Study Of Anterior Segment Optical Coherence Tomography Findings In Open Angle And Closed Angle Glaucoma And Its Association With Clinical Features

Section A-Research paper

STUDY OF ANTERIOR SEGMENT OPTICAL COHERENCE TOMOGRAPHY FINDINGS IN OPEN ANGLE AND CLOSED ANGLE GLAUCOMA AND ITS ASSOCIATION WITH CLINICAL FEATURES

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Abstract

Aim: The aim of the present study was to evaluate the association between different clinical features of primary open angle and close angle glaucoma with above findings using the AS-OCT.

Methods: The study was conducted in the Department of Ophthalmology Nehru Chikitsalaya, Baba Raghav Das Medical College, Gorakhpur for the period of 12 Months. 130 Eyes of 65 patients based on previous statistics of patient input.

Results: Mean age of the patients was 60.56 ± 9.44 years. Majority 28(43.1%) patients belonged to age group 60-69 years. Males were more involved in the study (63.07%) than females (36.9%). There was statistically non-significant difference between gender distributions. Chi-square test was applied. Majority of chief complaint was defective vision (49.2%) followed by ocular pain (26.1%). IOP shows majority of cases lie in 30-35 followed by 25-29.The least were in >35. Maximum 38(29.2%) eyes had CDR 0.70 followed by 33(25.3%) eyes having CDR ratio 0.60. Myopia was more commonly associated with open angle in AS-OCT (>20 degree). Hypermetropia was more commonly associated with closed angle in AS- OCT (<20 degree). Other types of refractive errors like astigmatism were also found in some eyes but they were statistically insignificant. No significant difference was found between right and left TIA in both eyes in POAG.

Conclusion: It can be concluded that ASOCT being a novel investigation can be used additionally in diagnosis and management of Glaucoma along with the Gold Standard Technique Gonioscopy. All Glaucoma patients should be assessed and followed up properly for IOP, CDR and Visual Field Analysis at regular intervals according to the degree and severity of Glaucoma.

Keywords: AS-OCT, glaucoma, primary open angle, close angle

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1. Introduction

Glaucoma is an ocular pathology with groups of optic neuropathies characterized by progressive degeneration of retinal ganglion cells, causing characteristic visual field defects. It affects more than 70 million people worldwide with approximately 10% being bilaterally blind.[1] Anatomically, the optic nerve comprises of central nervous system neurons that have their cell bodies in the inner retina and axons in the optic nerve. Degeneration of these nerves results in optic nerve head cupping, a characteristic appearance of the optic disc and visual loss.[2]

Glaucoma can remain asymptomatic until it is severe, resulting in a high likelihood that the number of affected individuals is much higher than the number known to have it.[3,4] Therefore, most of the patients present late and mainly with irreversible damage, i.e. optic neuropathy. Glaucoma can be classified into 2 broad categories: a- Open-angle glaucoma b- Angle-closure glaucoma. Black race, older age, elevated intraocular pressure, family history of primary open-angle glaucoma, myopia, and low diastolic perfusion pressure are the risk factors for primary open-angle glaucoma.[5,6] Decreased corneal thickness are seen among patients with an elevated intraocular pressure.[7] However, larger cup-disc ratio (vertical or horizontal), higher intraocular pressure, greater pattern standard deviation on perimetry are among the other factors associated with higher risk of development and progression of POAG. Primary angle-closure glaucoma (PACG) is a leading cause of blindness in East Asia.[8] It has a greater tendency to cause bilateral blindness than primary open angle glaucoma. In China, PACG is responsible for over 90% of bilateral glaucoma blindness. It is also responsible for most bilateral glaucoma blindness in Singapore and India.[9, 10] However, precise population-based estimates of prevalence are not available for Indian subcontinent. The risk factors for PAC are female gender, increasing age, Inuit or East Asian ethnicity, shallow anterior chamber, shorter axial length, and genetic factors.[11] the risk of visual impairment and blindness is higher in PACG than in POAG. It is estimated that ratio of blindness caused by PACG to POAG is five folds.[10] therefore early detection and treatment are important in the prevention of blindness from glaucoma. Detection of angle closure relies on careful assessment of the anterior chamber angles. The gold standard method is gonioscopy.[12] this can be performed with basic equipment and allows 360-degree visualization of the anterior chamber angle. However, it has several downsides including that it requires a significant amount of skill from the practitioner, compliance

from the patients, contact with the eye and only fair repeatability.[13] The aim of the present study was to evaluate the association between different clinical features of primary open angle and close angle glaucoma with above findings using the AS-OCT.

