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Ocular biometric characteristics of chronic angle closure glaucoma in a South Indian population: A comparative study with normal subjects

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ABSTRACT

Aim: To compare ocular biometric features of chronic angle closure glaucoma patients with normal subjects.
Materials and Methods: 35 chronic angle closure glaucoma patients (group A) were compared with 35 normal subjects (group B). Chronic angle closure glaucoma was diagnosed in eyes with peripheral anterior synechiae [PAS] of > 270 degrees with a chronically elevated IOP with disc and field changes. Patients with history of intraocular surgeries or trauma, secondary angle closure, active keratitis or corneal opacities, previous history of Nd Yag laser peripheral iridotomy and those on miotic drops were excluded. Contact ultrasonic biometry was used for measuring ocular biometric parameters like axial length, AC depth, and lens thickness. LAF and RLP were calculated. Statistical analysis: Chi-square test and Independent sample t-test as applicable.
Results: Mean age, gender distribution and axial length measurements in both the groups were comparable. Lens thickness and LAF were significantly higher in Group A ($p < 0.001$) whereas AC depth, keratometry and RLP were significantly lower in group A. Pachymetry, best corrected visual acuity and spherical equivalents were comparable in both groups.
Conclusion: It is concluded that the mechanism of chronic angle closure glaucoma can be explained by the ocular biometric parameters with possibility of some additional factors like variations in the iris thickness/ insertion.

1. Introduction

Approximately 50 million people worldwide are affected by glaucoma, with one third having primary angle closure glaucoma (PACG).[1] Over 25% with PACG turn blind, the prevalence of blindness being more than twice compared to open angle glaucoma.[2] Angle closure glaucoma is more common in India than in the West, the reasons for which are not clearly understood.[3]

Though the reasons for the relatively high prevalence of angle closure remain unclear, it is generally observed that these patients have shorter axial length, shallower anterior chamber and thicker lens.[3–7] The lens which is anteriorly placed and thicker usually results in shallower anterior chambers.[3] Aging process further adds to the gradual and progressive increase in lens thickness leading to exaggerated shallowing of the anterior chamber.[8]

Primary angle closure glaucoma generally has two types of presentations – those with acute onset of symptoms and those presenting in a relatively asymptomatic form. The prevalence of these two presentations varies in different races. In Asian population, the prevalence of acute form is more compared to the chronic form and the reverse is true in blacks.[9] The asymptomatic chronic form often presents late with advanced optic neuropathy in one eye which is a major cause of blindness in Asian population. The present study was conducted as the existing literature reviews lack in depth information regarding the ocular biometric features of chronic angle closure disease.

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The objective of the present study was to compare the ocular biometric features of chronic angle closure glaucoma patients in a South Indian population with normal subjects which might explain the mechanisms behind the disease.

2. Material and Methods

This was an observational study conducted at the glaucoma clinic of a tertiary care teaching institute over a period of two years after obtaining clearance from the Institutional Ethical Committee and informed consent from the patients.

Thirty five patients diagnosed with chronic angle closure glaucoma were included in the study (group A). The control group formed thirty five normal subjects with healthy eyes with no evidence of glaucoma (group B). The age group selected was between 40-80 years with a refractive error within ± 4 diopters of spherical equivalent. One eye was randomly selected for analysis.

Chronic angle closure glaucoma was diagnosed in eyes with peripheral anterior synechiae [PAS] of > 270 degrees with a chronically elevated intra ocular pressure (IOP) with optic disc and visual field changes, who remained asymptomatic or presented with occasional headache (chroni c primary angle closure glaucoma).[10]

Patients with previous history of intraocular surgeries or trauma, secondary angle closure, active keratitis or corneal opacities in whom gonioscopy and fundus examination could not be performed, were excluded from the study. We also excluded patients on miotic drops and those with a previous history of Nd Yag laser peripheral iridotomy.

