Ocular Biometry In Primary Angle Closure / Primary Angle Closure Glaucoma Patients

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Abstract

Introduction: Glaucoma is rapidly increasing as a major cause of blindness in India. Primary angle closure glaucoma (PACG) were less frequent but accounted for large number of glaucoma blindness. The rate of blindness in PACG is approximately two to five times higher than POAG. The ocular biometry (axial length, anterior chamber depth and lens thickness) in PAC/PACG patients help in better understanding of the factor associated with angle closure glaucoma and can be used as a screening tool in populations.

Aim & objective: To compare the ocular biometry parameter i.e. axial length (AL), anterior chamber depth (ACD) and lens thickness (LT) in normal and primary angle-closure (PAC) / primary angle-closure glaucoma (PACG) patients.

Methodology: A cross sectional comparative study, we measure the axial length, ACD and the lens thickness of subjects by using A-scan ultrasound biometry

Sample size: Total 136 eyes among them 32 eyes of PAC, 36 eyes of PACG patients and 68 eyes of non-glaucoma patients are statistically analysed using independent t-test, two-way analysis one-way analysis of variance, and $\chi2$ test.

Results & discussion: The mean age of the PAC/PACG patients was 57.07 (SD = 8.23) years and mean age of normal subject are 60.35 (SD= 8.68) years which is statically significant (p= 0.0254). In the PAC/PACG group female (60.29%) had more prevalence of disease than males. The mean (SD) axial length was shorter (p < 0.0001) in PAC/PACG 21.86 mm (0.58) compared to normal subjects 23.29 mm (0.54). The mean (SD) anterior chamber depth was shallower (p <0.0001) in PAC/PACG 2.37 mm (0.31) compared to normal subjects 3.33 mm (0.42). Mean (SD) lens thickness was greater (p < 0.0001) in PACG 5.09 mm (0.23) compared to normal subjects 4.38 mm (0.37).

Keywords: Axial Length, ACD, Lens Thickness

Introduction

Glaucoma is rapidly increasing as a major cause of blindness in India. [1] In 2013, the number of people (40-80 years old) with glaucoma worldwide was evaluated 64.3 million, and was predicted to increment up to 76.0 million by 2020 and 111.8 million by 2040.[1] POAG is the preponderant form of the disease in glaucoma group; PACG and secondary glaucoma were less frequent but accounted for large number of glaucoma blindness.[2]

PACG is more prevalent in Asians than Europeans and Africans with over 80.0% of those with PACG in Asia.[3] [4] Majority of primary angle closure glaucoma cases follow an asymptomatic course, nearly 20% of patients present with acute primary angle closure (APAC) that is associated with a significant risk of vision loss if treatment is not instituted immediately.[2] [5] [6] [7] The rate of blindness in PACG is approximately two to five times higher than POAG.[2][8] Eyes with PACG have recognizable

anatomical predisposition. **Von Graefe** revealed the association of glaucoma with a shallow anterior chamber. [9] **Rosengren** found that patients with glaucoma had a smaller ACD than normal persons. He also suggested that the shallow anterior chamber in acute glaucoma existed prior to the acute rise in pressure. [10] **Tornquist** found anterior chamber to be genetically determined. He also reported that the anterior chamber of the fellow eye of persons with uniocular acute glaucoma is shallower compared to normal. [11] The peculiar feature of PACG is shallow anterior chamber depth is due to abnormal association between the lens structure and the eye ball. The growth of the lens precedes to decreasing of approximately *0.35* to *0.50* mm of ACD in *50* years of age. [12] This diminution of the dimensions of the anterior chamber may play an important role in the pathogenesis of angle-closure glaucoma. [13] Thus the study reveals that the eyes associated with angle closure glaucoma appear to have significantly shorter AL, shallower ACD and greater LT as compared to the normal eyes. [8] [14] [15] [16]

Early detection of angle closure or an occludable angle at risk of closure is crucial, because laser iridotomy procedure is effective in preventing further angle closure, elevated intraocular pressure, and glaucomatous optic neuropathy. [17] [18] The gonioscopy evaluation of angle is considered as the gold standard examination of individuals at risk for PACG, it requires high skilled ophthalmologist. The ocular biometry (AL, ACD and LT) in PAC/PACG patients help in better understanding of the factor associated with angle closure glaucoma and can be used as a screening tool in populations. A-scan biometry is an inexpensive, portable device and non-invasive in nature , can easily mastered in the ocular dimensions measurement. [12] [19] [20]

Hence the present study was undertaken to study and compare the ocular biometry variable like **axial length, anterior chamber depth and lens thickness** in normal and PAC/ PACG patients. It also help to evaluate risk factor associated in PAC / PACG patients and therefore an important tool which can be used in screening of PAC / PACG patients in community. [21] [22] [23]

Aims & Objectives:

1.To compare the ocular biometry parameter i.e. axial length (AL), anterior chamber depth (ACD) and lens thickness (LT) in normal and PAC) / PACG patients.

