hospital of Central India. A single pre-treatment IOP of the primary open angle glaucoma patients was recorded from the Glaucoma Clinic data from Jan 2013 to Dec 2013. The inter-eye IOP asymmetry of these cases was compared with normal subjects without primary open angle glaucoma (POAG).

**RESULTS**

There were 84 (POAG) glaucoma patients and 168 control subjects in the study. It was observed that 23.8% patients suffering from glaucoma had an asymmetry of 2 mmHg while 20.23% had no asymmetry. Asymmetry as high as >20 mmHg was also seen in glaucomatous patients. Intraocular pressure asymmetry was a significant factor for having glaucoma (Odds ratio, 18.89%;  $P < 0.001$ ).

**CONCLUSION**

Inter-eye asymmetry of IOP is a common finding in patients with POAG. There is a direct relationship between the amount of IOP asymmetry between the fellow eyes and the likelihood of having glaucoma.

**KEYWORDS**

Glaucoma, Intraocular pressure asymmetry, Primary open angle glaucoma, POAG.

**HOW TO CITE THIS ARTICLE:** Khandelwal RR, Banait J. Intraocular pressure asymmetry: An indicator for glaucoma diagnosis. J. Evid. Based Med. Healthc. 2016; 3(42), 2098-2101. DOI: 10.18410/jebmh/2016/466

**INTRODUCTION:** Glaucoma is a heterogeneous group of disorder marked by damage to the optic nerve. It is the second leading cause of blindness worldwide accounting for 15% of blindness.<sup>1</sup> Almost half of the glaucoma blindness is found in Asian countries, out of which approximately 5.8 million blinds are expected to be present in India.<sup>2</sup> In India, the proportion of blindness due to primary open angle glaucoma (POAG) and primary angle closure glaucoma (PACG) is almost equal.<sup>3</sup> POAG is asymptomatic and usually diagnosed very late in the advanced stage of the disease. Mostly, it is diagnosed accidentally by elevated intraocular pressure. High intraocular pressure (IOP) is one of the most vital and modifiable risk factor for POAG. Early diagnosis plays an important role in the prevention of irreversible blindness due to glaucoma. The first Indian study to report various risk factors for primary glaucoma is from Southern India.<sup>4</sup> The role of intraocular pressure in delaying the glaucoma progression is mentioned by several studies published earlier.<sup>4,5,6</sup>

Inter-eye asymmetry of IOP has been considered to be a hallmark of glaucoma. It is found that patients with asymmetric IOP are at increased risk of visual field (VF) deterioration.<sup>7</sup> Many times IOP may be normal due to diurnal fluctuation, but asymmetry in IOP can still be present. Levine et al evaluated the asymmetries between eyes and concluded that IOP asymmetry increases risk for developing POAG.<sup>8</sup> There are relatively few studies addressing the amount of IOP asymmetry associated with glaucoma. The present study is undertaken to evaluate inter-eye asymmetry in known glaucomatous patients as compared to normal individuals.

**MATERIAL AND METHODS:** This was a retrospective case-control study, which was conducted in the eye OPD during April–June 2014. Data was collected (by the principle investigator) from the medical records of Glaucoma Clinic run by the senior ophthalmologist (guide and co-guide) from Jan 2013 to Dec 2013 (12 Months). Demographic details of all POAG cases were noted. Age-sex matched subjects with normal eye examination (only refractive error or cataract) and who do not have glaucoma based on the glaucoma guidelines were included in the control group. POAG was defined based on characteristic glaucomatous optic nerve

*Financial or Other, Competing Interest: None.*  
*Submission 28-04-2016, Peer Review 17-05-2016,*  
*Acceptance 24-05-2016, Published 26-05-2016.*  
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*DOI: 10.18410/jebmh/2016/466*

damage and characteristic confirmatory glaucomatous visual field damage.

