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Intraocular pressure (IOP) of the natives of high altitude versus low altitude

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Abstract:
Purpose*: To study intraocular pressure of natives of high altitude versus low altitude at Indira Gandhi Medical College Shimla in the hilly terrain of Himachal Pradesh.*
Method*s: A hospital based prospective observational study was conducted from July2017 to June2018 in the ophthalmology department at Indira Gandhi Medical College Shimla. Total of 200 healthy subjects underwent IOP measurement using Huvitz non contact tonometer. Of the 200 subjects, 100 subjects residing at a height, greater than 2000m above the sea level were included in the study group (cases), 100 subjects residing at a height of less than 2000m above the sea level were included in the control group.*
Results*: The study population consisted of 200 healthy subjects from 30 to 69 years of age. There were 49 males and 51 females were in the both the groups. IOP measurements was done in all cases and controls. IOP of both eyes of all subjects were taken. The mean IOP of cases for right and left eye was 12.51±1.60 and 12.53±1.74 respectively. The mean IOP of controls for right and left eye was 13.37±1.94 and 14.05±2.22 respectively. The mean IOP of cases was less than for controls which is statistically significant (all P <0.05).*
Conclusion*: This study concluded that natives of high altitude have lower IOP values as compared to low altitude. There was no relationship between IOP value and gender.*
Key words*: intraocular pressure, IOP, Huvitz non contact tonometer, tonometry*

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I. Introduction

Glaucoma is a multifactorial, chronic optic nerve neuropathy that is characterized by progressive loss of retinal ganglion cells (RGC), which leads to structural damage to the optic nerve head (ONH), retinal nerve fibre layer (RNFL), and consequent visual field defects. Early diagnosis and treatment of glaucoma has been shown to reduce the rate of disease progression, and improve patients' quality of life.[1]

A change in either IOP or ICP may affect the homeostasis of the ONH. The imbalance can be due to increased ICP, or to elevated IOP as in the case of glaucoma.[2] IOP is the pressure within the intraocular compartment anteriorly of LC. Posteriorly, the optic nerve (ON) is surrounded by the three layers of meninges: dura mater, arachnoid mater, and pia mater.[3] A device called a tonometer is used to measure IOP. An ideal tonometer needs to be accurate, minimally invasive, have adaptability to any patient, be easily handled by all of the medical staff, and have easy locomotion. Currently, no existing tonometer meets all these criteria.[4] However, the gold standard tonometer for IOP measurement is Goldmann's.[5] Another way to measure IOP is through a non-contact tonometer, blow, or pneumatic. The blow tonometer has a pneumatic system that produces a jet of air, which leads to flattening of the cornea and on the surface of which a beam of parallel light rays is projected, in which only the reflected parallel and coaxial rays are picked up by the receiver of the device, obtaining a maximum peak of light reception when the cornea is flattened.[6] The unique environment of high altitude includes factors such as low air pressure, hypoxia, dry and cold weather, prolonged and increased exposure to sunlight, strong solar infrared light and UV radiation, and prolonged snow cover, which all have effects on the human body in general and the eyes in particular. The eye, like every other organ, is affected by the hypobaric hypoxia of high altitude.[7,8]

This study was being conducted to assess Intraocular pressure in natives of high altitude as compared to that of low altitude so, as to have baseline data of IOP for higher altitude natives and to distinguish between disease normal racial IOP variations.

II. Material And Methods

A hospital based prospective observational study was conducted from July2017 to June2018 in the ophthalmology department at Indira Gandhi Medical College Shimla. The study population consisted of 200 healthy subjects from 30 to69 years of age. Of the 200 subjects, 100 subjects residing at a height, greater than 2000m above the sea level were included in the study group (cases), 100 subjects residing at a height of less than 2000m above the sea level were included in the control group. The study was conducted in accordance with Declaration of Helsinki and the guidelines for good ethical clinical practice. The study was approved by our institute ethics committee. Informed consent was obtained from all subjects. A complete ocular examination including visual acuity, refractive error, anterior and posterior segment examination, Gonioscopy with Goldman single mirror was done to rule out any anterior and posterior segment pathology. Subjects included were those of more than 30 years of age, with visual acuity of 20/20, refractive error less than ±3D, IOP less than 22mHg, a normal ONH with vertical CD ratio of less than or equal to 0.6 without asymmetry of more than 0.2. Patients excluded were those with history of ocular trauma, intraocular surgery/ laser, diabetes mellitus, family history of glaucoma, some ocular/neurological disease affecting ONH . IOP measurements were done in all cases and controls. IOP of both eyes of all subjects was taken. IOP was measured using Huvitz non contact tonometer.