2.Evaluation whether ocular biometry can be used as a screening tool in angle closure patients.

Materials and Methods:

Source of data - Mahatme Eye Bank and Eye Hospital, Chintaman Nagar, Near Rajiv Nagar, Somalwada, Nagpur – 440025, Maharashtra.

Study Design- Hospital- based Cross-sectional comparative study

Expected Duration of Study: From the date of Ethical committee clearance: August 2019 to March 2021

Inclusion Criteria: Adults aged more than 30 years Diagnosed Cases of PAC/ PACG patients

Normal subjects:

- Normal ocular examination with no evidence of glaucoma,

- Intra-ocular pressure of less than 22 mm of Hg

- Open angle on gonioscopy

Exclusion Criteria

1.Associated with Plateau iris configuration

2. Eyes with secondary glaucoma mechanisms such as

- Iris neovascularization,

- Lens intumescence or subluxation of lens

- Uveitic secondary glaucoma

- Traumatic secondary glaucoma

Methodology

History

Demographic data of patients was collected including name, age, sex, occupation and personal details. Detailed history of patients complaining of diminution of vision was taken including history of any anti-glaucoma treatment, other ocular symptoms associated with diminution of vision, other systemic disorders and relevant past history, family history and history of any acute angle closure attack in the past.

Ocular Examination

Ophthalmologic examination included best-corrected visual acuity (BCVA) (using Snellen's chart & Log MAR charts), slit lamp bio-microscopy to evaluate anterior chamber status as regards depth, peripheral anterior synechiae/posterior synechiae, grade of cataract, presence of peripheral laser iridotomy opening (if done),

assessment of the retina by indirect ophthalmoscopy, Goldmann's applanation tonometry, indentation gonioscopy using 3 mirror goniolens with shaffer's grading and A-scan ultrasound ocular biometry was used for measurement of AL, ACD and LT for all the subjects. The criteria for considering a diagnosis of angle closure was an occludable angle, defined as one in which there was a contact between iris and posterior trabecular meshwork in 2 or more quadrants with gaze in the primary position.[24] Visual fields, Central corneal thickness (CCT), Optical Coherence Tomography Retinal Nerve fiber layer (OCT-RNFL). Visual acuity with Snellen chart at 6 meters (6/6), at 20 feet (20/20), 1.0 vision in decimal charts and 0.0 log MAR are considered equivalent.

A-Scan Biometry

In eye of the subjects, measurements of Anterior chamber depth (ACD), lens thickness, axial length (AL) and its standard deviation were determined with A-scan (Quantel Medical, Compact Touch 3 in 1 ultrasound system A/B AND Pachymetry SN 6252, FRANCE) machine. It has a 11 MHz A-scan biometry probe for both contact and immersion techniques. Measurements were taken by using immersion A-scan biometry.

For immersion A-scan:

Scleral [Prager] immersion shell was used.

The immersion shell was filled with normal saline connected by the silicone tube to a 5 ml syringe.

The automatic sequences of five reliable readings with characteristic peaks were taken according to the pre-set amplitude and timing criteria for the ultrasound reflections with single application of the shell and probe.

The spikes and corresponding gates produced in all instances were carefully assess and un-reliable readings discarded before the mean value was recorded.

In each case, five AL readings were taken by the machine to provide an average reading with standard deviation displayed on the machine.

Results:

In our study total 136 subject (136 eyes) were evaluated by using a random table with odd numbers representing right eyes and even numbers left eyes. We will choose one eye from each participant these included 32 eyes with PAC, 36 eyes with PACG and 68 eyes of normal subjects. In total cases of PAC/PACG 41 (60.29%) were women and 27(39.71%) were men. In total cases of control group 40 (59.82%) were women and 28 (41.18%) were men. Mean age of the PAC/PACG patients was 57.07 (SD = 8.23) years and mean age of normal subject are 60.35 (SD= 8.68) is significant (p = 0.0254). Most of the PAC/PACG patients were in the range 50-59 years where females (17) 41.5 % out numbered the males (14) 51.9 %.

Comparison of mean axial length (mm) in two groups							
Group	No.	Range	Mean axial length (mm)	SD	Mean difference (mm)	95% CI difference in means	p value
PAC/PACG	68	19.81 to 22.72	21.86	0.58	1.43	1.24 - 1.62	0.0001
Normal	68	22.07 to 24.81	23.29	0.54			

The table showing that mean axial length was significantly shorter in primary angle closure glaucoma subjects 21.86 mm (0.58) than normal group 23.29 mm (0.54).

