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Evaluation of Lipid Profile and Thyroid Function in Hyper and Hypotensive Patients: a Case Control Study

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Abstract

The objective of this study was to evaluate the lipid profile and thyroid function in hyper and hypotensive patients. This case-control study was conducted among the hyper and hypotensive patients from Jan to June, 2018 in Baghdad. The participants were evaluated out of which 40 were hypertensive, 37 were hypotensive and 66 were enrolled as a normal control group. The levels of serum cholesterol, triglyceride, HDL, LDL and VLDL were determined by a spectrophotometer, as well as serum levels of thyroid hormones (TSH, fT4 and fT3) were determined by ELISA technique. The results indicated the presence of a significant increase in serum levels of cholesterol, triglyceride, VLDL and fT4 for patients with hypertension ($p<0.05$), and a significant decrease in serum level of triglyceride in patients with hypotension when compare with control. In addition, the results show the presence of a significant increase in cholesterol, triglyceride, HDL and VLDL levels as well as a highly significant decrease in fT4 level of patients with hypertension compared with patients with hypotension.

Keywords: *lipid profile; thyroid hormones; blood pressure; cholesterol; T4 and T3.*

Introduction

Blood pressure is the force exerted by blood on the walls of blood vessels or heart chambers. Blood pressure can be measured in capillaries and pulmonary circulation vessels. However, the term "blood pressure" without any specific descriptors usually refers to systemic arterial blood pressure, which is the blood pressure that flows in the arteries of the circulatory system. In clinical practice, this pressure is measured in mm Hg and is usually obtained by using the brachial artery of the arm. The arterial blood pressure in the large vessels consists of several distinct components, including systolic (higher) pressure and diastolic (lower) pressure [1-4]. The systolic pressure happens when the left ventricle is most contracted; the diastolic pressure occurs when the left ventricle is most relaxed prior to the next contraction. The normal systolic pressure, when the person sitting quietly, is within the range of 100–140 mmHg systolic and 60–90 mmHg diastolic [3,4]. Thyroid gland is an endocrine gland, found in the neck and produces thyroid hormones. Thyroid hormones, involving thyroxine (T4) and triiodothyronine (T3), strongly affect energy metabolism, regulate temperature and produce body heat. They also play an important role in the skeleton, muscle and cardiac contraction, memory and sleep [5]. Thyroid hormone synthesis depends on factors such as nutritional availability of iodine, and is mostly regulated by the thyroid stimulating hormone (TSH), sometimes called thyrotropin, a hormone produced by the pituitary gland. The synthesis and secretion of TSH is stimulated by the hypothalamic thyroid releasing hormone (TRH) and inhibited through negative feedback of the thyroid hormone itself [6]. Thyroid hormones have profound metabolic effects, and the most interesting is increased energy [7]. There are two types of intrinsic thyroid diseases, hyperthyroidism (overproduction) and hypothyroidism (underproduction). Hypothyroidism is a common disorder known as the high concentration of TSH with low concentrations of fT4, the most common in women.

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This is often caused by autoimmune thyroiditis where the immune system produces antibodies against normal thyroid tissue and / or antibodies that inhibit TSH receptors. Thus interfering with the natural regulation of thyroid hormone synthesis [8,9]. The lipid family contains several different structures with different functions, including fatty acids, triglyceride (TG), phosphate lipids and cholesterol. It has the ability to bind with protein to form lipoproteins, the form that enables lipids to be soluble and transport in human plasma. The lipoproteins are divided into four groups: Chylomicrons, low-density lipoproteins (VLDL), low-density lipoproteins (LDLs) and high-density lipoproteins (HDLs). LDL particles increase the risk of cardiovascular disease and arteriosclerosis [11-13]. Although the pathogenesis of atherosclerosis remains poorly understood, the accumulation of modified lipoproteins in vessel walls, such as oxidized LDL and other lipid metabolites, is thought to create a lipotoxic environment [14]. It has been found that thyroid hormones play an important role in regulating the metabolism of lipid. Thyroid dysfunctions can result in lipid abnormalities that increase the risk of endothelial dysfunction, hypertension and cardiovascular disease [16]. Accordingly, this study was designed to evaluate the lipid profile and thyroid function in Iraqi patients with hyper and hypotension.

Materials and Method

Patients and Controls

This study was conducted between Jan and June 2018, at the Dubai Laboratory / Almaghrib Street and clinical laboratory at Chemistry department/ College of Science/ Mustansiriyah University, Baghdad, Iraq. The study included 40 people (male and female) with high blood pressure, 37 with low blood pressure and 66 healthy people. Patient's ages ranged between (15-75) years and healthy volunteers between (15-72) years. Patients were collected from Baghdad Teaching Hospital. The symptoms and signs of the disease were diagnosed by specialist doctors in the hospital.

