Original Article

Comparison of Ocular Biometry between Primary Open Angle Glaucoma Patients and Normal subjects

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ABSTRACT

Introduction: Glaucoma is one of the major causes of irreversible blindness. In Nepal, the most common type of Glaucoma seen is Primary Open Angle Glaucoma. There are many risk factors associated with Primary Open Angle Glaucoma. The main objective of the study was to compare ocular biometric parameters in patients diagnosed with Primary Open Angle Glaucoma and age matched controls.

Material and methods: This is a hospital based cross sectional study done at Mechi Eye Hospital. The study included 137 cases of Primary Open Angle Glaucoma and 75 normal individuals as control. Axial length (AL), anterior chamber depth (ACD), Keratometry 'K' value and Central Corneal Thickness (CCT) were measured. Mann – Whitney U test was used for statistical analysis.

Results: Mean age in Primary Open Angle Glaucoma group was (55.25 ± 10.16 years) and in the control group was (60.96 ± 10.91 years). Axial length in the Primary Open Angle Glaucoma group (23.16 ±1.19 mm) was deeper as compared to the control group (22.69 ±0.89 mm), the difference was statistically significant ($p<0.001$). Anterior chamber depth (ACD) was statistically deeper in the Primary Open Angle Glaucoma group (3.05 ±0.51 mm) as compared to the control group (2.86 ±0.46 mm), ($p<0.01$). Central corneal thickness (CCT) was thinner in the Primary Open Angle Glaucoma group (519.5 ±36.25 um) as compared to the control group (525.40 ±37.77 um) but the difference was not found to be statistically significant ($p<0.19$). K value in Primary Open Angle Glaucoma (7.54 ±0.41mm) was higher than age-matched controls (7.58 ± 0.33mm) but the difference was not statistically significant ($p<0.79$).

Conclusion: Patients with Primary Open Angle Glaucoma had longer Axial length (AL) and deeper Anterior chamber depth (ACD) as compared to normal individuals.

Key words: Biometry, Primary Open Angle Glaucoma.

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Conflict of Interest : Nil

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INTRODUCTION

Glaucoma is one of the major causes of irreversible blindness worldwide. Quigley and Broman had estimated the total burden of glaucoma to be 60.5 million worldwide in 2010, which is expected to increase to 79.6 million by 2020, and among these 74% will have open angle glaucoma (OAG). Asian population is expected to represent 47% of all glaucoma patients and among these, 87% will have Angle Closure Glaucoma (ACG) (Quigley et al, 2006).

According to the Nepal blindness survey of 1984, 3.2 % of the total blindness in Nepal was reported due to glaucoma (Brilliant et al, 1985). In a population based study done in Kathmandu Valley in 2012, the prevalence of glaucoma was found to be 1.9%, among which Primary Open Angle Glaucoma (POAG) was seen in 1.24 %, Primary Angle Closure Glaucoma (PACG) in 0.39% and secondary glaucoma in 0.15%. Nine eyes were blind and two subjects were bilaterally blind due to glaucoma (Thapa et al, 2013).

Primary open angle glaucoma is one of the most common forms of glaucoma (Yasuyuki et al, 2006). There are many risk factors associated with POAG. High intraocular pressure (IOP) is seen in most individuals diagnosed with POAG. Furthermore, many people with high IOP may never develop glaucomatous optic nerve damage. Other risk factors like thin central corneal thickness (CCT), old age, black race, family history of glaucoma, are associated with increased risk of POAG (Worley et al, 2011).

The main aim of our study was to compare the Axial Length (AL), Anterior Chamber Depth (ACD), Keratometry (K) and Central Corneal Thickness (CCT) between patients diagnosed with POAG and age matched controls.

MATERIALS AND METHODS

It was a hospital based cross-sectional study done at Mechi Eye Hospital. In this study we included patients diagnosed with POAG with age more than 40 yrs and age matched controls with similar refractive error who were posted for cataract surgery. The study period was of 6 months from 1st July 2018 to 31st Dec 2018. It included 212 patients. If both eyes of the subject were eligible only one phakic eye was selected for analysis. Ethical clearance was obtained from The Institutional ethical committee. Diagnosed cases of POAG whose diagnosis was done according to the International Society for Geographic and Epidemiological Ophthalmology (ISGEO) guidelines as shown in table 1(Foster et al, 2002) were included.

