

Thyroid function tests, lipid profile and the diagnosis of thyroid diseases

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الخلاصة

تسلط هرمونات الغدة الدرقية تأثيرات واسعة كثيرة على أيض الدهون. و يتأثر تركيب و انتقال البروتينات الدهنية كثيراً بأمراض الغدة الدرقية. هدف البحث هو النظر بأمكانية وجود علاقة احصائية مهمة بين هرمونات الغدة الدرقية و مستوى الدهون في الدم في محاولة للاستفادة من هذه العلاقة في التشخيص السريري لاضطرابات الغدة الدرقية. لوحظ ارتفاع مهم في مستويات الكوليسترول الكلي و الدهون الفوسفوتية و الـ VLDL في حالة نقص الغدة الدرقية مع ازدياد طفيف في مستوى الترايكليرسايد, و في حالة فرط الغدة الدرقية فقط لوحظ انخفاض غير مهم في الكوليسترول الكلي و الدهون الفوسفوتية و تراكيز الـ VLDL و كذلك مستوى ترايكليرسايد البلازما. يظهر البحث الحالي أهمية استعمال نمط الدهون كخطوة أولية في التشخيص الأولي لاضطرابات الغدة الدرقية في حالة عدم توفر مواد فحص هرمونات الغدة الدرقية كما في المناطق البعيدة او في الظروف الاستثنائية.

ABSTRACT

Thyroid hormones exert an enormous range of effects on lipid metabolism. The composition and the transport of lipoproteins are seriously disturbed in thyroid diseases. The aim of this study is to look for a significant statistical correlation between thyroid hormones and levels of serum lipids in attempt to use such a correlation in the clinical diagnosis of thyroid disorders. Results: Significant elevated levels of total cholesterol, phospholipids and VLDL cholesterol were observed in hypothyroidism with a slight increase in the serum triglyceride. However in hyperthyroidism, an insignificant decrease of total cholesterol, phospholipids and VLDL cholesterol concentrations was observed as well as plasma triglycerides. Conclusion: The results of the present study suggests that the use of classical methods for the determination of lipid profile as a preliminary step in the diagnosis of thyroid disorder is to be of great importance, wherever radioimmunoassay assay kits of thyroid hormone are not available as in remote urban medical sites or in unfavorable circumstances.

INTRODUCTION:

Thyroid hormones are often stated as to accelerate the rate of fat metabolism more than other food stuff⁽¹⁾. Lipids are an important source of energy, stored in adipose tissue cells. Lipolysis or hyrolosysis of triglycerides is controlled by hormones such as catecholamines, TSH, glucagons and thyroxin. The action of theses hormones is mediated by the biosynthesis of cyclic adenosine monophosphate (cAMP) and the existence of active lipase enzyme⁽²⁾.

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Thyroid hormones exert an enormous range of effects on lipid metabolism. For example in hyperthyroidism lipid metabolism, synthesis and degradation are all accelerated⁽³⁾.

The composition and the transport of lipoproteins are seriously disturbed in thyroid diseases⁽⁴⁾.

This study aims to show that when thyroid hormones cannot be evaluated, then the use of lipid profile might be a possible alternative tool for the preliminary confirmation of thyroid disorder. Should the changes in lipid profile is not due to other cause after confirming with the physician.

MATERIALS AND METHODS:

One hundred and eighteen individuals were included in this study. All were clinically diagnosed by a physician. Due to technical reasons the number of male subjects was less than the females. They were classified into four groups as shown in table 1.

Table 1 . Subjects concerned in this study categorized according to their gender, age and disease status.

Groups	Tot. No.	Male	Female	Age range (years)	Remarks
Euthyroid	32	4	28	19-40	Including patients with non-toxic goiter
Hypothyroidism	36	6	30	20-53	Including 21 patients with cancer
Hyperthyroidism	28	5	23	22-45	All with toxic goiter
Control	22	4	18	27-37	Apparently healthy, none of them were alcoholic, diabetic, or having a history of coronary heart disease or thyroid disorder.

