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Comparison of Lipid Profile Components in Different Degrees of Age-Related Macular Degeneration in Northern Part of Iran

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Abstract

Background: Age-related macular degeneration (AMD) is the most common cause of blindness in the elderly.
Objectives: Due to the increasing rate of aging and the possible role of impaired lipid metabolism as a critical pathogenic factor in AMD, this study investigated the association between serum lipid profile and AMD in the elderly of the north of Iran.
Methods: This nested case-control study (as a part of the comparative cohort of "The Amirkola Health and Ageing Project") was performed on 77 patients with AMD and 231 healthy individuals over 60 years of age. During the ophthalmic examination, tropicamide 1% eye drops were used to dilate the pupil. Fluorescein angiography was used to diagnose AMD. Serum lipid profile components, such as triglycerides, total cholesterol, high-density lipoprotein (HDL), and low-density lipoprotein (LDL), were measured in blood samples through standard laboratory methods. All statistical analysis was performed using SPSS software (version 24).
Results: The triglycerides mean values in AMD patients and controls were 123.32 ± 56.27 and 138.32 ± 69.58 mg/dL, respectively (P = 0.075). The cholesterol mean values were 184.75 ± 43.87 and 189.59 ± 43.52 mg/dL in AMD patients and controls, respectively (P = 0.402). The LDL mean values in AMD patients and controls were 101.42 ± 32.08 and 103.45 ± 30.83 mg/dL, respectively (P = 0.621). The HDL mean values were 48.94 ± 11.93 and 50.37 ± 12.18 mg/dL in the AMD patients and controls, respectively (P = 0.365). Additionally, there was no significant difference between the different degrees of AMD in terms of mean triglycerides, cholesterol, LDL, and HDL.
Conclusions: In the present study, no significant association was observed between the levels of serum lipid profile components and AMD. In addition, no significant difference was observed between different degrees of AMD in terms of serum lipid profile components.

Keywords: Age-Related Macular Degeneration, Triglycerides, Cholesterol, High-Density Lipoprotein, Low-Density Lipoprotein

1. Background

Age-related macular degeneration (AMD) is the most common cause of blindness in individuals over the age of 70 and the cause of 7.8% of all cases of blindness in the world. The total number of AMD patients worldwide is more than 170 million. Considering that aging is the most critical risk factor for this disease, it is predicted that AMD patients will reach 288 million individuals by 2040 with the increase of the elderly population (1, 2). Studies show a higher prevalence of AMD in Europeans than in Asians and Africans (3). The prevalence of AMD in Iran has been reported within the range of 8.5 - 17.6% (4-6).

AMD is a multifactorial disease with unknown pathogenesis and etiology due to the complexity of the visual system and the ambiguity of the aging process. The most critical risk factor for this disease is aging. Studies show that individuals over 75 years are more than three times more likely to develop AMD than those aged 65 to 74 (7). The dysfunction of retinal pigment epithelium (RPE) cells is associated with the increased thickness and degeneration of Bruch's membrane and its calcification (8, 9). A hypothesis has been put forward that the deposition of lipids in the sclera and Bruch's membranes leads to its degeneration and increased postcapillary resistance in the choroid through aging. This feature reduces choroidal blood flow and increases hydrostatic pressure, leading to leakage of proteins and lipids and eventually the formation of Drusen deposits between Bruch's membrane and the RPE layer. According to this hypothesis, AMD is a vascular disease with pathogenesis similar to atherosclerosis (10, 11).

Dyslipidemia is one of the most critical risk factors

for cardiovascular disease (CVD). In addition to CVD, lipid profile analysis has revealed extensive information on the pathogenesis of other chronic diseases in which endothelial dysfunction and atherosclerosis are involved, including insulin-resistant diabetes and diabetic retinopathy (12-14). In addition to the significant association of AMD with CVD and atherosclerosis, there are other pieces of evidence for the role of dyslipidemia in the pathogenesis of AMD; firstly, Drusen is mainly composed of lipids; secondly, the proteins that transport lipids in the retina are biochemically similar to the proteins involved in the systemic metabolism of lipids (15); thirdly, in the retina, there is a complex system for the uptake, intercellular transport, storage, and removal of cholesterol mediated by various lipoproteins that play an essential role in retinal physiology.

Due to the numerous pieces of evidence that suggest the role of dyslipidemia in the pathogenesis of AMD, many studies in recent years have investigated the association between serum lipid levels and AMD. However, there have been disagreements and differences in the results of the aforementioned studies, and their outcomes have not yet led to a definitive conclusion. Furthermore, despite the significant impact of AMD on the quality of life of the elderly and its significant prevalence, compared to Western societies, relatively few studies have been conducted on the risk factors of AMD in Asian societies, especially in Iran.

2. Objectives

This study aimed to determine the association between serum lipid profile components (e.g., triglycerides, total cholesterol, high-density lipoprotein (HDL), and low-density lipoprotein (LDL)) and AMD in the elderly of the north of Iran.