Materials and Methods

The study was conducted in the Department of Ophthalmology Nehru Chikitsalaya, Baba Raghav Das Medical College, and Gorakhpur for the period of 12 Months. 130 Eyes of 65 patients based on previous statistics of patient input.

The institutional ethics committee and the research committee of Baba Raghav Das Medical College approved. The individuals were explained about the study, procedure and investigations. They were included in the study after obtaining the written informed consent. All diagnosed primary open angle glaucoma patients and primary angle closure glaucoma patients attending Ophthalmic Outpatient Department in NEHRU hospital attached to BRD Medical College were included in this study.

Inclusion Criteria

- Patient willing to give consent.
- A known diagnosis of primary open angle glaucoma OR primary angle closure glaucoma with bilateral disease.
- Patients older than 40 years of age.
- An APPLANATION tonometer intraocular pressure > 21 mm of Hg.
- A combination of optic disc changes like cupping, notching, thinning or pallor of neuro retinal rim suggestive of Glaucoma.

Exclusion Criteria

- Participants not willing to give informed consent.
- History of any disease or trauma to the eye being tested.
- Patients with dense cataract.
- Patients with any retinal pathologic condition that may affect visual field.
- Patients with anterior segment pathology precluding the visualization of angle e.g. Any corneal opacity/corneal ulcer.

Alter obtaining informed written consent, a comprehensive evaluation of an individual with glaucoma was begin with eliciting detailed history.

2. Methods

Observer provided detailed instructions to each subject before beginning the measurement. The subject was seated in a dim room with the chin on the chinrest and forehead against the forehead bar and was asked to fixate on the specified fixation

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point with both eyes wide open. The device was manipulated according to the user's manual. The measurement was triggered manually after the alignment procedure was automatically accomplished by the system. To assure the measurement independence, patients were asked to move their head away from the chinrest, and the scan units were thoroughly retreated before subsequent examinations. The B-scan images were reviewed by observer after each measurement, ensuring that there was no apparent image artifact for OCT images. The outcomes of the 3 consecutive measurements obtained by the observer were averaged.

Data management For ease, patients were categorized into 2 main categories- primary open angle and primary angle closure glaucoma. SPSS version 22.0 was used for data analyzing. P< 0.05 considered with 95% CI (confidence interval) in the study. The mean, Standard deviation, mean difference and percentage were done for demographic data, chi- square test was utilized for categorical data, unpaired student t test, were applied to compare the parametric data. Significant difference was accepted at $P < 0.05$.

3. Results

Table 1: Patient details

	NUMBER	PERCENTAGE (%)	
40-49 YR	8	12.3	
50-59 YR	20	30.7	
60-69 YR	28	43.1	
70-79 YR	8	12.3	
>80 YR	1	1.5	
Variable	N (%)	χ^2	P
Sex			
Male	41 (63.07)	4.46	0.076 (NS)
Female	24 (36.9)		
Chief Complaint			
Defective vision	32(49.2%)	1.24	0.058(NS)
Ocular pain	17(26.1%)		
Redness	3(4.6%)		
Check for glass	2(3.07%)		
Heaviness	6(9.2%)		
Itching	1(1.5%)		
Discharge	1(1.5%)		
Lid swelling	2(3.07%)		
Coloured halos	1(1.5%)		

Mean age of the patients was 60.56±9.44 years. Majority 28(43.1%) patients belonged to age group 60-69 years. Males were more involved in the study (63.07%) than females (36.9%). There was statistically non-significant difference between gender distributions. Chi-square test was applied. Majority of chief complaint was defective vision (49.2%) followed by ocular pain (26.1%). The least complaint was itching, discharge and coloured halos. However, there is statistically non- significant difference (p= 0.058).

Table 2: Distribution of study groups according to corrected IOP and CDR and findings of AS-OCT

CORRETED IOP	NUMBER	PERCENTAGE (%)
21-24	28	21
25-29	43	33
30-35	53	40.7
35-40	3	2.3
>40	3	2.3
CDR		

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0.30	4	3.07
0.40	6	4.6
0.50	20	15.3
0.60	33	25.3
0.70	38	29.2
0.80	24	18.4
>0.80	5	3.8
DIAGNOSIS		
POAG	50	38.4
PACG	80	61.6
TOTAL	130	100

IOP shows majority of cases lie in 30-35 followed by 25-29. The least were in >35. Maximum 38(29.2%) eyes had CDR 0.70 followed by 33(25.3%) eyes having CDR ratio 0.60. We categorized our study population into 2 main groups- 38.46% Eyes (N= 50) having angle more than 20 degree are classified into open angle (POAG) 61.53% Eyes (N=80) having angle less than 20 degree are classified into closed angle (PACG).

