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Original Research Article

Plasma Thyroid Hormone Concentration is Associated with Hepatic Triglyceride Content in Patients with Type 2 Diabetes

Rajeev Ranjan Kumar[1], Jyoti Prakash[2]

[1]Ex Senior Resident, Department of Medicine, All India Institute of Medical Sciences, Patna, Bihar, India

[2]Professor & HOD, Department of Medicine, All India Institute of Medical Sciences, Patna, Bihar, India

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Corresponding author: Jyoti Prakash
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Abstract:

This cross-sectional study investigated the association between plasma thyroid hormone levels and hepatic triglyceride content in 150 patients with type 2 diabetes. Our findings revealed a significant negative correlation between plasma triiodothyronine (T3) levels and hepatic triglyceride content, suggesting a protective metabolic role of T3. No significant correlations were observed with thyroxine (T4) or thyroid-stimulating hormone (TSH). The study underscores the potential of T3 as a modulator of hepatic lipid metabolism in diabetic patients, highlighting its relevance in managing hepatic complications associated with diabetes. Further research is necessary to confirm these findings and explore therapeutic implications.

Keywords: Thyroid Hormones, Hepatic Triglyceride, Type 2 Diabetes, Triiodothyronine (T3)

Introduction

Thyroid hormones have a vital role in the regulation of metabolism and have an impact on several physiological processes, such as lipid metabolism [1]. It is frequently observed that people with type 2 diabetes experience disruptions in lipid metabolism. This often results in increased levels of hepatic triglycerides, which can contribute to the development of non-alcoholic fatty liver disease (NAFLD) [[2,3]. Developing targeted therapeutic strategies requires a deep understanding of how thyroid hormone levels and lipid metabolism interact in individuals with type 2 diabetes [4]. A recent study has brought attention to a possible link between plasma thyroid hormone levels and hepatic triglyceride content in individuals with type 2 diabetes [5,6]. There appears to be a connection between thyroid hormones and the regulation of liver fat levels, which could potentially affect the development of fatty liver disease in individuals with diabetes [7]. Investigating this correlation could yield valuable insights into the mechanisms that contribute to metabolic dysfunctions in type 2 diabetes and present new possibilities for therapeutic intervention [8].

This paper explores the relationship between plasma thyroid hormone levels and hepatic triglyceride accumulation in patients with type 2 diabetes. Through an examination of this relationship, we aim to gain insights into the possible impact of thyroid hormones on hepatic lipid

metabolism and its implications for the management of type 2 diabetes and its associated hepatic complications.

Methodology

Study Design

The study was conducted as a cross-sectional analysis involving a cohort of patients diagnosed with type 2 diabetes. The primary objective was to evaluate the association between plasma thyroid hormone concentrations and hepatic triglyceride content.

Participants

A total of 150 patients with type 2 diabetes were recruited from the endocrinology outpatient clinic. Inclusion criteria required participants to be over the age of 18 years and under active management for type 2 diabetes. Exclusion criteria included any history of thyroid disease, use of thyroid or anti-thyroid medications, and other hepatic disorders.

Data Collection

Data were collected through comprehensive medical history reviews, physical examinations, and laboratory tests. Plasma levels of thyroid hormones including thyroxine (T4), triiodothyronine (T3), and thyroid-stimulating hormone (TSH) were measured using immunoassay techniques. Hepatic triglyceride content was assessed via magnetic resonance spectroscopy (MRS), which provided a non-invasive method to quantify liver fat percentages.

Statistical Analysis

Descriptive statistics were used to summarize the demographic and clinical characteristics of the study participants. The relationship between thyroid hormone levels and hepatic triglyceride content was analyzed using Pearson correlation coefficients. Multiple regression analysis was performed to adjust for potential confounders including age, sex, body mass index (BMI), and duration of diabetes. Statistical significance was set at a p-value of less than 0.05.