A complete ophthalmological evaluation was done by an ophthalmologist. Best corrected visual acuity (BCVA), automated refraction, keratometry, slit lamp examination using a Haag-Streit 900 slit lamp and applanation tonometry were done. Contact ultrasonic biometry [Sonomed model EZ Scan AB5500+] was used for measuring ocular biometric parameters like axial length, anterior chamber depth, and lens thickness by placing the probe over the central cornea. Average value of five measurements [with a standard deviation of <0.05mm$\}$ was calculated for statistical analysis. The measured parameters were used to calculate lens-axial length factor (LAF=LT/AL$\times$10) and relative lens position by Lowe's formula (RLP=[ACD $+\frac{1}{2}$ LT]/AL$\times$10).[11,12] Gonioscopic evaluation of angle was done using a Goldmann two mirror gonioprism under standard testing conditions and indentation gonioscopy was performed with Sussman four mirror lens in relevant cases. The optic disc evaluation was done using a 78D lens. Visual field testing (30-2 SITA Standard) was done by Humphrey Automated Perimetry. Measurements of corneal diameters were taken with Castroviejo calipers and average readings were calculated. Corneal thickness was measured using optical pachymeter.

Chi-square test was used to compare the categorical variables. Independent sample t-test was used to compare the continuous variables by group. Statistical analyses were conducted using SPSS Version 20.0 for Windows (IBM Corporation ARMONK, NY, USA).

3. Results

The mean age (57.6 ± 11.7 vs. 59.9 ± 11.3, p= 0.415) and gender distribution (p=0.810) in both the groups were comparable (Table 1). While comparing the ocular biometric parameters among the two groups it was found that there was no statistically significant difference in the axial length measurements between the two groups. (22.6 ± 0.5 vs 22.6 ± 0.8, p= 0.674). Comparison of anterior chamber depth showed a significantly lower value in Group A compared to Group B (2.7 ± 0.2 vs 3.3 ± 0.4, p <0.001). Group A had significantly higher l ens thickness as well (4.5 ± 0.2 vs 3.9 ± 0.5, p <0.001). Lens- axial length factor upon analysis showed a significantly higher value in Group A compared to Group B ($2.0\pm$ 0.1 vs 1.7 ± 0.2, p <0.001). In Group A, relative lens position value (2.2 ± 0.1vs 2.3 ±0.2,p value <0.001) and keratometry values (44.2 ± 1.4 vs 45 ±1.5, p value = 0.024) were significantly lower. Mean corneal diameter and pachymetry were comparable among the two groups (Table 2).

While Best Corrected Visual Acuity (BCVA) was compared among the two groups, it was found that 60% of cases and 10 0% of the control group had a BCVA of $>$6/60. Analysis of spherical equivalents showed hyperopic refractive error in all the study subjects. It was revealed that 71.4% of cases and 34.3% of the control group were having hypermetropia of $<$1D. While 65.7% controls showed hyperopic refractive error between 1-2 diopters only 28.6% of cases showed the same the difference was also statistically significant (p value= 0.002, Table 3).

4. Discussion

Ocular biometric studies have shown that primary angle closure glaucoma eyes have shorter axial length, thicker cornea with steep corneal curvature, shallower anterior chamber and thicker lens with anterior lens position compared to normal eyes.[13] However, ocular biometric features of chronic angle closure glaucoma patients have not been widely investigated.

In our study the mean age and sex of the cases and controls were comparable. Age distribution in various studies[4–8] shows that angle closure disease is more common in elderly people. This increased incidence with age is explained by the increasing thickness of th e lens with resultant increase in iridolenticular contact. Our study also showed a similar result. It is well documented that angle closure disease has a gender predisposition with females being more susceptible than males.[14,15] Our study also supports the literature.

