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Original Research Article

Diurnal variation of intraocular pressure in a tertiary care population

Jagriti Rana[1], Arti Singh[1], Kshama Dwivedi[1], Sanchita Saini[1,*], Sanskriti Singh[1]

[1] *Dept. of Ophthalmology, RIO, Moti Lal Nehru Medical College, Prayagraj, Uttar Pradesh, India*

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ABSTRACT

The intraocular pressure has been a subject of considerable speculation since it is the only modifiable risk factor for Primary Open Angle patients.
This fluctuation follows a reproducible pattern in most of the eyes. However, there are some eyes which do not follow a consistent pattern of this fluctuation. The need to precisely measure this pattern stems from the fact that a single office based measurement could miss these pressure peaks.
Recording the diurnal variation proves to be an effective tool in management of progression of Primary Open Angle Glaucoma as it not only identifies the time of the day when the pressure peaks to enable us to tailor the therapy to appropriately timing the drug administration but it also offers an understanding of range of intraocular pressure fluctuation during the day.

1. Introduction

Intraocular pressure at present is the only modifiable risk factor for the management of primary open angle glaucoma.

There is a diurnal variation in the intraocular pressure in normal eyes and eyes of glaucomatous subjects.[1,2] The intraocular pressure is dependent on a number of factors.[3,4] It is believed in normal subjects; the diurnal variation rarely exceeds 5mmHg. This difference may be exaggerated in glaucomatous subjects. The abnormal peak of the intraocular pressure, is presumably the significant level for the onset and progression of the glaucomatous changes.[5]

Recording the diurnal variation is an effective tool as not only it identifies the time of the day when the intraocular pressure peaks but also gives a much better understanding of the range of intraocular pressure fluctuation during the day.[6] This also shows how one should time the prescription of glaucoma medications in patients. Most people get their intraocular pressures recorded once in the clinic. This may not represent the true rise in the intraocular pressure in the day when we actually need to give the medication for maximum effectivity.

In the literature also, there are variable reports about as to which time of the day.[7,8] intraocular pressure rises maximally. The majority of patients exhibit similar patterns of diurnal fluctuation during the day but around ten to twenty percent patients exhibit variable diurnal fluctuation.

Morning or afternoon peaks have been most commonly reported along with erratic curves showing no clear rhythm.[9] A few studies have also reported biphasic peaks in the diurnal variation.[10]

We started the study with a few important questions in our mind. Does diurnal variation fluctuate in the same individual as the disease progresses, what is that time of the day when the intraocular pressure peaks in this subgroup of population. Another advantage would be that the treating clinicians can assess the effect of the diurnal variation over the treatment used by them.

2. Materials and Methods

A total of seventy-three patients were taken, out of which twenty subjects were normal, twenty-five were subjects diagnosed as having ocular hypertension (OHT) and twenty-

* *Corresponding author.*
E-mail address: drsanchita04@gmail.com (S. Saini).

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eight were having Primary Open Angle Glaucoma (POAG). We clubbed both the latter groups into glaucomatous group. The controls were those subjects who had an intraocular pressure of less than 21mmHg on two repeat measurements with normal appearance of the optic nerve heads and normal visual fields.

Subjects having POAG were diagnosed if they had the following characteristics: an intraocular pressure of greater than 21mmHg at same stage, glaucomatous optic nerve head changes, characteristic visual fields defects and open angles on gonioscopy.

Patients of OHT were diagnosed if they have an intraocular pressure of more than 21mmHg with no detectable visual field defects and normal optic discs. Patients of both OHT and POAG were group into glaucoma. The exclusion criteria were dense cataracts (more than C2, N2, P2) as specified by LOCS III classification, refractive errors (spherical equivalent less than -5.00D and astigmatism more than 2.00D, mean deviation less than -16.dB, other intraocular surgery, Primary angle Closure Glaucoma, pseudoexfoliation glaucoma and others, a previous history of intraocular surgery or a previous history of laser treatment).

An ethical clearance was taken from the institutional ethical committee and the protocol of the study was in accordance with the tenets of Declaration of Helsinki.

An informed consent was taken from each patient after the examination procedure was explained to each one of them. A comprehensive ophthalmic examination was performed after taking a good medical history from the patient. The ophthalmic examination included Best Corrected Visual Acuity (BCVA), slit lamp examination, gonioscopy, fundoscopy, visual field examination. The intraocular pressure was recorded by single observer, at four different times of the day (9am, 2pm, 5pm and 8pm). The mean intraocular pressure for all times was calculated by averaging the intraocular pressure readings taken at a particular point in a day.

3. Data analysis and Observations

In our study, among the non-glaucomatous population, 48.48 percent were males, aged between 45-65 years of age and the maximum females (54.39 percent) also belonged to this age group. Among the glaucomatous population the maximum percentage of males (55.56 percent) belong to the 45-65-year age group. The total number of females were also higher (47.62 percent) the same age (45-65year).

The mean age of non-glaucomatous subjects was 44.18±15.2 year and that of glaucomatous subjects were 58.33±13.69 year. The mean intraocular pressure recorded in the normal subjects was a follow:

The mean intraocular pressure in right eye in males at 2pm was 15.67±2.81mmHg and in females was 15.93±2.39 mmHg. The mean intraocular pressure in right eye at 5pm in males was 15.13±2.87 mmHg and in females was 16.37±2.24 mmHg. The mean intraocular pressure at 8pm in right eye was 15.75±3.28 mmHg in males and 16.06±2.46 mmHg in females. The mean intraocular pressure at 9am in right eye was 16.35±3.01 mmHg in males and 16.91±1.79 mmHg in females.

