Section: Biochemistry

Original Research Article

THE IMPACT OF HYPERTHYROIDISM ON LIVER ENZYMES AND CREATINE PHOSPHOKINASE

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Abstract

Background: Thyroid dysfunction ranks among the most prevalent endocrine disorders. Its irregularities may lead to a variety of clinical manifestations. the aim is to assess the patterns of liver biochemical abnormalities and CPK levels in hyperthyroid and euthyroid patients. **Materials and Methods:** This prospective study evaluated the levels of three thyroid hormones and four liver enzymens in the study subjects. **Result:** The findings revealed significantly elevated liver enzyme levels in hyperthyroid patients compared to healthy Conversely, serum CPK levels were significantly lower in hyperthyroid patients compared to controls. **Conclusion:** There is a proportional relationship between thyroid hormones and liver enzymes, while an inverse relationship exists with CPK levels in hyperthyroid patients.

INTRODUCTION

Thyroid disorders are prevalent globally and India is no exception. Approximately 42 million individuals are affected by thyroid diseases in India.[1] Often referred to as a silent illness, thyroid disorders can present subtle symptoms that may be easily missed during diagnosis.[2]

The thyroid gland, a small butterfly-shaped organ and releases two hormones: T4 (Thyroxine) and T3 (Triiodothyronine), which play a crucial role in metabolism.[3] It plays a vital role in growth, development, and functioning of organs, as well as for regulating the basal metabolic rate. Any disruption in their levels can significantly impact overall metabolism.[4-5]

Hyperthyroidism is a relatively common condition and characterized is characterized by excess of triiodothyronine (T3) and/or thyroxine (T4).[6] Liver produces thyroxine-binding globulin (TBG), pre-albumin, and albumin and are crucial for thyroid hormone metabolism. Additionally, it is involved in their conjugated biliary excretion, as well as processes such as oxidation, deamination, and the extra-thyroidal deiodination of thyroxine (T4) into triiodothyronine (T3) and reverse T3.[7-9]

The biochemical abnormalities and liver damage associated with hyperthyroidism can vary in both character and severity, but they primarily manifest as hepatitis. Skeletal muscle is significantly affected by thyroid hormones.[10-11] Serum CPK levels in healthy individuals are influenced by factors such as age, race, lean body mass, and physical activity. Initially, serum CPK was utilized as a diagnostic tool for progressive muscular dystrophy, but it has since evolved into a crucial clinical marker for muscle damage.[12-13] This study aims to explore the patterns of liver biochemical abnormalities and CPK levels in hyperthyroid patients.

MATERIALS AND METHODS

The prospective study cross-sectional study was conducted in the department of biochemistry at Government medical college and hospital, bettiah from march 2023 to December 2024. The study sample consisted of blood samples collected for clinical investigation.

Participants diagnosed with hyperthyroidism but not currently on any medication were included and subjects with active or recent infections, liver disease, musculoskeletal disorders, or cardiac conditions, pancreatic insufficiency, hepatobiliary infections, diabetes or hypertension were excluded from the study.

The participating subjects were divided into two groups:

Group I- Subjects with Hyperthyroidism

Group II- Subjects without Hyperthyroidism

A detailed demography and medical history was collected, and clinical examinations was done.

Approximately 5 ml of venous blood drawn under aseptic conditions into sterile tubes were allowed to clot and then centrifuged at 3000 rpm for 10 minutes

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to separate the serum. The serum was subsequently analyzed for T3, T4, and TSH levels using the Chemiluminescence immunoassay technique. Furthermore, SGOT, SGPT, and serum CPK levels were measured.

Three variables—T3, T4, and TSH—were assessed to exclude hyperthyroidism in healthy controls, while four liver enzyme variables, including ALT, AST, CPK, and ALK, were evaluated to determine liver function status.

RESULTS

The mean serum concentration of T3 in the cases was 3.42 ± 1.01 ng/ml, while the T4 level was 156.28 ± 15.22 ng/ml, and TSH measured 0.1036 ± 0.07 (µIU/ml). In contrast, the controls exhibited a T3 level of 1.41 ± 0.51 ng/ml, a T4 level of 88.73 ± 23.29 ng/ml, and a TSH level of 2.27 ± 0.88 (µIU/ml). [Table 1]

Table 1: Mean (±SD) of serum T3, T4 and TSH levels between the groups.

