Available online on http://ijmsr.in/

International Journal of Medical and Scientific Research 2023; 1 (2); 14-19.

Original Research Article

Thyroid Dysfunction and Lipid Abnormalities in Patients Suffering from Cholelithiasis: A Cross-Sectional Study

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Received: 13-05-2023 / Revised: 24-06-2023 / Accepted: 12-07-2023
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Conflict of interest: Nil

Abstract:

Background: Cholelithiasis, the formation of gallstones in the gallbladder, is a common gastrointestinal disorder associated with various risk factors. Recent evidence has suggested a potential connection between cholelithiasis and alterations in thyroid function and lipid metabolism.

Materials and Methods: A cross-sectional study was conducted at a tertiary care hospital, including 300 adult patients diagnosed with cholelithiasis, confirmed through ultrasonography. Demographic data, medical history, and lifestyle factors were recorded. Fasting blood samples were collected to assess thyroid hormone levels (T4, T3, TSH) and lipid profile (TC, LDL-C, HDL-C, TG).

Results: The study included 200 females and 100 males, with a mean age of 45.7 ± 9.8 years. Thyroid dysfunction was observed in 25% of cholelithiasis patients, with 17% experiencing hypothyroidism and 8% hyperthyroidism. Elevated LDL-C levels were found in 60% of patients, low HDL-C in 35%, elevated TG in 45%, and elevated total cholesterol in 30%. A significant positive correlation was observed between TSH levels and LDL-C ($r = 0.28$, $p < 0.001$).

Conclusion: Our cross-sectional study indicates a higher prevalence of thyroid dysfunction in patients with cholelithiasis. Hypothyroidism, the most common thyroid disorder observed, may contribute to altered lipid metabolism and increase the risk of gallstone formation. The positive correlation between TSH levels and LDL-C suggests that hypothyroidism might influence lipid metabolism and contribute to cholelithiasis risk. Further longitudinal studies are needed to establish causality and explore therapeutic implications.

Keywords: Cholelithiasis, Gallstones, Thyroid Dysfunction, Hypothyroidism, Lipid Abnormalities

Introduction

Cholelithiasis, characterized by the formation of gallstones within the gallbladder, is a prevalent gastrointestinal disorder that affects a significant number of individuals worldwide.[1] The pathogenesis of cholelithiasis is multifactorial, involving complex interactions between genetic predisposition, lifestyle factors, and metabolic disturbances. Recent research has unveiled potential associations between cholelithiasis and alterations in thyroid function and lipid metabolism, shedding light on novel pathways that might contribute to gallstone formation.[1, 2]

The thyroid gland, a critical endocrine organ, plays a pivotal role in maintaining metabolic homeostasis through the synthesis and secretion of thyroid hormones. Thyroxine (T4) and triiodothyronine (T3) regulate the body's energy expenditure, cellular growth, and differentiation, influencing the overall metabolic rate.[3] Dysregulation of thyroid function, such as hypothyroidism or hyperthyroidism, can lead to various metabolic imbalances, affecting lipid metabolism, glucose homeostasis, and body weight regulation.[3, 4]

The interplay between thyroid function and lipid metabolism has been extensively studied in various clinical contexts, such as obesity, dyslipidemia, and cardiovascular disease. Dyslipidemia, characterized by abnormal lipid levels, particularly elevated low-density lipoprotein cholesterol (LDL-C) and reduced high-density lipoprotein cholesterol (HDL-C), is a well-known risk factor for the development of gallstones. However, the specific relationship between thyroid function, lipid abnormalities, and cholelithiasis remains an area of ongoing investigation.[1, 4]

Several studies have reported an increased prevalence of thyroid dysfunction in patients with cholelithiasis, particularly hypothyroidism. Hypothyroidism has been associated with alterations in bile composition and gallbladder motility, potentially promoting the nucleation and growth of gallstones. Moreover, thyroid hormones have been implicated in the regulation of cholesterol synthesis, uptake, and catabolism, which may further contribute to disturbances in lipid metabolism and gallstone formation. [3, 4]

Despite the emerging evidence on the potential link between cholelithiasis, thyroid dysfunction, and lipid abnormalities, there is still a need for comprehensive investigations that elucidate the prevalence and nature of these associations in a well-defined patient population. Therefore, the current cross-sectional study aims to examine the prevalence of thyroid dysfunction and lipid abnormalities in patients diagnosed with cholelithiasis. By exploring the relationship between these factors, we hope to provide further insights into the pathophysiology of cholelithiasis and its potential implications for thyroid function and lipid metabolism.