STATISTICAL ANALYSIS: Data collected during study period is transferred to MS excel sheet for further process and analysis. Means and standard deviations were calculated for continuous variables. Comparison of means was done on two groups using statistical software SPSS version 20. Parametric tests of significance i.e. independent student t test was used to determine statistical significance and p value <0.05 was considered statistically significant.

III. Result

The study population consisted of 200 healthy subjects from 30 to 69 years of age. The mean age of cases (high altitude residents) and controls (low altitude residents) were 46.87±9.32 years and 46.65 ±9.68 years respectively. There were 49 males and 51 females in the both the groups. This is depicted in table 1& 2

Table 1:Demographic data for high altitude

Age in year	Total no of subjects	Gender male	Female
30-39	25	8	17
40-49	32	18	14
50-59	33	18	15
60-69	33	5	5
Total	100	49	51

Table 2: Demographic data for low altitude

Age in year	Total no of subjects	Gender male	Female
30-39	25	16	9
40-49	32	12	20
50-59	33	16	17
60-69	10	5	5
Total	100	49	51

IOP in Right and Left eye (Altitude wise)

IOP measurements was done in all cases and controls. The mean IOP of cases for right and left eye was 12.51±1.60 and 12.53±1.74 respectively. The mean IOP of controls for right and left eye was 13.37±1.94 and 14.05±2.22 respectively. The mean IOP of cases was less than for controls which is statistically significant (all P <0.05). This has been depicted in table 3.

Table 3 : IOP in Right and Left eye (Altitude wise)

IOP	High Altitude (Cases, n = 100)	Low Altitude (Controls, n=100)	p value
IOP/ Right	12.51±1.60	13.37±1.94	0.001`
IOP/ Left	12.53±1.74	14.05±2.22	0.00

IOP in Right and Left eye (Gender wise)

The average IOP for Right eye in male was 13.04±1.83 and in the female was 12.84±1.82. The average RNFL Thickness for left eye in male was 13.46±1.97and in the female was 13.13±2.47. The IOP parameters were slightly higher in males than females but difference was statistically insignificant with p value of less than 0.05. This has been depicted in table 4.

Table 4: IOP in Right and Left eye (Gender wise)

IOP	Male (n = 98)	Female (n=102)	p value
IOP/ Right	13.04±1.83	12.84±1.82	0.44
IOP/ Left	13.46±1.97	13.13±2.47	0.27

IV. Discussion

In our study the mean age of the high altitude residents (cases) was 46.87 years and low altitude residents (controls) was 46.65 years. Similarly, in a study conducted by TarekAlasil et al (2013)[10] the mean age was 53.7±16.3 years. The discrepancy between the two studies is because in our study age range taken was 30-69 years where as in their study age range was 9- 86 years.

The mean IOP of cases for right and left eye was 12.51±1.60 and 12.53±1.74 respectively. The mean IOP of controls for right and left eye was 13.37±1.94 and 14.05±2.22 respectively.

In a study conducted by J Bali, K P Chaudhary and R Thakur (2005)[11] the mean IOP of high altitude residents was 14.82. The slight discrepancy may be due to they used shiotz tonometer and in our study we used hyutz non contact tonometer .G J Louis, F Zizi M Dwek and D R Lazzaro (2007) [12]concluded in their study that blacks have greater IOP 17.66 mm of Hg) as compared to whites 15.33mm of Hg). Similarly in our study controls (low altitude residents) had greater IOP than cases (high altitude residents)

It is hypothesised that low IOP in high altitude residents may be due to adjustment of the body to low oxygen concentration (chronic hypoxia) which leads to vasodialatation of resistant vessels at higher altitudes causing decrease in perfusion pressure in cilliary vessels leading to decreased aqueous secretion and decreased IOP. To verify this, a study with a large sample size can be done.

V. Conclusion

This study concluded that natives of high altitude have lower IOP values as compared to low altitude. There was no relationship between IOP value and gender.

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