Table 1: ISGEO Classification of Glaucoma.

The diagnosis of Glaucoma in Cross –sectional prevalence surveys
The prevalence of glaucoma would be based on three levels of evidence: 1. Diagnosis based on the presence of structural and functional evidence where there is intraocular pressure >20mmHg, vertical cup-to-disc ratio >0.6, or difference in vertical cup-to-disc ratio between 2 eyes of >0.2. 2. Diagnosis based solely on structural evidence where visual field testing was not satisfactorily completed. 3. Diagnosis where the optic disc cannot be assessed and visual field testing is impossible but with VA<20/200 (LogMAR 0.10) and intraocular pressure >21 mmHg or VA <20/200 (LogMAR 0.10) in an eye which shows evidence of glaucoma filtering surgery, or medical records were available confirming glaucomatous visual morbidity.

Clinical Examination:

Patients' demographic profiles were recorded. Visual acuity was recorded using Snellen's chart. Goldman Applanation Tonometer (Haag-Streit, Koeniz, Switzerland) was used for measurement of Intraocular Pressure. The estimation of Vertical cup-disc ratio (CDR) in the slit lamp was done with a Volk 90D after pupillary dilatation. A 3-mirror Goldman lens (HaagStreit, Koeniz Switzerland)was used for gonioscopy. AL, ACD, and K values were measured with an IOLMaster 500, Carl Zeiss Meditec AG, Germany master. CCT was measured using Ultrasonic Pachymetry.

Exclusion criteria:

Age of patient <40 years, secondary glaucoma, Primary angle closure glaucoma (PACG), pseudophakic patients, intraocular pathologies altering IOP like uveitis, past ocular surgery.

Statistics and data analysis:

Data entry was done in SPSS version 11. Mann-Whitney U test was used for the statistical analysis to find correlation between dependent variables between two groups. Statistical tools used were Mean, Range, Percentage and Standard deviation.The correlation was considered significant if p value was less than 0.05 .

RESULTS

The total number of patients with POAG was 137 (137 eyes) and that of age matched control was 75 (75 eyes). Mean age of patients with POAG was 55.25±10.16 years, ranging from 40 to 82 years. Mean age of the control group was 60.96±10.91 years, ranging from 35 to 90 years. In the POAG group the total number of males was 90(65.2%) and females was 47(34.3%) whereas in the control group the total number of male was 33 (44 %) and female was 42 (56%).

As shown in Table 2, in the POAG group the AL ranged from (20.31mm – 32.66mm) and the mean AL was 23.16 ±1.19mm. In the control group the AL ranged from (20.02mm –

Table 2: Showing Mean Axial Length, Central Corneal Thickness, Corneal curvature and Anterior Chamber Depth in Control eyes and POAG eyes.

Variable	Control eyes (n=75)	POAG eyes (n=137)	P value
Axial length (mm)	22.69±0.89mm	23.16±1.19mm	<0.001
Central corneal thickness(mm)	525.4±37.77um	519.5±36.25um	0.19
Corneal curvature (mm)	7.58±0.33mm	7.54±0.41mm	0.79
Anterior chamber depth(mm)	2.86±0.46mm	3.05±0.51mm	<0.01

24.76mm) and mean AL was 22.69±0.89mm. Axial length was longer in the POAG group than in the control group and was found to be statistically significant (p<0.001).

CCT in the POAG group ranged from (426mm – 664mm) and in the control group it ranged from (382mm – 602mm). CCT was thinner in POAG group 519.5±36.25mm as compared to control group 525.4±37.77mm. The difference was not statistically significant (p=0.19).

Mean K value in POAG group was 7.54±0.41mm and in control group was 7.58±0.33mm but the difference was not statistically significant (p=0.79). Mean ACD in the POAG group was 3.05±0.51mm and in the control group was 2.86±0.46mm and the difference was statistically significant (p<0.01).

