Analysis of Epidemiological Distribution and Quality of Life in Patients of Advanced Glaucoma with Their Associated Fundus and Optical Coherence Tomography Features

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Abstract:

***Aim** – Analysis of epidemiological distribution and quality of life in patients with advanced glaucoma and their associated fundus and optical coherence tomography features*

***Material & method** –Patients diagnosed with glaucoma and no other ocular comorbidity were consecutively recruited. Clinical information was collected. All patients undergone serial monitoring of vision & intraocular pressure with added investigation like Gonioscopy, Dilated fundus examination for disc changes, Clinical photography & optical coherence tomography for retinal nerve fibre thickness and ganglion cell complex assessment. Participants were asked to complete glaucoma quality of life 15 questionnaires to assess quality of life associated with advanced glaucoma state.*

***Result** – Older patients of reserved socioeconomic profile residing in rural area are more at risk of unilateral or bilateral advanced glaucomatous disc damage due to lack of awareness of disease and its progression. The relative emphasis of main priorities of patients (reading and seeing details and outdoor mobility) changed with increasing severity of glaucoma.*

***Conclusions** –According to our study, advanced glaucomatous disc cupping is co-related with subsequent retinal nerve fibre layer and ganglion cell layer thinning as the disease progress, demonstrated by optical coherence tomography. Severity of glaucoma frequently has a large impact on a patient's quality of life.*

***Keywords:** Population survey, Disc cupping, Advanced glaucoma and Quality of life.*
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I. Introduction

Glaucoma refers to a group of conditions characterised by typical changes to the retinal nerve fibre layer and optic nerve head resulting in reduced visual field sensitivity. Its enormous social and economic impact can be appreciated by the fact that it remains as one of the leading cause of blindness worldwide [1]. Not surprisingly, glaucoma research is going on to reduce this burden through improved disease detection and more effective treatments. Specific areas of focus include methodologies for earlier diagnosis, elucidating modifiable risk factors and developing better intraocular pressure (IOP) -dependant and non IOP-dependant treatments. As the anatomical and functional changes from glaucoma are largely irreversible, early disease detection remains an important strategy to prevent visual impairment. This has been achieved by assessing optic nerve structure and function using optic nerve imaging and perimetry, respectively. Although fundamentally unchanged for several decades, both imaging and perimetric techniques have improved considerably. Newer strategies are emerging to complement these established techniques. These include retinal nerve fibre analysis and the detection of retinal ganglion cell apoptosis in vivo.

The fundamental concept of the proposed classification for cross sectional epidemiological research is that the term glaucoma is reserved for people with established, visually significant, end organ damage. In the public health context, glaucoma can be seen as an optic neuropathy associated with characteristic structural damage to the optic nerve and associated visual dysfunction that may be caused by various pathological processes.

There is no universally accepted definition of end-stage glaucoma. It may be based on a very constricted visual field, less than 10 or a visual acuity of 20/200 or worse that is attributable to glaucoma [2]. Glaucoma is the second leading cause of irreversible blindness in the general population, and the leading cause of blindness in black patients. Besides, patients with end-stage glaucoma have a high risk of further disease progression. Although peripheral vision is seriously affected, these patients may maintain good central vision sufficient enough to perform simple daily tasks. Due to the intractable nature of the disease the patient usually spends, following diagnosis, the rest of their life attending an eye hospital, taking frequent (daily) ocular anti-hypertensive medication and treatment is expensive, associated with side effects, and often inconvenient to

instill as well. It is therefore not surprising that glaucoma frequently has a large impact on a patient's quality of life [3]. 'Quality of life' is determined by an individual's own assessment of their physical, psychological and social wellbeing. The diagnosis of glaucoma affects people in different ways. Some readily accept the diagnosis and are keen to seek out information [4]. Others are more ignorant and disappear into the community, only to return years later with a marked deterioration in their visual function. Most patients fall in between the two extremes and adhere to their treatment in the main with little or no understanding of the disease process. Patients can lose their quality of life for a number of reasons like distress of the diagnosis, the insidious loss of vision and independence, the problems with frequent treatment and regular hospital outpatient appointment reviews.

