e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2024; 16(6); 645-648

Original Research Article

Parallel Study of Hypertensive (Non-Glaucomatous) and Glaucomatous Patients for Optic Disc Parameters

Mitaliben M. Prajapati[1], Radha I. Dass[2]

[1]Assistant Professor Department of Ophthalmology GMERS Medical College Valsad
[2]Associate Professor, Department of Ophthalmology, Shri M.P. Shah Govt. Medical College & Guru Gobind Singh Govt. Hospital, Jamnagar

Received: 25-03-2024 / Revised: 23-04-2024 / Accepted: 26-05-2024
Corresponding Author: Dr. Mitaliben M. Prajapati
Conflict of interest: Nil

Abstract:

Introduction: Glaucoma is a type of neurodegenerative disease characterized by morphological variations at the position of the optic nerve head (ONH) or retinal nerve fiber layer (RNFL) as well as damage to the visual field. Assessment of the diurnal fluctuations in IOP and MOPP is clinically relevant in glaucoma patients. Systemic hypertension, as such, may directly damage the small vessels of the optic disc and increase the risk of glaucoma.

Material and Methods: This is a cross-sectional observational study done with 50 patients, carried out at the Department of Ophthalmology tertiary care centre. It consists of two groups, the first group of 25 patients with essential hypertension, and the second group of 25 with POAG. The average age of patients included is 55.36 years.

Observation and Result: The average history of hypertension is from the past 5.23 years. The mean Average C/D Ratio of HTN Cases was RE-0.45+0.08 & LE -0.47+0.110. The mean Disc Area of HTN Cases was RE-1.66+0.11 & LE - 1.68+0.16 whereas the mean Disc area of the glaucoma group was RE- 2.12+0.47 & LE-2.04+0.40.

Summary: In comparison of the hypertensive group with the Glaucoma group, neuroretinal rim changes in Hypertension were not significant in comparison to Glaucoma. In other words, hypertension causes changes in other optic nerve parameters but does not have much effect on the neuroretinal rim. The neuroretinal rim, which is the intrapapillary equivalent of optic nerve fibers, indicates the amount of viable optic nerve tissue and is one of the most important morphological parameters to detect glaucomatous optic neuropathy and to grade the amount of glaucomatous optic nerve damage. In Glaucoma, because of mechanical stress from elevated IOP at the level of lamina cribrosa, posterior bowing and thinning of the lamina occur. This disrupts axonal transport. As a result, retinal ganglion cells undergo apoptotic cell death with loss of neuroretinal tissue of the optic disc and enlargement of parapapillary atrophy. All parameters in conjugation lead to Glaucomatous optic nerve atrophy.

Keywords: Glaucoma, Hypertension, Optic Nerve etc.

Introduction

Glaucoma is a type of neurodegenerative disease characterized by morphological variations at the position of optic nerve head (ONH) or retinal nerve fibre layer (RNFL) as well as damage in the visual field.

The morphology of the optic disc can reflect the structure and function status of the optic nerve [1].The optic nerve carries impulses for sight from the retina in the eye to the brain. It is composed of millions of retinal nerve fibers that bundle together and exit into the brain through the optic disc located at the back of the eye.

The optic disc has a centre portion called the "cup" which is normally quite small in comparison to the entire optic disc [2]. The term optic disc is frequently used to describe the portion of the optic nerve clinically visible on examination. This, however, may be slightly inaccurate as “disc” implies a flat, two-dimensional structure without depth, when in fact the “optic nerve head” is very much a three-dimensional structure that should ideally be viewed stereoscopically [3].

The cup-to-disc ratio (often notated CDR) is a measurement used in ophthalmology and optometry to assess the progression of glaucoma. The optic disc is the anatomical location of the eye's "blind spot", the area where the optic nerve and blood vessels enter the retina. The optic disc can be flat, or it can have a certain amount of normal cupping. The white cup is a pit with no nerve fibers [4]

The cup-to-disc ratio compares the diameter of the "cup" portion of the optic disc with the total diameter of the optic disc. The normal cup-to-disc ratio is less than 0.5. A large cup-to-disc ratio may imply glaucoma or other pathology. However, cupping by itself is not indicative of glaucoma. Rather, it is an increase in cupping as the patient ages that is an indicator of glaucoma. Deep but stable cupping can occur due to hereditary factors without glaucoma [5,6]

The exact pathophysiological mechanism of optic nerve damage in glaucoma is not fully understood. Besides the mechanical effect of raised intraocular pressure (IOP) on the optic nerve head (ONH), several vascular risk factors such as systemic hypertension, diabetes mellitus, atherosclerosis, vasospasm, etc., have also been implicated as potential factors capable of increasing the risk of open-angle glaucoma (OAG) [7].