3. Methods

3.1. Sampling

This nested case-control study (as a part of the comparative cohort of "The Amirkola Health and Ageing Project (AHAP)") was performed on 77 AMD patients (all AMD cases in AHAP), approved by the Ethics Committee of Babol University of Medical Sciences, Babol, Iran (IR.MUBABOL.REC.1399.125). The ophthalmic examinations, including visual acuity examination using the Snellen chart, eye pressure measurement, slit-lamp test, and posterior pole examination using noncontact lenses, were performed for all individuals. During the eye examination, tropicamide 1% eye drops were used to dilate the pupil. Fluorescein angiography was used to diagnose AMD. In addition, 231 healthy participants (threefolds of the case sample size) were considered the control group. The control group was matched with the case group for age, gender, and lipid-reducing drug through the frequency matching method.

After ophthalmologic examinations, 3 mL of participants' blood samples were collected, and serums were separated. Immediately, the serum lipid profile components, such as triglycerides, total cholesterol, HDL, and LDL, were measured in blood samples through standard laboratory methods in the Laboratory Department of Shahid Beheshti hospital, Babol, Iran.

3.2. Statistical Analysis

The collected data were analyzed using SPSS statistical software (version 24). Moreover, Fisher's exact test, independent samples t-test, and one-way analysis of variance were used as statistical tests. In this study, a P-value less than 0.05 was considered statistically significant.

4. Results

4.1. Demographic Results

In the case group, 54 (70.1%) and 23 (29.9%) patients were male and female, respectively. In the control group, 162 (70.1%) and 69 (29.9%) subjects were male and female, respectively. There was no significant difference in terms of gender between AMD patients and healthy individuals. The age mean values were 75.12 $\pm$ 7.96 and 74.23 $\pm$ 7.57 years in the case and control groups, respectively; however, there was no significant difference. Furthermore, among patients with AMD, 38 (49.35%), 19 (24.67%), 11 (14.28%), and 9 (11.68%) patients had early AMD, intermediate AMD, late atrophic (dry) AMD, and late exudative (wet) AMD, respectively.

4.2. Comparison of Lipid Profile Components in AMD Patients and Healthy Participants

In this study, the triglycerides mean values of AMD patients and controls were 123.32 $\pm$ 56.27 and 138.32 $\pm$ 69.58 mg/dL, respectively; there was no significant difference between the two groups in this regard (P = 0.075). The cholesterol mean values were 184.75 $\pm$ 43.87 and 189.59 $\pm$ 43.52 mg/dL in AMD patients and controls, respectively; there was no significant difference between the two groups in this regard (P = 0.402). The LDL mean values of AMD patients and controls were 101.42 $\pm$ 32.08 and 103.45 $\pm$ 30.83 mg/dL, respectively. There was no significant difference in LDL values between the two groups (P = 0.621). The HDL mean values were 48.94 $\pm$ 11.93 and 50.37 $\pm$ 12.18 mg/dL in

AMD patients and controls, respectively. There was no statistically significant difference in HDL values between AMD patients and controls (P = 0.365).

In addition, the mean values of lipid profile components in the different degrees of AMD patients were compared to those of the control group. There was no significant difference between the different degrees of AMD in terms of mean triglycerides, cholesterol, LDL, and HDL (Table 1).

5. Discussion

There is ample evidence for the possible role of dyslipidemia in the pathogenesis of AMD. Firstly, Drusen formation, which is the first sign of the disease, is based on lipid-rich particles (16, 17). Secondly, biochemical studies have shown that the lipid-transporter proteins in the retina are similar to the proteins involved in the systemic metabolism of lipids (18, 19). Thirdly, patients with AMD have a higher risk of developing atherosclerosis and CVD, and the presence of these diseases is considered a risk factor for AMD. Fourthly, according to genetic studies, several variants of cholesterol-related genes are associated with an increased AMD risk (20, 21). The fifth piece of evidence for this claim is animal studies on primates (22, 23) and rodents (24), showing that the accumulation of oxidized lipids in the retina can stimulate angiogenesis. However, despite strong biological evidence for an association between AMD and serum lipid levels, epidemiological studies have shown conflicting results that have not yet been conclusive. Additionally, despite AMD's significant impact on the quality of life of the elderly and its significant prevalence, relatively few studies on AMD risk factors have been conducted in Asian societies, especially in Iran, compared to those conducted in Western societies.