Comparison of anterior chamber depth (mm) in two groups							
Group	**No.**		**Mean ACD**	**SD**	**Mean difference (mm)**	**95% CI difference in means**	**p value**
		Range	**(mm)**				
PAC/PACG	68	1.61 to 2.93	2.37	0.31	0.96	0.84 - 1.09	0.0001
Normal	68	2.63 to 4.37	3.33	0.42			

The table showing that mean anterior chamber depth was significantly shallow in PAC/PACG subjects 2.37 mm (0.31) than normal group 3.33 mm (0.42).

Comparison of mean lens thickness (mm) in two groups							
Group	**No.**		**Mean lens**	**SD**	**Mean difference (mm)**	**95% CI difference in means**	**p value**
		Range	**thickness**				
			(mm)				
PAC/PACG	68	4.71 to 5.68	5.09	0.23	0.71	0.61 - 0.82	0.0001
Normal	68	3.30 to 5.07	4.38	0.37			

Mean lens thickness was significantly more in PAC/PACG subjects 5.09 mm (0.23) than normal group 4.38 mm (0.37).

Discussion

Our study was hospital based comparative cross-sectional study, carried out in our institute, Mahatme Eye Bank and Eye Hospital, Nagpur during the period from August 2019 to 31st May 2021.

This study was conducted to determine association between

3 parameter i.e., axial length, anterior chamber depth, lens thickness and primary angle closure / primary angle closure glaucoma patients.

The mean age of primary angle closure patients in our study was 57.07 and standard deviation of 8.23 and the age mean of control in our study was 60.35 and standard deviation of 8.68. Most PAC/PACG patients were in 50 – 59 years of age group.

In our PAC/ PACG study group, 41 (60.29%) were females and 27 (39.71%) were males and in normal control group 40 (59.82%) were females and 28 (41.18%) were males. The results shows that the females are approximately 1.5 times more affected than males PAC/PACG group. The study done by **R.George et al. in 2003** also revealed a significantly larger proportion of females in both the occludable angle (40 males: 103 females) and angle closure glaucoma (2 males: 20 females) groups p < 0.001.[25]

In our study the **mean axial length 21.86 mm** and standard deviation 0.58 in PAC /PACG group whereas the mean axial length of **control group was 23.29 mm** with standard deviation of 0.54 and 95% CI difference in means are 1.24 - 1.62 with **p value < 0.0001.** The **mean ACD 2.37 mm** and standard deviation of 0.31in **PAC/PACG group**

whereas the mean ACD of **control group was 3.33 mm** with standard deviation of 0.42 and 95% CI difference in means are 0.84 – 1.09 with **p value < 0.0001.** The **mean lens thickness 5.09 mm** and standard deviation 0.23 in **PAC /PACG group** whereas the mean lens thickness of control group was 4.38 mm with standard deviation of 0.37 and 95% CI difference in means are 0.61 – 0.82 with **p value < 0.0001.**

The study done by **Dakki Sherpa 2018** the mean (SD) axial length of 22.15mm (0.76) in PAC group whereas the mean axial length of control group was 22.98 mm (0.63). The mean (SD) ACD 2.85 mm (0.46) in primary angle closure group, whereas the mean ACD of control group was 3.59 mm (0.40). The mean lens thickness of 4.57 mm (0.58) of PAC group whereas the mean lens thickness of 4.43 mm (0.54). They find that short AL and shallow ACD is a strong risk factor of primary angle closure. Though LT more than 4.5 mm is a risk factor of primary angle closure [26]

Bheema Divya et al. 2016 :They reveals that Mean (SD) anterior chamber depth is shallower in PACG 2.34 mm (0.21) compared to normal subjects 3.03 mm (0.37) and Mean (SD) axial length is shorter in PACG 21.50 mm (0.92) compared to normal subjects 22.51 (0.84), (P<0.0001) which is statistically significant and shows that eyes with angle closure glaucoma have shorter axial length and shallower anterior chamber depth compared to normal eyes. [27]

In a study **Ramakrishna Swati et al. 2016:** The mean values of AL were 22.39 mm and 23.16mm in PACG and Normal group respectively. The mean values of ACD were 2.42 mm and 3.19mm in PACG and Normal group respectively. The mean values of LT were 4.77mm and 3.96mm in PACG and Normal group respectively. They shows that, AXL, ACD significantly less in PACG group and LT significantly more in PACG group as compare to normal group . [28]

Thus, comparing our study with the above studies, we may suggest that eyes with PAC/PACG have shorter axial length, shallow anterior chamber depth and greater lens thickness compared to normal eyes.

Conclusion

1. We found higher prevalence of PAC/PACG in older age group.
2. Women are more affected than men in PAC/ PACG group.
3. PAC / PACG are significantly associated with age and gender of patients.
4. PAC / PACG groups have shorter axial length and shallower anterior chamber depth and greater lens thickness as compared to normal eyes and is a strong risk factor of primary angle closure / primary angle closure glaucoma patients.
5. A-Scan biometry can be used as a screening tool and easy detection of PAC /PACG patients

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