Assessment of the diurnal fluctuations in IOP and MOPP is, therefore, clinically relevant in glaucoma patients [7]. Systemic hypertension may directly damage the small vessels of the optic disc and increase the risk of glaucoma [7]

Material and Methods:

This is a cross-sectional observational study carried out at the Department of Ophthalmology tertiary care centre from November 2018 to November 2020. In this study, optic nerve and optic disc changes in hypertensive non-glaucomatous patients and glaucomatous patients are compared.

Patients were selected randomly and informed about the nature of the study. Informed written consent was taken from all subjects willing to participate in the study. The study was carried out on a total of 50 patients visiting the ophthalmology department of a tertiary care hospital on an outpatient basis.

It consists of two groups of subjects: The first group of 25 patients with essential hypertension, either self-reported hypertension or newly diagnosed cases (defined as >=140 mm Hg systolic BP [SBP], and /or >=90 mm Hg diastolic BP [DBP]).

Participants with hypertension due to secondary causes (endocrine or kidney disease/steroid-induced) were excluded. The second group of 25 with POAG (diagnosed if glaucomatous cupping and characteristic field defects were present along thinned NRR on OCT) without hypertension (Congenital or any glaucoma other than POAG were excluded).

Inclusion Criteria:

- Patients with essential hypertension, either self-reported hypertension or newly diagnosed cases (defined as >=140 mm Hg systolic BP [SBP], and /or >=90 mm Hg diastolic BP [DBP]) with and without glaucoma.
- Patients with POAG.

Exclusion Criteria:

- Participants with hypertension due to secondary causes (endocrine or kidney disease/steroid induced).
- High Myopia, chorioretinitis scars, posterior uveitis, and those who had undergone previous ocular surgery.
- Patients with a history of endocrine, hepatic, metabolic, or cardiovascular disease

Detailed clinical history, General/Systemic/ocular examination, Visual acuity using Snellen charts, Slit lamp examination, IOP measurement by Non-contact tonometer and schiotz tonometer, Fundoscopic Examination: Both direct and indirect ophthalmoscopy (90D and 20D) and OCT. The observation was done and the results were analyzed.

Observation and Result:

Of the total 25 patients in the hypertension group, 12 were male and 13 were female. The average age of patients included is 55.36 years. The average history of hypertension is from the past 5.23 years. The average systolic blood pressure is 142 mm Hg. The average diastolic blood pressure is 83.4 mm Hg.

In our study on comparison of both groups, the following findings were seen: -

- Mean Average C/D Ratio of HTN Cases was RE-0.45+0.08 & LE -0.47+0.11 whereas Mean Average C/D Ratio of Glaucoma cases was RE-0.71+0.09 & LE-0.71+0.12. Which was statistically significant as p-value <0.05.
- Mean Disc Area of HTN Cases was RE-1.66+0.11 &LE -1.68+0.16 whereas Mean Disc Area of Glaucoma cases was RE-2.12+0.47 & LE-2.04+0.40. Which was statistically significant as p-value <0.05.
- Mean Rim Area of HTN Cases was RE-1.22+0.10 &LE -1.22+0.11 whereas Mean Rim Area of Glaucoma cases was RE-1.04+0.22& LE-0.99+0.28. Which was statistically insignificant as a p-value >0.05.
- Mean cup Volume of HTN Cases was RE-0.094+0.0382 &LE -0.094+0.0379 whereas Mean cup volume of Glaucoma cases was RE-0.572+0.3231 & LE-0.515+0.2848. Which was statistically significant as p-value <0.05.
- Mean RNFL thickness of HTN Cases was RE-94.76+6.58 & LE -94.64+6.64 whereas Mean RNFL thickness of Glaucoma cases was RE-70.52 +15.64 & LE-70.08+12.79. Which was statistically significant as p-value <0.05.
- Mean MOPP of HTN Cases was BE-54.17+3.38 whereas Mean MOPP of Glaucoma cases was RE-38.22 +5.05 & LE-38.57+4.89. Which was statistically significant as p-value <0.05.

