Study of the Epidemiology of Open Angle Glaucoma and Comparison of Central Corneal Thickness in Open Angle Glaucoma with Optical Coherence Tomography (OCT) and Ultrasonic Biomicroscopy (UBM)

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ABSTRACT:

Aim: 1.To study epidemiology of Primary Open Angle Glaucoma (OAG) in patients who attended general Out Door Patient Department at a tertiary referral care centre.
2.To measure and to compare Central Corneal Thickness (CCT) by Anterior Segment Optical Coherence Tomography (AS-OCT) and Ultrasound BioMicroscopy (UBM) in Primary Open Angle Glaucoma (POAG) patients. **Material and methods:** In this retrospective study, 90 eyes of 45 patients who were diagnosed with POAG were taken, during Sept 2011 to Sept 2013.After detailed history taking, slit lamp examination of anterior segment, Intra Ocular Pressure (IOP) measurement, Gonioscopy & fundus and visual field examination was done.UBM was done to analyse anterior segment parameters including anterior chamber angles and CCT.AS-OCT used to analyse central corneal thickness. **Result:** Majority of patients were in the age group of 41-60yrs(28 patients,62%), Male:Female - 29:16, 11 patients were presented at advanced stage of disease; out of them 7(63.63%) were from low socio-economical class, 62 eyes had CCT<540microns, 28 eyes had CCT>540microns in OCT ,Mean CCT:530u, 24 eyes had CCT<540microns, 66 eyes had CCT>550micron in UBM, Mean CCT:553u, UBM overestimates CCT in the range of 20-25 microns. **Conclusion:** POAG is a disease of old age with male dominance, in our study.25 % patients were presented with advanced glaucoma & most of them were from poor socio economical class. Majority had moderate glaucomatous changes. Both UBM and AS-OCT are useful for assessment of the anterior chamber and angle of the eye, therefore it is for the individual physicians to choose the platform that suits their preferences and needs.

Key Words: Primary Open Angle Glaucoma, CCT (central corneal thickness), UBM (ultrasound Biomicroscopy), OCT(Optical Coherence Tomography)

Introduction:

The word Glaucoma means "CLOUDED" in Greek. It refers to a group of diseases that differ in their clinical presentation, pathophysiology and treatment. It represents the second most common cause of blindness in the world, 13.5 million people being affected with glaucoma in India. Glaucoma is defined as multifactorial anterior ischemic optic neuropathy characterized by typical optic nerve head changes and visual field defects for which raised intraocular pressure is the most important risk factor. Glaucoma can be classified into developmental and acquired glaucoma. Open angle glaucoma is a chronic, progressive, anterior

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ischemic optic neuropathy that is accompanied by a characteristic cupping and atrophy of the optic disc, visual field loss, open angles and no obvious causative ocular or systemic conditions. Primary open angle glaucoma is a diagnosis of exclusion. Many multicentric trials (Ocular Hypertension Glaucoma Treatment Trial, Early Manifest Glaucoma Trial) have found out risk factors associated with POAG. Among the risk factors of interest in our study is **Central Corneal thickness (CCT).** Many studies have documented the role of central corneal thickness as an independent risk factor for progression from ocular hypertension to early glaucoma. So accurate measurement of CCT in glaucoma patients is of prime importance. We conducted the following study to answer the Question 'Can we measure CCT accurately and reliably on UBM in OAG patients'.

The study:

The presented study is a comparative study correlating central corneal thickness in POAG patients measured on **Anterior Segment Optical Coherence Tomography (AS-OCT) and Ultrasonic Biomicroscopy (UBM).**

The capability of AS-OCT to measure CCT has been demonstrated recently. This technique allows a two dimensional mapping of corneal thickness by using non-contact, non invasive, cross sectional visualisation of the human cornea. Anterior Segment Optical Coherence Tomography produces images similar to B-mode ultrasound imaging using light instead of ultra-sound. UBM had played the dominant role in objective imaging of the anterior chamber angle until AS-OCT was introduced in 2003. The advantage of AS-OCT is its non-contact scanning method that is performed in the sitting position, where UBM requires a plastic or silicone eyecup to hold a coupling medium, which requires supine positioned scanning.

Materials and methods:

Study design:

Our study was a retrospective study conducted at a tertiary referral care centre. The study was undertaken during the period of Sep 2011 to Sep 2013. We studied 90 eyes of 45 patients who were diagnosed with OAG.

