Original Article

Measurement and Expression of Exact Intraocular Pressure of Patient's Eye(S) and to Determine Normal or Pathological IOP

Bakht Samar Khan, Mustafa Iqbal, Zubeda Irshad, Abid Nawaz

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See end of article for authors affiliations

Correspondence to:
Bakht Samar Khan
Assistant Professor
Department of ophthalmology
Khyber Medical College
Peshawar Pakistan

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Purpose: To determine the exact and uniform IOP of patients eye(s) and need to redefine normal and pathological IOP leading to glaucoma.

Material and Methods: A prospective descriptive study of 10000 eyes of 5000 patients out of Which 450 eyes were selected .The patients were examined in the department of Ophthalmology of Khyber teaching hospital Peshawar Pakistan from June 2003 to May 2008. All patients underwent IOP measurement with different tonometers that is Goldman, Perkins and Air puff at the same time. The IOP was measured with distant looking eye position and near looking eye position to ascertain the difference in IOP.

Results: The distant looking IOP was higher as compared to near looking. Thus three Readings were obtained as distant looking IOP, near looking IOP and mean IOP.

Conclusion: The present way of expressing IOP as single reading (e.g.20 mm Hg) need to be replaced by two readings i.e. distant looking/ near looking (DL/NL) e.g. 21/16 mm Hg or as mean of distant looking and near looking IOP (e.g. 18.5 mm Hg).

To diagnose glaucoma and to determine the prognosis; the parameters usually used are visual acuity, tonometry, gonioscopy, fundoscopy, perimetry and family history. The added investigations include HRT (Hiedlberg retinal tomography), OCT (optical coherence tomography), GDX and VCC (glaucoma diagnosis and variable corneal compensation), pachymetry, FDT (frequency doubling illusion), ultrasound bimicroscopy and Arden screening test. Among these raised IOP is the best known risk factor for glaucomatous optic neuropathy[1]. The IOP is the only risk factor that is modifiable. It is taken as diagnostic and prognostic factor. IOP cannot in itself explain quite a number of glaucomatous optic neuropathies particularly ocular hypertension and low tension glaucoma[2]. So its reliability is questionable?[3]. But IOP is still relied on. This conflict needs to be resolved and is addressed in this study.

MATERIAL AND METHODS

In this prospective descriptive study all patients older than ten years coming to OPD or admitted in ophthalmology department of KTH Peshawar were studied (i.e. 10 000) eyes between June 2003 and May 2008. The IOP measurement was taken at distant looking and near looking eye positions at the same time. (Fig. 1-2) The results were placed in different groups. A total of 450 patients were selected who had IOP in the range where glaucoma was suspected. The IOP was labeled as Distant IOP while the patient was looking at a distance of six meters or more. And Near IOP while the patient was looking at his finger placed at half an arm distance. The average of these two was labeled mean IOP.

RESULTS

Out of 10,000 eyes examined 450 eyes were selected for study. These were placed in different groups. In

one group of 100 eyes having distant looking IOP of 25 mmHg near looking IOP was also measured. The near looking IOP was 20 mmHg in 15 eyes, 19mmHg in 25 eyes, 18mmHg in 25eyes, 18mmHg in 20 eyes, 17 mmHg in 20 eyes and 16 mmHg in 15 eyes (Table 1).

In another group 100 eyes having distant looking IOP of 24mmHg the near looking IOP was measured. The near looking IOP was 20 mmHg in 15 eyes, 19mmHg in 25 eyes, 18mmHg in 25eyes, 18mmHg in 20 eyes, 17 mmHg in 20 eyes and 16 mmHg in 15 eyes (Table 2).

In third group of 100 eyes having distant looking IOP of 23 mmHg, the near looking IOP was 18 mmHg in 20 eyes, 17 mmHg in 20 eyes, 16 mmHg in 10 eyes, 15 mmHg in 30 eyes and 14 mmHg in 20 eyes (Table 3).

Table 1: Difference between DL and NL IOP

No. of eyes	Distant lookin IOP mm Hg	Near looking IOP mm Hg	Mean IOP mm Hg
100	25	20 (15)	22.5 (15)
		19 (25)	22.0 (25)
		18 (25)	21.5 (25)
		17 (20)	21.0 (20)
		16 (15)	20.5 (15)

Table 2: Difference between DL and NL IOP

No. of eyes	Distant lookin IOP mm Hg	Near looking IOP mm Hg	Mean IOP mm Hg
100	24	20 (10)	22.0 (10)
		19 (15)	21.5 (15)
		18 (30)	21.0 (30)
		16 (20)	20.0 (20)
		15 (25)	19.5 (25)

In fourth group 100 distant looking IOP of 22 mmHg near looking IOP was 18 mmHg in 20 eyes, 17 mmHg in 20 eyes, 16 mmHg in 10 eyes, 15 mmHg in 20 eyes, 14 mmHg in 15 eyes and 13 mmHg in 15 eyes (Table 4).