Sample Collection and Preparation

Five millilitres of blood, of each individual of patients and healthy control, were withdrawn from vein. Blood sample was placed in a gel tube and allowed to clot on bench for 20 min, then centrifuged at 3000 rpm for 10 min. The obtained serum was stored in a refrigerator at − 20 °C for subsequent analysis.

Sample Analysis

Serum levels for lipid profile (cholesterol, triglyceride and HDL) were determined using colorimetric method by following the protocol of the commercially available Linear kits (Spain). LDL and VLDL were also calculated. The serum levels of TSH, fT3 and fT4 were determined by an automated ELISA microplate reader analyzer, model IRE 96-SFRI - MedicalExpo (SPAIN), following the protocol of the commercially available *AcuuBind* TSH Elisa kit supplied by Monobind Inc. (USA), Bioactive diagnostic fT3 and fT4 Elisa kits supplied by bioactiva diagnostica GmbH (Germany).

Statistical analysis

All data were analyzed using descriptive statistics and ANOVA one way test of the Statistical Package for Social Sciences (SPSS) program version 20.0. The resulting values were expressed as mean ± standard deviation (SD). Pearson's correlation analysis was also carried out to determine the relationships between all study variables. The statistical tests were significant at $p < 0.05$ and highly significant at $p < 0.01$ with a confidence interval of 95%

Results and Discusion

All obtained data were analyzed statistically and presented as mean ± standard deviation. The p values were also included to verify differences in levels of study parameters between patients and control. The calculated mean values ± SD of lipid profile (cholesterol, triglycerides, HDL, LDL and VLDL) in sera of control, patients with low blood pressure and patients with high blood pressure are summarized in Table 1. The results indicated the presence of a significant increase in serum levels of cholesterol, triglyceride and VLDL for patients with high blood pressure when compare with control. While no significant differences were found in HDL and LDL levels. The results also indicated the presence of a significant decrease in serum level of triglyceride and non-significant differences in cholesterol, HDL, LDL and VLDL for patients with low blood pressure in comparison with control. In addition, the results show the presence of a significant increase in cholesterol, triglyceride, HDL and VLDL levels of patients with high blood pressure compared with patients with low blood pressure, while no significant difference was found in LDL level. The mean values ± SD of thyroid hormones (TSH, fT4 and f T3) for the three study groups were calculated from

the obtained data and the collective results are presented in Table 2. The serum mean values ± SD of thyroid hormones indicated the presence of a significant increase in fT4 concentration in patients with low blood pressure compared with control group ($p<0.05$), as well as a highly significant decrease in fT4 concentration patients with high blood pressure compared with patients with low blood pressure group ($p<0.001$). No significant difference was detected between patients with low blood pressure and control groups. In addition, the results further statistically reveal no significant difference in levels of TSH and fT3 between both patients groups and control group ($p>0.05$). The correlation between all lipid profile and thyroid hormones parameters included in this work was studied for hypertension and hypotension groups, respectively, using Pearson correlation analysis. The collective results are displayed in Tables 3 and 4. The analysis showed no correlation between all parameters and in both cases, hyper and hypotension. Hypertension affects approximately 26% of the adult population worldwide [17]. Hypertension is an independent indicator of cardiovascular disease and cerebrovascular disease leading to death [18]. It should be noted that most blood pressure studies may focus on high blood pressure, while studies on low blood pressure are rare. Unlike high blood pressure, low blood pressure is not associated with serious illness or death [19], and it is widely accepted that lower blood pressure is better than elevation [20]. However, most studies, based on whether low blood pressure can lead to adverse health outcomes, have shown that low blood pressure is associated with physical or mental symptoms or illnesses [21,22]. It has been reported previously by Hitesha *et al.* that the levels of cholesterol, triglyceride and VLDL in hypertensive patients were significantly higher than those in normal persons [18], and these results are consistent with the current work results. A previous study conducted by Choudhury *et al.* has reported that the serum levels of cholesterol, triglyceride and LDL were higher in hypertensive patients than those of healthy subjects [23], which agree with the results obtained in this work. Similar results have suggested an association between hypertension with risk factors such as hypercholesterolemia [24]. Also it was found that the hypertensive patient is more likely to have metabolic syndrome compared to the normal person, and increased serum lipid profile is associated with high blood pressure cases [25]. The results of the present study strongly support this point where similar findings were recorded, see Figures 1-4. It was found that hypertension was directly associated with high levels of triglyceride, cholesterol and LDL during pregnancy, suggesting that lipid profile plays a vital role in regulating blood pressure for pregnant women [26].