Inclusion criteria:

Diagnosed cases of POAG with clear corneas.

Exclusion criteria:

- POAG patients who underwent any type of surgical intervention
- POAG patients with hazy corneas
- Pre perimetric glaucoma patients
- Angle closure glaucoma patients
- Congenital /Juvenile glaucoma patients
- Mixed mechanism glaucomas
- Traumatic Glaucoma, Malignant Glaucoma

- Secondary Glaucoma

All patients included in our study underwent following set of examinations:

- A detailed history-taking especially family history and examination of anterior segment with slit lamp was done in all patients selected for the study
- Photographic documentation of the anterior segment finding was done.
- IOP was measured using Perkin's hand held tonometer.
- Gonioscopy was done using Goldman two mirror and graded as per Shaffer's classification.
- Fundus examination using direct or indirect ophthalmoscope and slit lamp biomicroscopy was done in all patients.
- Visual field examination with Octopus perimeter was done in all patients.
- UBM using a 50Hz probe was done at biometry mode to analyse anterior segment parameters including central corneal thickness.
- Anterior segment-optical coherence tomography use to measure central corneal thickness.

UBM Technique:

In UBM (Biomedix) procedure, the patient is in supine position with topical anaesthesia (Lignocaine 2%) and a Silicone cup containing saline or gel holds the lids open and allows immersion of the probe. . UBM reaches specific areas of the eye such as the lens, zonules, ciliary body and pars-plana. Images are seen on the monitor.

Image 1- UBM Techniue
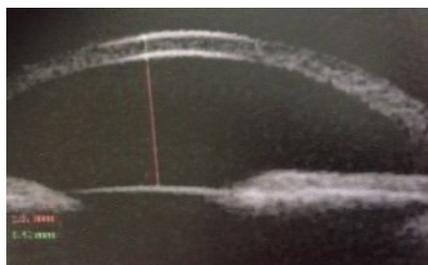
AS-OCT Technique:

AS-OCT done with instrument 3D-Topcon Medical Systems, Oakland, NJ. It is used with the patient seated in the upright position. Images are seen through the monitor and the operator conducts the examination. During examination give instruction to patient look straight to the object and not to blink the eye.

Image 2- AS-OCT Technique
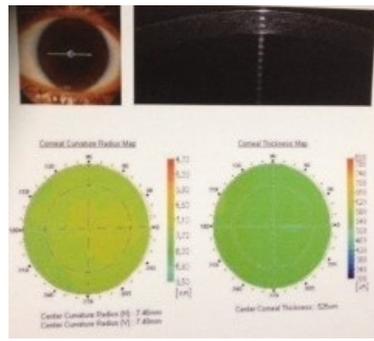

Observations & Discussion:

90 eyes of 45 patients diagnosed with POAG satisfying our inclusion criteria were included in our study.

Age-wise distribution: In our study, the age of the patients ranged between 30 to 80 yrs. Majority of patients were in the age group of 41-60 yrs(28 patients, 62.22%) followed by 61-80(11 patients, 24.44%).

