

# A survey of clinical co-relation amongst Serum Lipids and Primary Open Angle Glaucoma (POAG).

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**Abstract : Introduction :** Glaucoma is one of the world's leading contributors to blindness. The most significant risk factor is intraocular pressure. However, some instances proceed despite intraocular pressure reduction, confirming the view that glaucoma pathogenesis may include additional individual risk factors, not just I.O.P. as previously thought. Few studies have demonstrated the concentration of serum lipids to be linked to the incidence of glaucoma. The study's objective was to see if there is any association between elevated blood lipid levels and the development of Primary Open Angle Glaucoma (POAG).

**Methods and materials :** This study included 20 people with POAG and 20 who did not have glaucoma (controls). All patients had an ophthalmic examination, and a fasting lipid profile was conducted on each participant, which encompassed the following investigations: 1) Total cholesterol, 2) Triglyceride levels, 3) Low-Density Lipoproteins (LDL), and 4) High-Density Lipoproteins (HDL) levels. These variables were compared and contrasted between the experimental and control groups.

**Results :** With a p-value of  $< 0.05$ , the values of Total cholesterol, Triglycerides, and LDL were dramatically higher in cases than in the control group. Patients had lower HDL levels than controls, but the disparity in HDL levels is statistically insignificant.

**Conclusion :** Dyslipidemia is a health concern for POAG on its own. POAG is noticeably associated with high serum cholesterol, triglycerides, and LDL.

**Index Terms-** Triglycerides(TG's), High density Lipoproteins (HDL), Low density Lipoproteins(LDL), Primary Open Angle Glaucoma(POAG)

## Introduction

Glaucoma is one of the leading causes of permanent vision impairment worldwide <sup>(1)(2)</sup>. POAG (primary open-angle glaucoma) is a long-term and progressive neuropathy (optic nerve degeneration) and is India's second most significant cause of irreversible blindness <sup>(3)</sup>. The precise process of anatomic and functional impairment in POAG patients is uncertain. An increase in I.O.P. (intraocular pressure) is the principle. Whenever I.O.P. is elevated, either there is direct pressure and shear injury to the retina's delicate nerve fiber layer or ischemic damage due to blood vessel constriction feeding the head of the optic nerve produces optic nerve injury when I.O.P. is elevated <sup>(4)</sup>. Additional characteristics worth noting include age and ethnic origin, as well as health conditions like as hypertension, diabetes, and glaucoma in the family <sup>(5)(6)(7)</sup>. Research into additional glaucoma risk factors is needed to develop treatments that reduce the disease's incidence. According to recent studies, there are increased odds of POAG in those with hyperlipidemia <sup>(8)</sup>. Oxidative stress, direct sequelae of the Lipid Peroxidation in the cells may damage the sensitive trabecular meshwork and the internal layer of the vasculature of the optic nerve head, or cardiovascular changes that result from elevated cholesterol levels (atherosclerosis) can severely restrict ocular perfusion <sup>(9)</sup>.

## Material and Methods

Our case-control study was conducted from December 2021 to July 2022 at the Ophthalmology Department of a tertiary care facility in Maharashtra. Twenty open-angle glaucoma cases and twenty healthy control subjects were included in the research, which was conducted in accordance with the Helsinki declaration.

### Inclusion Criteria(Cases)-

1. All subjects over 18 years suffering from POAG were considered for the study.
2. Unrestricted I.O.P. over 21 mm/hg on Goldman's Applanation Tonometry
3. Subjects with open angles of the anterior chamber on gonioscopy
4. Optic disc changes specific to glaucoma like an increased cup to disc ratio, thinning of the neuro-retinal rim, bayonetting sign on fundus examination
5. Peculiar visual field defect analyzed by Perimetry.