DISCUSSION

AL is one of the risk factors for glaucoma. Patients with high axial myopia have thin sclera and lamina cribrosa which are responsible for high scleral tension(Funata et al, 1990; Jonas et al, 2004). As a result, it can cause biomechanical changes of the optic nerve head and increase the risk of glaucomatous damage of the optic nerve head (Sigal et al , 2005). In our study, the AL in POAG group was found to be significantly higher(p<0.001) than age matched controls. In the study done by Oku et al (2009), POAG patients were compared with control subjects which showed that the increased axial length and increased IOP were significantly associated with POAG. Whereas when control subjects were compared with NTG patients only axial length was found to be significantly associated. In the Singapore Malay Eye Study done by Perera et al(2010), longer axial length was associated with POAG. Patients with moderate to high myopia were more likely to have POAG, the association was found to be significant after the CCT adjustment. CCT and corneal curvature were not found to be significantly associated with POAG. Another study conducted by Pai et al(2017), also showed that the increasing AL was significantly associated with POAG. In the Meiktila eye study conducted by Casson et al(2007) the AL, myopia and increasing age were significantly associated with open angle glaucoma in univariate analysis.

Thin CCT is also one of the risk factors for POAG. Thin central cornea leads to underestimation of true IOP which may result in late diagnosis thus resulting in greater damage of optic nerve (Ulmer et al, 2012). In our study the POAG group had thinner CCT as compared to the control group but it was not statistically significant (p= 0.19). In the study conducted by Ulmer et al (2012), POAG cases had lower CCT than the control cases and the CCT between POAG cases and control cases was significantly different. Within the POAG cases, the low tension subset had significantly lower mean CCT compared with the high-tension subset.Another study done by Mokbel et al (2010) showed that thin CCT was significantly correlated with neuroretinal rim area loss, optic disc area, vertical and horizontal cup to disc ratio. Thin CCT was also significantly associated with worsened mean deviation of visual field and increased use of antiglaucoma medications. In the study conducted by Papadia et al (2007), the correlation between CCT and both SD and PSD was found to be significant. Thinner cornea was significantly associated with the worst damage. Kohlhaas et al (2006) showed strong correlation between CCT and IOP obtained by Goldmann Applanation Tonometry at three IOP levels 20mmHg, 35mmHg and 50mmHg, whereas the correlation between IOP and corneal curvature and IOP and axial length at all three IOP levels were not found to be significant.

Regarding the correlation between corneal curvature and POAG, very few studies have been published. Corneal curvature is also considered as one of the factors to influence the accuracy of IOP (Whitacre et al, 1993).The steeper the corneal curvature, more area of the cornea needs to be indented to produce the standard area of contact. Therefore, the IOP measurement is expected to be artifactually higher in steeper cornea and lower in flatter cornea (Harada et al, 2008).In the study done by Mark (1973), it was found that increase of 1.0 D in curvature corresponds to an increase of 0.34 mm Hg in the tonometric value. In our study corneal curvature was more in the POAG group as compared to the control group. The association was not found to be statistically significant. Morad et al(1988) conducted a study which showed that the corneal curvature was similar in NTG patients, POAG patients and healthy subjects. The difference between the group was not found to be statistically different. Harada et al (2008) conducted a study in which the correlation of CCT and corneal curvature on IOP measured by Goldmann Applanation tonometer was examined. No significant correlation was found between IOP measured by non-contact applanation tonometer and corneal curvature radius.In the study done by Gunvant et al (2004), the effect of CCT and corneal curvature on IOP was measured. The mean corneal curvature when increased by 1mm,1.14mmHg rise in IOP was seen by GAT and 2.6mmHg rise in IOP by pulsatile ocular blood flow tonograph. In the Tajimi Study done by Yasuyuki et al (2006), no significant correlation was found between corneal curvature and glaucoma.

In our study the ACD was deeper in POAG patients as compared to control and it was significantly associated. Also the AL was more in POAG patients. So greater the AL, greater should be ACD. In the study done by Maggon et al (2019), AL and ACD was measured in patients who reported for cataract surgery. It showed that as the mean AL increased, there was an increase in mean ACD also. There was a weak positive correlation of 0.13 which was statistically significant. Adewara et al (2017) conducted a study which showed that the mean ACD in the control group was higher than in the control group. The difference was not found to be statistically significant. In the glaucoma group positive correlation was found between IOP and ACD.In the Singapore Malay Eye study done by Perera et al (2010) , the mean ACD was more in the control group than in the POAG group but the difference was not significantly associated.

CONCLUSION

In conclusion, patients with POAG had longer Axial length (AL) and deeper Anterior chamber depth (ACD) as compared to normal subjects and the association was statistically significant.

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