| AGE	MALE	FEMALE	TOTAL
30-40	6	0	6
41-60	16	12	28
61-80	7	4	11
TOTAL	29	16	45

Various studies have been done by many researchers, Wales (Hollows and Graham) Framingham, Mass(Liebowitz and Co- workers), Baltimore White (Tielsch and Co workers), Baltimore Black (Tielschand Co-workers). They have concluded that the risk of OAG increases with maximum incidence 12% in age range of 70-80 yrs.
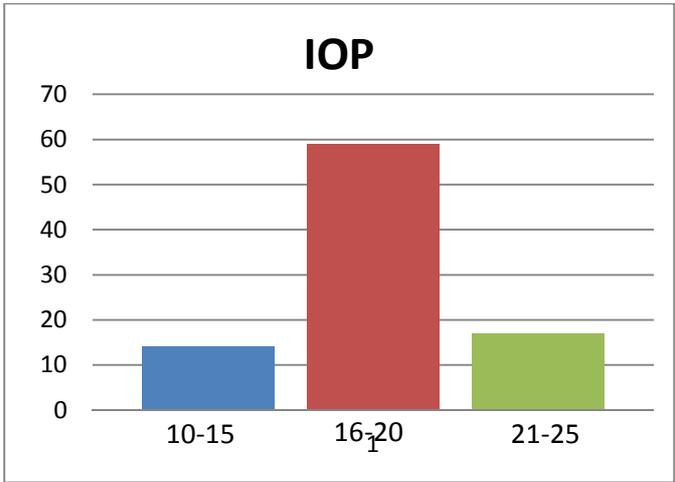
Sex-wise distribution:
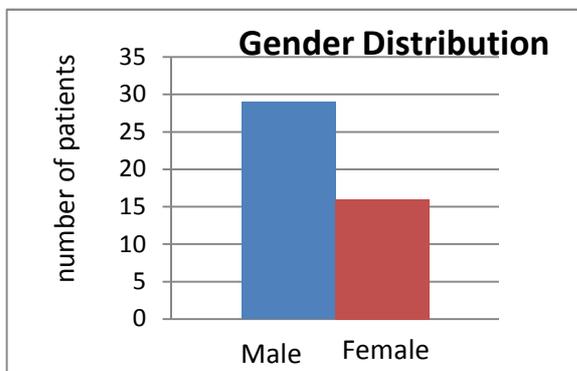
Male outnumbered females, 29 vs. 16.

**Influence of socio economical status on stage of diagnosis of disease:**
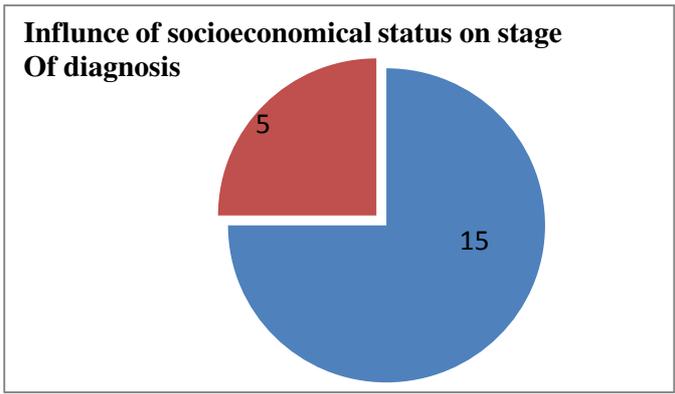
20 out of 45 patients had advanced glaucomatous changes at the time of presentation. Out of them, 15 were from low socio economical class, which indicates lack of awareness of disease among them.

Since the inclusive criteria included only well controlled glaucoma patients with clear cornea, most of the patients had IOP in the range of 16-20(59 eyes, 65.55%)

Optic Nerve Head Change
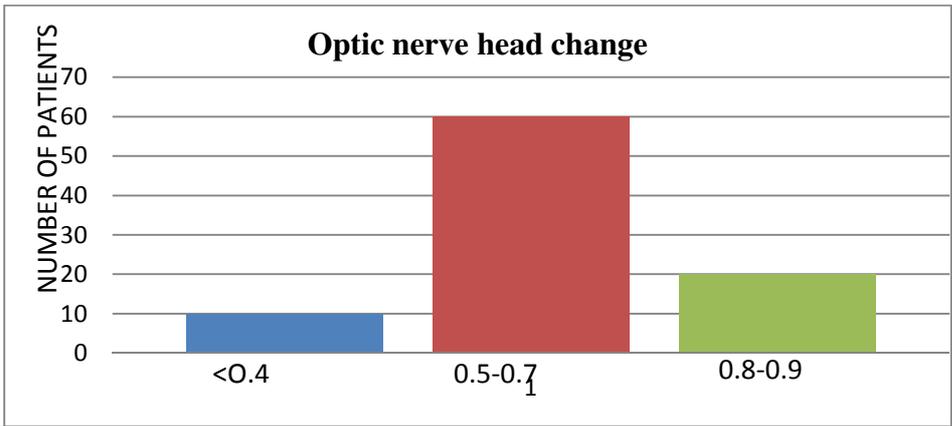
10 eyes had early ONH changes, 60 eyes had moderate ONH changes and 20 eyes had advanced damage.