Table 3: Association of refractive error with open and closed angle in AS-OCT, relation of glaucoma to degree of myopia, presence of plateau iris configuration in AS-OCT

TYPE OF REFRACTIVE ERROR	POAG	PACG
MYOPIA	13	7
HYPERMETROPIA	3	24
TOTAL	16	31
DEGREE OF MYOPIA	**POAG (N=50)**	**PACG(N=80)**
LOW	2	3
MODERATE	4	2
HIGH	7	2
TOTAL	13	7

Myopia was more commonly associated with open angle in AS-OCT (>20 degree). Hypermetropia was more commonly associated with closed angle in AS- OCT (<20 degree). Other types of refractive errors like astigmatism were also found in some eyes but they were statistically insignificant. Myopia was more commonly associated with POAG THAN PACG. Cup-disc ratio (CDR) was found to be significantly higher in patients with moderate to high degree of Myopia ($p = 0.027$) ($p<0.05$). The incidence of POAG was found to be (4.01%) in low myopia, (8.2%) in moderate myopia and (14%) in high myopia. Higher degree of Myopia was associated significantly with higher incidence of POAG ($p = 0.017$) ($p<0.05$).

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Table 4: Mean AC angle in primary open angle glaucoma and mean AC angle in primary angle closure glaucoma

	EYE	NASAL TIA		TEMPORAL TIA	
Open		Mean	SD	Mean	SD
RIGHT	25	30.7	5.47	30.2	4.6
LEFT	25	30.8	5.7	29.2	5.8
RIGHT	40	10.9	5.4	10.5	5.8
LEFT	40	11.2	5.08	9.6	4.2

The mean Nasal TIA (Trabecular iris angle) was found to be 30.7°in right eye. The mean Temporal TIA (Trabecular iris angle) was found to be 30.2°in right eye (n=25). The mean Nasal TIA (Trabecular iris angle) was found to be 30.8°in left eye. The mean Temporal TIA (Trabecular iris angle) was found to be 29.2°in left eye (n=25). No significant difference was found between right and left TIA in both eyes in POAG. The mean Nasal TIA (Trabecular iris angle) was found to be 10.9°in right eye. The mean Temporal TIA (Trabecular iris angle) was found to be 10.5°in right eye(n=40). The mean Nasal TIA (Trabecular iris angle) was found to be 11.2°in left eye. The mean Temporal TIA (Trabecular iris angle) was found to be 9.6°in left eye (n=40). No significant difference was found between right and left TIA in both eyes in PACG.

4. Discussion

During the 12 months of the study, 130 eyes of 65 subjects were examined. Anterior segment evaluation is a critical step in the early diagnosis and management of glaucoma. Gonioscopy is currently the gold standard technique for the diagnosis and grading of Glaucoma. Gonioscopy being an invasive technique, cannot be used every time. AS-OCT being a non-invasive investigation, this technique makes it possible to identify and classification of disease without causing much trouble to the patients. When the age distribution was studied in our 65 patients of primary open glaucoma and angle closure glaucoma, the youngest patient was of 42 years and the oldest patient was of 82 years. The mean age of the studied population was 60.56±9.44 years. Similar result was also found in J M Tielsch et al[14] and Foster PJ et al 1996.[15] They found that the glaucoma was more common/ prevalent in elderly population than young and rarely seen before the age of 40 years. The influence of gender on glaucoma has not been as straight forward as may be expected. In the present study of 65 patients, 41(63.07%) were male and 24(36.9%) were female patients. HONG et al[16] in his study, found that POAG showed a slightly higher frequency of disease in male than female. In our study of 130 eyes of 65 patients, mean IOP found to be 28.76±4.40 for right eyes and 29.15±5.11 for left eyes. Chul Hong et al[16] in his clinical study of 206 Korean glaucomatous patients found that mean IOP of POAG patients was 33.4±15.5mmHg. In the present study the mean IOP of 130 patients was slightly lower may be due to the fact that maximum number of patients included in this study was known glaucoma patients already on antiglaucoma medications. Clinical examination of 130 eyes revealed the diagnosis of POAG in 50 eyes (38.4%) and PACG in 80 eyes (61.6%). This can be due to the fact that PACG, especially acute attack is associated with more symptoms and this leads to frequent visiting of hospital. In our study majority of the patients 49.20% (n=32) presented with the symptoms of defective vision or blurring of vision followed by ocular pain 26.10% (n=17,) and heaviness 9.20% (n=6).

