A Survey of the Relationship Between Serum Cholesterol and Triglyceride to Glaucoma: A Case Control Study

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Abstract: *Purpose/Aim*: primary Open-angle glaucoma (POAG) is an asymptomatic, progressive optic neuropathy characterized by enlarging optic disc cupping and visual field loss. POAG is a major cause of blindness and is characterized by progressive degeneration of the optic nerve and is usually associated with elevated intraocular pressure.

Regarding the fact that dyslipidemia has a relationship with some ophthalmic diseases such as cataract, it sounds that the same relationship also exists with POAG. Therefore, it was decided to study the relationship between serum cholesterol and triglyceride to POAG.

Methods: The present study was done on 40 primary Open-angle glaucoma (POAG) patients (cases) and 40 healthy individuals (controls). In order to diagnose POAG, Intra ocular pressure (IOP) was measured by means of Applanation tonometry, and then was confirmed through perimetry and ophthalmoscopes. The controls were patients' attendants who had referred to Birjand Valli-e-asr clinics but did not have POAG. After a fasting of 12 hours, blood samples were derived to determine serum level of triglyceride and cholesterol levels. Then, the results of the tests together with the participants' demographic information were individually registered in a questionnaire.

The obtained data was analyzed by means of SPSS software (version 15) and statistical tests including T-test and Chi-square.

Results: Mean levels of cholesterol (211.18± 51.91mg/dl in cases, 162.38±39.56 mg/dl in controls) and triglyceride (165.92±88.58 mg/dl in cases, 99.46± 43.08 mg/dl in control) were significantly higher in cases than in controls. Hypercholesterolemia and hypertriglyceridemia were significantly higher in the cases compared with the controls. There was a positive association between POAG and dyslipidemia (OR=7.14 [95% CI: 2.3-22.2] for Hypercholesterolemia and OR=16.9 [95% CI: 2.1-14.8] for hypertriglyceridemia.

Conclusion: Hyperlipidemia can be a risk factor of getting POAG.

Keywords: Primary Open-angle glaucoma (POAG), Triglyceride, Cholesterol, Case-Control study.

INTRODUCTION

POAG is a gradual and progressive ophthalmic disease, which can cause the destruction of the ophthalmic nerve and the incidence of blindness with the passage of time. POAG is a major cause of blindness and is characterized by progressive degeneration of the optic nerve and is usually associated with elevated intraocular pressure Open-angle glaucoma is an asymptomatic, progressive optic neuropathy characterized by enlarging optic disc cupping and visual field loss. The disease is increasing worldwide and it has been stated that by the year 2010 about 4.5 million people will become blind due to glaucoma [1]. According to the results of "Tehran Eye Study", 2.7% of decrease of sight is because of glaucoma [2].

The disease, particularly during the initial stages, is asymptomatic and it has been said that half of the people who suffer from the disease are unaware of its occurrence. However, gradually they develop signs such as increasing IOP, cupping of the optic disk, and distortion of visual field. Elevated intraocular pressure is a strong, modifiable risk factor for open-angle glaucoma, but it is not diagnostic. Measurement of intraocular pressure by primary care physicians to screen patients for glaucoma is not recommended Routine. Formal visual field testing (perimetry) is a mainstay of glaucoma diagnosis and management.

Regarding the importance of the disease identifying its risk factors is necessary. Different factors have been stated to have their own roles in the incidence of the disease. One of the factors mentioned is "race". It is said that glaucoma is more prevalent among the Asian race [3, 4].

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With respect to socioeconomically factors, various studies have been done the results of which have been contradictory. In a study conducted in Rotterdam, it was found that among susceptible factors only obesity in women had a significant relationship with the increase in internal ophthalmic pressure. However; cigarette smoking, socioeconomically position, and alcohol consumption did not have any effects [5]. Based on a study in Tehran, lower socioeconomically levels were as risk-factors to POAG [6].

Regarding the relationship between physical activity, diet, and antioxidants to glaucoma various studies have been done the results of which, too, have proved to be contradictory. Some studies claim that decreasing antioxidative defence and increasing of oxidative stress are effective in the pathogenesis of the disease [7]. Another study found no relationship between homocysteine level and glaucoma [8]. One study has mentioned consumption of omega 3 as a decreasing factor of IOP [9]. Some studies have been carried out on the role of blood lipids in the pathogenesis of glaucoma and they have accounted blood fats as risk-factors [10-12], but in some a significant relationship has not been found [13, 14].

Thus, with respect to the high prevalence of cardiovascular disease and dyslipidemia in Iran [15-17] and its relationship to some ophthalmic diseases such as age-related Macular Degeneration [18] and cataract [19] we were persuaded into studying the levels of serum lipids in_glaucoma and comparing with healthy individuals.

METHODS

This case-control study was done on 40 primary Open-angle glaucoma (POAG) patients and an equal number of healthy individuals.

The aim of the study was explained to each group and after receiving their written consents they were included in the study. All of the cases were examined by an ophthalmologist by means of a slit-lamp, Ophthalmoscope and Applanation tonometry and the occurrence of POAG in them was confirmed.