Co-relation of CCT with optic head changes:

Out of 64 eyes documenting thin corneas (<540), glaucomatous optic nerve head changes were documented in 33(51.56%) eyes; reflecting positive correlation (r=+0.33)

The study done by Jost B. Jonas, Andrea Stroux, Isabel Velten, Anselm Juenemann, Peter Martus and Wido M. Budde on 854 eyes of 451 patients with OHT/POAG showed a highly significant association between a thin central cornea and more pronounced

glaucomatous optic nerve damage in patients at the time of first referral to a glaucoma centre. Central corneal thickness correlated significantly (p<0.001) and positively with the area of the neuroretinal rim and negatively with the loss of visual field. Development or progression of glaucomatous visual field defects detected in 119(21.0%) eyes was statistically independent of central corneal thickness, in univariate (p=0.99) and multivariance Cox regression analyses (p=0.19)

MPakravan, AParsa, MSanagou, CF Parsa. Central corneal thickness and correlation to optic disc size: a potential link for susceptibility to glaucoma. Also concluded by OHTs study, Normal Tension Glaucoma/OHT/POAG patients with advanced glaucomatous optic nerve head had thin corneas thus indicating thin cornea increases the likelihood of disc damage.

Visual field change:
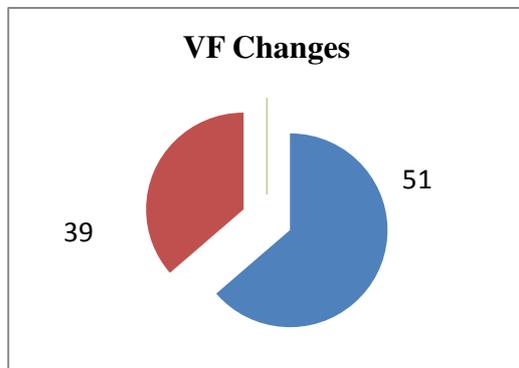
No VF defects were documented in 39 eyes and majority of patients had vf defects (51 eyes)

Correlation of CCT with VF:

Out of 64 eyes who had thinner corneas (<540) in our study, 34(53.13%) documented visual field defects. This correlation was found to be statistically significant(r=+0.43).

Meireles SH et at in his study on 450 patients documented severe field loss associated with lower corneal thickness compared with patients with mild and moderate visual field loss and normal corneal thickness.

In Jonas et al. s prospective study of 861 eyes (Normal, OHT and POAG), Follow up of 5 years, CCT correlated positively with area of neuro-retinal rim, but negatively with VF loss. Progression of VF defects in 119 eyes (21%) was independent.

Herndon LW, Weizer JS, Stinnett SS: Central corneal thickness is a risk factor for advanced glaucoma damage.

Jimenez-Rodriguez E, Lopez-De-Cobos M, Luque-Aranda R, Lopez-Egea_Bueno MA, Vazquez-Salvi AI, Garcia-Campos JM: A thin central cornea is a well known risk factor for the development of POAG and probably represents a predictor of greater severity of visual field loss in established patients.
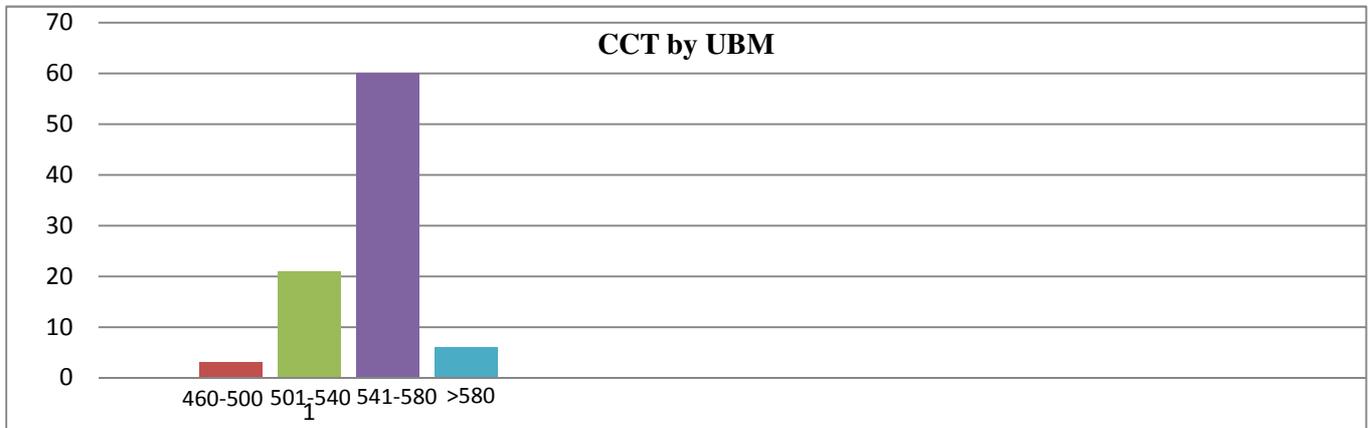
CCT via OCT:
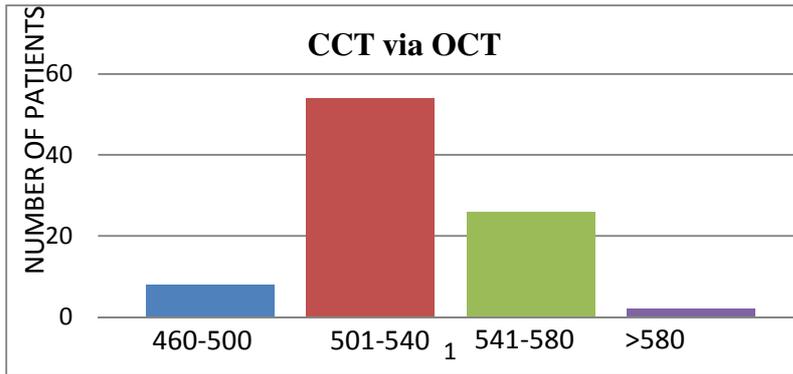
62 eyes had <540 microns. 28eyes had CCT>540 microns.