Table 1: On comparison of hypertensive group with glaucoma group

OCT Parameter	Hypertensive group		Glaucoma group		p-value	
	Mean + SD		Mean + SD			
	RE	LE	RE	LE	RE	LE
Average C/D Ratio	0.45+0.08	0.47+0.11	0.71 +0.090	0.71+0.116	0.00	0.00
Disc Area	1.66+0.11	1.68+0.16	2.12 +0.475	2.04+0.399	0.000001	0.00002
Rim Area	1.22+0.10	1.22+0.11	1.036 +0.223	0.989+0.278	0.22	0.19
Cup Volume	0.094+0.0382	0.094+0.0379	0.572+0.323	0.515+0.285	0.00	0.00
RNFL Thickness	94.76+6.58	94.64+6.64	70.52 +15.64	70.08+12.79	0.00	0.00
MOPP	54.17+3.38	54.17+3.38	38.22 +5.05	38.57+4.89	0.00	0.00

In the comparison of the hypertensive group with the glaucoma group, there was a significant difference in Average cup disc ratio, Disc Area, cup volume, RNFL thickness, and MOPP. For the other parameters like the Rim area, the differences were statistically insignificant between the Hypertension and Glaucoma groups. (P-value->0.05)

Discussion

Systemic hypertension may directly damage the small vessels of the optic disc and increase the risk of glaucoma. However, despite prior studies, the association between systemic hypertension, BP, or perfusion pressure and OAG remains unclear.

Our study included 25 Hypertensive Patients 12 Males and 13 Females. Cases from 45 years to 72 years with Average age of Hypertensive cases were 55.36 years. The average Duration of Hypertensive was 5.32 years. The average MOPP among the Hypertensive cases was 54.18. Glaucoma Group includes 25 Patients, 12 Males and 13 Females, with ages of 29 to 72 years and with Average age of 50.36 years. Average MOPP-RE-38.22, LE-38.57.

Results were consistent with the study done by O.S. Punjabi, A.G. Bostrom et al [8] which included 200 eyes of 103 patients suspected of having normal tension open-angle glaucoma based on large cup–to–disc ratios (>0.5) but with normal intraocular pressures and without peripheral visual field defects [8,10].

Patients with systemic hypertension showed a significant increase in cup area cup–to–disc area ratio and cup volume over time. There was a significant decrease in rim area (3.91%, p=0.0279), rim–to–disc area ratio (1.15%, p=0.0052) in these patients with time.

A study by Topouzis Fortis et al [9] conducted a study to find the association of blood pressure (BP) status on the optic disc structure including a total of 232 subjects with hypertension. HRT images of the optic disc were taken. Rim area was significantly different among groups when DBP was considered as the criterion to classify subjects (P = .005). In regression models, cup area, and cup-to-disc (c/d) ratio were increased in subjects with normal DBP that was the result of treatment, as compared with both the high DBP and untreated normal DBP groups. In patients without glaucoma, the DBP <90 mm Hg that results from antihypertensive treatment is associated with increased cupping and decreased rim area of the optic disc.

Summary

When the Hypertensive group compared to the Glaucoma group significant changes were observed in Average cup disc ratio, Disc Area, cup volume, RNFL thickness, and MOPP, while changes in Rim Area were not statistically significant. This indicates that Neuroretinal rim changes in Hypertension were not significant in comparison to Glaucoma. In other words, Hypertension causes changes in other optic nerve parameters but does not have much effect on the neuroretinal rim.

The neuroretinal rim which is the intrapapillary equivalent of optic nerve fibers indicates the amount of viable optic nerve tissue and is one of the most important morphologic parameters to detect glaucomatous optic neuropathy and to grade the amount of Glaucomatous optic nerve damage.

In Glaucoma because of mechanical stress from elevated IOP at the level of lamina cribrosa, posterior bowing and thinning of lamina occurs. This disrupts axonal transport. As a result, retinal ganglion cells undergo apoptotic cell death with loss of neuroretinal tissue of the optic disc and enlargement of parapapillary atrophy. All parameters in conjugation lead to Glaucomatous optic nerve atrophy.

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