



A STUDY TO DETERMINE THE PROPORTION OF PRIMARY OPEN ANGLE GLAUCOMA IN PATIENTS WITH SYSTEMIC HYPERTENSION

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ABSTRACT

Introduction: Primary Open Angle Glaucoma (POAG) is associated with elevated Intraocular Pressure (IOP) and typically affects patients over 50 years old. POAG can be managed with topical medications like prostaglandin analogs and beta-blockers. However, systemic hypertension can increase glaucoma risk by damaging optic disc vessels, causing vascular dysregulation, and impairing the blood-retinal barrier through endothelial dysfunction. **Objectives:** This study explores the link between systemic hypertension and POAG, examining the proportion of POAG in hypertensive patients and its relationship with blood pressure, intraocular pressure, and hypertension severity. **Methodology:** A hospital-based cross-sectional study was conducted at the Department of Ophthalmology, Dr. S.N. Medical College, Jodhpur, from May 2025 to July 2025 on 70 patients, after obtaining institutional ethical approval. The study included patients with documented systemic hypertension, aged above 40, and on antihypertensive medications. Age and sex-matched non-hypertensive controls were also included in a 1:1 ratio. Patients with closed angles, corneal scarring, media opacities, or recent ocular surgeries were excluded. **Results :** The mean age of patients in Group A (Case) was 59.16 ± 8.7 years, while in Group B (Control) it was 56.63 ± 9.93 years ($P=0.21$, NS). The male-to-female ratio was 2.18:1 in Group A and 1.92:1 in Group B). Group A had significantly higher systolic and diastolic blood pressure readings compared to Group B. The majority of hypertensive patients (44.29%) were newly diagnosed or had a duration of hypertension up to 2 years, with a significant difference in duration of hypertension observed ($\chi^2 = 12.51$, $p\text{-value} = 0.0058$). The majority of patients in both Group A and Group B had normal fundus findings, with no statistically significant difference between the two groups. Abnormal fundus findings, such as cupping and disc hemorrhage, were present in 17.1% of Group A patients and 5.7% of Group B patients, but the difference was not significant. **Conclusion :** POAG is a major health concern due to its silent and progressive nature. This study found a significant correlation between intraocular pressure and blood pressure levels, highlighting the importance of screening for POAG in hypertensive patients, especially males and regularly monitoring IOP and blood pressure levels.

KEYWORDS : Primary Open Angle Glaucoma, Intraocular Pressure, Systemic Hypertension

INTRODUCTION

Globally, the occurrence of glaucoma is rising in incidence and is likely to affect 111.8 million population by 2040. In a systematic meta-analysis, the global incidence of glaucoma was found to be 3.54%. Glaucoma is one of the leading causes of irreversible vision loss both in India and globally. Among the different types of glaucoma primary open angle glaucoma (POAG) is the most common type with high prevalence¹. It is often called the "silent blinding disease" or "sneak thief of sight"². POAG is often associated with elevated IOP, which is considered a major risk factor for its development and progression³. The elevation of IOP above 21 mmHg is an important indicator for retinal ganglion cell damage and visual field defect in glaucoma⁴. Prostaglandin analog / prostamide, beta-blocker, alpha-adrenergic agonist, carbonic anhydrase inhibitor, rho kinase inhibitor and cholinergic agonist medications are available in topical ophthalmic formulations for lowering IOP⁵.

The disease occurs primarily in patients over 50 years of age, but can develop in younger patients as well. In India, it is estimated that 1.6% to 4.0% of the people have POAG⁶. Age, race, inheritance, myopia, diabetes mellitus, hypertension, migraine, intake of caffeine, aging, cigarette smoking and thyrotoxicosis are considered as important risk factors for the onset of primary open angle glaucoma⁷.

Systemic hypertension may directly damage the small vessels of the optic disc and increase the risk of glaucoma⁸. Moreover, systemic hypertension can cause vascular dysregulation, affecting the autoregulatory capacity of the optic nerve head's blood supply⁹. This vascular dysregulation can exacerbate optic nerve damage in glaucoma patients. Additionally, endothelial dysfunction associated with hypertension can impair the blood-retinal barrier and the optic nerve head's microcirculation, further contributing to glaucomatous damage¹⁰.

POAG is often asymptomatic and patients may suffer substantial vision loss prior to diagnosis and treatment. Therefore it is essential to identify at-risk populations and develop accurate screening tests to make the diagnosis so that sight preserving treatment can begin early in the disease process.

This study aims to investigate the relationship between systemic hypertension and primary open-angle glaucoma (POAG). The primary objective is to determine the proportion of POAG in patients with systemic hypertension presenting to the outpatient department (OPD). Secondary objectives include examining the relationship between blood pressure, intraocular pressure, and POAG in hypertensive patients compared to a normotensive control group, as well as exploring the association between the severity of systemic hypertension and the proportion of POAG.