Table 1: Comparison of age and gender

Variables	Group A		Group B		P value
	Mean	SD	Mean	SD	
AGE	57.6	11.7	59.9	11.3	0.415
		%		%	0.810
Male	15	42.9	16	45.7	
Female	20	57.1	19	54.3	

Table 2: Comparison of ocular biometry

Parameters	Group A		Group B		P value
	Mean	SD	Mean	SD	
Axial Length (mm)	22.6	0.5	22.6	0.8	0.674
Lens Thickness (mm)	4.5	0.2	3.9	0.5	<0.001
LT/AL factor	2.0	0.1	1.7	0.2	<0.001
Anterior Chamber Depth (mm)	2.7	0.2	3.3	0.4	<0.001
Keratometry (dioptre)	44.2	1.4	45.0	1.5	0.024
Corneal Diameter (mm)	11.7	0.6	11.7	0.4	0.841
Pachymetry (μm)	515.3	27.6	511.9	18.8	0.549
Relative Lens Position	2.2	0.1	2.3	0.2	<0.001

Table 3: Comparison of baseline parameters

Variables		Group A n (%)	Group B n (%)	P value
Best corrected Visual acuity	>6/60	21(60.0)	35(100.0)	
	≤6/60	14(40.0)	-	
Spherical equivalent	<1 dioptre	24(68.6)	12(34.3)	0.004
	1-2 dioptre	11(31.4)	23(65.7)	
	>2 dioptre	-	-	

Contrary to the previous studies the axial length values were comparable to the normal eyes in our study. But our axial length values were similar to study by Sihota et al.[16] (22.61± 0.88). We got statistically significant difference in the other ocular biometric parameters like anterior chamber depth and lens thickness between cases and controls. In our study cases had a thicker lens with a shallow anterior chamber. An increase in lens thickness secondary to aging process might lead to gradual closure of the angles with formation of peripheral anterior synechiae. This being a slow process might lead to chronic angle closure disease. The shallower anterior chamber depth in chronic angle closure is suggested to be secondary to a thicker and more anterior position of the crystalline lens. Similar observation was made in our study as well.

The importance of lens thickness/axial length factor in primary angle closure disease was evaluated by Lan et al[15] as this ratio was high for the angle closure spectrum of disease. It indicates the relative size of the lens in the eye. Our study subjects also had a statistically significant higher ratio compared to the control group. Study by Markowitz et al also showed that in angle closure disease lens thickness/axial length factor was age dependent and greater than normal in most of the age groups.[17]

Regarding relative lens position, our study showed statistically significant difference between cases and control groups. The study subjects had anterior positioning of lens compared to the controls. Literature review reveals studies supporting the importance of relative lens position in angle closure.[15–17] Pachymetry values were normal and comparable in the two groups in our study (515.30±27.6mm vs 511.9±18.8mm). Study by Sihota et al[16] also supports the results. (5 24.2 ± 30.6 vs 524.5± 12.8). Our study showed statistically significant results regarding corneal curvature between cases and controls with cases having a flatter corneal curvature (44.2±1.4 vs 45.0±1.5 p=0.024). These observations made in our study were not in agreement with study by Sihota et al.[16] (44.50 ± 1.54 vs 43.76 ± 0.79).

In our study we got a control group of non glaucomatous subjects comparable in age and gender. But we couldn't find any difference in mean axial length among cases and controls which is against the popular belief that angle closure glaucoma occurs in small eyes. This might be due to the fact that the chronic variety of primary angle closure disease was not studied in detail. Our study demonstrated that patients with chronic angle closure glaucoma had a more crowded anterior segment compared to the control

group due to the thicker and anterior positioning of the lens even though the axial length was comparable.

Recent developments like ultrasound biomicroscopy, anterior segment OCT and Scheimpflug video imaging may throw light into the ultra structural features and dynamic changes of the anterior ocular structures. So let us hope that future studies may throw more light in to the mechanisms involved in chronic angle closure disease. Limitations of the current study were the inherent errors that could occur when cases and controls we re selected from a hospital setting.

5. Conclusion

It is concluded that the mechanism of chronic angle closure disease can be explained by the ocular biometric parameters with possibility of some additional factors like variations in the iris thickness/ insertion.

6. Source of Funding

None.

7. Conflict of Interest

None.

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