Parameter	Groups	Mean ± SD	P- value
T3 (ng/ml)	Group I	3.42 ± 1.01	0.0001
	Group II	1.41 ± 0.51	
T4 (ng/ml)	Group I	156.28 ± 15.22	0.0001
	Group II	88.73 ± 23.29	
TSH (µIU/ml)	Group I	0.1036 ± 0.07	0.0001
	Group II	2.27 ± 0.88	

Subjects in Group I exhibited significantly elevated liver enzyme levels compared to healthy subjects. The average serum ALT level in hyperthyroid patients was 143.3 ± 48.23 IU/L, while in the control group, it was 27.09 ± 8.12 IU/L. For AST, the mean level in cases was 178.08 ± 81.74 IU/L, compared to 27.49 ± 12.31 IU/L in controls. Additionally, ALK levels were recorded at 312.01 ± 117.31 IU/L in hyperthyroid patients, in contrast to 74.65 ± 21.16 IU/L in the control group. Conversely, serum CPK levels were significantly lower in hyperthyroid patients, with a mean of 16.63 ± 6.79 IU/L, compared to 21.42 ± 7.98 IU/L in controls.

Table 2: Mean (±SD) of serum ALT, AST, ALK, and CPK levels between the groups.

Parameter	Groups	Mean ± SD	P- value
ALT (IU/ml)	Group I	143.3 ± 48.23	0.0001
	Group II	27.09 ± 8.12	
AST (IU/ml)	Group I	178.08 ± 81.74	0.0001
	Group II	27.49 ± 12.31	
ALK (IU/ml)	Group I	312.01 ± 117.31	0.0001
	Group II	74.65 ± 21.16	
CPK (IU/ml)	Group I	16.63 ± 6.79	0.0001
	Group II	21.42 ± 7.98	

DISCUSSION

Thyroid gland is a key metabolic-endocrine organ, producing thyroid hormones T3 and T4, which are crucial for the growth, development, and proper functioning of all body organs. These hormones play a vital role in regulating the basal metabolic rate of all cells, including hepatocytes, thus influencing the overall function of various organs. Additionally, the liver, muscles, and kidneys metabolize thyroid hormones, thereby managing their systemic endocrine effects. Sharma VK et al. reported an increase in of SGPT, SGOT, and ALK levels, but lower CPK levels in cases of hyperthyroidism.[14-15]

Hepatic dysfunction frequently occurs in individuals with thyroid disorders. In the liver, thyroid hormones undergo glucuronidation and sulfation before being excreted into bile. They also play a crucial role in bilirubin metabolism by regulating glucuronyl transferase and ligandin, a transport protein in the liver. Abnormal liver function tests (LFTs) are often seen in patients with hyperthyroidism.[16] Previous study result indicates that hepatic dysfunction may result from the hypermetabolic state associated with thyrotoxicosis, which elevates hepatic oxygen consumption without a corresponding increase in hepatic blood flow. This situation can exacerbate low oxygen levels in the centrilobular regions, potentially impairing the function of centrilobular hepatocytes. Additionally, some researchers found that hyperthyroidism is frequently linked to elevated levels of hepatocellular enzymes, particularly ALT and ALP, which can serve as a diagnostic indicator for identifying significant hepatic changes in hyperthyroid patients.[17]

The study reports of Kanwar G et al. shows an elevated serum levels of ALT, AST, and ALP in patients with clinical hyperthyroidism.[18] Our findings align with this, showing that as thyroid hormone levels rise, there is a corresponding increase in liver enzyme levels, specifically ALT, AST, and ALK. Musculoskeletal disorders frequently occur alongside thyroid dysfunction. While it is well-documented that these disorders are prevalent in individuals with hypothyroidism, they are also found in those suffering from thyrotoxicosis. Ranka R and Mathur R found that serum CPK activity was reduced in hyperthyroid patients.[19] Compared to healthy

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individuals, hyperthyroid patients exhibit lower serum CPK activity. Additionally, the study by Rupa G et al highlighted the early identification of thyroid dysfunction linked to myopathies, reporting decreased CPK levels in hyperthyroid patients.[20] Our study's results are consistent with these previous findings.

CONCLUSION

Patients who exhibit unexplained liver abnormalities and altered serum CPK levels should undergo thorough evaluation, including an assessment of thyroid function. This study indicates a proportional relationship between thyroid hormones and liver enzymes, while an inverse relationship exists with CPK levels in hyperthyroid patients.

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