The controls were patients' attendants who had referred to Birjand Valli-e-asr clinics but did not have POAG or other ophthalmic disorders. The cases and controls were frequently matched for age, sex. For both group members a questionnaire covering information including age, sex, residence, family history of glaucoma, and cardiac risk factors was filled out (per person) by a trained medical student.

In both the cases and controls the following measures were taken as exclusion criteria:

History of cardiovascular disease, hypertension and diabetes, ophthalmic trauma or eye surgery, taking of systemic or local Corticosteroid, taking of anti-hyperlipidemic drugs or oral/local beta blockers [20-22].

Total serum cholesterol (TC), and triglycerides (TG) were measured by taking a sample of 5mL blood from the right brachial vein after 12 hours overnight fasting. The blood samples were sent to central lab of Vali-Asr Hospital. TCand TG was measured by the standard enzymatic method (Pars Azmon kit, Iran).

The Ethics Review Committee of Birjand University of Medical Sciences approved this study. All cases and controls signed the informed consent. We used Chi-square test and T test at 0.05 significant levels for data analysis using SPSS software version 15.

RESULTS

The patients' and controls' characteristics are shown in Table **1**. As it is seen in the table, the two groups were matched.

Table 1: Demographic Data of Study Participitants

Variable	Case	Control	p value
Mean age (yr)	**64.9±1.97**	**60.4±1.8**	**0.07**
sex			
Male	24(60%)	24(60%)	0.82
Female	16(40%)	16(40%)	0.82
Location			
City	23(57.5%)	17(42.5%)	0.82
Village	27(67.5%)	13(32.5%)	0.82

The mean level of cholesterol, triglyceride was significantly higher in the cases than in the controls (Table **2**).

Figure **1** shows the prevalence of hypercholesterolemia and hypertriglyceridemia in both groups.

The prevalence of hypercholesterolemia was 52.5% in cases, 4% in controls ($p< 0.001$) and the prevalence of hypertriglyceridemia was 32.5%in cases, 5%in controls ($p< 0.001$).

Table 2: The Mean of Cholesterol and Triglyceride in 2 Groups

Variable	Case N=40	Control N=40	p value
Cholesterol (mg/dl)	211.2±51.9	162.3±39.6	0.001
Triglyceride (mg/dl)	165.9±88.6	99.5±43.1	0.001

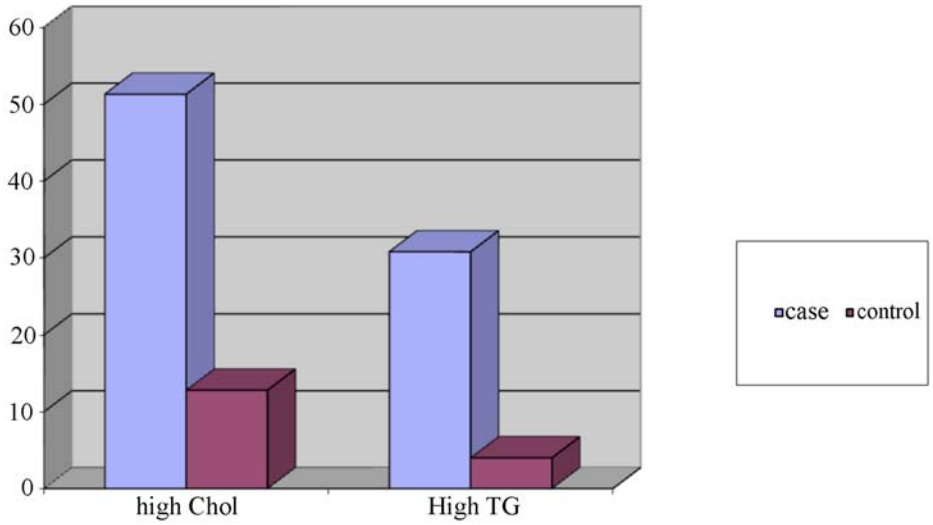

Figure 1: The prevalence of hypercholesterolemia and hypertriglyceridemia in both groups.

Table 3: The Effect of High TG and High Chol on Galucoma

Variable	Case	Control	OR	p-value
High chol	21 (52.5%)	6 (14%)	7.14(2.3-22.2)	< 0.001
High TG	13 (32.5%)	2 (5%)	16.9(2.1-14.8)	< 0.001

Logistic regression analysis, too, revealed that the chance of getting POAG in individuals with abnormal cholesterol is 7.14 times those with normal cholesterol, and the chance of contracting POAG in people whose triglyceride is abnormal is 16.9 times the individuals with normal triglyceride. These differences were statistically significant (Table **3**).

DISCUSSION

The present study assessed the relationship between cholesterol and triglyceride and POAG.

The results obtained showed that there is a great relationship between high cholesterol and triglyceride to POAG. According to the present study, not only mean cholesterol and triglyceride in POAG patients is significantly higher than those of healthy individuals but high lipids, particularly high triglyceride also had a significant relationship with POAG (OR=16.9).