IOP was not used as a diagnostic consideration when classifying patients as having glaucoma. Patients who were diagnosed as having glaucoma (Primary open angle glaucoma, Pigmentary glaucoma, Pseudoexfoliative glaucoma) with unquestionable visual field loss and disc changes in one or both eyes, and who also had a documented pre-treatment IOP measurement in each eye were included from the Glaucoma Clinic. Patients who were diagnosed with congenital glaucoma, angle closure glaucoma, secondary glaucoma of any type (such as neovascular glaucoma, inflammatory glaucoma, or steroid-induced glaucoma) and all those having had trauma or surgery of any kind on either eye were excluded. Patients with ocular disease (e.g. Uveitis, CRAO, CRVO, RD, Anisometropia with >5D difference between eyes) were also excluded. All patients underwent thorough ocular examination. IOP in each eye at the baseline (pre-treatment level) was measured by Goldmann applanation tonometry. Subtracting the lower IOP from the higher, the amount of IOP asymmetry between the two eyes was calculated. The amount of inter-eye asymmetry was described as asymmetry in steps of 1 mm/Hg difference.

The frequency of various levels of IOP asymmetry in the two groups was analysed for diagnostic significance. Information sought included:

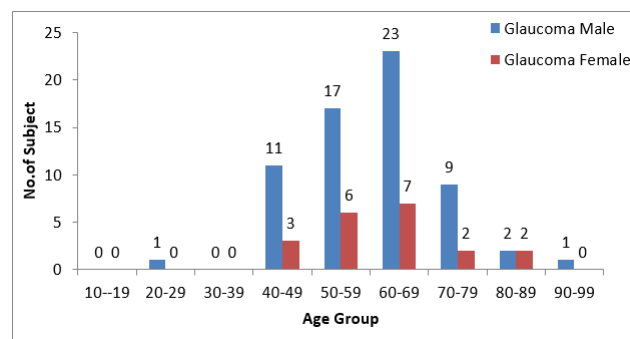
- 1) Any maximum amount of asymmetry, more than which is never found in "normals" (i.e. patients who do not have glaucoma), or is only present in around 1% of normals who may be in a preliminary stage of glaucoma.
- 2) Any maximum amount of asymmetry, below which glaucoma is never present.
- 3) Sensitivity/specificity characteristics at different levels of IOP asymmetry to determine if there is an amount of asymmetry which is a statistically significant indication of glaucoma ( $p < .01$ ) or any level of symmetry which is a statistically significant ( $p < .01$ ) indicator of "normal".

**STATISTICAL ANALYSIS:** Statistical significance of difference in the asymmetry (difference of intraocular pressure in two eyes) between cases and control group was evaluated using "t" test for independent samples was

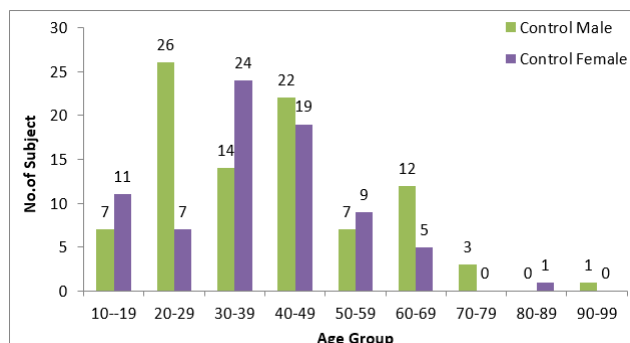
performed. Sensitivity and Specificity were determined for the threshold asymmetry IOP levels. The data was analysed using SPSS version 18.0.