II. Materials and Methods

This is a population based analytic study done in outpatient department in upgraded department of tertiary eye care hospital in central Rajasthan India. We examined total 50 patients previously diagnosed glaucoma with advanced glaucomatous damage to disc as cup: disc ratio equal or more than 0.7: 1, who came for regular follow-up in the glaucoma unit. All patients were 40 years of age or older, spoke hindi, and had no cognitive impairment. Patients with all stages of glaucomatous optic nerve damage as cup: disc ratio equal or more than 0.7: 1 and undergoing all types of treatment, including surgery, were included. For comparison and analysis, reference population was selected within same age group without any significant ocular diagnosis. End-stage glaucoma grossly based on a very constricted visual field, less than 10 or a visual acuity of 20/200 or worse that is attributable to glaucoma. Further investigations like gonioscopy, dilated fundus examination, clinical photography, Optical coherence tomography were carried out and the results were analysed.

Advanced stage glaucoma carries a diagnostic challenge. Visual field examination is either unreliable or impossible. Only when a central island of vision remains, visual field tests of the central degrees can be chosen. That's why we didn't get any useful information regarding visual field of the patients due to significant low vision. Small changes in the visual field may be deleterious to central vision but it can be difficult to differentiate them from inter-test fluctuation. Small neuroretinal rim changes may correspond to significant changes in the visual acuity. On the other hand, OCT may be useful in the detection of glaucomatous progression. In advanced or progressive glaucoma, imaging can be justified every 3–4 months to look for change [5]

Optical coherence tomography (OCT) in glaucoma offers the opportunity to objectively measure the retinal nerve fibre layer and its associated change with time. It is an attractive tool in glaucoma assessment due to its ability to take non-contact, objective high-resolution measurements. Newer generation OCT scanners, referred to as spectral or Fourier domain (SD) OCT, are 200 times faster than the older time-domain (TD) octs, reducing patient movement artefact and increasing axial resolution. The new SD octs are able to achieve a resolution of 3-6 microns compared with a 10-micron resolution previously achieved with TD OCT [6].

The English version of the Glaucoma Quality of life Questionnaire GQL-15 was accomplished by the patients and reference population with the help of their regional language. All the responses of both the groups were noted and analysed by using commercially available software. Glaucoma QoL questionnaires, especially the Glaucoma Quality of Life-15 (GQL-15), are highly correlated with visual indices and visual performance, and can be used quantitatively to assess patient satisfaction or to detect increasing visual burden [7]. Quality of life (QoL) assessment can assist the clinician and patient to make difficult clinical choices, as well as to individualise therapy. It allows the clinician to assess the impact of glaucoma on the patient's daily life and then guide appropriate interventions, including modification of the patient's home environment to minimise obstacles, improve lighting, or to receive appropriate assistance. As more information, revealed by QoL analysis in severe glaucoma patients, it can be used to inform newly diagnosed patients about the potential impact of glaucoma on their lives in a meaningful way. There are a number of well-documented tools that have been used to quantify the subjective status of glaucoma patients [7,8]. These include

- Generic instruments i.e. not disease state specific : SF-36 (The Medical Outcomes Study Short Form-36), SIP (The Sickness Impact Profile)
- Vision specific instruments :VF-14, NEI-VFQ (The National Eye Institute Visual Function Questionnaire) , NEI-VFQ-25 (The 25-item National Eye Institute Visual
  Function Questionnaire, ADVS (The Activities of Daily Vision Scale)
- Glaucoma-specific instrument :GSS (The Glaucoma Symptom Scale) , COMTOL (The Comparison of Ophthalmic Medication for Tolerability) , GQL-15 (The Glaucoma Quality of Life-15) , SIG (The Symptom Impact Glaucoma Score)

