Evaluation of Role of Creatine Kinase Activity as a Diagnostic Tool for Thyroid Function

Shamali Jungare[1], Ajay Jungare[2], Sanjay Sonone[3]

{[1]Assistant Professor, [3]Professor, Department of Biochemistry} {[2]Assistant Professor, Department of Pathology}

Government Medical College and Hospital, Akola, Maharashtra, INDIA.

[*]Corresponding Address:

shamaliajungare@rediffmail.com

Research Article

Abstract: Thyroid dysfunctions are common endocrine disorders. Thyroid function tests which are usually done are measurement of blood hormones - triiodothyronine (T3), thyroxine (T4) and thyroid stimulating hormone (TSH) which are affected by various non-specific conditions. Therefore the present study was done to evaluate the role of alternative biochemical parameter - creatine kinase (CK) in diagnosing thyroid disease. Thyroid function and creatine kinase activity was measured in 50 patients with thyroid disorders. The decreased levels of T3, T4 and increased levels of TSH in hypothyroid patients is well established but whether there is any correlation of creatine kinase with hypothyroidism is not well established. Our study showed that in hypothyroid patients there is significant increase in CK and finding were reversed in hyperthyroid patients. Thus measurement of CK levels may act as a good tool to diagnose thyroid disorders.

Key words: Creatine kinase, hypothyroidism, hyperthyroidism, Enzyme linked Immunosorbentassay (ELISA)

Introduction

Thyroid dysfunctions are common endocrine disorders affecting 5-10 % of individuals over life span. Clinical signs & symptoms are often nonspecific & diagnosis and monitoring of therapy depends crucially on measurement of thyroid hormones (T3, T4, and TSH) in blood [1], [2]. Musculoskeletal disorders often accompany thyroid dysfunctions. In addition to well known observation that musculoskeletal disorders are common in patients with hypothyroidism, they are also observed in thyrotoxicosis and level of CK is altered in both these conditions [2],[3]. Serum CK was first used as a diagnostic aid in progressive muscular dystrophy [4], [5]. It has since then become important clinical marker for muscle damage. The serum CK levels in the healthy individuals depends on age, race, lean body mass & physical activity [5], [6], [7]. In recent years studies has been conducted to establish a relationship of CK levels in thyroid diseases [8]. Skeletal muscle is affected by hypothyroidism more profoundly in cases of overt hypothyroidism & less so when subclinical hypothyroidism is present [9], [10]. Concentration of CK in serum is often increased in patients with primary hypothyroidism [11], [12] but evidence for any change in thyrotoxicosis is conflicting. Some authors report normal & others subnormal CK activity [13], [14]. Thus assay of CK activity in serum may prove to be valuable in screening thyroid diseases and thus present study is carried out to evaluate role of CK as an alternative diagnostic tool in patients of thyroid diseases.

Material and Methods

The study was done at Govt. medical college & Hospital, Akola, Maharashtra. The study group comprised of 50 patients randomly selected from patients coming for thyroid function tests in the biochemistry diagnostic laboratory. There were 30 hypothyroid cases and 20 hyperthyroid cases. 25 age & sex matched persons were taken as controls. Exclusion criteria was taken to rule out other diseases which can alter the results of study like cardiovascular, neuromuscular diseases, recent cerebral stroke, gross hepatic and renal dysfunction and pulmonary infarction. All patients were screened for any drug history, especially drugs which can affect CK or thyroid hormone levels. Recent history of any intramuscular injections, strenuous exercise was ruled out. Informed written consent was obtained for venepuncture. Venous blood was withdrawn for investigations taking all aseptic precautions. Serum was separated and investigated either immediately or it was preserved at 2-8 C for up to three days for CK measurement. CK was measured by modified International Federation of Clinical Chemistry (IFCC) method based on the principle that ATP formed by reaction of CK on creatine phosphate and ADP reacts with glucose to form glucose 6 phosphates, which reduces NADP to NADPH. The rate of reduction of NADP to NADPH is measured at 340 nm. Serum T3, T4, TSH were measured by enzyme immunoassay on STAT FAX 4300 CHROMATE ELISA Reader using ERBA Thyrokits by ERBA Diagnostics Mannheim GmbH, Germany.

Results

Results are given in table 1 & 2.