MATERIALS AND METHODS

A hospital based cross sectional study was conducted at Department of Ophthalmology, Mathuradas Mathur Hospital, Jodhpur attached to Dr. S.N. Medical College, Jodhpur, Rajasthan, India after approval from institutional Ethical Committee and expected to be conducted between May 2025 to July 2025.

The inclusion criteria comprise patients of both genders, with documented systemic hypertension who are currently on antihypertensive medications, and are above 40 years of age. Additionally, age and sex-matched non-hypertensive controls will be included in a 1:1 ratio with the hypertensive patients. The exclusion criteria consist of patients with gonioscopy showing a closed angle, any corneal scarring or media opacities, and those with a recent history of ocular surgeries. Consecutive sampling technique was used.

Sample Size: Sample size was calculated at 95% confidence interval and 10% relative allowable error using the formula for sample size for estimation of a single sample proportion

$$N = \frac{(Z_{1-\alpha/2})^2 P (100-P)}{E^2}$$

$$\frac{(1.96)^2 \times 20 \times 80}{10^2}$$

The value comes out to be 61.46 rounded off to 70
Where,

$Z_{1-\alpha/2}$ = Standard normal deviate for 95% confidence interval (taken as 1.96)

P = Expected proportion of POAG in systemic hypertension (taken as 20% as per R. Aalath et al.¹¹)

E = Absolute allowable error (taken as 10%)

Procedure

All patients underwent a comprehensive examination assessment, which included a single blood pressure measurement using a mercury sphygmomanometer, visual acuity assessment with Snellen's chart, slit lamp examination, gonioscopy with Goldman's single mirror gonioscopes, intraocular pressure (IOP) measurement using non-contact and Schiottz tonometers, visual field assessment with perimetry, and fundus examination by direct and indirect ophthalmoscopy. The diagnosis was based on a combination of clinical findings and tests, including IOP measurement, optic nerve head evaluation, and visual field assessment. An IOP greater than 21 mmHg was considered suggestive but not definitive. Fundoscopic examination showing an increased cup-to-disc ratio (>0.5 or asymmetry >0.2 between eyes) was also a key diagnostic criterion.

Standard and Operational Definitions

Hypertension is defined as - Patient with history of hypertension on antihypertensive therapy or systolic blood pressure >140 mmHg and diastolic blood pressure >90 mmHg as per JNCC (Joint National Committee).

Systemic hypertension, commonly known as high blood pressure, is a major public health concern affecting a significant portion of the global population. It is a well-established risk factor for various cardiovascular diseases, including stroke, myocardial infarction and heart failure. Hypertension is also known to affect microcirculation, which can impact various organs, including the eyes¹².

Primary open-angle glaucoma (POAG) is a chronic, progressive optic neuropathy characterized by the gradual loss of retinal ganglion cells and their axons, which leads to visual field defects and, if untreated, irreversible blindness¹³.

Methodology of Data Collection and Monitoring:

Detailed history was taken, including past medical illnesses (hypertension, diabetes), family history of glaucoma, and demographic information (age, gender, residence, education, occupation). The study used several tools for examination, including Schiottz tonometry, gonioscopy, noncontact tonometry for central corneal thickness measurement, and direct and indirect ophthalmoscopy. A Proforma was used to record data. A comprehensive ocular examination was performed on each participant. It included visual acuity, examination of the eyelids, extraocular movements, conjunctiva, cornea, anterior chamber, iris, pupil, and lens. A thorough fundus examination and intraocular pressure (IOP) measurement were also conducted. General examination, including vital signs (pulse rate, systolic and diastolic blood pressure) was also recorded.

The diagnosis of POAG was made based on the presence of characteristic optic disc changes, visual field defects, and elevated intraocular pressure.

Table 4 : Fundus

Fundus	Group A (Case)				Group B (Control)				P value
	RE		LE		RE		LE		
	Number of Patients	Percent	Number of Patients	Percent	Number of Patients	Percent	Number of Patients	Percent	
Normal	58	82.86	58	82.9	66	94.29	66	94.3	0.83
Abnormal	12	17.14	12	17.1	4	5.71	4	5.7	
Total	70	100.00	70	100.0	70	100.00	70	100.0	

DISCUSSION

Demographic Distribution (Table 1)

Age: Kuang TM et al (2020)¹⁴ reported mean age of 59.16 ± 16.23 years for Group A and 59.49 ± 16.29 for Group B. In contrast, Khandelwal R et al (2020)¹⁵ found slightly higher mean age for Group A (61.01 ± 11.1 years) compared to Group B (59.18 ± 10.53 years). The present study reported mean age of 59.16 ± 8.70 years for Group A and 56.63 ± 9.93 years for Group B.

Gender: In terms of gender distribution, Khandelwal R et al (2020)¹⁵ reported with 59.00% males and 44.00% females in Group A, and 57.00% males and 43.00% females in Group B. Cantor E et al (2018)¹⁶ found a slightly higher proportion of males in Group B (65.90%) compared to Group A (52.30%). The present study reported a higher

Approval of the institutional Ethical Committee was taken prior to initiating the study.