The Glaucoma Quality of Life (GQL-15) questionnaire asks 15 rating-scored questions to assess the degree of functional disability caused by glaucoma. The questions used were the 15 most significant predictors of visual field loss derived from an original 62 point questionnaire. They include six questions relating to actions demanding functional peripheral vision, six relating to dark adaptation and glare, two relating to central

and near vision and one relating to outdoor mobility.(Table 6) The glaucoma symptom scale (GSS) It includes 10 items, grouped into 2 domains: the non-visual symptoms (six items) and the visual ability (four items) subscales. Furthermore, it is short and easy to use and thus, very practical for implementing in daily clinical practice.(Table 7)

III. Results

The study was conducted on total 50 patients having advanced glaucomatous damage who came for regular follow-up in the glaucoma unit at a tertiary eye hospital in central Rajasthan in India. Total 25 male and 25 females were included in this study ($x^2=0$,p=1 difference statistically not significant). there were 08 females in age group 40-50 years, 07 females in 51- 60 years, 06 females in 61-70 years and 04 females in > 70 years. Similarly 07 males in 51-60 years, 08 males in 61-70 years, 10 males in > 70 years. (Table -1)

Among those with glaucoma, 45% were taking medications only, 13% were not receiving medications (but had received either a laser trabeculoplasty or a trabeculectomy), 42% were taking medications and had received a laser trabeculoplasty or trabeculectomy. Of the patients with glaucoma, 62% were taking a topical β-blocker with alpha agonist , 18 % were taking dorzolamide eyedrop, 17% were taking prostaglandin analog preperations , and 3% were taking an oral carbonic anhydrase inhibitor.

We also studied patients according to socioeconomic categories and their demography to find out any co-relation of distribution of advanced glaucomatous disc changes in them. This included total 13 unresreved and 17 reserved patients of rural origin whereas 12 unreserved and 08 reserved patients from urban area (Table-2 x^2 =1.33, p=0.24 ,difference not statistically significant) showing their equal distribution of end stage glaucoma but higher cup disc ratio in lower socioeconomic rural based patients supporting the fact that they ignore the disease at early stage and progress rapidly to advanced glaucoma due to lack of knowledge and facilities. Grossly there is progressive thinning of peripapillary retinal nerve fibre layer thickness and parafoveal ganglion cell layer thickness as the cup disc ratio goes on increasing till advanced changes of optic atrophy. (Table-3)

Quality of life in patients with advanced stage of glaucoma and reference group assessed by Glaucoma QOL-15 questionnaire results shows that glaucoma especially advanced stage affects patients frequently socially and psychologically that influence the perception of their visual morbidity. All four domain of quality of life (glare, peripheral vision, central near vision and outdoor mobility) has highly significant statistical value than reference group. That means glaucoma especially advanced stage has significant and large impact on patients quality of life in daily routine. (Table 4)

As expected, a larger percentage of the glaucoma group positively endorsed each of the 10 ocular complaints of the Glaucoma Symptom Scale than reference group individuals (Table 5). This difference was statistically significant (P<.05)

After observing all total 50 patients with the data of age, sex, locality, socioeconomic profile, fundus changes, optical coherence tomography findings we came to know that as stated in literature young age group patients shows less advanced disc changes compared to older age group without any gross sex predilection. Reserved categories of socioeconomic group of rural origin were more affected by advanced disc cupping as compared to reserved urban.

As in this study we took average retinal nerve fibre layer thickness and ganglion cell layer thickness which appears to be very slightly differing in all the three groups, but on studying individual patients showed marked changes in these variants structurally on studying optical coherence tomography findings

Table 1 : Age And Gender Wise Distribution of Patients

Sr. No.	Male	Female
<40 Years	00	00
40-50 Years	00	08
51-60 Years	07	07
61-70 Years	08	06
>70 Years	10	04
Total	**25**	**25**

(x^2=0,p=1 difference statistically not significant)

Table 2: Distribution Of Patients According to Socioeconomic Category And Demography

	Unreserved No. Of Patients	Reserved No. Of Patients
Rural	13	17
Urban	12	8
Total	25	25

(x^2=1.33, p=0.24 ,difference not statistically significant)

