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Original Research Article

A study of anterior chamber angle biometric measurements in closed angle glaucomas and healthy subjects using imaging tool

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ABSTRACT

Purpose: This observational study aims to examine the ability of an imaging tool in differentiating between anterior chamber angle biometric measurements of closed angle glaucomas and healthy subjects.
Materials and Methods: This was a hospital based cross-sectional observational study. Seventy five subjects were grouped into three groups of 25 subjects each based on appropriate inclusion and exclusion criteria. Using AS-OCT, major outcome variables measured wereanterior chamber depth, lens thickness, lens vault and anterior opening distance 750 (AOD 750). Intraocular pressure and axial length were also noted.
Results: Statistical analysis showed that there was significant difference in IOP(p=0.02), axial length (p=0.0001), lens thickness (p=0.0001) and lens vault among the studied groups.
Conclusion: The study results show that in phacomorphicglaucoma, anterior chamber depth was less and lens vault, axial length & angle opening distance 750 were more as compared to acute primary angle closure glaucoma.

1. Introduction

Today, glaucoma is a major cause of irreversible blindness in world. This optic neuropathy has only one modifiable risk factor, the elevated intraocular pressure (IOP). The structural optic disc damage should also clinically correlate with visual field defects. Classically, glaucoma is divided into two major types namely open angle and angle closure glaucoma. These are further divided into primary and secondary subtypes based on the cause. Primary angle closure glaucoma leads to more blindness than primary open angle glaucoma (POAG). [1]

Among secondary angle closure glaucomas, phacomorphic glaucoma is very common in India.

A gonioscopic evaluation of anterior chamber angle in closed angle glaucomas reveal a lot of variation in anatomy. Patients may have narrow or occludable angles with no other abnormal association or along with closed angle, there may be associated peripheral anterior synechiae and/or raised intraocular pressure orthey may have associated optic nerve damage. Also, the disease causing factors may be acting at different morphologic levels in the eye:- small cornea, shallow anterior chamber, the abnormal iris causing pupillary block, aciliary body abnormality resulting into plateau iris, a swollen lens causing phacomorphic glaucoma, or a pathology posterior to the lens resulting in malignant glaucoma.

Viewing of anterior chamber (AC) angle is an important step in a glaucoma workup, particularly in identifying the closed angle variants. Gonioscopy, though an essential investigation has some limitations. It is a subjective assessment and a lot depends on cooperation of subject and clinical experience of the examiner. The new imaging tools that are being used to evaluate the anterior segment in recent

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times provide us a relatively more objective evaluation of anterior chamber angle that can also be easily quantified. Ultrasound biomicroscopy (UBM) and Anterior segment optical coherence tomography (AS-OCT) are the popular imaging tools that are providing a new insight in both research and diagnosis of closed angle glaucoma patients these days.

The advantages of Optical coherence tomography (OCT) include its non-contact nature and high resolution of images. It gives biometric measurements of angle in real time and in vivo. Measurements that are taken include thickness of central cornea, depth of anterior chamber, angle opening distance, trabecular iris space area, trabecular iris angle, and scleral spur angle, lens vault and lens thickness.

Moghimi et al (2013)[2] compared angle biometric measurements of different subtypes of angle-closure disease with normal eyes. Mei et al (2013)[3] evaluated the lens thickness and lens position in symptomatic and asymptomatic subgroups of primary angle closure (PAC) patients. Mansouri et al (2014)[4] used anterior segment optical coherence tomography (AS-OCT) for angle biometric measurements in lens induced glaucoma and mature cataract cases.

Our study compared the AS-OCT parameters in primary angle closure glaucoma, phacomorphic glaucoma and healthy subjects with the objective to identify AS-OCT parameters that can be used as an indicator for early intervention in primary angle closure patients and mature cataract patients before the actual dreadful glaucoma sets in.

