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# AN EXPLORATORY PROFILE OF PATIENTS WITH PRIMARY OPEN ANGLE GLAUCOMA ATTENDING A HIGH-VOLUME EYE HOSPITAL IN EASTERN NEPAL (BIRAT EYE HOSPITAL)

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**ABSTRACT**

**Purpose.** To explore the profile of patients with primary open angle glaucoma (POAG) attending Birat eye Center, a high- volume eye hospital in eastern Nepal

**Methods.** 100 patients (200 eyes) with POAG, mean age of 54, seeking medical service for the first time for their condition were enrolled in the study. Measurements of vertical cup-to-disc ratio (CDR) were performed with indirect ophthalmoscopy using a slit-lamp (Haag-Streit) with a 78D Volk lens by 2 experienced clinicians, and the results were averaged. Average visual field (VF) sensitivity were obtained in decibels (dB) with an Octopus 600 automated perimeter (Haag-Streit, Zeiss Inc.), and intra-ocular pressure (IOP) were recorded with a Riester Schiontz tonometer in millimeters of mercury under supine condition in all the patients.

**Results.** There was a linear correlation between average CDR and average VF sensitivity in both eyes ($r^2$=0.30). There was no correlation between levels of IOP to either CDR measurements or average VF sensitivity. VF damage was more correlated in between the two eyes ($r^2$=0.20), compared to CDR ($r^2$=0.06). However, the correlation between absolute difference of CDR measurements and VF sensitivity between the two eyes, were the strongest ($r^2$=0.47).

**Conclusion.** Most of the patients with POAG attending the center had moderate to severe level of neural damage, and basic ONH examination by estimation of vertical CDR, and especially the degree of asymmetry between two eyes was found to be a useful indicator for the presence of glaucoma.

**KEYWORDS :** primary open angle glaucoma, POAG, cup-to-disc ratio, CDR

**Introduction -**

Glaucoma is a blinding disease characterized by the excavation of the optic nerve head (ONH) with a correlated loss of visual field (VF) sensitivity. It is often asymmetric, and progressive in nature. Clinically, optic nerve head cupping gives an indication of glaucomatous neurodegeneration, and the vertical cup-to-disc ratio (CDR) of the optic nerve, though subjective and variable, remains as one of the first procedures performed on a glaucoma suspect as well as in a patient with glaucoma. Even with the introduction of optical coherence tomography and other forms of scanning laser ophthalmoscopy which are capable of high resolution scans of the retina and the ONH (1–4), CDR evaluation remains as one of the few methods for the determination of damage to the ONH in most of the primary care centers, and eye care centers in the developing world (5–10). Moreover, visual field assessment is considered the gold standard for examining the functional loss in the disease. Average sensitivity obtained from automated perimetry serves as a good indicator for the global loss in function in patients with glaucoma (11,12).

Unfortunately, due to various socioeconomic and access issues, most of the patients suffering from glaucoma are actually diagnosed after a significant level of neural damage in developing countries (7). In this study, we present the descriptive profile of patients encountered in a high-volume eye care center in eastern Nepal. There is a paucity of information regarding the POAG patients in a high volume centers in Asia, and most of the work has focused in secondary glaucoma during the management of patients with cataract (13). One of our faithful objective was to make the medical/research community aware of the snapshot of the nature of the burden of glaucoma faced by these centers, which serve a majority of people in underdeveloped areas of the world; and another aim was to investigate the global structure-function relationship in moderate to severe form of the disease to describe the raw natural history of the disease, as none of the patients enrolled had received any previous treatment for their condition.

Hence, in this study we studied the profile of 100 patients with various severity of glaucoma, the relationship between average CDR and average visual field sensitivity, and the nature of asymmetry present in the sample.

