

Research Article

Effect of posture on intra ocular pressure: a pilot study

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ABSTRACT

Background: The objective of the present study was to investigate the change in IOP with respect to posture using Schiottz tonometer. IOP values differ in the same individual when measured with the subject sitting or supine and IOP have been reported to be higher with the subject supine than when sitting.

Methods: The entire work was accomplished with the 100 male subjects with age ranging between 20 and 40 years. The IOP values were recorded from the individuals using Schiottz tonometer (Improved). The intraocular pressure was recorded in the lying position followed by a rest of 2 minutes in the sitting position.

Results: The Mean IOP in supine position in Right & Left eyes was 16.261 ± 2.47 mmHg & 16.14 ± 2.53 mmHg respectively. The Mean IOP in sitting position in right & left eyes was 14.04 ± 2.52 mmHg & 13.88 ± 2.81 mmHg respectively. In our study, the mean IOP was decreased by 2.22 mmHg (13.65%) & 2.26 mmHg (14.01%) in right and left eye's on changing the posture from supine to sitting.

Conclusion: From the results of our study, it can be concluded that posture has a definite effect on IOP & the mean IOP was more in supine position than in sitting position.

Keywords: Glaucoma, Intraocular pressure, Tonometry

INTRODUCTION

The intraocular pressure (IOP) refers to the pressure exerted by intraocular contents on the coats of the eyeball. The normal level of IOP is maintained by dynamic equilibrium between the aqueous humor formation, its outflow and episcleral venous pressure. IOP is distributed evenly throughout the eye, so that the pressure is always the same in the posterior vitreous as it is in the aqueous humour. Aqueous humour is a clear fluid with a pH 7.1-7.2, a viscosity of 1.025-1.040 relative to water and low protein, urea and glucose content. Aqueous occupies the anterior and posterior chambers of the eye - the total volume is approximately 0.3 ml with 0.25 ml in the anterior chamber and the remaining 0.05 ml in the posterior chamber. The intraocular pressure is important in maintaining the shape of the eyeball and the Optical integrity. Normal IOP varies between 10.5 and 20.5 mmHg with a mean

pressure of 15.5 ± 2.57 mmHg. The intraocular pressure is created by aqueous formation which has two components: a hydrostatic component from the arterial blood pressure along with ciliary body tissue pressure and an osmotic pressure induced by the active secretion of sodium and other ions by the ciliary epithelium. The IOP serves as the tissue pressure of the vascularized internal structures of the eye and is much higher than the tissue pressure elsewhere in the body (5 mmHg). Normal IOP is pulsatile, reflecting in part its vascular origin and the effects of blood flow on the internal ocular structures. Any single measurement of IOP is just a momentary sample and may or may not reflect the average pressure for the patient in that hour, day or week.

Intraocular pressure levels have been reported to differ in the same individual (healthy individuals and those with glaucoma) when measured with the patient sitting or

supine, and IOPs have been reported to be higher with the patient supine than when sitting.

The IOP increases when changing from the sitting to the supine position, with reported average pressure difference of 0.3 to 6.0 mmHg. It has been reported that IOP elevation by postural change ranges from 2.5 to 5.6 mmHg in normal eyes and from 3.5 to 8.6 mmHg in glaucomatous eyes or eyes with ocular hypertension.¹

Patients with systemic hypertension have a significantly greater IOP increase after 15 minutes in the supine position than do normotensive control subjects. Whole body, head-down tilt leads to further increase in IOP, which correlates with degree of inversion, is greater in glaucomatous eyes, and appears to be related to elevated episcleral venous pressure. In normal people the episcleral venous pressure was reported to increase approximately 1 mm Hg when position is changed from sitting to supine recumbent.^{2,3} Elevation of episcleral venous pressure on lying down would increase outflow resistance and cause a rise in IOP in supine position.

METHODS

The entire study was carried out at Dr. Pinnamaneni Siddhartha institute of medical sciences and research foundation, Chinnavutapalli. The study was accomplished with the 100 male subjects with age ranging between 20 and 40 years. For the present study, the intra ocular pressure values were recorded from the individuals using Schiottz tonometer (Improved).

The intraocular pressure was recorded in the lying position followed by a rest of 2 minutes in the sitting position. This is to study the difference between postural variations of IOP.

Informed consent was taken from the subjects. The study was approved by the institutional ethical committee.

Statistical analysis

Statistical analysis was done using Graph pad 6 software. Un-paired t test was used to compare the IOP in supine and standing positions. P value <0.05 was considered significant.

RESULTS

The mean IOP in supine position in right & left eye's was 16.261 ± 2.47 & 16.14 ± 2.53 respectively. The Mean IOP in sitting position in right & left eye's was 14.04 ± 2.52 & 13.88 ± 2.81 respectively.

From the results of our study, the mean IOP was decreased by 2.22 mmHg (13.65%) & 2.26 mmHg (14.01%) in right and left eye's on changing the posture from supine to sitting.

Table 1: Mean IOP in supine & sitting posture in right and left eye.