In 2009, Pavljasević conducted a similar study in Bosnia and Herzegovina. The researches tested 50 patients with open-angle glaucoma and 50 healthy individuals with respect to their serum lipids and it was found that cholesterol level in the case group was 6.14mol/dm and in the control group it was 2.04mol/dm. It was, then, concluded that the amount of serum lipids can act as a predictive factor in contracting glaucoma, which is in accord with the result of the present study [23].

In a study done by Chisholm in1988 on 183 patients with glaucoma, with the aim of surveying serum lipid levels, it was found that only hypertriglyceridemia in female adults was significantly high [24].

Regarding the effect of lipids on the genesis of glaucoma different comparative studies, including the effect of lipid condition proper or the synergic effect of this and macular degeneration have been conducted.

E. G. Wierzbowska, in 2008, studied about 255 patients. He divided the patients into the following three groups: macular degeneration group (83 subject), glaucoma group (34 subject), combination of macular degeneration and glaucoma (138 subject). These groups were studied with respect to risk factors. The results indicated that a full-fat diet, high cholesterol level, and coronary artery disease in patients with a combination of these two diseases (glaucoma and macular degeneration) is more common than glaucoma alone [10].

Lipid levels and glaucoma can have a relationship with diet. Various studies have been done in order to survey different factors involved, like diet. Pasquale, in a review study, assessed the articles concerning environmental factors, lifestyle and diet in glaucoma patients. Regarding fat consumption and its relationship with glaucoma, findings are contradictory. However, in a study on animals, it was stated that omega 3 consumption, which is a lowering agent of serum lipids (particularly triglycerides) decreases IOP. But, whether considering diet will be able to prevent glaucoma is not certain; however, all people are recommended to have a diet rich in vegetables and fruits but low in fats [9].

Kashivagi (2012) in an article studied the relationship between full-fat diet and glaucoma. In this study, 50 male white rabbits (aged 12 weeks) received a full cholesterol diet for 10 months. After this period, most of the rabbits developed white nodules in the iris and corneal obscurity, proved by macroscopic observation. Five of the rats were histopathologically studied.

In one of the rabbits glaucoma histopathological damages were clearly observable. Thus, these scholars commented that a full cholesterol diet may have a role in glaucoma occurrence [11].

Maybe, the relationship between lipids and glaucoma is due to the association of this disorder with other cardiac risk factors such as diabetes and hypertension. In a study conducted in Michigan University, were identified all beneficiaries aged ≥40 years individuals who had 1 or more ophthalmic visits were included in a cohort study (2001-2007). The aim of this study was to assess the elements of metabolic syndrome and glaucoma. The results showed that diabetes and hypertension proper or associated with each other have a role in the occurrence of glaucoma. But, dyslipidemia alone even lowered the risk of glaucoma about 5%. However, in cases that dyslipidemia is associated with diabetes or hypertension the risk increases [12].

One of the other cardiac risk factors that is often associated with dyslipidemia is "obesity", which may have an important role in the occurrence of glaucoma. In a study on 3939 participants in Rotterdam in a 10 year follow-up glaucoma patients were assessed. According to this study only obesity in women had a significant relationship with increasing IOP. But cigarette – smoking, socioeconomical status and alcohol consumption had no effect [5]. Since obesity is one of the significant secondary causes of dyslipidemia, especially hypertriglyceride, the effect of facts to cause glaucoma may be due to obesity.

Of course, studies regarding the role of lipids in the incidence of glaucoma have a lot of contradictory results. E. g. in the study Stewart conducted in South Carolina in 1996 a comparison was drawn between total cholesterol and HDL of 25 glaucoma patients and those of 25 healthy individuals. The findings of the study showed that there is no relationship between HDL and total cholesterol to IOP [13].

In Beijing eye study, about 3251 individuals (age≥45 years) had their complete ophthalmic examination. Blood serum lipids were also measured. After adjustment various factors (such as age, sex, residence, income level, BMI, cigarette smoking, diastolic blood pressure, and blood sugar) the effect of dyslipidemia on the incidence of ophthalmic diseases was studied. Results showed although in dyslipidemia patients IOP significantly increased, this had no significant relationship with glaucoma [14].

In another study done on 8778 glaucoma patients and the same number of healthy individuals; who had been matched with respect to age and sex, the cases were assessed in relationship to the use of different medicines such as beta blockers, thiazids, and statins during the previous 5 years. The findings revealed that taking oral beta blockers can prevent the progress of glaucoma, but statins have no role in the prevention of glaucoma [22].

CONCLUSION

High cholesterol and triglyceride can have a role in the incidence of POAG. However, regarding the contradictory results of various studies and the role of race in the occurrence of glaucoma it is suggested that

more comprehensive studies concerning the metabolic syndrome and its elements, including dyslipidemia in glaucoma patients in Iran should be conducted.

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CONFLICT OF INTEREST STATEMENT

There is no conflict of interest in this article.

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