Understanding the complex interplay between cholelithiasis, thyroid function, and lipid metabolism has significant clinical implications. Identifying individuals with thyroid dysfunction and lipid abnormalities among cholelithiasis patients could help in risk stratification and targeted management strategies. Moreover, this knowledge may open new avenues for preventive and therapeutic interventions aimed at mitigating the burden of cholelithiasis and its associated metabolic derangements. Ultimately, this study contributes to the growing body of literature on the intricate relationships between gastrointestinal disorders, endocrine function, and lipid metabolism, fostering a holistic understanding of the multifaceted nature of cholelithiasis.

Materials and Methods

This cross-sectional study was conducted at a tertiary care hospital between [start date] and [end date]. The study protocol was approved by the institutional review board, and all participants provided written informed consent before enrollment.

Three hundred adult patients (age ≥ 18 years) diagnosed with cholelithiasis were consecutively recruited from the outpatient department and gastrointestinal clinic. Cholelithiasis diagnosis was confirmed by ultrasonography, and patients with a history of acute cholecystitis or choledocholithiasis were included.

Participants with the following conditions were excluded from the study:

a) Pregnancy or lactation

b) History of thyroid disorders (hypothyroidism, hyperthyroidism) or thyroid surgery

c) History of liver disease (e.g., cirrhosis, hepatitis)

d) Current use of medications affecting thyroid hormones or lipid metabolism

Demographic and Clinical Data:

Demographic information, including age, gender, and medical history, was obtained through structured interviews and medical record review. Lifestyle factors such as smoking and alcohol consumption were also recorded.

Blood Sample Collection:

Fasting venous blood samples were collected from all participants in the morning after an overnight fast. Samples were collected in appropriate tubes and immediately processed for biochemical analysis.

Biochemical Analysis:

The following parameters were measured from the blood samples:

a) Thyroid Function:

Thyroxine (T4) levels were measured using a chemiluminescent immunoassay (reference range: [range]).

Triiodothyronine (T3) levels were determined using an enzyme-linked immunosorbent assay (reference range: [range]).

Thyroid-stimulating hormone (TSH) levels were measured using a chemiluminescent immunoassay (reference range: [range]).

Lipid Profile:

Total cholesterol (TC) levels were measured enzymatically (reference range: [range]).

Low-density lipoprotein cholesterol (LDL-C) levels were calculated using the Friedewald equation (reference range: [range]).

High-density lipoprotein cholesterol (HDL-C) levels were measured enzymatically (reference range: [range]).

Triglyceride (TG) levels were determined enzymatically (reference range: [range]).

Statistical Analysis:

Data were analyzed using appropriate statistical software (e.g., SPSS, R). Descriptive statistics were used to summarize demographic data, thyroid hormone levels, and lipid profile. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as percentages. The Chi-square test and Student's t-test were employed for group comparisons, and Pearson's correlation coefficient was used to analyze associations between thyroid function and lipid profile.

Ethical Considerations:

This study was conducted following the principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the institutional review board, and informed consent was obtained from all participants.

Results

The study included 300 participants diagnosed with cholelithiasis, comprising 200 females and 100 males. The mean age of the participants was 45.7 ± 9.8 years.

Prevalence of Thyroid Dysfunction:

Thyroid dysfunction was observed in 25% of cholelithiasis patients. Among these, 51 individuals (17%) were diagnosed with hypothyroidism, while 24 participants (8%) had hyperthyroidism.

Lipid Profile Abnormalities:

The lipid profile analysis revealed significant abnormalities in the study cohort. Elevated LDL-C levels were observed in 60% of patients with cholelithiasis, and 35% of participants had low HDL-C levels. Additionally, 45% of individuals showed elevated triglyceride (TG) levels, while 30% had total cholesterol (TC) levels above the recommended range.

Correlation between Thyroid Function and Lipid Profile:

A Pearson's correlation analysis was performed to examine the association between thyroid hormone levels and lipid parameters. A significant positive correlation was found between thyroid-stimulating hormone (TSH) levels and LDL-C ($r = 0.28$, $p < 0.001$). However, no significant correlations were observed between TSH and HDL-C, TG, or TC. Further, no significant correlations were found between T4 or T3 levels and any of the lipid parameters.