Table1: Levels of Lipid profile in patients with high and low blood pressure and healthy volunteers.

Variables	Control		Low B.P		High B.P		*p* values		
	Mean	S.D	Mean	S.D	Mean	S.D	Control & Low B.P	Control & High B.P	High B.P & Low B.P
Chol. (mg/dl)	170.3	43.03	165.0	26.73	198.6	36.43	0.857	< 0.05	< 0.05
Tri(mg/dl)	126.5	86.40	112.7	35.74	180.2	74.66	< 0.05	< 0.05	< 0.001
HDL(mg/dl)	37.79	7.62	32.29	4.88	41.11	15.06	0.105	0.062	< 0.05
LDL(mg/dl)	105.5	38.83	110.2	22.10	120.4	37.81	0.871	0.115	0.558
VLDL(mg/dl)	25.55	17.14	22.53	7.09	36.04	14.93	0.721	< 0.05	< 0.05

Table 2. Levels of thyroid hormonesin patients with high and low blood pressure and healthy volunteers.

Variables	Control		Low B.P		High B.P		*p* values		
	Mean	S.D	Mean	S.D	Mean	S.D	Control & Low B.P	Control & High B.P	High B.P & LowB.P
TSH (μU/ ml)	3.008	1.768	3.393	1.905	2.905	2.378	0.74	0.96	0.65
fT4 (ng/ dl)	0.957	0.156	1.272	0.348	0.849	0.157	< 0.05	0.33	< 0.001
fT3 (pg/ ml)	2.82	1.04	2.76	0.93	2.80	1.769	0.87	0.98	0.99

Table 3. Correlations between variables in hypertension patients group (r value).

variable	T.C	T.G	HDL	LDL	VLDL	TSH	fT4	fT3
T.C	1	0.164	0.102	0.833	0.164	0.77-	0.068-	0.116
T.G	0.164	1	0.007-	0.228-	1.000	0.158	0.130-	0.286
HDL	0.102	0.007-	1	0.301-	0.006-	0.298	0.153	0.025-
LDL	0.833	0.228-	0.301-	1	0.299-	0.245-	0.043-	0.008
VLDL	0.164	1.000	0.006-	0.229-	1	0.166	0.130-	0.289
TSH	0.077-	0.158	0.298	0.245-	0.166	1	0.302-	0.088
fT4	0.068-	0.130-	0.153	0.043-	0.130-	0.332-	1	0.303
fT3	0.116	0.286	0.025-	0.008	0.289	0.088	0.303	1

Table 4: Correlations between variables in hypotension patients group (r value).

Variable	T.C	T.G	HDL	LDL	VLDL	TSH	fT4	fT3
T.C	1	0.580	0.239	0.970	0.581	0.317	0.223	0.094-
T.G	0.580	1	0.251-	0.435	1.000	0.129	0.183	0.305-
HDL	0.239	0.251-	1	0.149	0.250-	0.106	0.078-	0.124-
LDL	0.970	0.435	0.149	1	0.435	0.318	0.228	0.012
VLDL	0.581	1.000	0.250-	0.435	1	0.131	0.185	0.304-
TSH	0.317	0.129	0.106	0.318	0.131	1	0.360	0.337
fT4	0.223	0.183	0.078-	0.228	0.185	0.630	1	0.379
fT3	0.094-	0.305-	0.124-	0.012	0.304-	0.337	0.379	1

Conclusion

Although valuable information is available about blood pressure disorders, its association with thyroid disorders remains unclear. The current study did not show a clear association between TSH and fT3 levels and high blood pressure. The results obtained show that the level of fT4 of healthy subjects is hardly affected relative to those in hypotension patients giving a positive indication of the presence of a significant association

between this hormone and blood pressure. More studies are recommended to understand the mechanism of the relationship between thyroid hormones and blood pressure. Moreover, the current study suggests that biochemical distortions in lipid profile (especially cholesterol, HDL and VLDL) are clearly associated with BP disorders. Furthermore, from Pearson's correlation analysis we can conclude that there is no association between thyroid hormones and lipid profile. More importantly, the current study confirms that serum cholesterol, HDL and VLDL may be useful in identifying patients at risk of hypertension because they are useful tests that provide important diagnostic information.

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Conflict of Interest: None to declare.

Ethical Clearance: All experimental protocols were approved under the Department of Chemistry, College of Science, Mustansiriyah University, Baghdad, Iraq and all experiments were carried out in accordance with approved guidelines.

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