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Evaluation of HDL and LDL Cholesterol Profiles in Patients With Thyroid Dysfunction

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Abstract

Background: Thyroid disorders are among the most prevalent endocrine abnormalities globally. Thyroid hormones significantly influence lipid metabolism, including the synthesis, degradation, and mobilization of lipids. Consequently, lipid profile alterations are frequently observed in individuals with thyroid dysfunction. **Aim and Objectives:** This study aimed to evaluate the alterations in HDL and LDL cholesterol levels in patients with thyroid dysfunction. **Materials and Methods:** A cross-sectional observational study was conducted involving 60 participants, including 20 patients each with hypothyroidism, hyperthyroidism, and euthyroid (normal thyroid function) status. Serum levels of total cholesterol, triglycerides, high-density lipoprotein cholesterol (HDL-C), very low-density lipoprotein cholesterol (VLDL-C), low-density lipoprotein cholesterol (LDL-C), and the LDL/HDL ratio were measured and statistically analyzed using tests for significance in mean differences. **Results:** Hypothyroid patients exhibited significantly elevated levels of total cholesterol, LDL-C, and triglycerides, along with a reduction in HDL-C. In contrast, hyperthyroid patients showed significantly lower levels of total cholesterol, triglycerides, LDL-C, VLDL-C, and LDL/HDL ratio compared to euthyroid controls.

Conclusion: Thyroid dysfunction is associated with significant changes in lipid metabolism. Hypothyroidism, in particular, is linked to a dyslipidemic profile that may increase cardiovascular risk. Therefore, routine thyroid function screening is recommended, especially in patients with lipid abnormalities, to facilitate early diagnosis and management of thyroid-related cardiovascular complications.

KEY WORDS: Thyroid Dysfunction; Hypothyroidism; Hyperthyroidism; Lipid Profile

Introduction

Thyroid diseases are among the most prevalent endocrine disorders worldwide. Hypothyroidism is a clinical syndrome caused by a deficiency of thyroid hormones, resulting from decreased secretion of thyroxine (T4) and triiodothyronine (T3), regardless of the underlying cause. This deficiency leads to a generalized slowing of metabolic processes [1]. Biochemically, reduced T4 and T3 levels cause a compensatory rise in pituitary thyroid-stimulating hormone (TSH) secretion, leading to elevated serum TSH levels—a key laboratory marker useful in the early detection of thyroid failure [2].

Thyroid disorders rank second only to diabetes mellitus in terms of prevalence, affecting over 1% of the general population and approximately 5% of individuals above 60 years of age [3,4]. The incidence of thyroid dysfunction increases with age, especially among women. In hypothyroid patients, lipid abnormalities are common due to elevated low-density lipoprotein (LDL) levels, decreased lipoprotein lipase activity, and increased fatty acid esterification [5].

Thyroid hormones play a critical role in carbohydrate metabolism by enhancing cellular glucose uptake, glycolysis, gluconeogenesis, and gastrointestinal absorption of glucose. They also promote insulin secretion and amplify its effects on carbohydrate metabolism. These metabolic effects are largely due to increased activity of cellular enzymes induced by thyroid hormones [6]. In addition, thyroid hormones accelerate fat metabolism by stimulating rapid fat mobilization from adipose tissue, increasing plasma free fatty acid levels, and promoting the oxidation of fatty acids by cells [6].

Thyroid dysfunction profoundly affects lipoprotein composition and transport, with the extent of lipid abnormalities varying based on the severity and duration of the disease [7,8]. Several studies have suggested that hypothyroidism is associated with an increased risk of coronary artery disease due to atherogenic changes in the lipoprotein profile [9]. Specifically, high-density lipoprotein cholesterol (HDL-C) tends to decrease in hypothyroidism [10]. Conversely, hyperthyroidism results in increased cholesterol excretion and enhanced LDL turnover, leading to reduced total cholesterol and LDL cholesterol levels [7]. Furthermore, thyroid hormones accelerate triglyceride turnover and chylomicron clearance rates.