### Exclusion Criteria(cases) –

1. Previous history of any trauma to the eye or other ocular pathology, excluding errors Refraction.
2. Previous operative history for glaucoma.
3. If the patient gives any significant systemic or local history giving rise to secondary glaucoma.
4. If the patients are previously started on medications aimed to decrease the lipid levels, e.g., Statins, among others.

### Inclusion Criteria (Control)

1. Subjects who have I.O.P. less than 21mmhg.
2. Patients not presenting with any changes of increased I.O.P. in the optic disc and no changes in the visual fields.

3. No evidence of any PXF syndrome in the eyes.

Exclusion criteria (Control)

1. Myopia greater than five diopters.
2. If any antecedent ocular surgery is done.
3. Cataracts occur as a result of trauma, dislocated lens or complex cataracts.

Evaluation of patients was done by

1. Snellen's chart visual acuity test unassisted and correcting refractive error, if any.
2. Examination of the anterior segment was done using a slit lamp.
3. Goldmann's applanation tonometer was used for checking I.O.P.
4. Gonioscopy to check the structure of the angles using a Volk gonio lens.
5. Indirect ophthalmoscope-aided funduscopy to check for any glaucomatous changes
6. Perimetry testing on Zeiss Humphrey field analyzer for any defective visual fields.
7. Fasting blood samples were collected for laboratory analysis of serum lipids concentrations. The lipid profile includes measurements of total cholesterol, triglycerides (T.G.L.), low-density lipoproteins (LDL), and high-density lipoproteins (HDL). The N.C.E.P.: ATP III guidelines define hypercholesterolemia as total cholesterol > 200 mg/dl, hypertriglyceridemia as triglycerides > 150 mg/dl, LDL > 130 mg/dl as high, and HDL 40 mg/dl as low, were used to establish and determine the lipid reference values <sup>(10)</sup>.

#### Statistical Analysis of data-

Mean, Standard Deviation, and Mean Standard Error was calculated. Statistical Analysis was carried out using SPSS software, unpaired t-test and chi-square test.

A P-value of less than 0.05 was considered significant statistically.

Tabloid 1-Population Analysis of the study population

Variables	Cases(n=20)	Controls(n=20)
Average age(Span in years)	55 years	52 years
Sex (M/F)	12:8	11:9
Obesity (>=25)	3/20(15%)	1/20 (5%)
Location (Rural/urban)	15/20(75%)	11/20(55%)

The study's patients varied in age from 45 to 70, with an average age of 55 years (cases) and 52 years (controls). Almost all of the study population was 50-56 years of age. The sex correlation of the study was 12:8 (cases) and 11:9(controls).75% (cases) of the study population hails from a rural community, whereas 11/20 cases were from an apartment-dwelling civic area. In our study, seven patients were overweight, and three were found to be morbidly obese(cases), whereas only one case suffered from obesity.

Tabloid 2- Lipid levels of the study population

Variable(Lipid levels)				cases (n=20)	Controls (n=20)
Increased Cholesterol		(>200mg/dl)		10/20(50%)	4/20(20%)
Increased Triglyceride		(>150 mg/dl)		9/20(45%)	3/20(15%)
Increased LDL		(>130 mg/dl)		12/20(60%)	4/20(20%)
reduced HDL		<40 mg/dl)		13/20(65%)	12/20(24%)

Raised cholesterol levels were seen in 10 out of 20 patients(50%) in the control group when only 4 out of 20 subjects were detected. Nine cases in the cases group had elevated triglyceride levels but were noted only in 3 patients in the control group.

Tabloid 3- assessment of serum lipids

Variables	Cases(n=20)	Controls(n=20)
Average Cholesterol(mg/dl)	225.23(+/-7.07)	145.22(+/-4.47)
Average Triglyceride(mg/dl)	152.08(+/-6.67)	101.76(+/-6.03)
Average LDL (mg/dl)	148.3(+/-5.74)	99.35(+/-4.17)

Average HDL (mg/dl)	38.71(+/-1.46)	41.88(+/-1.27)
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Analysis of average cholesterol was 225.23(+/-7.07)mg/dl, average TG's came out to 152.08(+/-6.67)mg/dl, average LDL was 148.3(+/-5.74)mg/dl, and average HDL was 38.71(+/-1.46)mg/dl in the category of the case. In the control group, the average cholesterol was 145.22(+/-4.47), the average TG's level was 101.76(+/-6.03), and the average LDL was 99.35(+/-4.17), and the average HDL was 41.88(+/-1.27).