Mean CCT: 530

CCT by UBM:

24 eyes had CCT<540 microns. 66 eyes had CCT>540 micron. Mean CCT: 553u

UBM overestimates CCT in the range of 20-25 microns.

p Value And Statistical Significance:

When we correlate value (central corneal thickness) of both OCT and UBM with t-test. The P value is less than 0.0001

By conventional criteria, this difference is considered to be highly statistically significant.

Paul et al' found Artemmis 2 CCT values to average 11 micrometer thinner than Ultrasonic pachymeter (USP), which , together with the 30-micrometer difference observed in our present study, suggests an expected difference between Visante and USP of 19 micrometer.

Li and co- workers (2207) concluded that AS-OCT under-estimated corneal thickness compared with that measured with USP.

Bland-Altman analysis showed the CCT as measured by USP was significantly higher by 16.5+/- 11.7microm than AS-OCT (limits of agreement -6.1 to 39.1, p<0.001).

Milla et al showed Visante OCT to give consistently thinner results than the Sirius Scheimpflug system UBM (Schwind, Kleinostheim, Germany) centrally and peripherally.

Dip neuroscienze e Organi di Senso, University di Bari, Italy (MD) found that there was significant difference between the mean CCT, and angle parameters measured by AS-OCT and HF-UBM.

We conclude UBM is not reliable for accurate measurement of CCT than OCT.

CONCLUSION:

- P0AG is a disease of old age. Most of the POAG patients were beyond 50 years (64%)
- Male dominance was noted in our study.
- Most of the patients have more than ambulatory vision, only one patient was crippled with poor vision.
- 25% patients had advanced ONH changes but majority of patients had moderate ONH changes.
- Patients coming from lower socio economical class usually present at advanced stage of glaucoma which indicates lack of awareness of disease among them.
- Glaucomatous VF defects were documented in 51 eyes.
- Positive correlation was noted between thin corneas and VF defects. Similarly patients with thin corneas had advanced ONH changes. This association was also noted in our study.
- UBM and AS-OCT have their specific advantages and uniqueness in their role in anterior segment imaging. Ideally both should be used in glaucoma evaluation, though in reality clinicians do not have the luxury to have both imaging modalities.
- The two modalities differ in their ease of use, The UBM, unlike that of AS-OCT necessitating longer training and reasonably good understanding of the anatomy of the anterior segment on the part of the examiner. However, the quality of images captured by the UBM, especially of the peripheral angle recess is slightly better than that of the AS-OCT.
- UBM is not a sensitive instrument to measure CCT as compared to OCT. Neither it is specific to rightly pick up thin corneas, since no standardization methods are available to measure CCT. It lacks reproducibility and accuracy.
- Still more research and advancements are required to standardize the methods and techniques in order to make UBM reliable, accurate and reproducible.
- Ultimately both modalities are useful for qualitative and quantitative assessment of the individual physicians to choose the platform that suits their preferences and needs.

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