Hepatic lipogenic activity is increased in hyperthyroidism and decreased in hypothyroidism. Thyroid hormones reduce hepatic output of total cholesterol and very low-density lipoprotein (VLDL) by lowering fatty acid re-esterification and increasing oxidation of newly synthesized fatty acids. Conversely, hypothyroid patients exhibit increased hepatic secretion of VLDL [11]. Elevated plasma triglyceride levels have also been reported in hypothyroid patients [12]. The LDL/HDL ratio is typically elevated in hypothyroidism and decreased in hyperthyroidism [13].

Lipid abnormalities show considerable individual variability [7]. The association between elevated lipid levels and the risk of coronary artery disease is well established [11]. Therefore, this study was conducted to investigate alterations in lipid profiles, specifically HDL and LDL cholesterol, in patients with thyroid dysfunction. Early detection of lipid abnormalities in hypothyroid and hyperthyroid patients can help reduce morbidity and mortality associated with cardiovascular complications of thyroid disease.

Materials and Methods:

It was a hospital-based case-control study and was conducted upon patients known to have hypothyroidism and hyperthyroidism at NCMCH, Panipat, Haryana, India, during the period of 2023-2024. In the present study, 20 patients aged 30-70 years who were diagnosed as hypothyroid and confirmed by the estimation of fasting serum TSH ≤ 3.5-6 ng/dl by ELISA reader. On two occasions, they were selected from the medicine OPD and IPD of NCMCH, Panipat. 20 normal, healthy subjects were selected as controls. A written consent in English and the vernacular language was taken on the pro forma.

Inclusion Criteria

Hypothyroid group

Diagnosed hypothyroid patients in the age group of 30–70 who were on treatment for 1 year or more were included in the study.

Hyperthyroid group

Diagnosed hyperthyroid patients in the age group of 30–70 who were on treatment for 1 year or more were included in the study.

Control group

Normal age-matched healthy adults with normal thyroid function were included in the study.

Exclusion Criteria

Subjects with a known history of other systemic and infectious diseases were excluded from the study.

Sample Collection:

Under aseptic and antiseptic conditions, 5 ml of the blood sample collected from the antecubital vein of each of the subjects. All the blood samples were allowed to clot for serum separation. Blood samples were centrifuged at 4000 rpm for 15 minutes.

Analysis of the Sample:

All the samples were processed according to exhaustive standard laboratory guidelines after using the institution guidelines for quality control fasting TSH was diagnosed in ELISA. Serum cholesterol, serum triglycerides, and serum HDL were tested by endpoint CHOD-PAP, endpoint GPO-TRINDER, and endpoint Trinder reaction, respectively. Serum LDL and VLDL tested by Friedwald's equation [6]

Data Analysis:

Statistical analysis of the data was done by SPSS (version 2024), where the values ≤ 0.05 were considered as significant.

Result:

A total of 20 hypothyroidism patients and 20 age- and sex-matched normal individuals were selected for the study. The statistical analysis of the parameter is as follows. The mean level of serum cholesterol, triglycerides, HDL, LDL, and VLDL activity of hypothyroid patients was significantly increased when compared to normal subjects.

Table 1: Comparison of lipid profile of hypothyroid group and control group

Variables	**Hypothyroid (Mean± SD)**	**Control (Mean± SD)**	**P-value**
Total cholesterol [mg/dl]	260.25±44.73	172.85±19.32	<0.01
Triglyceride [mg/dl]	151.70±31.01	89.30±10.17	<0.01
HDL-C[mg/dl]	23.70±4.37	45.45±8.17	<0.01
VLDL-C [mg/dl]	30.34±6.2	17.86±203	<0.01
LDL-C [mg/dl]	205.71±43.55	109.54±20.5	<0.01
LDL-C: HDL-C ratio	9.02±2.69	2.52±0.83	<0.01

Table 2: Comparison of lipid profile of hyperthyroid group and control group

Variables	**Hypothyroid (Mean± SD)**	**Control (Mean± SD)**	**P-value**
Total cholesterol [mg/dl]	142.25±7.73	172.85±19.32	<0.01
Triglyceride [mg/dl]	82.05±4.19	89.30±10.17	<0.01
HDL-C[mg/dl]	49.4±4.42	45.45±8.17	<0.01
VLDL-C [mg/dl]	16.41±0.84	17.86±203	<0.01
LDL-C [mg/dl]	76.44±8.82	109.54±20.5	<0.01
LDL-C: HDL-C ratio	1.57±0.31	2.52±0.83	<0.01