With a p-value of <0.0001 and a confidence interval of 95%, baseline cholesterol, triglycerides, and LDL were substantially higher among cases than in controls. The amount of HDL in patients was decreased than in controls, although this difference was not statistically significant ( $p = 0.0541$ ).

### Discussion

Numerous studies have found a link between hyperlipidemia and POAG. Reactive oxygen species may harm the delicate trabecular meshwork, damage the endothelium of blood vessels that supply the optic nerve head or create atherosclerotic changes due to lipid peroxidation. Increased amounts of cholesterol may also compromise ocular perfusion. Elevated serum lipid concentrations may increase blood viscosity and episcleral venous pressure, restricting the outflow facility. Higher amounts of total cholesterol, particularly the atherogenic LDL fraction, may impact glaucoma<sup>(11)</sup>. Egorow et al. demonstrated that atherogenic hyperlipidemia with impaired antioxidative activity might be present in glaucoma patients<sup>(12)</sup>. Another report discovered that statins administered for more than 23 months might significantly decrease the likelihood of glaucoma<sup>(13)</sup>. Davari et al. discovered a link between POAG and dyslipidemia in a case-control study. They concluded that POAG might be exacerbated by hyperlipidemia<sup>(14)</sup>. The average cholesterol level in the cases was 6.14 mol/dm, while it was 5.96 mol/dm in the controls. The average triglyceride level in the cases was 2.38 mol/dm, while it was 2.04 mol/dm in the controls. High-density cholesterol was 1.45 mol/dm on average in the cases and 1.40 mol/dm in the controls, respectively. LDL in the study population was 3.98 mol/dm and 4.08 mol/dm in the controls. This indicates that the test group had higher blood cholesterol levels than the control group, hinting that hypercholesterolemia may be a prognostic factor in diagnosing POAG<sup>(15)</sup>. The Beijing eye research, which included 3251 people over 45, discovered that I.O.P. was considerably higher in dyslipidemic patients<sup>(16)</sup>. Researchers Wang and Bao performed several meta-analyses to examine the association between hyperlipidemia and glaucoma. Hyperlipidemia is linked to glaucoma. However, there is significant variability across research<sup>(17)</sup>. More studies will help us understand the processes that cause dyslipidemia and the development of POAG. Several studies have found elevated Aqueous humor levels, lipid peroxides, trabecular meshwork, and Schlemm's canal in POAG cases versus Control eyes, implying that increasing lipid peroxidation by oxidative stress is accountable for the demolition of Schlemm's canal and trabecular meshwork<sup>(18)</sup>. Several mechanisms, including reduced intraocular pressure and neuroprotection, could explain how statins reduce the risk of POAG. Statins have previously been shown to affect rho kinase and myosin II adenosine triphosphatase, both of which are found in the eye's trabecular meshwork. Earlier Findings reveal that statins produce increased nitric oxide release and enhanced aqueous outflow. Furthermore, the past analysis revealed that statins have anti-excitotoxic, anti-inflammatory, and anti-apoptotic properties that can help preserve retinal ganglion cells. In POAG patients, the breakdown of these cells results in permanent blindness. In addition, some genes related to cholesterol metabolism have been linked to I.O.P. and POAG in phylogenetic analysis association studies.

### Conclusion

According to current research, dyslipidemia is strongly connected with an elevated risk of glaucoma. The outcomes of this investigation give practitioners relevant information on hyperlipidemia therapy to reduce the occurrence of glaucoma.

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