



Total Sialic Acid, Lipid Associated Sialic Acid and Lipid Profile in Patients with Thyroid Dysfunction

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Abstract

Total sialic acid refers to a family of compounds derived from nine unsubstituted carbon chain neuraminic acids.

Sialic acid plays a role in normal thyroid function and is altered in thyroid diseases, further more lipids have been shown to change in thyroid disorders.

The current study was conducted to evaluate the level of total sialic acid, lipid associated sialic acid, total cholesterol, triglyceride, HDL – cholesterol and LDL cholesterol in sera of patients with thyroid dysfunction to find the relation between those parameters and thyroid diseases.

The study sample was composed of 58 patients with newly diagnosed hypothyroidism, 62 patients with newly diagnosed hyperthyroidism and 60 healthy individuals as pathological control who are attending Al-Yarmouk Teaching Hospital/ Baghdad during the period between October 2020 to April 2022. Total sialic acid, lipid associated sialic acid, T3, T4, TSH, cholesterol, triglyceride, HDL-cholesterol and LDL-cholesterol tests were done for the groups of the sample.

Results showed that there was significant increase in Total sialic acid, total cholesterol, triglyceride, HDL-cholesterol and LDL —cholesterol in patients with hypothyroidism while there was no significant change in lipid associated sialic acid in patients with hyperthyroidism and hypothyroidism. The study concluded that thyroid dysfunctions alter the levels of lipid profile and sialic acid.

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Keywords: Thyroid Dysfunction, Sialic Acid, Lipid Profile, Hypothyroidism, Hyperthyroidism, Lipid-Associated Sialic Acid

Introduction

The thyroid gland plays an important role in regulating growth, metabolism and development ^[1]. The most common thyroid diseases are hypothyroidism and hyperthyroidism ^[2]. Hypothyroidism is the clinical syndrome the is caused by reduced production of the thyroid hormones ^[3]. Hyperthyroidism is caused by the excessive production and secretion of the thyroid hormones ^[4]. Sialic acid is a family of negatively charged nine-carbon sugars found on the surface of cells and proteins. Acting as a crucial component in cellular communication, development, and various physiological and pathological processes like viral infection ^[5]. Lipid associated sialic acid is fraction of serum sialic acid that is associated with lipids, its level is observed to be altered in many pathological conditions such as malignancies, cardiovascular diseases and liver disease ^[6]. The relationship between sialic acid and several diseases have been investigated, therefore this study is designed to assess the levels of sialic acid, lipid associated sialic acid in patients with thyroid gland dysfunction. Thyroid disorders are known to influence lipid metabolism; alterations in thyroid function result in changes in the composition and transport of lipoproteins ^[7].

The lipid profile is a biochemical test that measures the concentration and distribution of lipids in the bloodstream, it includes the measurement of total cholesterol, triglycerides, high-density lipoprotein cholesterol (HDL-C), and low-density lipoprotein cholesterol (LDL-C)^[8]. The lipid profile can provide a diagnostic insight for evaluating metabolic and endocrine functions such as diabetes mellitus, liver disease, and thyroid dysfunction^[9].

Patients and Methods

Patients: the study sample was composed of 62 patients with age range (25-60 years), newly diagnosed hypothyroidism, 68 patients with age range (25-55 years), newly diagnosed hyperthyroidism and 50 healthy individuals with age range (25-60 years) as a control group, they were attending AL-Yarmouk Teaching Hospital during October 2020 to April 2023. The patients were diagnosed clinically and by hormonal studies. Tests of T3, T4, TSH, total cholesterol, triglyceride, HDL, LDL, total sialic acid and lipid associated sialic acid were done for all those groups.

Blood Sampling: blood was allowed to coagulate at room temperature and then centrifuged for 10 minutes at 3000 rpm. The resulting sera were separated and placed in a test tube,

which was then stored in deep freeze to be kept for use.