Statistically significant increased amount of serum total Cholesterol, Triglycerides, HDL, and VLDL was found in hypothyroid patients and hyperthyroidism patient. Statistically significant found for serum lipid profile level in hypothyroid patients and controls. ($p<0.05$)

Certainly! Here's a more concise, polished, and clearer version of the **Discussion** section, improving flow and academic tone while retaining the key findings and interpretations:

Discussion

This study aimed to assess the impact of thyroid dysfunction on lipid profile alterations, focusing on total cholesterol, triglycerides, HDL-C, LDL-C, VLDL-C, and the LDL/HDL ratio in hypothyroid, hyperthyroid, and control groups.

In hypothyroid patients, serum total cholesterol, triglycerides, LDL-C, and VLDL-C levels were significantly elevated compared to controls, while HDL-C levels were significantly reduced. These findings align with previous studies by Deschampheleire et al. [15], Kutty et al. [16], Nishitani et al. [17], and Valdermarsson et al. [12]. The dyslipidemia observed in hypothyroidism is likely due to decreased activity of lipoprotein lipase and hepatic lipase, which slows the clearance of triglyceride-rich lipoproteins and LDL particles [12,18]. Additionally, hypothyroid patients exhibit reduced LDL receptor numbers on hepatocytes, contributing to decreased LDL clearance and increased plasma LDL-C levels [7].

The reduction in HDL-C observed may be attributed to impaired synthesis, mobilization, and degradation of lipids in hypothyroidism [14]. Since HDL-C levels are inversely correlated with coronary artery disease (CAD) risk, this decrease further exacerbates cardiovascular risk [14]. Elevated LDL/HDL ratios in hypothyroid patients reinforce the increased atherogenic potential and risk for CAD [13,19].

In contrast, hyperthyroid patients demonstrated significantly lower total cholesterol, triglycerides, LDL-C, and VLDL-C levels, accompanied by elevated HDL-C levels compared to controls. These results are consistent with prior reports [15,17,20,21]. The reduced lipid levels in hyperthyroidism are likely due to increased hepatic lipase activity, enhanced LDL catabolism, increased cholesterol excretion, and accelerated triglyceride turnover [11,18]. The increase in HDL-C may result from decreased activity of cholesteryl ester transfer protein (CETP) and hepatic lipase, which limits cholesteryl ester transfer from HDL to VLDL [7,22].

The LDL/HDL ratio was significantly lower in hyperthyroid patients, reflecting a more favorable lipid profile and potentially lower cardiovascular risk compared to hypothyroid individuals [13]. These findings emphasize the critical role of thyroid hormones in regulating lipid metabolism, synthesis, and mobilization [23]. Overall, hypothyroidism is associated with an atherogenic lipid profile characterized by elevated total cholesterol, LDL-C, triglycerides, and reduced HDL-C, increasing the risk for CAD. Conversely, hyperthyroidism tends to present with a lipid profile that may reduce cardiovascular risk. Early detection and management of thyroid dysfunction, including treatment with L-thyroxine for hypothyroidism, may help reverse lipid abnormalities and reduce cardiovascular complications [23,24].

Strength and Limitations of the Present Study

There are a few limitations of the study. In the present study, only 30–70 years ages subjects participated in the research. Hence, in the feature, we would like to include an

increase in a number of participants to reach a concrete conclusion. The present study was given an impact to understand about the increased concentration of the lipid profile is involved in the aetiopathogenesis of autoimmune thyroid destruction.

CONCLUSION

A major risk factor for cardiac disorders, the lipid profile can change significantly as a result of altered thyroid function. Therefore, regular thyroid hormone test may be very beneficial for the early detection and management of heart disease linked to thyroid dysfunction. It may be possible to treat hyperlipidemia with specifically targeted thyroid hormone analogues without developing systemic thyrotoxicosis.

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