Table 3: Distribution of findings on Fundus And Optical Coherence Tomography

Cup Disc Ratio	Average Retinal Nerve Fibre Thickness		Average Ganglion Cell Layer Thickness	
	Superior	Inferior	Superior	Inferior
0.7 : 1	75.83	95.33	62.16	63
0.8 : 1	75.91	77.75	57.57	53.28
$\geq$0.9 : 1	73.71	74.28	44.33	51.16

Table 4: Distribution according to quality of life by GQL-15

Domains	Cases(N=50) Mean $\pm$ S.D	Controls (N=50) Mean $\pm$ S.D	t -test/p- value
Glare	14.41$\pm$5.79	6$\pm$1.02	t=10.11 p=0.0001
Peripheral vision	17.50$\pm$7.25	6$\pm$2.18	t=10.74 p=0.0001
Central near vision	5.58$\pm$2.90	2$\pm$0.89	t=8.72 p=0.0001
Outdoor mobility	2.16$\pm$1.46	1$\pm$0.55	t=5.25 p=0.0001

Table 5: Distribution according to glaucoma symptoms scale (GSS-10) score

Variables	Cases(50)	Controls(50)	t test/p value
Visual complains related (4)	8$\pm$3.8	2$\pm$0.05	t=11.16 p=0.0001
Non Visual complains related (6)	6$\pm$4.49	4$\pm$0.11	t=3.14 p=0.002

Table 6: The Glaucoma Quality Of Life-15 Questionnaire

	None	A little bit	Some	Quite a lot	Severe	Do not perform for non visual reasons
Reading newspaper	1	2	3	4	5	0
Walking after dark	1	2	3	4	5	0
Seeing at night	1	2	3	4	5	0
Walking on uneven ground	1	2	3	4	5	0
Adjusting to bright light	1	2	3	4	5	0
Adjusting to dim light	1	2	3	4	5	0
Going from light to dark or vice versa	1	2	3	4	5	0
Tripping over objects	1	2	3	4	5	0
Seeing objects coming from sides	1	2	3	4	5	0
Crossing the road	1	2	3	4	5	0
Walking on steps/stairs	1	2	3	4	5	0
Bumping into objects	1	2	3	4	5	0
Judging distance of foot to step/curb	1	2	3	4	5	0
Finding dropped objects	1	2	3	4	5	0
Recognizing faces	1	2	3	4	5	0

The Glaucoma Quality Of Life-15 Questionnaire: List of daily activities with the strongest relationship with visual field loss in Glaucoma (patients instructions: please circle the correct answer on the scale ranging from 1 to 5 where (1) stands for no difficulty, (2) for a little bit difficulty, (3) for some difficulty (4) for quite a lot difficulty (5) for severe difficulty. If you do not perform any of the activities for other than visual reasons, please circle (0). Does your vision give you any difficulty, even with glasses, with the following activities?)

Table 7: The Glaucoma symptom Scale (GSS)

	Symptoms	Yes, very bothersome	Yes, somewhat bothersome	Yes, a little bothersome	Yes but not bothersome at all	No, absent
1	Burning, smarting, stinging					
2	Tearing					
3	Dryness					
4	Itching					
5	Soreness, tiredness					
6	Blurry or dim vision					
7	Feeling of something in eye					
8	Hard to see in daylight					
9	Hard to see in dark places					
10	Halos around lights					

IV.   Discussion

Our Study showed a data of 50 patients of known case of glaucoma patients with advanced and end stage glaucomatous disc changes equal or more than 0.7:1 co-related with their decreased visual acuity and

optical coherence tomography features relating thinning of retinal nerve fibre layer and ganglion cell complex. The potential power of Spectrum Domain OCT in glaucoma management is enormous but is dependent on establishing structural and functional relationships. Ideally changes should be detected earlier than with the traditional gold standard of visual fields and ophthalmoscopic examination of the optic nerve head. The changes detected should also be reproducible so that progression can be accurately monitored with time. Vizzeri et al[9] and Gonzalez-Garcia et al[10] both demonstrated that excellent reproducibility can be obtained with two different commercially available machines (Cirrus and RTVue). In addition, other investigators looking at variability and comparing spectral based technology with time based systems concluded that there was less variability in retinal nerve fibre layer measurements with the newer technology[11,12] . Like Time Domain OCT, the newer Spectrum Domain OCT can obtain data in two methods - direct circular scanning and re-sampling the data of interest.