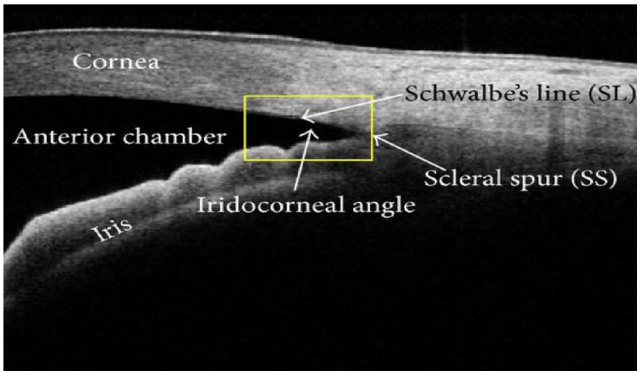

Figure 1: Anterior chamber structures on AS-OCT

2. Materials and Methods

This hospital based observational study of cross-sectional study design was conducted on total 75 subjects at Upgraded Department of Ophthalmology, SMS Medical College & Hospital, Jaipur after obtaining due approval from institutional research review board. A sample size of 25 subjects in each of three groups (acute primary angle closure glaucoma; phacomorphic glaucoma; healthy subjects) was calculated at 80% study power and alpha error of 0.05 assuming standard deviation (SD) =0.44mm anterior chamber depth in the affected eye.

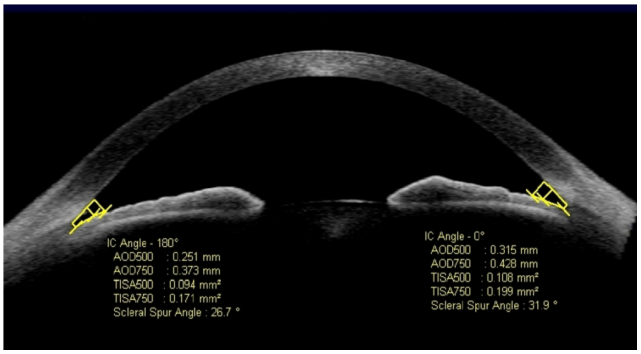

Figure 2: AS-OCT parameters

The study population for the two glaucoma subgroups in this study were phakic patients above 20 years who presented with following clinical features:- 1. Minimum two symptoms suggesting acute increase in IOP, which maybe nausea/ vomiting, sudden blurring of vision, eye pain and/or throbbing headache or history of coloured halos around light. 2 Intraocular pressure above 30 mm of Hg. 3. Ocular signs (seen on slit lamp examination) - corneal edema, conjunctival congestion, shallow AC and a non-reacting semi-dilated pupil. 4. Closed angles in atleast 270 degrees on gonioscopic examination. For acute primary angle closure group, the additional inclusion criterion wasa transparent normal positioned lens. For phacomorphic glaucoma, the additional inclusion criterion was a cataractous swollen nomal positioned lens. The subjects for healthy subgroup were recruited from normal volunteers who were satisfying the following inclusion criteria:- 1. IOP ≤21 mmHg with no history of raised IOP. 2. Normal visual field. 3. Healthy appearance of optic disc. 4. Open angles. Patients who were having pre-existing glaucoma or ocular infection/inflammation or ocular trauma or surgery in affected or contralateral eye or any corneal pathology or myopia were excluded from the study.

All the study subjects underwent complete eye examination along with AS-OCT screening in the affected eye. All the major AS-OCT parameters including anterior chamber depth, lens thickness, lens vault, anterior chamber volume and AOD 750& TISA 750 were measured. Axial length and intraocular pressure were also noted. Once the desired sample size was collected, the data was processed and analysed.

3. Observations

Total of 25 patients were included in each group. The mean age was 63.20±6.60, 60.92±5.83 and 36.16±8.26 years in acute primary angle closure glaucoma (APAC);

phacomorphic glaucoma and normal groups respectively. There was significant (p=0.0001) difference in age among the groups. We found male preponderance in each group with 60% males in APAC, 56% in phacomorphic and 76% males were normal. The post hoc tests revealed that IOP (after the acute attack was broken) was significantly (p=0.02) higher among patients of APAC glaucoma (15.12±2.58) than normal group (13.44±1.58). Axial length was significantly (p=0.0001) lower among patients of phacomorphic glaucoma (22.41±0.55mm) than normal group (23.40±0.33mm). Lens thickness was significantly (p=0.0001) higher among patients of APAC (4.27±0.24mm) than normal group (4.15±0.19mm). Lens thickness was also significantly (p=0.0001) higher among patients of phacomorphic (4.73±0.25mm) than APAC group (4.27±0.24mm). Lens vault was significantly (p=0.0001) higher among patients of phacomorphic (1411.12±265.80 μm) than normal group (575.40±108.72) μm.

