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Original Research Article

Association of lipid profile with primary open angle glaucoma in non-obese patients

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ABSTRACT

Background: Hyperlipidemia has been shown to be associated with Glaucoma as well as increased intra ocular pressure (IOP). We conducted a case control study to further study the association of Lipid profile with Primary Open Angle Glaucoma (POAG) in non-obese patients.

Materials and Methods: With the approval from Institutional Ethics Committee (ICE) and written informed consent, 100 adult patients were included in the case control study. The methods applied in the study adhered to the tenets of the declaration of Helsinki. 50 non-obese POAG patients of above 40 years aged were included as cases and another 50 without Glaucoma were taken as controls. Patients were further subjected to biochemical investigation of the serum lipid profile performed by Vitros 5600.

Results: Mean total cholesterol, triglyceride and low-density lipoprotein (LDL) levels were found to be significantly higher in non-obese POAG cases as compared to that in controls ($p<0.05$), whereas mean high density lipoprotein (HDL) levels were significantly lower in non-obese POAG cases as compared to that in controls ($p<0.001$). The odds of high cholesterol levels to be associated with POAG in non-obese are statistically significant ($p<0.001$).

Conclusion: The study demonstrated a relationship of serum lipid levels with risk of primary open angle glaucoma.

1. Introduction

India is one of the most affected countries with more than 12 million people suffering from [1] Primary Open Angle Glaucoma (POAG). POAG is marked by degeneration of retinal ganglion cells and resultant changes in the optic nerve head. Multiple factors have been shown to have a role in the pathogenesis, including high IOP, vascular insufficiency, oxidative stress and immune factors.[2,3] Association of hyperlipidaemia with POAG and with increased IOP is well documented,[4–7] more so, there is association with specific lipids. We conducted a case control study to further study the association of Lipid profile with POAG in non-obese patients.

2. Materials and Methods

With the approval from Institutional Ethics Committee (ICE) and written informed consent from all patients, a case-control study was conducted in the Department of Ophthalmology, of a Tertiary Care Centre over a period of 24 months.

2.1. Inclusion criteria

Patients were assigned to two groups, 50 consecutive non-obese POAG patients of above 40 years were included as cases and another 50 consecutive patients without glaucoma were taken as controls. In accordance with the IEC, the

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methods applied in the study adhered to the tenets of the declaration of Helsinki.

Demographic data, including age and gender was noted. A general and systemic examination of the patients was carried out and medical history regarding systemic and chronic illnesses such as uncontrolled Hypertension/uncontrolled Diabetes mellitus,[8,9] any personal history of drug intake, smoking and chronic alcohol intake, and any significant family medical history was obtained.

2.2. Exclusion criteria

Patients with high myopia, uveitis, BMI> 30.0, media opacities like corneal opacity, Cataract, Retinal detachment, Diabetic retinopathy/ Hypertensive retinopathy, age-related macular edema, systemic conditions, like uncontrolled Hypertension/uncontrolled Diabetes mellitus.[8,9] smoking and chronic alcoholism were excluded from the study.[10]

2.3. Methodology

Ophthalmological assessment of the patients was done, best corrected visual acuity was measured using Snellen's chart for both the eyes. This was followed by torch light examination, pupillary reaction, anterior segment examination, distant direct ophthalmoscopy, slit lamp examination. Van-Herick's grading for intraocular pressure measurement was done using Goldmann applanation tonometer. Gonioscopy was performed to evaluate the angle structures, visual field analysis was done by standard automated perimetry (Humphrey Field Analyzer- HFA II 720-5545-3.2/3.2; Humphrey-Zeiss) using Swedish Interactive Threshold Algorithm (SITA) Standard Central 30-2 program. Optic disc imaging was performed using Cirrus HD Spectral Domain Optical Coherence Tomography (SD-OCT). Later, fundus evaluation by direct ophthalmoscopy and fundus photography by Carl Zeiss VISUCAM 524 fundus camera was also done.

Patients were further subjected to biochemical investigation of Serum lipid profile, performed by Vitros 5600, using 5ml of blood sample, obtained from all study subjects under aseptic conditions.

Fasting triglyceride levels were graded as- Normal: <150 mg/dl, Mild hypertriglyceridemia: 150 to 499 mg/dl, Moderate hypertriglyceridemia: 500 to 886 mg/dl, Very high or Severe hypertriglyceridemia: >886 mg/dl.

LDL-C levels were considered as Optimal when <100 mg/ dl, Near optimal/Above optimal when 100 to 129 mg/dl, Borderline high when 130 to 159 mg/dl, High when 160 to 189 mg/dl and Very high when >190 mg/dl.

HDL levels were considered as Low when <40 mg/dl, High< 60 mg/dl.

Clinical profiles of the cases and controls were documented and ocular evaluation was done as mentioned and lipid levels were compared.

2.4. Statistical analysis

The data was analyzed using Statistical Package for Social Sciences, version 21.0. Data was represented as numbers and percentages. Chi-square test, Independent samples 't'-test and ANOVA were used to compare the data. A 'p' value <0.05 was considered statistically significant.