**Methods-**

**Participants -** 100 patients of mean age of 54.01 ± 13.4 (Range = 18 to 89 years, median age= 55) years of age with primary open angle glaucoma at their first presentation were enrolled in the cross-sectional, prospective study. The patients able to perform reliable automated visual field results within the study period of 3 months, under the supervision of the first author, were enrolled in a consecutive manner. Informed consent was obtained from all the subjects, and the study strictly adhered to tenets of the Declaration of Helsinki. The study was approved by the hospital administration. Patients with other ocular, and systemic conditions e.g., significant cataract, diabetic retinopathy etc., which could affect vision in any form were excluded from the study. Patients with refractive error greater ±6 Diopters, and those with hypertension were also excluded.

All of the patients were diagnosed glaucoma for the first time, and were not under any medication for the condition. All the patients underwent a detailed examination of the posterior segment with the use of a direct/indirect ophthalmoscopy. ONH examination under mydriasis was performed if required with the use of topical Tropicamide (1% in concentration). Vertical Cup-to-disc ratio (CDR) was calculated by approximating the ratio of the vertical extent of the cup relative to the extent of the disc in the vertical quadrant. CDR was also noted by a second observer, and average of the two readings was used in further analysis.

Tonometry was performed by a Schiontz tonometer with patient under supine position after the application of a topical anesthetic (1% Lidocaine Sodium) (14,15). Standard automated perimetry (SAP) was performed with an Octopus 600 visual field analyzer (Haag-Streit diagnostics, Zeiss Inc.), and SAP results with positive and negative catch trials under 33% were only enrolled in the study. Mean visual field sensitivity parameter was noted for all the patients.

Data were tabulated and analyzed using Microsoft Excel 2010 program (Redmond, WA, USA). Differences between two eyes were investigated using paired t tests. P value less than 0.05 was considered to be significant. Linear regression was used to describe the relationship between all parameters and r-squared values were used to show the strength of correlation.

**Results-**

Figures 1 (a-d) show histograms representing the age of individual patients in years, cup-to-disc ratios, visual field (VF) sensitivity (dB) and intraocular pressure (mm of Hg) of each eye from all the patients included in the study, respectively. Table no. 1 shows the mean ± standard deviation, median and range of the above listed parameters.

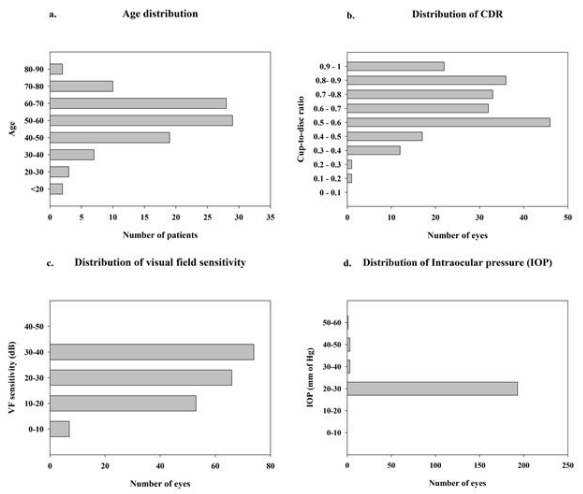


Figure 1- Horizontal bar graphs describing the distribution of (a) age of the patients in years; (b) cup-to-disc ratio (CDR); (c) visual field sensitivity in Decibels (dB), and (d) intraocular pressure measured in millimeters of mercury, in the y-axis, number of patients (n=100) in the y-axis in x-axis for (a), and number of eyes (n=200) in the y-axes for (b-d).

**Table no. 1**

| Parameters | Mean ± SD | Median | Min value | Max value |
|---|---|---|---|---|
| **CDR** | 0.715 ± 0.17 | 0.7 | 0.2 | 1 |
| **VF sensitivity (dB)** | 15.05 ± 7.71 | 17.1 | 0 | 27.3 |
| **IOP (mm of Hg)** | 17.13 ± 3.54 | 17.3 | 13.4 | 41.5 |

Table 1 describes the mean, and standard deviation; median; minimum value, and maximum values of cup-to-disc ratio (CDR), visual field sensitivity in Decibels (dB), and intraocular pressure in millimeters of Mercury for 200 eyes of patients with glaucoma, respectively.