	IOP supine mmHg	IOP sitting mmHg	Inference
Right eye	16.261 ± 2.47	14.04 ± 2.52	P <0.0001 HS
Left eye	16.14 ± 2.53	13.88 ± 2.81	P <0.0001 HS

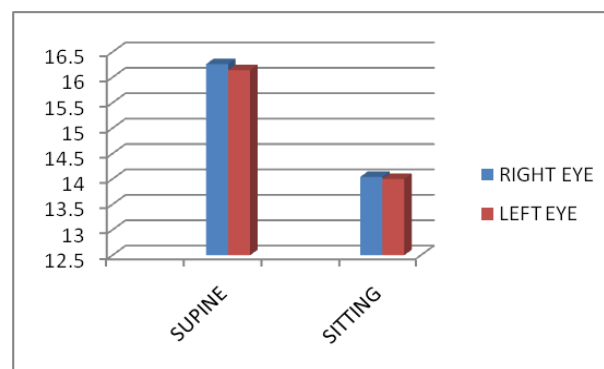


Figure 1: IOP (mmHg) in supine and sitting posture.

DISCUSSION

Normal IOP levels reflect a balance between aqueous production and aqueous outflow, the latter being dependent on outflow resistance. Aqueous production requires adequate perfusion of a healthy ciliary body to allow active secretion and ultra-filtration. The outflow is principally via the trabecular meshwork to collector channels leading to the episcleral veins. A small amount of aqueous also escapes via the uveoscleral outflow.

There were contrasting studies on the relationship between facility of outflow and an elevation of the IOP in lying posture. Williams and Peart⁴ found no correlation between tonography results and postural IOP changes. Inglima⁵ found an increase in the IOP measurements in lying posture in subjects with chronic simple glaucoma.

The IOP increases when changing from the sitting to the supine position, with reported average pressure difference of 0.3 to 6.0 mmHg. The postural influence on IOP is greater in eyes with glaucoma and persists even after a successful trabeculectomy.⁶ In a study of ocular hypertensive patients, normal control subjects and the patients with low tension glaucoma, all had an average IOP increase of 4 mmHg in changing from the sitting to supine position, which remained stable after 30 minutes in the low tension and normal groups, but increased an additional 1.6 mmHg in the ocular hypertensive patients and was associated with an equally significant decrease in blood pressure.⁷ Patients with systemic hypertension have a significantly greater IOP increase after 15 minutes in the supine position than do normotensive control subjects. Whole body, head-down tilt leads to further increase in IOP, which correlates with degree of inversion, is greater in glaucomatous eyes, and appears to be related to elevated episcleral venous pressure.

The intraocular pressure increases to a varying degree when the patient changes his posture from sitting to a recumbent position. Jain MR and Marmion VJ⁷ found significant increase in intraocular pressure in normal subjects when there is a change in posture from sitting to lying down. IOP elevation by postural change ranges from 2.5 to 5.6 mmHg in normal eyes and from 3.5 to 8.6 mmHg in glaucomatous eyes or eyes with ocular hypertension. They postulated that the probable mechanism for the postural change was related to changes in the blood volume which decreases in the erect posture after about 30 minutes as a result of hydrostatic capillary changes. Fall in blood pressure in recumbence which occurs rapidly; usually within 30 seconds also contribute to the increase in IOP which was due to reflex phenomenon governed by a baroreceptor mechanism. Hydrostatic changes as mediated through venous pressure, capillary perfusion, and blood volume changes, would take longer to produce an effect by change in posture. Age would also tend to accentuate this change and if the baroreceptor mechanism were the basis for it, it would be expected that this would increase with age. Takahiro Kiuchi, Yuta Motoyama, Tetsuro Oshika et al.⁸ observed from their studies in patients with normal tension glaucoma that visual field damage occur progressively due to postural changes in Intraocular Pressure. Kothe AC⁹ found an acute elevation of IOP because of postural change from sitting to supine & he concluded that postural change cause changes in hydrostatic pressure in the eye, particularly an elevation of episcleral venous pressure. Liu JH, Sit AJ, Weinreb RN¹⁰ studied about the 24 hour IOP variation in healthy individuals and observed that the IOP fluctuates over the diurnal and nocturnal periods which is influenced by body position and found that the IOP of a subject lying down can be at least 3 to 4 mm Hg higher than that of a patient who is sitting.

Friberg et al.¹¹ concluded that orbital venous pressure increases quickly, depending on posture, because of the numerous interconnections between the orbital drainage routes and the lack of venous valves in the orbit.

The findings of our study correlate with the study of Leonard TJK et al.¹² who observed a marked elevation (>4 mmHg) of the IOP in lying posture when compared with IOP in sitting posture. The probable mechanism for the increase in IOP in supine posture may be due to the increase in resistance in aqueous flow (Tsukahara S¹³) or it may be due to an increase of choroidal blood volume.¹⁴ Dumskyj et al.¹⁵ and Singleton et al.¹⁶ reported that patients who had orthostatic hypotension with autonomic imbalance experienced notable IOP changes by sudden fluctuations of blood pressure with the postural change. Hirooka and Shiraga¹⁷ investigated IOP elevation with postural change in patients with primary open-angle glaucoma and reported that the magnitude of IOP elevation was significantly greater in eyes having more advanced visual field defects.

CONCLUSION

From the results of our study it can be concluded that IOP varies with posture. The intraocular pressure increases to a varying degree when the subject changes his posture from sitting to a recumbent position.

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Conflict of interest: None declared

Ethical approval: The study was approved by the institutional ethics committee

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