**RESULTS:** Data was collected from 84 diagnosed glaucoma patients and 164 controls. The demographic profile of glaucoma (POAG) cases is shown in Figure 1 and control group is shown in Figure 2. The mean IOP parameters were similar in both eyes within each group as seen in Table 1 and Figure 3. The distribution of study participants at different levels of IOP asymmetry in individual groups is shown in Figure 4 where the X axis shows the IOP asymmetry (1 unit= 1 mmHg) and Y axis shows the frequency of subjects. On applying statistical formulas, IOP asymmetry was found to be a significant risk ( $p < 0.001$ ) factor for having Glaucoma as shown in Table 2 and Calculation 1.

### OBSERVATIONS:



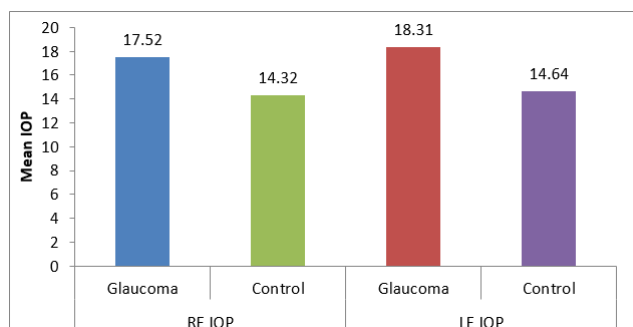
**Fig. 1: Demographic Profile of POAG Group**



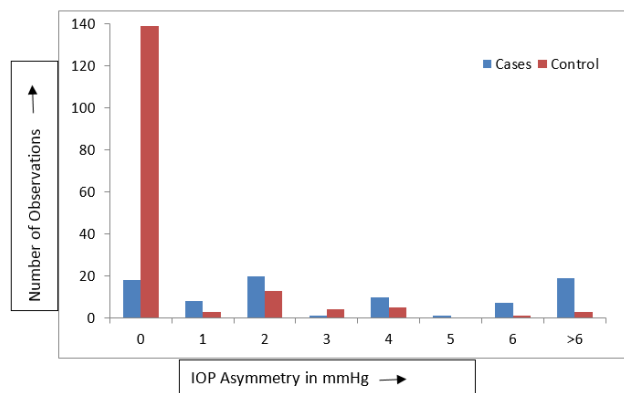
**Fig. 2: Demographic Profile of Control Group**

Group Statistics						T value	P Value
	Group	N	Mean	Std. Deviation	Std. Error Mean		
Right eye IOP	Glaucoma	84	17.52	7.109	0.776	4.9	<0.001
	Control	168	14.32	3.151	0.243		
Left eye IOP	Glaucoma	84	18.31	8.205	0.895	4.7	<0.001
	Control	168	14.64	4.050	0.312		

**Table 1: The Mean IOP Parameters of POAG Cases and Controls**



**Fig. 3: The Mean IOP Parameters in Both Eyes within each Group**



**Fig. 4: IOP Asymmetry in Individual Groups**

**DISCUSSION:** The purpose of this study was to find a correlation between IOP asymmetry and glaucomatous changes. The inter-eye asymmetry of IOP in POAG was recorded from the medical records of glaucoma clinic. There were 84 diagnosed cases of POAG in our study during the study period.

A population based cross-sectional study was done on four thousand eight hundred subjects by Vijaya L et al. Out of these, one hundred twenty seven subjects were diagnosed to have POAG for the first time and more than 90% of the population was unaware of the disease.<sup>4</sup> A glaucoma survey done by Palimkar A et al found that among those patients diagnosed to be suffering from glaucoma, the proportion of open angle glaucoma was 13.1%.<sup>9</sup> Thapa S. S. et al found that overall prevalence of glaucoma was 1.9%. In his survey, out of all glaucoma cases, POAG accounted for 68%.<sup>10</sup>

In another Indian study done by Ramakrishna R et al, it was concluded that the prevalence of glaucoma in rural population of Southern India is not lower than the reported for white population elsewhere.<sup>11</sup>

