ORIGINAL
ARTICLE

CORRELATION BETWEEN INTRA-OCULAR PRESSURE AND CAROTID ARTERY PRESSURE IN GLAUCOMA

Submitted: 07 January, 2022
Accepted: 18 April, 2022

Erma Sarwar[1]
Nimra Asif[2]
Ummara Rasheed[3]

For Authors' affiliation & contribution see end of Article

Corresponding Author:

Erma Sarwar
Bsc, Investigative ophthalmology
College of Ophthalmology & Allied Vision Sciences, Lahore. (COAVS)
ermasarwar.25@gmail.com

ABSTRACT

PURPOSE: *To investigate the relationship between carotid artery velocity and intraocular pressure (IOP) in advanced glaucoma patients.*

METHODS: *In this descriptive cross sectional study undertaken at the Institute of Ophthalmology, Mayo Hospital/ College of Ophthalmology & Allied Vision Sciences from September to December 2021, 48 patients with advanced glaucoma and visual defects in both eyes participated. All patients underwent carotid Doppler examinations to determine carotid artery velocities and pressure. IOP was measured in both eyes, and carotid Doppler, an ultrasonographic method, was used to measure the velocities of the right and left common and internal carotid arteries. The study's patients all had glaucomatous disc damage. The study's 10 patients all had systemic hypertension. Diabetes was known to affect 10 patients. 12 patients were already taking glaucoma medications. The IOP was determined using a contact tonometer. The normal intraocular pressure range is 10 to 21 mm Hg. People of different ages have different velocity scales. The carotid artery velocity and IOP correlations were investigated.*

RESULTS: *The study included 48 subjects. There were 50 percent males and 50 percent females of various ages. The correlation between carotid artery velocity and IOP was found to be statistically insignificant (P > 0.05) in the study. The average IOP for both eyes was 11 mm Hg, with a range of 11.0-45 mm Hg for the right eye and 11.0-45 mm Hg for the left. The average carotid artery velocity was 45.5 cm/s, with both the right and left arteries ranging from 25.5 to 60.5 cm/s.*

CONCLUSION: *This study suggests that there is no significant relationship between carotid artery velocity and IOP in advanced glaucoma patients.*

KEYWORDS: *IOP, Carotid artery velocity, Carotid Doppler, Tonometry, Glaucoma, Hypertension, Diabetes.*

INTRODUCTION

Glaucoma is an optic neuropathy which is mainly caused by high intraocular pressure. The fluid builds up in the eye causing high pressure. Glaucoma has different types; open angle, closed angle , normal tension glaucoma.[1]

Normal tension glaucoma is a progressive optic neuropathy with intraocular pressure within statistically normal range (< 21 mm Hg). In this type clinically no elevation of intraocular pressure is noted. The primary open angle glaucoma is a progressive optic neuropathy in which changes in optic nerve and visual field defects are noted.[2] Angle closure glaucoma; it is the type of glaucoma in which the angle is narrow and fluid does not flow due to the blocked drainage system. Acute angle closure is an ocular emergency characterized with sudden pain in eye, headache, and eye strain. Angle closure glaucoma occurs when the fluid pressure in eye is raised.[3] In this way fluid does not circulate in the eye properly and pressure increases and the angle is blocked. Patient may feel sudden pain in the eye, increased strain, heachache, vomiting and complaints of blurred vision. In other words, in angle closure glaucoma trabecular meshwork and uveoscleral pathway are blocked.[4]

Normal tension glaucoma is the type of glaucoma in which the pressure remains throughout normal, but damage occurs to the optic nerve. The normal pressure remains 12 to 22mmHg.[5]

High intraocular pressure is due to the imbalance between production and drainage of fluid of eye which is aqueous humor, aqueous humor is for the nutrition of eye. High IOP is due to the increased production and decreased aqueous outflow through trabecular meshwork. One of the main structures of the drainage angle, the trabecular meshwork plays a very important role in the drainage of aqueous humor.[6]

The heart gives off the largest artery, the aorta which carries the blood throughout the body. The aorta gives off the common, external and the internal carotid arteries. The carotid arteries are one on each side; right and left carotid arteries. The carotid artery is made up of three layers; inner layer, tunica intimae, medial layer; tunica media, outer layer; tunica adventitia.[7] Carotid arteries supply blood to brain and head, hence play a vital role in transporting oxygen rich blood, from neck to the brain. In the neck, each of these branches off into an internal and an external carotid artery. Carotid artery disease is a condition in which the carotid arteries narrow. This narrowing reduces the amount of oxygen-rich blood that can flow from these vessels.[8]