Methods: T3, T4, and TSH were measured by vidas instrument, using ELFA technique (Enzyme Linked Fluorescent Assay). Triglyceride, total cholesterol, HDL and LDL were determined by colorimetry. Serum sialic acid and lipid associated sialic acid determination were done depending on formation of chromogen by addition of resorcinol reagent, the chromogen formed was extracted by butyl acetol – methanol reagent.

Statistical analysis

Data expressed as mean $\pm$ SD. Unpaired Student's t-test was used to evaluate differences between the groups. For all tests, a two-tailed $p < 0.05$ was considered statistically significant. All calculations were made using Excel 2003 program for Windows.

Results

The serum total sialic acid values were significantly increased in hypothyroidism (99.5 ± 9.65 mg/dl) and significantly decrease in hyperthyroidism (27 ± 7.5 mg/dl) when compared with the result of healthy individuals (67.3 ± 8.5 mg/dl) as shown in table (1).

Table 1: The comparison of Total Sialic acid of sera of hypothyroidism, hyperthyroidism and healthy individuals. (Mean $\pm$ SD)

Group	No.	Serum Total Sialic acid mg/dl
Healthy individuals	60	67.3 ± 8.5
Hyperthyroidism	62	$27 \pm 7.5^*$
Hypothyroidism	58	$99.5 \pm 9.65^{**}$

* $p = 0.001$ for comparison between hyperthyroidism and healthy individuals

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The serum lipid associated sialic acid showed no difference in patients with hyperthyroidism (15.36 ± 2.99 mg/dl),

hypothyroidism (17.65 ± 3.65 mg/dl) when compared to healthy (14.85 ± 3.88) individuals as shown in table (2)

Table 2: The comparison of lipid associated sialic acid of sera of hypothyroidism, hyperthyroidism and healthy individuals. (Mean $\pm$ SD)

Group	No.	Serum lipid associated sialic acid mg/dl
Healthy individuals	60	14.85 ± 3.88
Hyperthyroidism	62	$15.36 \pm 2.99^*$
Hypothyroidism	58	$17.65 \pm 3.65^{**}$

* $p = 0.001$ for comparison between hyperthyroidism and healthy individuals

* $p = 0.001$ for comparison between hyperthyroidism and healthy individuals

The serum cholesterol values were significantly increased in hypothyroidism (282 ± 18.5 mg/dl) and significantly decreased in hyperthyroidism (98.8 ± 12.9 mg/dl) when

compared with the result of healthy individuals (130 ± 15.6 mg/dl) as shown in table (3).

Table 3: The comparison of cholesterol of sera of hypothyroidism, hyperthyroidism and healthy individuals. (Mean $\pm$ SD)

Group	No.	Serum Cholesterol mg/dl
Healthy individuals	60	98.8 ± 12.9
Hyperthyroidism	62	$130 \pm 15.6^*$
Hypothyroidism	58	$286 \pm 28.5^{**}$

* $p = 0.001$ for comparison between hyperthyroidism and healthy individuals

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The serum triglyceride values were significantly increased in hypothyroidism (393 ± 20.4 mg/dl) and significantly decreased in hyperthyroidism (70 ± 26.4 mg/dl) when

compared with the result of healthy individuals (120 ± 25 mg/dl) as shown in table (4).

Table 4: The comparison of triglyceride in sera of hypothyroidism, hyperthyroidism and healthy individuals. (Mean $\pm$ SD)

Group	No.	Serum triglyceride mg/dl
Healthy individuals	60	120 $\pm$ 25*
Hyperthyroidism	62	70 $\pm$ 26.4*
Hypothyroidism	58	393 $\pm$ 20.4

*p= 0.001 for comparison between hyperthyroidism and healthy individuals

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The serum HDL values were significantly increased in hypothyroidism (64.4 $\pm$ 12.8 mg/dl) and significantly decreased in hyperthyroidism (32.8 $\pm$ 3.9 mg/dl) when

compared with the result of healthy individuals (43.5 $\pm$ 5.6 mg/dl) as shown in table (5).