In the current study, among all the diagnosed cases of glaucoma, it was observed that the maximum cases of POAG were in the age group of 60 to 69 and the disease showed predominance in males over females. The Chennai based study showed that majority of patients (85.22%) were in the age range of 40-70 years, while only 14.78% patients were above 70 years of age. As regards gender, the percentage of male patients (58.26%) was higher than that of females (41.74%).<sup>4</sup>

Garudadri C et al published the importance of IOP in causing glaucomatous damage. He supported these findings by showing that in patients with asymmetric intraocular pressures, visual field loss is usually more severe in the eye with high intraocular pressure. He concluded that intraocular pressure was a significant risk factor for both POAG and PACG.<sup>12</sup>

The mean IOP parameters were similar in both eyes within each group in our study. Within the control group, 82.73% showed no asymmetry and the remaining 17.27% had no glaucomatous changes even in presence of IOP asymmetry. Only 1.7% individuals in the control group showed an asymmetry of  $\geq 6$  mmHg without any changes in the optic disc or visual field. The maximum IOP asymmetry in the control group was 8 mmHg.

In the POAG group, it was observed that 23.8% patients had an asymmetry of  $\geq 2$  mmHg while 20.23% patients showed no asymmetry. Thus, no minimum value of IOP asymmetry was found to be diagnostic of glaucoma. Asymmetry as high as  $>20$  mmHg was seen in glaucomatous patients.

In a study on low pressure glaucoma, Greenfield et al found no relationship between IOP asymmetry and visual field loss.<sup>13</sup> Ong LS et al have suggested that IOP asymmetry is indicative of glaucoma only in patients whose maximum pressures are  $<21$  mmHg.<sup>14</sup> Furthermore, no study has considered the degree of IOP asymmetry, but only its absolute presence or absence, usually designating cut-offs of  $>1$  to 3 mmHg IOP difference between the fellow eyes.

The research was conducted to check the sensitivity and specificity of considering IOP asymmetry as a risk factor for glaucoma. On statistical analysis, the test was found to be 79% sensitive while the specificity was 82.7%. William et al did logistic regression analysis in his study on IOP asymmetry and demonstrated that inter-eye IOP asymmetry is a significant risk factor for having glaucoma (odds ratio, 2.14; 95% confidence interval(CI), 1.86-2.47;  $p < 0.001$ ).<sup>15</sup>

In our study, Odd's ratio was found to be 18.89%, thus indicative of a relative risk. The inference would be: A person with IOP asymmetry will have almost 19 times greater risk of developing glaucoma as compared to a normal individual. Thus IOP asymmetry was found to be a significant risk factor for having POAG ( $p < 0.001$ ).

Strengths of our study include a strict definition while selecting patients of glaucoma. The exclusion criterion for the control group was also stringent and subjects with other ocular disorders were not included. All IOP measurements were recorded before initiating glaucoma therapy.

An important limitation in our study was that the IOP measurement was taken only once in each subject between 9 am to 11 am. The ability to determine IOP accurately with Applanation tonometry is limited, frank error of measurement, errors due to surrounding and the instrumental errors may be present. Another possibility of error is due to diurnal variations in IOP of a subject in the same eye. These may account for the fact that several controls in the study had asymmetric IOP whereas certain glaucoma patients had no or minimal asymmetry.

The importance of IOP in causing glaucomatous damage is supported by the findings that in patients with asymmetric intraocular pressures, visual field loss is usually more severe in the eye with high intraocular pressure.

**CONCLUSION:** In conclusion, IOP asymmetry is a risk factor for POAG which should be considered in patients who show consistent IOP asymmetry on repeated clinic visits and especially if those measurements are recorded within 2 hours of the same time of the day as the baseline IOP. A high level of suspicion should be kept in mind for patients showing IOP asymmetry of as low as 2 mmHg between two eyes. Eyes with such asymmetry should be labelled as "glaucoma suspects" and must be followed up. It will definitely help in early diagnosis of POAG and prevent the sight threatening complications due to glaucoma seen in developing countries like India.

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