In the present study, the mean values of lipid profile components (e.g., triglycerides, cholesterol, HDL, and LDL) in the AMD patients were higher than in the control group; however, this difference was not statistically significant. The aforementioned results are in line with the results of studies by Semba et al. (25), Alabain et al. (26), and Cackett et al. (27), which did not show a significant association between serum lipid levels and AMD. Nevertheless, in a study by Husain et al., the level of all components of the serum lipid profile in patients with AMD was significantly higher than in the control group (28). Sasaki et al. showed that total triglycerides and HDL levels in men were significantly associated with AMD. However, in the general population (both women and men), cholesterol and LDL were significantly associated with AMD; nonetheless, HDL and triglycerides were not correlated with AMD (29). In Davari et al.'s study, the serum levels of triglycerides, total cholesterol, and LDL were significantly higher in AMD patients than in controls; nevertheless, the HDL level was not significantly different between the two groups (30). In studies by Acar et al. and Husain et al., higher levels of HDL and lower levels of triglycerides were associated with an increased incidence of AMD (28, 31).

In this study, 70.1% of patients were male, and the mean age of patients was 75.12 years. In a study by Sasaki et al., as in the present study, most AMD patients were men (29). The aforementioned results are also in line with the results of Husain et al.'s and Davari et al.'s studies, in which most AMD patients were men (28, 30).

Although some studies have shown no association between lipid profiles and AMD, most studies indicate a higher prevalence of lipid profile disorders in AMD patients, especially HDL (26, 32, 33). The present study showed that the levels of serum lipid profile components are not related to AMD. Furthermore, in this study, no significant difference was observed between different degrees of AMD in terms of the levels of components of serum lipid profile, which confirms the results of studies, such as those performed by Cho et al. (34), Park et al. (35), and Erke et al. (36). Regarding other variables studied in the present study, such as smoking and diabetes, no significant association was noticed between the above-mentioned variables and AMD. In Sasaki et al.'s and Cho et al.'s studies, as in the present study, no significant association was observed between smoking and AMD and between diabetes and AMD (29, 34). In the study of Davari et al., no significant association was observed between the two groups (AMD and control groups) regarding smoking (30).

5.1. Conclusions

In brief, there was no significant association between serum lipid profile components with AMD and its degree. In addition, age, gender, diabetes, and smoking were not associated with AMD status and its degree. Due to the presence of studies with opposite results, it is suggested to carry out further studies on the association of lipid profile components and AMD with a larger sample size. Furthermore, this association could be investigated in different lipid-related metabolic diseases.

Footnotes

Authors' Contribution: Kh. E. contributed to the acquisition of the data. F. F., E. M., R. G., and S. R. H. carried out the analysis and interpretation of the data. A. B., G. R, and M. G. provided administrative, technical, and material support. S. A. R. supervised this manuscript.

Conflict of Interests: There is no conflict of interest in this manuscript.

Table 1. Comparison of Lipid Profile Components in Different Degrees of Age-Related Macular Degeneration

Lipid Component and AMD Degree (mg/dL)	Mean ± SD	Confidence Interval (95%)		P-Value
		Upper Limit	Lower Limit	
TG				0.267
Control group	138.87 ± 69.58	147.89	129.85	
Early AMD	129.66 ± 60.84	149.66	109.66	
Intermediate AMD	110.05 ± 65.33	141.54	78.56	
Atrophic AMD	110.45 ± 20.83	124.45	96.46	
Exudative AMD	140.33 ± 40.62	171.56	109.11	
Total	134.99 ± 66.75	142.47	127.50	
Chol				0.892
Control group	189.59 ± 43.52	195.24	183.95	
Early AMD	184.29 ± 49.03	200.41	168.17	
Intermediate AMD	182.42 ± 34.26	198.94	165.90	
Atrophic AMD	183.55 ± 39.71	210.23	158.86	
Exudative AMD	193.11 ± 49.58	231.23	155.00	
Total	188.38 ± 43.59	193.27	183.50	
LDL				0.901
Control group	103.45 ± 30.83	107.44	99.45	
Early AMD	101.47 ± 34.60	112.85	90.10	
Intermediate AMD	97.95 ± 29.26	112.05	83.84	
Atrophic AMD	100.82 ± 30.45	121.28	80.36	
Exudative AMD	109.23 ± 32.54	134.24	84.21	
Total	102.94 ± 31.11	106.43	99.45	
HDL				0.452
Control group	50.37 ± 12.18	51.59	48.79	
Early AMD	49.32 ± 12.15	53.31	45.33	
Intermediate AMD	50.47 ± 11.18	55.87	45.08	
Atrophic AMD	50.09 ± 10.65	57.25	42.93	
Exudative AMD	42.67 ± 13.91	53.36	31.97	
Total	50.01 ± 12.11	51.37	48.65	

Abbreviations: AMD, age-related macular degeneration; TG, triglycerides; Chol, cholesterol; LDL, low-density lipoprotein; HDL, high-density lipoprotein.

Ethical Approval: This study was approved by the Ethics Committee of Babol University of Medical Sciences, Babol, Iran (IR.MUBABOL.REC.1399.125) (link: ethics.research.ac.ir/EthicsProposalView.php?id=129497).

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Informed Consent: This manuscript is a retrospective cohort, for which informed consent is not applicable.

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