Table 5: The comparison of HDL of sera of hypothyroidism, hyperthyroidism and healthy individuals. (Mean $\pm$ SD)

Group	No.	Serum HDL mg/dl
Healthy individuals	60	43.5 $\pm$ 5.6
Hyperthyroidism	62	32.8 $\pm$ 3.9
Hypothyroidism	58	64.4 $\pm$ 12.8

*p= 0.001 for comparison between hyperthyroidism and healthy individuals

*p= 0.001 for comparison between hyperthyroidism and healthy individuals

The serum LDL values were significantly increased in hypothyroidism (135 $\pm$ 25.2 mg/dl) and significantly decreased in hyperthyroidism (44.5 $\pm$ 8.5 mg/dl) when

compared with the result of healthy individuals (70.5 $\pm$ 15.2 mg/dl) as shown in table (6).

Table 6: The comparison of cholesterol of sera of hypothyroidism, hyperthyroidism and healthy individuals. (Mean $\pm$ SD)

Group	No.	Serum Cholesterol mg/dl
Healthy individuals	60	70.5 $\pm$ 15.2
Hyperthyroidism	62	44.5 $\pm$ 8.5 *
Hypothyroidism	58	135 $\pm$ 25.2 **

*p= 0.001 for comparison between hyperthyroidism and healthy individuals

*p= 0.001 for comparison between hyperthyroidism and healthy individuals

Discussion

Total sialic acid level increases in many diseases, particularly those involving inflammatory processes and vascular damage, such as certain cancers, cardiovascular damage, diabetes and Alzheimer's [10].

Total sialic acid value was shown to be increased in the current study in patients with hypothyroidism, decreased in those with hyperthyroidism when compared to healthy individuals, those results are consistent with that observed by Ullal *et al* in 2012. [11] This increase may be due to low metabolic rate, mild inflammation and lipid abnormalities associated with hypothyroidism [12].

The serum lipid associated sialic acid showed no difference in patients with hyperthyroidism and hypothyroidism when compared to healthy individuals, no previous study correlates the change of lipid associated sialic acid with thyroid dysfunction, while there were previous studies that showed the association between its level and other diseases Singh *et al* 2001 [13].

The lipid profile was significantly changed in hyperthyroidism and hypothyroidism, in hypothyroidism there was an increase in total cholesterol, LDL, and triglycerides, which is caused by a decrease in metabolic rate and reduction in the hepatic LDL receptor activity which leads to impaired LDL clearance as shown by Canaris *et al* in 2000 [14], while the elevated HDL in is most likely due to reduced hepatic lipase activity, which causes HDL accumulation which is consistent with Sinha *et al* in 2018 [15].

Conversely in hyperthyroidism these patients showed a significant decrease in the levels of total cholesterol, LDL, HDL, and triglycerides when compared to healthy control group, this reduction was despite the increased activity of HMG-CoA which is a rate-limiting enzyme in synthesis of cholesterol reductase in hyperthyroidism, Duntas *et al* 2002, observed that serum cholesterol is reduced because of the increased LDL receptor expression and increase bile acid synthesis [16]. The decrease in HDL can be explained by the increased cholesteryl ester transfer from HDL to VLDL via Cholesteryl Ester Transfer Protein and enhanced hepatic lipase-mediated HDL catabolism, the reduced triglycerides level is caused by accelerated lipolysis and increased VLDL clearance due to the influence of thyroid hormone as stated by Rizos *et al* in 2011 [17].

Conclusion

Total sialic acid, total cholesterol, triglyceride, HDL and LDL increase in patients with hypothyroidism and may be useful as a risk factor for developing diseases for example ischemic heart disease.

Lipid associated sialic acid level did not change neither in hypothyroidism nor in hyperthyroidism.

Total sialic acid, total cholesterol, triglyceride, HDL and LDL level decreased in patients with hyperthyroidism.

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