Venous blood samples were withdrawn from all subjects in the morning between (9:00-12:00 am) after fasting for at least 10 hours.

The samples were allowed to clot at room temperature, and then centrifuged to obtain the sera. These sera samples were stored in a deep freeze at -20 °C until analysis.

Biochemical parameters included in this study were

1. Hormonal tests: This included T3, T4 and TSH. Radioimmunoassay kits were supplied by Amersham Corporation (England).
2. Lipid profile: This included: Total cholesterol (TC), triglycerides (TG), very low-density lipoprotein (VLDL) and total phospholipids (TPL). All tests were measured by the enzymatic method using kits supplied by BioMerieux (France). Except VLDL was calculated using the Friedwald formula⁽⁵⁾. The formula is only valid at serum triglycerides concentration of less than 400 mg/ml.

$$\text{VLDL} = \text{TG}/5$$

Student t-test was applied for the statistical analysis.

RESULTS AND DISCUSSION:

While overt thyroid disturbances, characterized by symptoms and/or clinical signs with abnormal serum levels of thyroid hormones, are generally associated with perturbations in the lipid profile, the situation is less clear as far as subclinical thyroid disturbances, defined by isolated abnormalities of thyroid stimulating hormone (TSH) levels, are concerned⁽⁶⁾.

In profound hypothyroidism, elevated levels of total cholesterol (36.60%), triglycerides (62.85%) and VLDL (62.85%) levels were observed as shown in table (2) and figure (1).

Table 2 . Mean $\pm$ SD of all chemical parameters for all studied groups.

	NR	Control	Euthyroid	Hypothyroidism	Hyperthyroidism
TT3(nmol/L)	1.2-2.8	1.44 $\pm$ 1.15	1.28 $\pm$ 0.58	0.44 $\pm$ 0.61	4.4 $\pm$ 1.35
TT4(nmol/L)	60-160	119.33 $\pm$ 41.54	101.65 $\pm$ 26.83	31.61 $\pm$ 10.83	210.27 $\pm$ 97.5
TSH(mU/L)	0.4-7.0	7.58 $\pm$ 1.06	6.31 $\pm$ 2.65	34.42 $\pm$ 4.1	1.27 $\pm$ 1.54
TPL (g/L)	1.25-2.75	2.42 $\pm$ 0.53	2.61 $\pm$ 0.92	3.311 $\pm$ 0.94	2.44 $\pm$ 0.47
TC(Mmol/L)	<5.2	4.74 $\pm$ 1.35	5.21 $\pm$ 1.735	6.475 $\pm$ 1.735	3.57 $\pm$ 0.95
TG(Mmol/L)	0.57-1.74	1.4 $\pm$ 0.67	3.74 $\pm$ 0.24	2.28 $\pm$ 0.15	1.59 $\pm$ 0.48
VLDL		0.28 $\pm$ 0.134	0.748 $\pm$ 0.048	0.456 $\pm$ 0.03	0.318 $\pm$ 0.96