Carotid artery stenosis is one of the most common and serious vascular disease . It is the narrowing of aortic valve opening. The stenosis in aorta restricts the blood flow. This narrowing usually occurs due to plaque formation; atherosclerosis.[9] The factors like carotid artery velocity are studied in accordance with intraocular pressure to study the significance of carotid artery stenosis in glaucoma. The normal carotid artery velocity ranges from 30 to 40 cm/sec. This velocity is measured through carotid Doppler (ultrasound results). Doppler ultrasound has become the first choice for carotid artery stenosis screening, for both the evaluation of plaques and flow characteristics.[10]

METHODS

Patients with glaucoma who had advanced visual defects in both eyes were included in the study. In this study, 48 patients with advanced glaucoma and visual defects in both eyes participated. To determine carotid artery velocities and IOP, all patients underwent carotid Doppler examinations. IOP was measured in both eyes, and carotid Doppler, an ultrasonographic method, was used to measure the velocities of the right and left common and internal carotid arteries. The study's patients all had glaucomatous disc damage. The study's ten patients all had systemic hypertension. Diabetes was known to affect ten patients. Twelve patients were already taking glaucoma medications. The IOP was determined using a tonometer. The normal intraocular pressure range is 10 to 21 mm Hg. People of different ages have different velocity scales. The carotid artery velocity and IOP correlations were investigated.

RESULTS

The study included 48 participants. There were 50 percent males and 50 percent females of various ages. The patients in the study had all had a history of glaucoma. Other systemic diseases, such as hypertension and diabetes, were present in some patients. The minimum IOP for the right eye was 11.0mmHg and the maximum IOP was 45 mm Hg, while the IOP for the left eye was the same as the right eye and the average IOP was 11 mm Hg. The velocities of the right carotid artery and the left carotid artery were measured. The minimum carotid artery velocity was 25.5cm/s, and the maximum was 60.5cm/s. Both arteries had an average velocity range of 45.5cm/s. The correlation between carotid artery velocity and IOP was insignificant, as the P-value was greater than 0.05, indicating that both are statistically insignificant to each other. This data shows mean Pearson values for both carotid artery velocities and IOP, which is significant for IOP in both eyes but insignificant for IOP and CAV correlation. The p-value is 0.36 (>0.05), indicating that the relationship between the two is insignificant.

DISCUSSION

Glaucoma patients were studied in various age and gender groups. All patients with glaucomatous disc damage had their intraocular pressure measured. Previous studies of carotid Doppler ultrasonography in glaucoma patients found an increased tendency of stenosis lesions and decreased flow in the carotid arteries on the side with the most glaucomatous damage. Different patients had high or low intraocular pressure depending on disc damage and age. Carotid Doppler was used on patients with glaucoma to determine carotid artery pressure.[11] The velocity of the common carotid artery was calculated using separate readings for the right and left carotid arteries.[12]

This study was done on 48 patients, 24 of whom were males and 24 females, and their IOP and carotid artery pressure or velocity were measured at the same time to see if there was any correlation between the two. Glaucoma damages the optic disc and the major risk factor is raised intraocular pressure, so it is necessary to consider the physiological parameters determining the relationship in order to comprehend any circulatory information provided by the carotid arteries.[12]

All of the patients have the same ocular history, which is glaucomatous disc damage caused by any type of glaucoma. All of the patients who underwent examination had an ocular history of glaucoma of varying durations for the various age groups; some had a history of 4 years, some of 6 years, and so on; the mean or average value was 5 years. The intraocular pressure for both eyes was measured, and the results were different.

High carotid artery velocities are expected in glaucoma patients with high IOP. For example, a group of patients with IOPs of 40mmHg or higher should have high pressure in the carotid arteries, but there was no significant correlation between IOP and CAP. Carotid artery velocities were normal in patients with high, low, or normal IOP.[13]

The carotid artery's normal velocity is between 35 and 40cm/s, but it can be higher in some elderly patients, particularly those with other systemic diseases. Patients with diabetes or cardiac disease may have a faster carotid artery. A study was carried out on patients with high intraocular pressure and glaucoma to investigate the relationship between IOP and carotid artery velocity (CAV). Before and after IOP and CAV calculations, the results revealed an insignificant correlation between the two factors.[14]

Some of the patients were on antihypertensive medication, 5 had diabetes, and 6 had other ocular diseases that could lead to decreased blood supply to the eyes and an increased risk of optic nerve damage.