3. Results

In the current case-control study, a total of 50 non-obese patients of POAG (age range- 40-78 years; mean age 54.44 years; 62% males) and another 50 patients without Glaucoma (age range- 42-64 years; Mean age- 52.54 years; 48% males) were taken as cases and controls respectively.

The analysis demonstrated that mean total cholesterol, triglyceride and LDL levels were significantly higher in non-obese POAG cases as compared to that in controls ($p<0.05$), whereas mean HDL levels were significantly lower in non-obese POAG cases as compared to that in controls ($p<0.001$). (Table 1)

The odds of high levels of cholesterol, triglycerides and LDL to be associated with POAG in non-obese were found to be statistically significant with $p<0.001$ (Table 2), ($p<0.029$) (Table 3), and ($p=0.003$) (Table 4) respectively. The odds of low levels of HDL to be associated with POAG in non-obese were found to be statistically significant with $p<0.001$ (Table 5).

4. Discussion

Glaucoma is a progressive optic nerve neuropathhy and is a leading cause of irreversible vision loss throughout the world.[7] Lipid dysregulation is an important factor in the pathogenesis of Glaucoma. Sustained dysregulation may lead to degenerative changes in the retinal and choroidal vasculature which may further result into early ischemic retino-neural angiopathy,[11,12] resulting in hypoperfusion and leading to disturbances in ganglion cell micro circulation, causing permanent visual disturbances.[13] The underlying mechanism could be explained by oxidative stress and subsequent atherogenic changes induced by dyslipidemia.[14,15]

The characteristic feature of the present work is that we explored the relationship of specific Serum lipid levels in non-obese patients with POAG by evaluating this relationship for mean levels and categorical assessments by dividing the data into different strata of cut-off values. We explored these relationships by evaluating them for overall study population. We compared the data using tests of hypothesis as well as by calculating the simple odds ratio.

The role of High density lipoprotein cholesterol (HDL-c) in Glaucoma is controversial. While most of the studies do not find it to be significantly associated with Glaucoma

Table 1: Comparison of lipid level between non-obese POAG and controls

Parameter	Non-Obese POAG (n=50)		Controls (n=50)		Statistical significance	
	Mean	SD	Mean	SD	t	
Total cholesterol (mg/dl)	208.65	36.92	190.14	21.72	3.054	0.003
Triglyceride (mg/dl)	226.62	56.82	154.62	37.06	7.505	<0.001
LDL (mg/dl)	127.16	28.50	108.56	19.57	3.804	<0.001
HDL (mg/dl)	36.04	8.22	50.66	8.04	-8.987	<0.001

Table 2: Comparison of total cholesterol between non-obese POAG and controls

Parameter	Non-obese POAG (n=50)		Controls (n=50)		Statistical significance		
	NO.	%	NO.	%	c2	p	OR (95% CI)
Normal TG (<200mg/dl)	23	46.0	33	66.0		<0.001	Ref.
Borderline high TG (>200-239 mg/dl)	11	22.0	17	34.0			0.92 (0.37-2.35)
High TG (>240mg/dl)	16	32	0	00			47.04 (2.69-823.53)

Table 3: Comparison of triglyceride between non-obese POAG and controls

Parameter	Non-obese POAG (n=50)		Controls (n=50)		Statistical significance		
	NO.	%	NO.	%	c2	p	OR (95% CI)
Normal TG (<150mg/dl)	10	20.0	20	40.0	4.762	0.029	Ref.
Mild TG (>150-499 mg/dl)	40	80.0	30	60.0			2.67 (1.09-6.52)
Moderate TG (>500-886 mg/dl)	0	0	0	0			
Severe TG (>886 mg/dl)	0	0	0	0			

Table 4: Comparison of LDL between non-obese POAG and controls

Parameter	Non-obese POAG (n=50)		Controls (n=50)		Statistical significance		
	NO.	%	NO.	%	c2	p	OR (95% CI)
Optimal LDL (<100 mg/dl)	13	26.0	18	36.0	13.69	0.003	Ref.
Near/above optimal LDL (>100-129 mg/dl)	17	34.0	26	52.0			0.91 (0.35-2.32)
Borderline high LDL (>130-159 mg/dl)	10	20.0	6	12.0			2.31 (0.67-7.96)
High LDL (>160-189 mg/dl)	10	20.0	0	0			28.78 (1.55-534.94)
Very high LDL (>190 mg/dl)	0	0	0	0			

Table 5: Comparison of HDL between non-obese POAG and controls

Parameter	Non-obese POAG (n=50)		Controls (n=50)		Statistical significance		
	NO.	%	NO.	%	c2	p	OR (95% CI)
Low HDL (<40 mg/dl)	17	34.0	41	82.0	23.65	<0.001	8.84 (3.49-22.39)
Normal HDL (>40-60 mg/dl)	33	66.0	9	18.0			
High HDL (>60 mg/dl)	0	0	0	0			

or to have a protective effect, there are a few studies that report that higher HDL-c levels are also associated with increase in IOP and Glaucoma-risk.[8,10,16–19] Despite these controversies, dyslipidemia today is recognized as a potential risk factor for Glaucoma. Similarly, changes in the inner diameter of the retinal arteries and veins result in altered blood flow velocity and vascular resistance indices in the retrobulbar arteries, which may act as a basis for glaucomatous changes.[9] The most important finding of this study is that mean total cholesterol, triglyceride and LDL levels are significantly higher in cases as compared to that in controls whereas mean HDL levels are significantly lower in cases as compared to that in controls. Higher total cholesterol, triglyceride, LDL and lower HDL levels have significantly higher odds of POAG in non-obese as compared to that of controls.