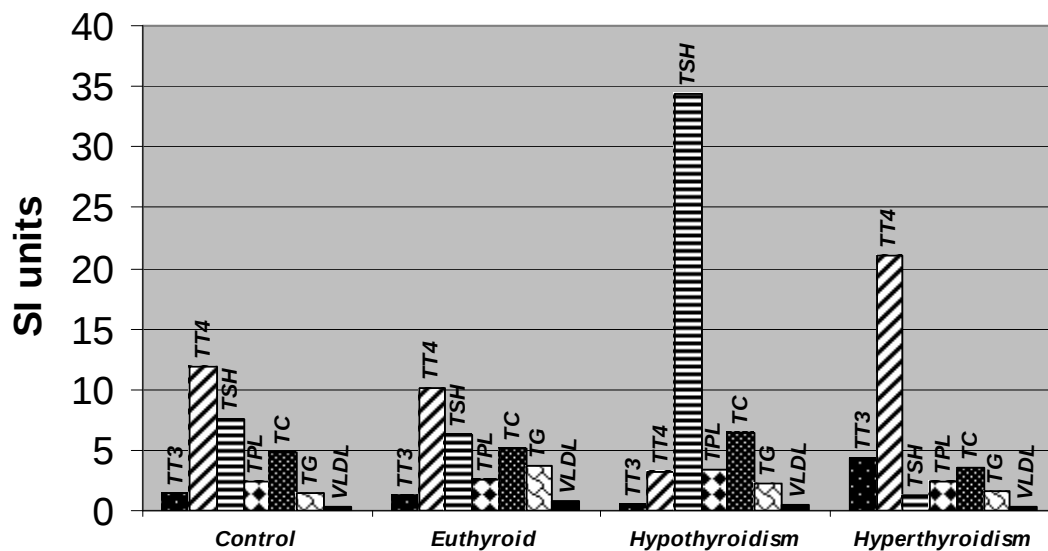


FIGURE 1. ALL CHEMICAL PARAMETERS STUDIED.

Note: 1. hormone levels indicate the type of thyroid disorder.
2. all TT4 values are divided by 10 to fit the figure.

The increase in the level of TC might be due to the fact that hypothyroidism increases the oxidation of plasma cholesterol mainly because of an altered pattern of binding and to the increased levels of cholesterol, which presents a substrate for the oxidative stress as cardiac oxygen consumption is reduced in hypothyroidism⁽⁷⁾. This reduction is associated with increased peripheral resistance and reduced contractility⁽⁸⁾. Hypothyroidism is often accompanied by diastolic hypertension that, in conjunction with the dyslipidemia, may promote atherosclerosis⁽⁹⁾. While the increase in TG might be a result of impaired removal of endogenous triglycerides and elimination of exogenous fat particles. These results might be overcome after hormonal replacement⁽¹⁰⁾.

The elevation of VLDL can be explained as due to a decreased fractional clearance of LDL by a reduced number of LDL receptors in the liver. There are certain enzymes that are regulated by thyroid hormones e.g. cholesteryl-ester transfer protein (CETP) and hepatic lipase (HL). When the activity of such enzymes are decreased this will result in reduced transport of cholesteryl esters from HDL(2) to very low-density lipoproteins (VLDL), this might integrate with the total elevation of serum VLDL in hypothyroidism⁽¹¹⁾.

Total phospholipids serum level was increased in hypothyroid patients by 36.80%. It is well established that hypothyroidism is characterized by essential disorders of the phospholipids metabolism which occurs already at the initial stages of the disease advances with progression of its severity. Examination of phospholipids and their fraction is one of the important supplementary objective methods of diagnosis of hypothyroidism⁽¹²⁾.

However in hyperthyroidism, a decrease of total cholesterol concentrations (24.68%) was observed although not significant, as shown in table (2). Hyperthyroidism exhibits a severe impairment in the lipid metabolism in a way it enhances excretion of cholesterol and an increased turnover of LDL resulting in a decrease of total and LDL cholesterol⁽¹³⁾. Plasma triglycerides were altered in the hyperthyroid state (13.57%) which was believed to be mainly due to the increased synthesis of endogenous plasma triglycerides⁽¹¹⁾, as shown in table (2).

Total phospholipids serum level was also altered in hyperthyroidism but very little (0.82%). As shown in table (2).

Meanwhile in the euthyroid subject serum total cholesterol level was altered but insignificantly, there was only a slight raise (9.9%), while triglycerides showed a very much higher increase (167.1%) together with VLDL. Phospholipids on the other hand showed only a slight alteration (7.85%).

Elevations of plasma TG have been reported frequently in euthyroid, due to the slight decrease in thyroid hormones. One way in which thyroid hormones might lower TG would be to promote their clearance from plasma. In some patients hypothyroidism a delayed clearance of chylomicrons was noted⁽¹⁵⁾.

The results of the present study suggests that the use of classical methods for the determination of lipid profile as a preliminary step in the diagnosis of thyroid disorder might be of great importance, wherever thyroid hormone radioimmuno assay kits are not available as in remote urban medical sites or in unfavorable circumstances.

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