We also found that TISA750 was significantly (p<0.05) lower among patients of APAC (0.02±0.01mm^2) than normal group (0.16±0.04mm^2). TISA750 was also significantly (p<0.05) lower among patients of phacomorphic (0.06±0.02mm^2) than normal group (0.16±0.04mm^2). TISA750 was also lower among patients of APAC (0.02±0.01mm^2) than phacomorphic group (0.06±0.02mm^2). Anterior chamber depth (ACD) was significantly (p=0.0001) lower among patients of APAC (1.95±0.12mm) than normal group (3.39±0.57mm). ACD was also significantly (p<0.05) lower among patients of phacomorphic (1.88±0.19mm) than normal group (3.39±0.57mm). Anterior chamber volume (ACV) was significantly (p=0.0001) lower among patients of APAC (97.79±5.36 mm^3) than normal group (134.99±16.03mm^3). ACV was also significantly (p=0.0001) lower among patients of phacomorphic (94.36±6.76mm^3) than normal group (134.99±16.03mm^3) (Figures 3, 4 and 5).

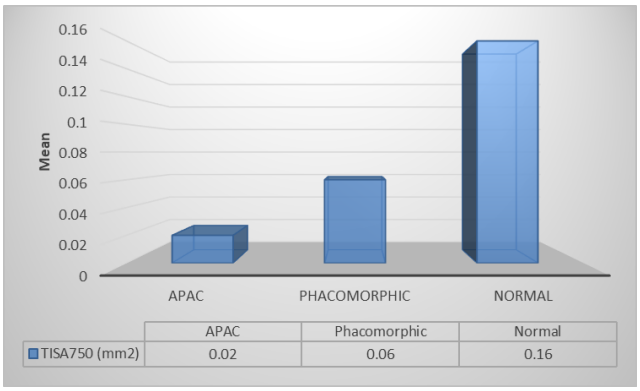

Figure 3: Comparison of TISA750 among the groups

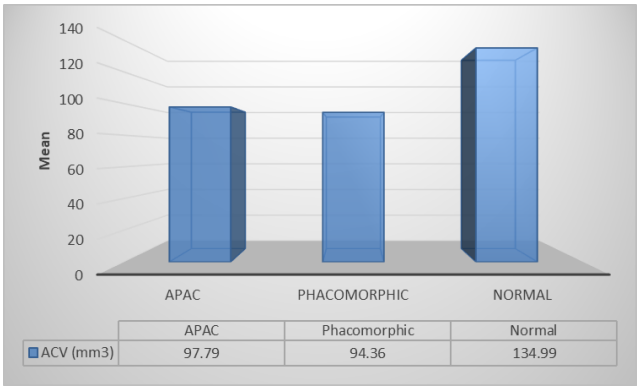

Figure 4: Comparison of ACV among the groups

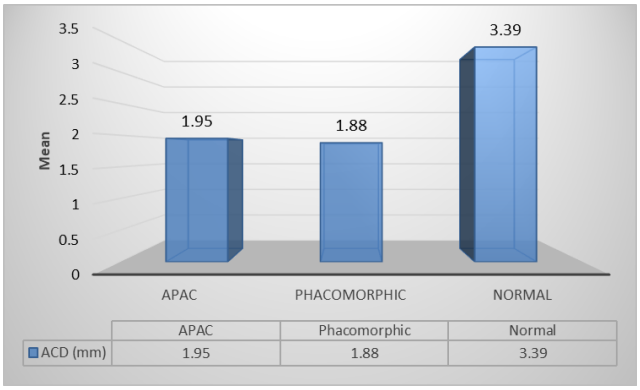

Figure 5: Comparison of ACD among the groups

4. Discussion

Though gonioscopy is the mainstay in diagnosis and follow-up of closed angle glaucomas, the newer anterior segment imaging techniques like AS-OCT which provide real time biometric measurement of parameters of anterior chamber angle are fast becoming a reliable investigation tool in management of both acute primary & secondary closed angle glaucomas.

