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A Study on Plasma Lipid Levels and Risk of Primary Open Angle Glaucoma

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Aim : To find an association of dyslipidaemia as an independent risk factor for POAG.
Type: Hospital based case control study
Methods : In this case-control study, a total of 100 subjects comprising 50 patients with POAG documented by an array of clinical tests and 50 age-matched controls were included in the study done in the department of Ophthalmology of a teaching hospital in Karnataka, India . Fasting lipid profile comprising of total cholesterol, triglycerides, low density lipoproteins and high-density lipoproteins was done. Statistical analysis was performed using unpaired t-test and chi square test using SPSS 24 software. p value < 0.05 was considered as significant.
Results: Among the cases, 56% with elevated serum cholesterol levels, 52% with raised triglyceride levels and 60% with elevated low-density lipoprotein levels were found to have primary open angle glaucoma. Levels of total cholesterol, total triglycerides and LDL were significantly higher in cases than in controls with a statistically significant pvalue < 0.05. Hence, from this study we conclude that dyslipidaemia is an independent risk factor for POAG.
Conclusion: Dyslipidaemia is significantly associated with an increased risk of primary open angle glaucoma. This study provides clinicians with information on adopting multifactorial approach to detect and control hyperlipidaemia and thereby effectively manage POAG.

I. INTRODUCTION

Primary Open-angle glaucoma (POAG) is a multifactorial condition characterized by a progressive neurodegenerative disease that leads to glaucomatous optic neuropathy and eventually glaucomatous visual field loss leading to progressive loss of sight. Various mechanisms and theories are known to cause primary open angle glaucoma (POAG) and among them metabolic disorders like diabetes, hypertriglyceridemia, hypercholesterolemia, are noteworthy [7]. The characteristics of POAG include high intraocular pressure, changes in optic disc and neuro retinal rim, visual field defects and open anterior chamber angle on gonioscopy. Glaucoma is found to affect 2–3% of people above 40 years of age [1]. About 50% of people remain asymptomatic and hence undiagnosed. According to a study, about 111.8 million people will be affected with glaucoma worldwide by 2040, with majority of cases in Asia and Africa.[2] Hyperlipoproteinemia's occur due to metabolic disorders in production and decomposition of lipids. Total lipids include cholesterol, triglycerides and phospholipids. Lipids are transported in the form of lipoproteins in the blood andconsists of high-density lipoproteins (HDL), low density lipoproteins (LDL) and very low density lipoproteins

(VLDL). High density lipoproteins are considered as protective factor preventing atherosclerosis (8). It is found that atherosclerosis with raised intraocular pressure has a bad impact on pulse volume in glaucoma (9).
For instance, a study by Lin and colleagues, found that hyperlipidaemia increased the odds of developing POAG (10). This study aims to establish a relation between plasma lipid levels and its variants with POAG.

II. AIM

- To prove a relationship between serum lipid values (cholesterol, triglyceride, low density cholesterol, high density cholesterol) and primary open angle glaucoma (POAG).
- To find association of dyslipidaemia as an independent risk factor for POAG.

III. MATERIALS AND METHODS

It is a Case control study done over a period of 6 months in the department of ophthalmology of a teaching hospital in Karnataka, India. A total of 100 subjects were included in the study .50 cases and 50 age matched controls were considered. Demographic data including age,

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gender, address was noted. Ophthalmic examination included visual acuity testing using Snellen's chart, slit lamp examination of anterior segment and grading of anterior chamber depth using Van-Herrick's grading, intraocular pressure was measured using Non- Contact Tonometer. Gonioscopy was done to examine the structures of the anterior chamber angle. Fundus examination by indirect ophthalmoscopy using +60D lens was done to determine the changes in the optic nerve head and visual field charting was performed to assess visual field defects. Diagnosis of primary open angle glaucoma was done on the basis of raised IOP, optic nerve
head changes and visual field defects.