Figure 2 (a- b) describe the relationship between CDR and VF sensitivity for right and left eyes of the glaucoma patients, respectively. A simple linear regression fit the data satisfactory ($r^2 = 0.30$), and the correlation was found to be very similar in both eyes. The downward sloping of the fit captures, the relative drop in VF sensitivity with increase in CDR, and the intercepts could roughly indicate the level of visual field sensitivity started declining, which was around 32 for both the eyes.

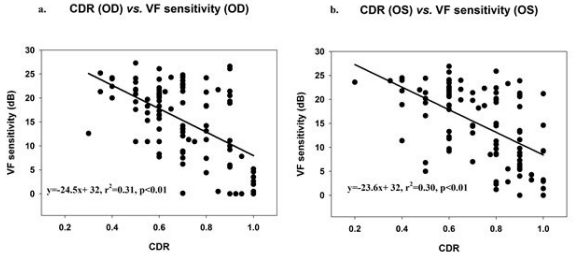


**Figure 2-** Scatter-plots showing cup-to-disc ratio in the x-axis, and visual field sensitivity in Decibels (dB) in the y axis for the right eye in (a) and for the left in (b). The solid lines represent simple linear regression fits through the respective data.

However, the intra-ocular pressure (IOP) did not correlate significantly with either the CDR parameter, or the mean visual field sensitivity, with r-squared values of under 0.10 for all attempted correlations.

Figure 3(a-b) show the correlation between mean VF sensitivity and cup to disc ratio (CDR) between the two eyes, respectively. The correlation was higher for VF sensitivity compared to that of CDR (r-squared of 0.20 vs. 0.06, respectively), which shows a better predictive ability of VF sensitivity for retinal damage than CDR, especially for moderate to severe glaucoma.

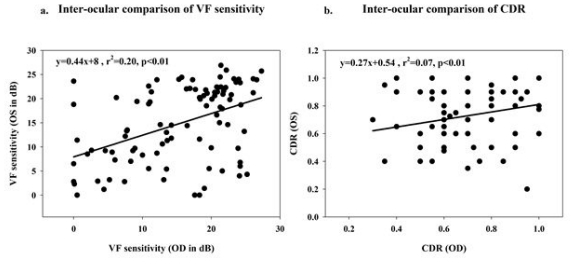


Figure 3- (a) Scatter-plot showing visual field (VF) sensitivity of the right eye in dB (x-axis), and that of the left eye (y-axis) (b) Scatter-plot showing cup-to-disc ratio (CDR) of the right eye (x-axis), and that of the left eye (y-axis). Both the solid lines represent simple linear regression fits through the respective data.

Figure 4 shows the correlation between the absolute differences of CDR and VF sensitivity between the two eyes. The average absolute asymmetry of CDR (± standard deviation) was 0.10 ± 0.14, and 3.95 ± 5.80 dB for absolute difference in average visual field sensitivity (± SD). However, the correlation between absolute difference in IOP and that of absolute difference in either VF sensitivity, or CDR was virtually non-existent (r-squared of less than 0.05).

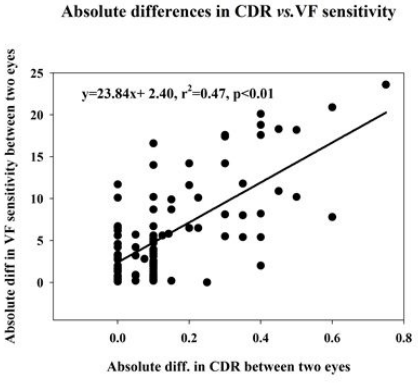


Figure 4- Scatter-plot showing the absolute differences of cup-to-disc ratio between two eyes in the x-axis, and absolute differences of visual field sensitivity between the two eyes in Decibels (dB) in the y axis. The solid line represents a simple linear regression fit through the respective data.