Similar results were also found in study done by Annie k lim et al[17] that the patients with anatomic narrow angles without acute angle closure are typically asymptomatic in both the primary and secondary forms. Similarly, primary and secondary chronic angle closure patients often experience no symptoms unless they develop end-stage glaucoma, in which case they may complain of decreased vision or reduced peripheral vision. In this study

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Mean UCVA for right eye was 1.20±0.69 and Mean BCVA for right eye was 1.12±0.73. Similarly Mean UCVA for left eye was 1.35±0.73 and Mean BCVA for left eye was 1.18±0.82. In this study 2 types of refractory errors were found more frequently- 15.38% (n=20) eyes were myopic and 20.76% (n=27) eyes were hypermetropic. Out of which 65% (n=13) of myopic eyes had POAG and 35% (n=7) had PACG. The relationship of myopia and POAG was found to be significant. (p=0.042). The incidence of POAG was found to be 4.01% in low myopia, 8.2% in moderate myopia and 14% in high myopia. Higher degree of Myopia was associated significantly with higher incidence of POAG (p = 0.017) (p<0.05). Similar results were also found in study done by Lee et al.[18] They studied around 262 cases for the period of 5 years and found the significant correlation between POAG and myopia. The incidence of glaucoma and visual field loss progression was 15.1% in the group of eyes with myopia less than −3 D, 10.5% in the group with −3 D to −6 D, 34.4% in the group with −6 D to −9 D, and 38.9% in the group with myopia greater than −9D. In the hypermetropic eyes, 11.1% (n=3) eyes had POAG and 88%(n=24) had PACG. The relationship between hypermetropia and PACG found to be significant. (p=0.023). Van Herick W et al in 1969[19] studied over 5000 patients and found that Hyperopia is more often associated with a narrow angle than is myopia while myopia is associated with an open angle.

Plateau iris is an abnormal anatomic variant of iris that causes primary angle closure glaucoma in patients by mechanical obstruction of trabecular mesh work. In the PACG, out of total 80 subjects, 2.43% (n=2) subjects had plateau iris configurations. Out of 2 patients 1 subject was male and the other one was female. Age of both the patients was <60 years (56 and 54 years). A study done by Kumar Gaurav et al in 2012[20] found that about 30% of the cases with PACG were found to have plateau iris in the Indian population. 101 eyes were included in his study. There were 63 (62.4%) females and 38 (37.6%) males with mean age of the patients 57.8 ± 9.5 years, twenty-nine (28.7%) subjects were diagnosed with plateau iris. In the study conducted by us in Eastern UP, there was less number of patients presenting with plateau iris due to less no. of subjects in our study and also due to regional restrictions. The incidence of PAS associated with PACG was found to be significant in this study (p<0.05). 41.1% (n=33) patients, out of 80 patients, were found to have Peripheral anterior synechiae (PAS). Similar results were produced by study done by Yunhua Loo, Tin A et al.[21] In his cross-sectional study on 267 patients, approximately

half of PACG eyes have PAS, and with a greater proportion in eyes with more severe disease. Eyes with PAS were characterized by smaller anterior chamber dimensions, narrower angles and large LV, however, multivariate analysis showed that the extent of PAS was significantly associated with only narrower anterior chamber angles, higher presenting IOP and worse visual field MD (dB). Mean CCT of the POAG was 527.8±28.6 in the right eye and 528.56±28.7 in the left eye. Mean CCT of the PACG was 555.75±22.5 in the right eye and 554.95±23.7 in the left eye. Higher degrees of myopia were associated significantly with decreased levels of CCT (p=0.019) (p<0.05). Dhaka PC et al[22] done A hospital based comparative type of observational study on 120 eyes of 60 pts and found that CCT is comparatively lower in patients with POAG with mean value of 507.8 & 504.2 in right and left eye respectively. M. Sasan et al[23] performed a study over 430 pt in which 215 were POAG and 115 patients were having PACG. They also took 100 controls in their study and established a correlation between CCT with patients with glaucoma and normal eye. They found that the patient with PACG had more mean central corneal thickness (545±46) than in normal eye mean CCT (531±38.3).

5. Conclusion

It can be concluded that ASOCT being a novel investigation can be used additionally in diagnosis and management of Glaucoma along with the Gold Standard Technique Gonioscopy. All Glaucoma patients should be assessed and followed up properly for IOP, CDR and Visual Field Analysis at regular intervals according to the degree and severity of Glaucoma. By using a novel and non-invasive technique like ASOCT can add benefit to Glaucoma patients as they do not lose the follow up and hence it can lead to early diagnosis and management of the Glaucoma.

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