Statistical Analysis

Proportion and percentage was calculated for qualitative data. Mean (SD), median was calculated for quantitative data and appropriate statistical tests will be applied wherever needed. P-value of less than 0.05 was taken as statistically significant.

RESULTS

Table 1: Demographic Distribution

	Group A (Case) (n=70)		Group B (Control) (n=70)		Chi Square	P value
	No. of Patients	Percent	No. of Patients	Percent		
Age Group (Years)						
40-49	11	15.71	18	25.71	4.51	0.21 (NS)
50-59	21	30.00	15	21.43		
60-69	31	44.29	31	44.29		
70-79	7	10.00	6	8.57		
Mean + SD	59.16+8.7 years		56.63+9.93 years			
Gender						
Male	48	68.57	46	65.71	0.61	0.43 (NS)
Female	22	31.43	24	34.29		
Male : Female	2.18:1		1.92 : 1			

Table 2 : Blood Pressure Status

	Group A (Case) (n=70)		Group B (Control) (n=70)		Chi Square	P value
	No. of Patients	Percent	No. of Patients	Percent		
SBP (mmHg)						
< 140	13	18.57	69	98.57	134.41	<0.0001 (S)
140-149	20	28.57	1	1.43		
150-159	31	44.29	0	0.00		
> 160	6	8.57	0	0.00		
Mean + SD	145.11+12		120.29+4.5			
DBP (mmHg)						
70-79	8	11.43	10	14.29	73.51	<0.0001 (S)
80-89	24	34.29	58	82.86		
90-99	31	44.29	2	2.86		
>100	7	10.00	0	0.00		
Mean + SD	86.49+8.7		78.86+4.0			

Table 3 : Duration of Hypertension

Duration of Hypertension	Number of Patients	Percent	Chi Square	P value
1-2 years	31	44.29	12.51	0.0058 (S)
2-4 years	21	30.00		
4-6 years	10	14.29		
> 6 years	8	11.43		
Total	70	100.00		
Mean + SD	= 3.44 + 2.3 years			

proportion of males in Group A (68.57%) and Group B (65.71%) compared to females. Overall, the three studies suggest that males are slightly overrepresented in both Group A and Group B.

Systolic Blood Pressure

The mean SBP values in Group A ranged from 143.36 mmHg (Khandelwal R et al, 2020)¹⁵ to 145.11 mmHg (Present Study), while the mean SBP values in Group B ranged from 120.29 mmHg (Present Study) to 125.8 mmHg (Cantor E et al, 2018)¹⁶. The findings of the present study are consistent with those of Bhattacharyya S et al (2018)¹⁸ and Khandelwal R et al (2020)¹⁵, which also reported significantly higher SBP values in Group A compared to Group B. In contrast, Cantor E et al (2018)¹⁶ reported relatively similar SBP values between Group A and Group B. (Table 4)

Diastolic Blood Pressure

The mean DBP values in Group A ranged from 86.33 mmHg (Khandelwal R et al, 2020)¹⁵ to 90.35 mmHg (Bhattacharyya S et al, 2018)¹⁸, while the mean DBP values in Group B ranged from 75.9 mmHg (Cantor E et al, 2018)¹⁶ to 81.7 mmHg (Khandelwal R et al, 2020)¹⁶. The findings of the present study are consistent with those of Bhattacharyya S et al (2018)¹⁸ and Khandelwal R et al (2020)¹⁵, which also reported significantly higher DBP values in Group A compared to Group B. Cantor E et al (2018)¹⁶ reported relatively similar DBP values between Group A and Group B, although the mean DBP value in Group A was slightly lower.

Duration of Hypertension

The majority of patients (44.29%) have been hypertensive for 1-2 years, followed by 30% with a duration of 2-4 years. A smaller proportion of patients have been hypertensive for 4-6 years (14.29%) or more than 6 years (11.43%). ($\chi^2 = 12.51$, p-value = 0.0058, S). The mean duration of hypertension in the study population is 3.44 ± 2.3 years (Table 2 and Table 3)

Fundus

The study found that 82.86-82.9% of patients in Group A (Case) and 94.3% in Group B (Control) had normal fundus findings in both eyes, with no significant difference between the groups ($p=0.83$). Abnormal fundus findings were seen in 17.14% of Group A and 5.7% of Group B patients. (Table 4)

CONCLUSION

Primary open angle glaucoma is a major health concern worldwide because of its usually silent, progressive nature and it is one of the leading preventable causes of blindness in the world. Intraocular pressure was found to be significantly correlated ($p<0.001$) with systolic and diastolic blood pressure levels and the intraocular pressure increased with increasing systolic as well as diastolic blood pressure levels. It was observed that the proportion of POAG with systemic hypertension was more in males compared to females. Therefore, it is important to screen for primary open angle glaucoma in systemic hypertensive patients along with regular monitoring of intraocular pressure and blood pressure levels.

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