Serum lipid levels were assessed using twelve hour fasting blood samples by autoanalyzer. The total lipid profile consisted of total cholesterol, triglycerides (TGL), Low Density Lipoproteins (LDL) and High Density Lipoproteins

(HDL). Mean, Standard deviation and standard error of means
were calculated. Statistical analysis was performed using unpaired t-test and chi square test using SPSS 24 software. p value < 0.05 was considered as significant.

Criteria for diagnosing of Primary open angle glaucoma

- raised IOP above 21mmhg
- optic nerve head changes detected on direct ophthalmoscopy
- Open angles on gonioscopy
- visual field defects.

According to National Cholesterol Education Program: Adult Treatment Panel III (NCEP: ATP III) guidelines,

Hypercholesterolemia is defined as

1. Total cholesterol >200 mg/dl,
2. Hypertriglyceridemia, when triglycerides > 150mg/dl,
3. LDL > 130 mg/dl was considered high and
4. HDL < 40 mg/dl was considered low.[14]

INCLUSION CRITERIA FOR CASES

1. Elevated intraocular pressure (IOP) above 21 mmHg, untreated.
2. Open anterior chamber angles on gonioscopy
3. Glaucomatous optic disc changes (increased cup/disc ratio, thinning of the neuro retinal rim, notching) on ophthalmoscopy
4. Visual field defects characteristic of glaucoma by standard automated perimetry with the Humphrey Visual Field Analyser.

INCLUSION CRITERIA FOR CONTROLS

1. IOP below 21 mm Hg
2. No glaucomatous changes in the optic disc
3. No visual field loss characteristic of glaucoma
4. No pseudo exfoliation material in the lens capsule or pupil

EXCLUSION CRITERIA FOR CASES

1. History of ocular trauma, ocular surgery
2. Any systemic or local condition causing secondary glaucoma.
3. Persons taking lipid lowering drugs like statins.

EXCLUSION CRITERIA FOR CONTROLS

1. High myopia (>6D)
2. History of intraocular surgery, subluxated, traumatic and complicated cataracts.
3. People on lipid lowering drugs like statins.

DEMOGRAPHIC CHARACTERISTICS- table 1

CHARACTERISTICS	CASES(n=50)	CONTROLS(n=50)
Range of age (years)	40-80	35-75
Mean age (years)	58.49±8.81	56.36±9.27
Gender (male:female)	28:22	32:18

The cases in our study were within the age group of 40- 80 years with mean age of 58.49 ±8.81years and controls were within 35- 75 years with mean age 56.36±9.27 years. Number of females were more in cases and males were more in controls.[table1]

DYSLIPIDEMIA IN CASES AND CONTROLS

Levels of cholesterol, triglyceride and LDL were found to be elevated in cases with significant p value <0.05 in cases. Low levels of LDL were found in 68% of cases with nonsignificant p value(0.1142).

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Table 2

Lipid parameters	Cases (n=50)	Controls (n=50)	Percentage cases	Percentage controls	P value
High cholesterol (>200mg/dl)	28	9	56%	18%	**<0.001**
High triglyceride (>150mg/dl)	21	6	52%	12%	**<0.001**
High LDL (>130mg /dl)	30	9	60%	18%	**<0.001**
Low HDL(<40mg/dl)	34	28	68%	56%	0.1142

MEAN SERUM LIPID VALUES

Mean cholesterol , triglyceride and LDL levels were higher in cases when compared to controls with a significant p value (<0.001). Mean HDL levels in cases were not significant (p value 0.0531)

Table 3

Serum lipid parameters	Cases (n=50)	Controls (n=50)	P values
Mean cholesterol (mg/dl)	221±6.23	170.31±5.60	<0.001
Mean triglyceride (mg/dl)	158.25±6.92	109.80±8.34	<0.001
Mean LDL(mg/dl)	147.3±4.06	106.20±6.14	<0.001
Mean HDL (mg/dl)	34.30±4.40	35.42±4.03	0.0531