There is no correlation between elevated intraocular pressure and the current group of people with stenosis in any artery and high carotid velocity (IOP). Patients with carotid artery disease, on the other hand, may experience monocular or ipsilateral ocular symptoms. When the arteries become blocked, blood flow to the brain may be reduced, resulting in vision problems. Nonetheless, a study of glaucomatous disc damage patients revealed that normal and high carotid artery velocities are unrelated.

The study also looked at a person's history of other systemic diseases, such as hypertension and diabetes. 35% of the patients were hypertensive and taking antihypertensive medication, and 28% had diabetes.

A p-value greater than 0.05 indicated that there was no statistically significant difference in volume blood flow for either the internal or common carotid arteries. The study also looked at the relationship between carotid artery velocity and intraocular pressure (IOP), and the p-value of 0.36 was insignificant. This implies that there is no statistically significant relationship between carotid artery velocity and IOP.

CONCLUSION

The relationship between IOP and carotid artery velocity is weak. The increased IOP in glaucoma has no effect on Carotid artery velocity. The data P-value is insignificant.

Authors' Affiliation & Contribution

[1]Erma Sarwar
BSc, Investigative ophthalmology
College of ophthalmology and Allied Vision Sciences (COAVS), Lahore.
ermasarwar.25@gmail.com
Methodology, Literature search, Data collection

[2]Nimra Asif
BSc, Optometry
College of ophthalmology and Allied Vision Sciences (COAVS), Lahore.
cheekusalvakia.ke@gmail.com
Data collection, Proof reading

[3]Ummara Rasheed
M.Phil Statistics
College of ophthalmology and Allied Vision Sciences (COAVS), Lahore.
Results, Data Analysis

REFERENCES

1. Weinreb RN, Khaw PT. Primary open-angle glaucoma. Lancet. 2004;363(9422):1711-20.
2. Baudouin C, Kolko M, Melik-Parsadaniantz S, Messmer EM. Inflammation in glaucoma: from the back to the front of the eye, and beyond. Prog Retin

Eye Res. 2021;83(4):100-916.

3. Youngblood H, Hauser MA, Liu Y. Update on the genetics of primary open-angle glaucoma. Exp Eye Res. 2019;18(8):107-795.

4. Choquet H, Paylakhi S, Kneeland SC, Thai KK, Hoffmann TJ, Yin J, et al. A multiethnic genome-wide association study of primary open-angle glaucoma identifies novel risk loci. Nature communications. 2018;9(1):1-14.

5. Group CN-TGS. Natural history of normal-tension glaucoma. Ophthalmol. 2001;108(2):247-53.

6. Unterlauft JD, Elsaesser K, Grehn F, Geerling G. Intraocular pressure and trabecular meshwork outflow facility after descemet stripping endothelial keratoplasty. J Glaucoma. 2016;25(3):263-8.

7. Bouthillier A, Van Loveren HR, Keller JT. Segments of the internal carotid artery: a new classification. Neurosurgery. 1996;38(3):425-33.

8. Sobieszczyk P, Beckman J. Carotid artery disease. Circulation. 2006;114(7):244-57.

9. Inzitari D, Eliasziw M, Gates P, Sharpe BL, Chan RK, Meldrum HE, et al. The causes and risk of stroke in patients with asymptomatic internal-carotid-artery stenosis. N Eng J Med. 2000;342(23):1693-701.

10. Grant EG, Benson CB, Moneta GL, Alexandrov AV, Baker JD, Bluth EI, et al. Carotid artery stenosis: gray-scale and Doppler US diagnosis—Society of Radiologists in Ultrasound Consensus Conference. Radiology. 2003;229(2):340-6.

11. Blackshear W, Phillips D, Chikos P, Harley J, Thiele B, Strandness Jr D. Carotid artery velocity patterns in normal and stenotic vessels. Stroke. 1980;11(1):67-71.

12. Cedrone C, Mancino R, Cerulli A, Cesareo M, Nucci C. Epidemiology of primary glaucoma: prevalence, incidence, and blinding effects. Prog Brain Res. 2008;173(4):3-14.

13. Davanger M, Ringvold A, Blika S. The probability of having glaucoma at different IOP levels. A Ophthalmo. 1991;69(5):565-8.

14. Seo HR, Jin SW, Rho SH. Relationship Between Nocturnal Dip, Carotid Artery Blood Flow, Brain Ischemic Change in Open Angle Glaucoma. J Korean Ophthalmol Soc. 2013;54(9):1386-94