In the present study, in hypothyroid subjects the mean value of T3, T4 and TSH were found to be 0.42 ± 0.08, 4.65 ± 0.60 and 13.47 ± 5.09 respectively (Table 1). The mean CK levels in these subjects were found to be 192.03 ± 19.91 (Table 2). In hyperthyroid subjects the T3, T4, and TSH levels were 4.78 ± 1.33, 15.92 ± 2.53 and 0.21 ± 0.09 respectively (Table 1). The mean CK levels in these subjects were found to be 60.7 ± 14.75 (Table 2). The results show that mean CK levels in hyperthyroid subjects were significantly lower as compared to hypothyroid subjects. In control group the mean serum CK levels were found to be 74.68 ± 20.58 and in hypothyroid subjects it is significantly increased i.e.192.03 ± 19.91 as compared to controls.(Table 2)

Table 1: Levels of Serum T3, T4 and TSH in Hypo and Hyperthyroid Subjects.

Parameter	Control (n=25)	Hypothyroid (n=30)	Hyperthyroid (n=20)
T3 Mean±SD	1.20 ± 0.25	0.42 ± 0.08	4.78 ± 1.33
T4 Mean±SD	9.12 ± 0.97	4.65 ± 0.60	15.92 ± 2.53
TSH Mean±SD	1.81 ± 0.69	13.47 ± 5.09	0.21 ± 0.09

T3 values are expressed in ng/ml.
T4 values are expressed in µg/dl.
TSH values are expressed in µIU/ml.

Table 2: Levels of Serum Ck Levels in Control, Hypo and Hyperthyroid Patients.

Parameter	Creatine Kinase (IU/L)
Control (n=25)	74.68 ± 20.52
Hypothyroid (n=30)	192.03 ± 19.91 (p value = <0.0001)
Hyperthyroid (n=20)	60 ± 14.75 (p value = <0.01)

Discussion

The study was done to evaluate the role of CK as supportive parameter for hypothyroid or hyperthyroidism. The finding of this study confirm that serum CK activity significantly increased in hypothyroidism which are in accordance with other reports [1],[4],[22],[23]. The increase in CK in hypothyroidism can be explained by various mechanisms. The hypo-metabolic state of hypothyroidism can cause reduction in glycolysis and oxidative phosphorylations and thus reducing adenosine triphosphate (ATP) concentration beyond a critical limit. The alteration in sarcolemmal membranes can cause increased cell permeability and the leakage of CK from cells. [1],[15],[16]. Another possibility is reduced turnover of CK because of hypothyroidism, allowing serum activity to rise generating a marked release of CK through the altered sarcolemmal membranes [1], [17]. Some patients with primary hypothyroidism may have a marked myopathy [18] with associated histological changes in muscle cells [19]. It is widely suggested that increase results from leakage of the enzyme from muscle cells [20] related to subnormal body temperature accompanying primary hypothyroidism [17]. The increase may also reflect a decrease in enzyme clearance [21]. Hypothyroid patients have increase activity of serum creatine kinase that is mostly due to increase CK-MM as CK isoenzyme analysis in six cases of primary hypothyroidism showed only the MM isoenzyme to be present in four patients, and MM with a trace of MB in the other two [1]. This finding also confirms previous studies that indicated skeletal muscle to be the major source of the increase plasma CK activity [1], [2]. We also found lower activity of CK in hyperthyroidism, similar reports were found by other authors [1],[4],[22],[23], and suggests that in the hyper metabolic state there may be increase enzyme degradation which may have contributed to these low CK activity. That the muscle cell is less permeable than normal to efflux of CK in hyperthyroidism unlikely, although possibly in these circumstances the muscle cell might reflect loss of muscle bulk [1],[24]. Thus our study proved that there is inverse relation in the serum levels of T3, T4 and CK in thyroid diseases. In hypothyroid patients there is significant increase in CK the fact that may be used as a parameter for screening hypothyroid patients. Thus the estimation of CK levels will be valuable in screening for hypothyroid patients.

Conclusion

We found that there was increased in serum CK levels in hypothyroid subjects as compared to those having normal thyroid status. Similarly we also found that decreased in serum CK levels in hyperthyroid as compared to control group. The significantly high occurrence of CK in hypothyroid subjects emphasizes the importance of measurement of CK in hypothyroidism.

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*Corresponding Author:
Dr. Shamali Jungare
Flat No. 12, 'Siddhivinayak Manor'
Behind Hotel Center-Plaza
Ramnagar, Akola,
Maharashtra, INDIA. 444001
E mail - shamaliajungare@rediffmail.com