IV. RESULTS

In this study ,Mean age of participants was over 55 years of age with male preponderance .Among the cases of POAG, we found that 56% had elevated serum cholesterol levels as compared to 18% of normotensive controls.52% of glaucoma cases were found to have elevated triglyceride levels as compared to 13% of normotensive controls.60% of patients with POAG were found to have elevated LDL levels . Levels of total cholesterol, total triglycerides and LDL were significantly higher in cases than in controls with a statistically significant pvalue < 0.05. Mean cholesterol over 220 mg /dl , mean triglycerides over 150mg/dl and mean LDL over 140 mg/dl were found to be significantly associated with POAG. No significant association was found with low levels of HDL and POAG.

V. DISCUSSION

Various theories have been postulated regarding the metabolism of lipids leading to POAG . Some of them being peroxidation of lipids causing oxidative stress which might directly damage trabecular meshwork and endothelium of blood vessels supplying the optic nerve head. High cholesterol causing atherosclerotic changes in the blood vessels may affect ocular perfusion. Increased lipid levels would lead to raised episcleral venous pressure as well as increased blood viscosity, thereby causing a consequent decrease in outflow of aqueous.

The higher values of atherogenic LDL fraction, may have certain influence in glaucoma (11). In our study a positive association was found between POAG and dyslipidaemia (hypercholesterolemia and hypertriglyceridemia) which was similar to a study by Davari et al. Hence, we conclude that hyperlipidemia can be a risk factor for POAG [3]. The Beijing eye study on 3251 individuals (aged>45years) showed that in patients with dyslipidemia, IOP was significantly increased. [4] Similarly in the present study, we found that glaucoma cases had significantly more dyslipidemia as compared to normotensive controls

Our study is in accordance with the study by Pavljasevic et al who concluded that dyslipidemia as an independent metabolic disorder, may influence occurrence of glaucoma but together with other risk factors such as: age, sex, positive family disease history [6]. Wang and Bao performed multiple distinct meta-analyses to further clarify the association of hyperlipidemia with glaucoma [5]. They studied all the papers that assessed the correlation between hyperlipidemia and glaucoma and detected a marked association between hyperlipidemia and glaucoma with significant heterogeneity among studies and concluded that hyperlipidemia is significantly associated with an increased risk of glaucoma which is similar to the findings in this study. Egorow et al. found that patients with glaucoma may have atherogenic hyperlipidaemia with decreased antioxidative activity (12). The statins in usage longer than 23 months may significantly

reduce the risk of glaucoma was concluded from a study done by McGwin et al(13).

Limitation of this study was the small sample size .Hence further studies with with a large sample size as well as association of other risk factors should be undertaken .

VI. CONCLUSION

Dyslipidaemia is significantly associated with an increased risk of primary open angle glaucoma. Primary open angle glaucoma has a long asymptomatic period and the affected individuals can develop severe damage before they seek professional help. It has been regarded as a disease that fits well the criteria for screening. It is highly prevalent in the Asian population. Atherosclerosis and POAG are genetically predisposed and appear in older age group over 50 years of age. Dyslipidaemia, as an independent metabolic disorder, may have influence on the appearance of glaucoma along with other risk factors such as: age, sex, positive family history of POAG.As POAG and increased cholesterol levels are seen in older people , the definitive mechanism leading to POAG due to dyslipidaemia needs to be further studied .Treatment begun early in its course is probably more effective at preventing significant loss of vision. Serum lipid values could be one of predictable factors in primary open-angle glaucoma diagnosis and in people diagnosed with POAG serum dyslipidaemia should be ruled out. Investigations like serum triglyceride levels should be checked for in patients with POAG as it can help in better management in patients of POAG. This study provides clinicians with information on adopting multifactorial approach and control hyperlipidaemia to prevent the incidence as well as effective management of POAG .

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