Previously some workers[20] compared serum total cholesterol and triglyceride levels between POAG cases and age-sex matched healthy controls. Mean age of cases in their study was 64.9±1.97 years, of which majority (60%) were males and were from urban areas (57.5%). Mean serum total cholesterol and triglyceride levels were 211.2±51.9 and 165.9±88.6 mg/dl respectively in cases as compared to 162.3±39.6 and 99.5±43.1 mg/dl respectively in controls. Hyper cholesterolemia and hyper triglyceridemia were seen in 52.5% and 32.5% of cases respectively as compared to 14% and 5% of controls respectively, thereby showing a significant difference between two groups. The authors thus recognized hyperlipidemia as a risk factor for POAG.

In another studyconducted as a case-control study, including 40 patients of POAG as cases and 40 individuals without Glaucoma as controls, where mean age of cases was 56 years and majority (65.0%) were males and from urban areas (75%), a total of 6 (15%) had BMI >25 kg/m^2. There was no statistically significant difference found between cases and controls for age, sex, locality and BMI. Hyper cholesterolemia, hypertriglyceridemia, high LDL and low HDL levels were seen in 50%, 45%, 60% and 67.5% of cases respectively as compared to 17.5%, 15%, 17.5% and 32.5% of controls respectively. Mean total cholesterol, triglyceride, LDL and HDL levels were 215.95±6.44, 153.05±7.87, 142.7±6.24 and 39.68±1.55 mg/dl respectively in cases as compared to 168.35±5.16, 108.60±6.32, 102.2±4.39 and 40.83±1.63 mg/dl respectively in controls, thus showing a significant difference between two groups. The findings showed that Glaucoma cases had a high prevalence of deranged lipid levels as compared to controls.

Results of other workers further support this hypothesis. Gupta et al.[21] Compared lipid levels between 100 POAG cases and 100 age-matched controls. Mean age of cases was 56.36±7.91 years. Majority were females (59%) and were from urban areas (67%). Mean total cholesterol (TC), triglyceride (TG), LDL and HDL levels were 217.15±6.29, 156.05±7.91, 144.1±4.24 and 37.28±4.43 mg/dl respectively in cases and 174.95±5.23, 112.70±8.67, 109.8±6.27 and 38.46±4.18 mg/dl respectively in controls. As compared to controls, cases had significantly higher TC, TG and LDL levels. Prevalence of hypercholesterolemia, hypertriglyceridemia, high LDL and low HDL was 51%, 42%, 60% and 68% respectively in cases as compared to 18%, 13%, 18% and 57% respectively in controls. Statistically, a significant difference between two groups was observed for hypercholesterolemia, hypertriglyceridemia and High LDL. The authors concluded that dyslipidemia is an independent risk factor for POAG.

Roy and Ghanta,[22] conducted their study on 50 cases of POAG and 50 controls. Mean age of cases was 56.5 years, of which majority were females (56%) and urban residents (68%). Mean total cholesterol, triglyceride, LDL and HDL levels were 216.95±6.30, 154.50±7.82, 143.2±4.22 and 38.73±1.44 mg/dl respectively in cases as compared to 170.95±5.12, 109.66±6.34, 104.05±4.70 and 39.52±1.80 mg/dl respectively in controls. Proportion of those with high cholesterol, triglyceride and LDL was 52%, 44% and 60% respectively in cases as compared to 16%, 14% and 18% respectively in controls. Except for HDL levels, all the other three lipids were significantly higher in cases as compared to that in controls. The authors concluded that dyslipidemia was an independent risk factor for POAG.

Our results have been in sync with findings, we further demonstrated association of POAG in non-obese adult patients with specific lipids.

5. Conclusion

Total cholesterol, triglyceride and LDL levels were significantly higher in cases as compared to that in controls, whereas mean HDL levels were significantly lower in cases as compared to that in controls. Higher total cholesterol, triglyceride, LDL and lower HDL levels had significantly higher odds of POAG in non-obese as compared to that of controls. The findings of the present study were interesting and were able to document a relationship of Serum lipid levels with risk of Glaucoma. However, small sample size, an open analytical approach and probability of higher incidental findings in view of small sample size, are certain limitations of the study.

6. Ethical Approval

This study was conducted after taking approval from the Ethical committee of the Era Lucknow Medical College and Hospital, Lucknow.

7. Source of Funding

Nil.

8. Conflict of Interest

None.

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