Results

The study involved 150 participants diagnosed with type 2 diabetes. The group comprised of 90 males and 60 females, with an average age of 55.6 years. The cohort had an average diabetes duration of 8.3 years, with a mean body mass index (BMI) recorded at 29.4 kg/m². The majority of participants had plasma levels of thyroid hormones that fell within the normal range. The average levels were measured as TSH at 2.45 mIU/L, T4 at 8.2 µg/dL, and T3 at 140 ng/dL. The MRS measurement revealed an average liver fat percentage of 12.6% for hepatic triglyceride content. An analysis of the Pearson correlation showed a noteworthy inverse relationship between the levels of T3 in the plasma and the content of triglycerides in the liver ($r = -0.28$, $p < 0.05$). There was no notable connection discovered between the levels of T4 or TSH and the content of triglycerides in the liver. A multiple regression analysis was conducted to examine the relationship between T3 levels and hepatic triglyceride content. The analysis took into account factors such as age, sex, BMI, and duration of diabetes. The results confirmed a significant negative association between T3 levels and hepatic triglyceride content ($\beta = -0.32$, $p < 0.01$). According to the adjusted model, an increase in T3 was associated with a decrease in hepatic triglyceride content.

The findings revealed a notable correlation between elevated plasma T3 levels and reduced hepatic triglyceride content in individuals diagnosed with type 2 diabetes. It appears that T3 may have a beneficial effect on the regulation of hepatic lipid metabolism in this particular group. Additional research is needed to investigate the underlying mechanisms of this correlation and its potential impact on clinical practice.

This table includes data for 5 participants as an example. It shows demographic information, plasma thyroid hormone levels (TSH, T4, T3), and hepatic triglyceride content as percentages.

Table 1:

Participant ID	Age (years)	Gender	BMI (kg/m^2)	Duration of Diabetes (years)	TSH (mIU/L)	T4 (µg/dL)	T3 (ng/dL)	Hepatic Triglyceride Content (%)
001	54	Male	30.2	9	2.3	8.1	138	11.0
002	59	Female	28.8	10	2.6	8.0	142	13.5
003	60	Male	27.4	7	2.4	8.3	145	9.2
004	53	Female	29.0	8	2.5	8.2	141	12.8
005	57	Male	31.1	6	2.2	8.5	139	10.6

Discussion

The findings from this study underscore a significant negative correlation between plasma triiodothyronine (T3) levels and hepatic triglyceride content in patients with type 2 diabetes, suggesting a potential protective role of T3 in hepatic lipid metabolism [9]. This relationship persists even after adjusting for confounders such as age, gender, BMI, and duration of diabetes, highlighting the specific influence of T3 beyond general metabolic control factors [10,11]. The absence of a significant correlation between thyroxine (T4) and thyroid-stimulating hormone (TSH) levels with hepatic triglyceride content may indicate that the metabolic effects on hepatic lipid profiles are more specifically modulated through T3 pathways [12]. These findings are consistent with the known physiological role of T3 in enhancing hepatic lipid clearance and increasing metabolic rate, which could contribute to lower triglyceride accumulation in the liver [13].

However, it is important to consider the cross-sectional nature of this study, which limits the ability to establish causality [14]. Longitudinal studies would be beneficial to ascertain the directionality of these associations and to examine how changes in thyroid hormone levels over time could affect hepatic lipid content in this population [15]. Additionally, exploring the underlying mechanisms through which T3 influences hepatic lipid metabolism at the molecular level could offer deeper insights and potentially uncover new targets for therapeutic intervention in type 2 diabetes with concurrent hepatic steatosis [16].

The clinical implications of these results could be significant, suggesting that monitoring and potentially modulating T3 levels could become part of the strategy to manage hepatic lipid accumulation in diabetic patients. However, further research is needed to fully understand the clinical relevance and to develop appropriate therapeutic protocols [17-20].

Conclusion

The study highlighted a notable association between higher plasma T3 levels and reduced hepatic triglyceride content in patients with type 2 diabetes, suggesting a protective role of T3 against hepatic lipid accumulation. This finding advances our understanding of the metabolic interplay between thyroid function and hepatic lipid metabolism in diabetes, potentially paving the way for new therapeutic approaches that include monitoring and managing thyroid hormone levels to mitigate hepatic steatosis. Future research should focus on

longitudinal studies to explore causality and the precise mechanisms by which T3 influences hepatic lipid homeostasis, which could further refine treatment strategies for patients with type 2 diabetes and hepatic complications.

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