From a 3-D data set, Shin et al[13] tested retinal nerve fibre layer (RNFL) thickness measurement reproducibility by both re-sampling and direct circular scanning using the RTVue OCT; they were able to show excellent reproducibility in both modes. Improved reproducibility of RNFL measurement by Spectrum Domain-OCT may enhance the ability to detect glaucoma at an earlier stage by enabling the detection of smaller changes at an earlier stage than Time Domain-OCT previously allowed. However, due to the slow progression of glaucoma and the relative newness of this technology we must wait for longer-term studies to determine its ability to detect glaucoma at an early stage.
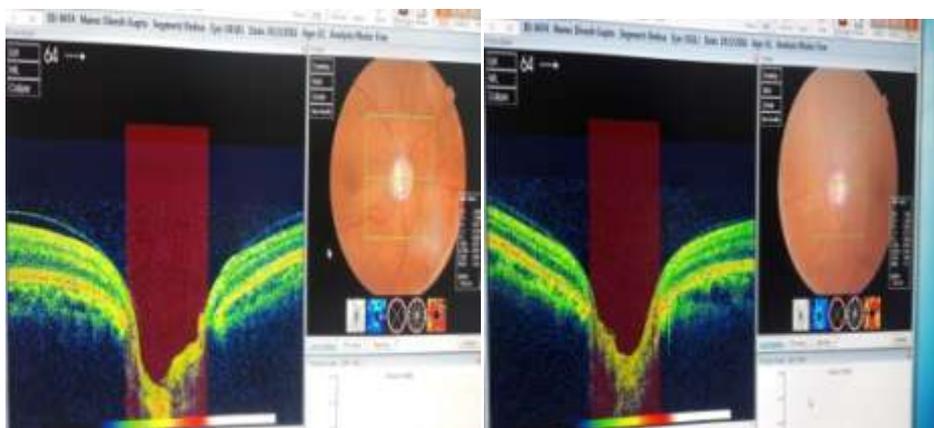

Figure 1: OCT and Fundus pictures of Right eye (Up left) & Left eye (Up right)

Therefore to avoid any dilemma we selected patients with advanced disc cupping ≥0.7:1 Cup disc ratio with known Glaucoma avoiding other patients like having physiological disc cupping. Increasing disease severity led to a poorer quality of life (QoL) status, as demonstrated by Glaucoma QOL-15 questionnairs. Central and near vision, peripheral vision, and outdoor mobility were the most affected domains among individuals with glaucoma[14]. Knowledge and information regarding the QoL of glaucoma patients could be useful in several aspects. It can help 'decision making' concerning customized disease management of individuals with glaucoma and promote alterations and guidelines regarding patients' daily living and safety (i.e. adjustment of home environment), in order to avoid problems concerning adaptation to variable lighting conditions, avoiding obstacles, near activities, outdoor mobility/activities (walking, driving) and other tasks that glaucoma patients seems to give the greatest importance and are significantly correlated with their QoL.[5,16]

V.   Conclusions
In advance stage glaucoma there is a higher incidence of visual loss than early glaucoma. So, frequent patient monitoring and quick decision making should be done. Higher level of consideration should be given to the more neglected group of patients of lower socioeconomic profile and those residing in rural area in relation to awareness of disease, symptomology and its progression, importance of timely follow up, regarding compliance of drugs used, so that everyone should at least take care of avoiding the disease progression to more advanced end stage.

Inclusion of quality of life assessment in patients with glaucoma into routine clinical practice can complement treatment modalities by providing comparable symptom profiles. And, ultimately, may help illuminate the quality of life experienced by patients with glaucoma.

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