In another group 50 eyes having distant looking IOP of 28 mmHg near looking IOP was 24 mmHg in 05 eyes, 21 mmHg in 19 eyes, 20 mmHg in 11 eyes, 19 mmHg in 14 eyes and 16 mmHg in 01 eye (Table 5).

Table 3: Difference between DL and NL IOP

No. of eyes	Distant looking IOP mm Hg	Near looking IOP mm Hg	Difference in IOP mm Hg	Mean IOP mm Hg
100	23	18 (20)	5 (20)	21.5 (20)
		17 (20)	6 (20)	20.0 (20)
		16 (10)	7 (10)	19.5 (10)
		15 (30)	8 (30)	19.0 (30)
		14 (20)	9 (20)	18.5 (20)

Table 4: Difference between DL and NL IOP

No. of eyes	Distant lookin IOP mm Hg	Near looking IOP mm Hg	Mean IOP mm Hg
100	22	18 (20)	20.0 (20)
		17 (20)	19.5 (20)
		16 (10)	19.0 (10)
		15 (20)	18.5 (20)
		14 (15)	18.0 (15)
		13 (15)	17.5 (15)

Table 5: If near looking IOP taken then

No. of eyes	Near looking IOP mm Hg	Distant looking IOP mm Hg
55	16	25 (15)
		24 (20)
		23 (10)
		22 (10)

Table 6: Difference between DL and NL IOP

No. of eyes	Distant lookin IOP mm Hg	Near looking IOP mm Hg	Mean IOP mm Hg
25	28	24 (03)	27.0 (03)
		21 (10)	24.5 (10)
		20 (05)	24.0 (05)
		19 (02)	23.5 (02)

On the other hand when we select 55 eyes having near looking IOP as 16 mmHg and observed their

distant IOP, the results were as follows. The distant looking IOP was 25 mmHg in 15 eyes, 24 mmHg in 20 eyes, 23 mmHg in 10 eyes and 22 mmHg in 20 eyes (Table 6).

Fig.I: Distant looking IOP was 24 mm Hg

Fig. 2: Near looking IOP 16 mm Hg

DISCUSSION

The IOP variation has been reported with various physiological and pathological situations[4]. For example with sitting and lying position and circadian variation. We are reporting for the first time IOP variation while the eye is looking at distance and then at near. On various occasion this discrepancy was noted. With present diagnostic criteria when air puff or even Goldmen tonometers were used in small rooms cases of IOP of 17- 20 mmHg with cupping of the disc were labeled as normal tension glaucoma. While working in comparatively larger rooms and using the Perkin tonometer the same eyes had IOP more than 21mmhg. The observation of this discrepancy leads to the idea of discovering some better method for measurement of IOP with lesser or no discrepancy like other studies[5]. With the technique presented in this study glaucoma can be diagnosed more accurately and particularly it will be helpful in monitoring the effect of medication. At present after glaucoma medication if IOP is measured with air puff or Goldman tonometer and the reading comes 17 mmHg the situation will appear satisfactory but when at the same time same instrument is used in a distant looking eye position the IOP could be actually more i.e. up to 22 mmHg. This shows relying on a single reading could be erroneous and might mislead the management plan.

In majority of studies the normal intra ocular pressure is mentioned as up to 21 mmHg. If this value is applied to this study, the number of glaucoma or ocular hypertensive cases will be as follows.

1. 450 if only distant looking IOP is considered
2. 33 if only near looking IOP is considered.
3. 145 if mean IOP is taken

After above described observations all 450 cases were investigated for glaucoma. Only 100 cases were finally labeled as glaucoma. Suggestion is that if distant looking IOP is more than 21 and near looking IOP comes more than 16 the eye should be further investigated for presence of glaucoma.

Explanation and mechanism

In 1976 Kaufman[6] and his colleague mentioned that disinsertion of the ciliary muscle from trabecular meshwork abolishes aqueous outflow[7]. Bill et al in 1983 stated that contraction of ciliary muscle is responsible for increased outflow facility as contraction of ciliary muscle causes widening of inter trabecular space in juxtacanalicular region and this contraction cause's compression of interstitial spaces which stops uveoscleral outflow. Normally 90% aqueous flows through trabecular meshwork pathway and 10% through uveoscleral pathway but when the later is closed due to near looking eye position the aqueous outflow through former increases to compensate for it and even more. The net result is increased aqueous outflow and low IOP comparatively. Contraction of sphincter pupillae has no effect on aqueous outflow[8].

CONCLUSION

The value of IOP comes different in same eye when measured while looking at a distance and then near. So instead of taking a single value of IOP as final result , taking two measurements, one while eye is looking at distance and another while eye is looking at near or by taking mean of these two values is more realistic and correct indicator of IOP in an eye.

Author's affiliation

Dr. Bakht Samar Khan
Assistant Professor
Department of ophthalmology
Khyber Medical College
Peshawar

Prof. Mustafa Iqbal
Department of ophthalmology
Khyber Medical College
Peshawar

Dr. Zubeda Irshad
Lecturer Girls Medical College
Peshawar

Dr. Abid Nawaz
Associate Professor
Ghandahara Medical University
Peshawar

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