On an average, a higher mean intraocular pressure was recorded in glaucomatous study subjects, on the basis of their gender and at different times of the day.

The mean intraocular pressure recorded at 9 am in the right eye of the male was 16.26±2.9 mmHg in right eye and 21.18±9.75 mmHg in left eye. The corresponding values were 18.08±7.35 mmHg and 21.09±6.89 mmHg in females, respectively. The mean intraocular pressure in both the eyes was recorded at 2pm, 5pm and 8pm by the same observer, using the same tonometer and the values have been recorded in table 2b. A slightly higher mean intraocular pressure was recorded in female subjects.

The mean highest intraocular pressure in glaucomatous subjects was at 9am and in the non-glaucomatous subjects it is at 2pm in males and 8pm and 2pm respectively in females.

4. Discussion

As the intraocular pressure varies during the 24 hours of the day, measuring the intraocular pressure at same designated time of the day may not be enough. But, at the same time, hospitalising each and every patient of glaucoma to monitor the intra ocular pressure could be a tedious task as it is time consuming and not feasible in all hospital settings. But the diurnal variation of intraocular pressure will positively affect the management of those patients of glaucoma who show a normal intra ocular pressure in the clinic but are still progressing functionally. It would be definitely advantageous in the future to establish the diurnal intraocular pressure characteristics with glaucoma progression. Tan et al[11] found that the peak intraocular pressure in their study was recorded at 8.00am, which was the first time of day they had used to document the intraocular pressure. This is consistent with our findings where the peak intraocular pressure was recorded at 9.00 am in glaucomatous subjects. In another study by Huang et al,[12] they found that the highest intraocular pressure recorded in glaucoma subjects was between 10.00 am and 3.00 pm but, they also reported that intraocular pressure was highest at night in two patients between 8.00 pm and 1.00 am.

In non-glaucomatous study subjects in our study the highest mean intraocular pressure recorded in males and females both was at 2.00 pm, this was found to be statistically significant.

Also Tajunisah et al[13] performed a case controlled prospective study and found that highest percentage of suspected glaucoma patients had maximum peak at 10.00 am – 11.00 am and trough after midnight (2.00 am – 3.00 am) wherein those of controlled group there was peak at

6.00pm to 7.00pm and trough was recorded at 2.00am to 3.00am. whereas in our control group of non-glaucomatous subjects the peak was observed at 2.00 pm in males and females.

Saccá et al[14] in their study showed that the highest intraocular pressure was measured in morning in POAG, NTG and normal subjects whereas the lowest values were observed during early afternoon hours and thus showing the use of diurnal intraocular pressure curves for assessment of relative risk of increase in intraocular pressure and efficiency of therapeutic approach.

Wilensky J. Jacob et al[15] recorded well defined diurnal intraocular pressure curve in OHT, OAG and control groups with peaks in morning and mid-day. There were also differences between the curves of both the eyes in OHT (33 percent) and OAG (36 percent), but this was not observed in normal control group. As intraocular pressure is the only modifiable and important risk factor, determining the diurnal variation of increase in intraocular pressure that tends to occur in different group of patients like POAG, OHT as compared to normal control subject group would help us in determining the right time to obtain the maximum benefit of the drugs we used and can also modify the current practise of prescribing the medications to glaucoma subjects to increase their number of years with good quality of vision and delay the glaucomatous visual downfall.

5. Conclusion

The intraocular pressure is known to vary over the course of the day, averaging about 3 to 6mmHg in most of the eyes. In many eyes this fluctuation follows a reproducible pattern, with a peak during the mid-morning hours. However, there are some eyes which follow no consistent pattern of fluctuation of intraocular pressure, a single office-based measurement may be unlikely to record the peak of the diurnal variation. The inconvenience of obtaining around the clock measurement of intraocular pressure led to the need for predicting the peak variation in intraocular pressure, owing to its clinical implications in glaucoma patients. It is unreasonable to assume that a single intraocular pressure measurement represents the average pressure over the 24hour period. This has special implications for patients with normal tension glaucoma. Knowledge of the daily pressure excursions helps in tailoring therapy and blunting the pressure peaks by appropriate timing of the drug administration.

The results of our study concluded the peak of intraocular pressure to be present in the early morning hours for the glaucomatous subjects which is consistent with the previous studies. Non glaucomatous eyes reported their peak in the mid-morning hours. A slightly higher mean intraocular pressure was recorded in the female subjects. High intraocular pressure is well established risk factor for the glaucoma progression and the current treatment are based on the pressure control to prevent the progressive optic neuropathy and field loss.

Hence, the study of the short-term intraocular pressure fluctuation in glaucomatous subjects and its comparison to the normal population has led to a comprehensive understanding of intraocular pressure fluctuation which being a major risk factor and primary treatment outcome, can affect the diagnosis and management of glaucoma patients.

6. Source of Funding

None.

7. Conflict of Interest

None.

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Author biography

Jagriti Rana Associate Professor

Arti Singh Assistant Professor

Kshama Dwivedi Associate Professor

Sanchita Saini Junior Resident

Sanskriti Singh Junior Resident

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