**Discussions-**

The distribution of the population sample was skewed towards people older than 40 years of age and peaking around the age ranges of 40-60. This was expected, given the nature of primary open angle glaucoma, and is line with various prevalence studies conducted in the region (5,16). 45 out of 100 patients were female, however population studies have shown females to be more affected with glaucoma. Our gender ratio, even though a weak metric, could have been skewed due to the lower access of female patients to health care in the region (5). The distribution of vertical cup-to-disc in the normal population peaks at around 0.5, while in our patient population, it was skewed towards a higher number (17,18). The mean vertical CDR was around 0.71 ± 0.17, with a median of 0.7. These values were similar to those reported by Dandona et al and other co-workers (5,6). This proves the relative efficacy of vertical CDR assessment in patients with glaucoma or glaucoma suspects and a vertical CDR of greater than 0.70 might actually be a marker for further assessment of referral (19). The mean of CDR in Nepalese general population has been quoted to be around 0.26 (0.60 as the 97.5th percentile) (20).

On the other hand, visual field assessment done with a supra-threshold approach gave better indicator of the severity of the disease than the vertical CDR measurement alone. The average visual field sensitivity of the sample of the patients was around 15 ± 7.70 dB, with a median

value of 17.1. This showed that the majority of patients presented in their early-moderate to moderate stage of visual field loss. This indicates a need of awareness in the general society regarding glaucoma, alongside the absolute need of access to healthcare in this region. Interestingly, even though glaucoma tends to be asymmetric in nature, we did not find any significant differences in CDR, IOP, and visual field sensitivity between the two eyes; p values for the difference between CDR, IOP, and visual field sensitivity being 0.18, 0.17 and 0.53, respectively for the differences in mean between the two eyes. The correlation between the CDR and average visual field was fitted satisfactorily by linear regression analysis for both the eyes, which predicted a rapid correlated fall of CDR and VF sensitivity, once the CDR values crossed approximately 0.45, and the VF sensitivity when it is reduced beyond 20 dB.

The weaker correlation between CDRs of two eyes (r2=0.06), but a larger correlation between average visual field sensitivities of two eyes (r2=0.20), we believe, might be an artifact due to a higher dynamic range (or steps) of visual field testing methodology. Similar results have been found with other population studies (5). Intraocular pressure measured with Schiontz tonometer has been found to be variable, and literature suggests that inferences about IOP of a single patient by the use of this technique could be erroneous. However, even with its caveats, Schiontz tonometer is still is use in the clinics in our region, most probably because of its relatively quicker method of calibration, price, and sterilization. Hence, given the variability it was inconceiv able to use the results obtained from tonometer, but it did provide us an insight on the levels of IOP in our population. Only a few, i.e., 7 out of 200 eyes had an IOP greater than 30 mm of Hg. This indicates that the level of IOP, irrespective of the method does not significantly indicate the amount of damage from the disease, even in patients who have not received any treatment.

Average asymmetry of CDR between the two eyes in the patients was 0.1, and 3.95 dB for the visual fields. Thus, it should be imperative for the practitioners to not make the decision about the presence of the disease by waiting for the patient to develop a clear asymmetry, but investigate for other signs and glaucoma, including the visual field when in doubt. However, normal values of CDR asymmetry has been found to be much smaller with 0.1 being the 97.5th percentile in a normal population (20).

Limitations- Given the development of technology in the developed world, it wouldn't be inappropriate to call the practices discussed in the paper to be "archaic", but the harsh reality is that most centers in the developing do not have access to many state-of-the-art diagnostic instruments. In this paper, we have tried to present a snapshot of the profile of patients attending an eye-care center in eastern Nepal, who are some of the most impoverished group of people in the world, and presented to us for the first time. This has allowed us to investigate the raw natural history of the disease with minimal use of technology, which is available to most centers, like ours. The mean difference between test and retest for vertical CDR determination between the two observers was -0.007, with 95% CI of 0.07 (%COR of 5), and although repeatable, the use of more modern instrumentation e.g., OCTs and SLOs could have made the study more in line with current practices in medical research.

Finally, this study gives the snapshot of patients attending high-volume eye care center in Nepal with glaucoma and reflects the raw pathophysiology of glaucoma in the patients.

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