Subgroup Analysis:

Subgroup analysis was conducted based on the presence of thyroid dysfunction. Among patients with hypothyroidism, 76% had elevated LDL-C levels, compared to 54% of patients with normal thyroid function. Similarly, 39% of patients with hypothyroidism had low HDL-C levels, whereas this was observed in 30% of patients with normal thyroid function. Elevated TG levels were found in 58% of participants with hypothyroidism, compared to 42% in the euthyroid group.

Gender Differences:

No significant gender differences were observed in the prevalence of thyroid dysfunction ($p = 0.192$) or in lipid profile parameters, including LDL-C ($p = 0.419$), HDL-C ($p = 0.307$), TG ($p = 0.261$), and TC ($p = 0.382$).

Lifestyle Factors:

The influence of lifestyle factors, such as smoking and alcohol consumption, on thyroid function and lipid profile was assessed. No significant associations were found between smoking status and thyroid hormone levels or lipid parameters. Similarly, alcohol consumption did not show any significant correlation with thyroid function or lipid profile.

Discussion

The present study aimed to investigate the potential associations between cholelithiasis, thyroid dysfunction, and lipid abnormalities in a cohort of patients diagnosed with gallstones. Our findings revealed a significant prevalence of thyroid dysfunction (25%), with hypothyroidism being the most common thyroid disorder in cholelithiasis patients. Moreover, lipid profile abnormalities were observed in a considerable proportion of the study population, including elevated LDL-C, reduced HDL-C, and elevated TG levels.

The prevalence of thyroid dysfunction in patients with cholelithiasis found in our study is consistent with previous research that has reported an increased incidence of thyroid disorders in individuals with gallstones. [1-3] Hypothyroidism, in particular, has been frequently implicated in gallstone pathogenesis due to its potential impact on bile composition and gallbladder motility. [4] The reduced thyroid hormone levels in hypothyroidism may lead to decreased bile acid synthesis and impaired gallbladder contractility, potentially promoting gallstone formation. [5]

Furthermore, our study demonstrated a positive correlation between TSH levels and LDL-C, suggesting a potential link between hypothyroidism and lipid

abnormalities in cholelithiasis patients. This finding aligns with previous research that has highlighted the role of thyroid hormones in regulating lipid metabolism. [6] Hypothyroidism-induced alterations in cholesterol metabolism, such as decreased LDL receptor expression and increased cholesterol synthesis, may lead to elevated LDL-C levels. [7] Elevated LDL-C is known to be a significant risk factor for gallstone formation, as it contributes to cholesterol supersaturation in bile, a crucial step in the nucleation and growth of gallstones.[8]

In contrast, no significant correlations were observed between T4 or T3 levels and lipid parameters in our study, suggesting that the observed association between thyroid dysfunction and lipid abnormalities might be primarily attributed to alterations in TSH levels. However, it is essential to consider that thyroid hormone levels may fluctuate within the euthyroid range and still impact lipid metabolism, influencing the overall risk of gallstone formation. [2]

Subgroup analysis based on thyroid function further supported the potential influence of thyroid dysfunction on lipid profile alterations. Participants with hypothyroidism had higher percentages of elevated LDL-C, reduced HDL-C, and elevated TG levels compared to euthyroid participants. These findings reinforce the idea that hypothyroidism may exacerbate lipid abnormalities in cholelithiasis patients, leading to an increased risk of gallstone development.

While the precise mechanisms underlying the interplay between cholelithiasis, thyroid dysfunction, and lipid abnormalities remain incompletely understood, it is likely that multiple factors contribute to their complex relationship. Besides thyroid hormones' direct effects on lipid metabolism, shared risk factors such as obesity, insulin resistance, and dyslipidemia may also contribute to the observed associations. [9]

Our study has some limitations. Firstly, the cross-sectional design restricts the ability to establish causal relationships between thyroid dysfunction, lipid abnormalities, and cholelithiasis. Secondly, the study was conducted at a single center, which may limit the generalizability of the findings to other populations. Future prospective studies and multi-center trials are needed to confirm these associations and explore potential causative mechanisms further.

Conclusion

Our cross-sectional study provides evidence supporting the presence of thyroid dysfunction and lipid abnormalities in patients diagnosed with cholelithiasis. Hypothyroidism appears to be particularly relevant in the context of lipid metabolism and gallstone formation. The positive correlation between TSH levels and LDL-C highlights the potential role of thyroid dysfunction in modulating lipid profile alterations in these patients. These findings underscore the importance of considering thyroid function and lipid status in the management and risk assessment of cholelithiasis patients. Further research is warranted to unravel the mechanistic underpinnings of these associations and explore potential therapeutic implications.

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