The present cross-sectional observational study conducted in Department of Ophthalmology, SMS Medical College & Hospital, Jaipur with the objective to describe anterior chamber angle biometric measurements using anterior segment optical coherence tomography in acute closed angleglaucomas and healthy subjects confirms the findings of earlier done studies that have used AS-OCT to evaluate pathogenesis of closed angle glaucomas.

A shallow anterior chamber depth (ACD) predisposes to development of closed angle glaucomas.[5,6] Moghimi et al (2013)[2] found statistically significant variation in different subtypes of primary closed angle glaucoma.

Zonular laxity and choroidal volume expansion have been proposed by some researchers as possible mechanisms for anterior lens movement in an acute attack (Quigley et al, 2003).[7] Normally, a pupillary block mechanism is

Table 1: Comparision of major study variables among the three groups

	APAC	Phacomorphic	Normal	p-value
IOP (after attack was broken)	15.12±2.58	14.56±2.34	13.44±1.58	0.02
Axial length (mm)	21.77±0.57	22.41±0.55	23.40±0.33	0.0001
Lens thickness (mm)	4.27±0.24	4.73±0.25	4.15±0.19	0.0001
Lens vault (μm)	1128.04±129.41	1411.12±265.80	575.40±108.72	0.0001

considered the primary cause of PAC, inducing iris bombe and resulting in increased iris curvature. A lens-induced mechanism has been suggested in the development of both APAC and phacomorphic angle closure (Tomey and Al-Rajhi, 1992).[8] Iris curvature might be reduced after anterior displacement of the lens leading to the volcano type appearance of the iris (Shabana et al, 2012).[9]

Nongpiur et al (2011)[10] observed that lens vault is a prominent prognostic feature of PACG. They found that iris is pushed more anteriorly in eyes with larger vault, resulting in a closed angle. A similar view on the role of lens vault in pathogenesis of closed angle glaucomas is also put forward by other studies.[2,11,12] Lee et al (2014)[13] proposed that reduced iris curvature in an acute attack can be explained by high LV.

In the study, the analysis of variance showed that there was significant (p=0.0001) difference in lens vault among the groups. The post hoc tests revealed that lens vault was significantly (p=0.0001) higher among patients of APAC glaucoma (1128.04±129.41 mm) than normal group (575.40±108.72 mm). Lens vault was also significantly (p=0.0001) higher among patients of phacomorphic (1411.12±265.80 mm) than normal group (575.40±108.72 mm). Compared with normal controls, Moghimi et al (2013)[14] reported a larger lens vault in both acute primary and acute lens induced gluacoma. But, lens induced glaucoma eyes had a mean lens vault that was significantly more than the lens vault in APAC eyes. The variation in LV in the two subgroups remained statistically significant even after adjusting for age.

Mansouri et al (2014)[15] compared axial length in mature cataract and phacomorphic glaucoma cases but did not find statistical significance. In their view, a predisposing morphology of anterior segment of eye plays a more pertinent role in genesis of phacomorphic angle closure.

Our study had few limitations. It was a cross- sectional study. Secondly we did not evaluate morphology of anterior chamber angle before the acute episode. So, theoretically, we cannot be sure about the role the anterior chamber biometric measurements and lens thickness played in the actual pathogenesis of the acute condition. The study could not address the combined lens-related and pupil block mechanisms. Also, this study excluded cases in which we were unable to break the acute attack medically and by that we might have excluded more severe cases in each group. Also, the study was unable to measure lens thickness accurately in mature cataracts.

5. Conclusion

In spite of its limitations, the present study was able to highlight the role of newer imaging tools in measurement of anterior chamber angle dimensions and concluded that evaluation of AS-OCT parameters do have a role in management of closed angle glaucomas. However, more studies especially of longitudinal nature are needed to get a more in depth information on the subject.

6. Source of Funding

None.

7. Conflict of Interest

None.

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