
SERUM CREATINE KINASE ACTIVITY IN THYROID DYSFUNCTION

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Summary

The serum activity of creatine kinase was determined in 52 patients with hypothyroidism (19 males and 33 females), 110 patients with hyperthyroidism (27 males and 83 females) and 187 control subjects (47 males and 140 females). The creatine kinase activity in patients with hypothyroidism was on the average significantly higher than controls ($p < 0.005$). In hyperthyroid patients, although the serum activity of creatine kinase was significantly lower as compared with controls, however, it is within the normal range. Hypothyroidism should be put into consideration in patients presented with symptoms suggestive of cardiovascular abnormality without other evidence of myocardial damage and have raised creatine kinase activity.

Introduction

Creatine kinase (CK) is a cytoplasmic and mitochondrial enzyme with wide tissue distribution¹. Its physiological role is associated with adenosine triphosphate (ATP) generation that is required for contractile or transport systems². creatine kinase catalyzes the reversible phosphorylation of creatine, a reaction in which ATP is the donor of the phosphate group³. Creatine kinase activity is greatest in

striated muscle, brain and heart tissue which contain some 2500, 550 and 470 u/g protein, respectively. Other tissues, such as kidney and the diaphragm, contain significantly less activity (< 30 u/g protein), while the liver and erythrocytes are essentially devoid of activity⁴. Despite the wide tissue distribution of creatine kinase, it consider as muscle specific enzyme with clinical utility in the detection of acute or chronic disorder of muscle⁵.

Abnormalities of thyroid function can cause a wide array of muscle disorders. These conditions are related to the important role of thyroid hormones in

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regulating the metabolism of carbohydrates and lipids as well as the rate of protein synthesis and enzymes production. Thyroid hormones also stimulate calorogenesis in muscle, increase muscle demand for vitamins, and enhance muscle sensitivity to circulating catecholamines⁶.

The purpose of the present study was to evaluate the changes in the serum activity of creatine kinase among patients with hypothyroidism and hyperthyroidism.

Patients and Methods

Patients

The study was carried out in 162 patients with thyroid diseases. Fifty two patients (19 males and 33 females; 2-61 years of age) with hypothyroidism and in 110 patients (27 males and 83 females; 4-65 years of age) with hyperthyroidism. They were patients referred from different hospitals and clinics in Basrah for the suspicion of thyroid dysfunction. The diagnosis was based on clinical grounds and serum levels of T4 and T3.

Controls

The group consist of 187 individuals (47 males and 140 females, 7-63 years of age). All were seen consecutively in the same diagnostic laboratory for the suspicion of thyroid dysfunction and they were in fact euthyroid depending on the results of thyroid hormones assay.

Methods

Serum concentration of T4 and T3 were measured by enzyme immuno assay (EIA) using bioleisa kits (COD. 3000-1147 and 3000-1146 respectively) from biokit, S.A. Span; as well as by radio immunoassay (RIA) using Gamma-CoatTM RIA kits (Ref CA-1541 and CA 1535 respectively) from DiaSorin, USA. Serum activity of creatine kinase was measured by enzymatic colorimetric

method using kit (Cat. No. CK 1673) from Randox Laboratories Ltd., U.K. All procedures were followed according to the instruction of the manufacturer. Quality control sera from were included in each assay batch for all the above analytes.

The data were statistically analyzed using student t-test for the difference between two means. $P < 0.05$ was considered to be statistically significant.

Results

The mean values and the standard error of the mean for T4, T3 and serum activity of creatine kinase in the hypothyroid and hyperthyroid male patients compared to normal control males are summarized in table 1. The mean values of serum creatine kinase activity in male patients with hypothyroidism were significantly increased in comparison with controls ($p < 0.005$). Although the mean values of creatine kinase activity in hyperthyroid male patients are within the normal range, however, it is significantly lower as compared to controls ($P < 0.005$).

Table 2 summarized the results obtained in female patients with hypothyroidism, hyperthyroidism and control subjects. Similarly the serum activity of creatine kinase was significantly higher among hypothyroid females as compared with control females ($P < 0.005$). Also the serum creatine kinase activity in hyperthyroid females is within the normal range, but ut us significantly lower as compared to control females ($p < 0.005$).

Discussion

The results of the presented study revealed that hypothyroid patients have significantly higher serum creatine kinase activity as compared with controls ($P < 0.005$). This finding also have been reported by other authors⁷⁻¹². The

source of the raised serum creatine kinase activity appears to be skeletal rather than cardiac muscle¹³⁻¹⁵. Myopathy was frequent complication of hypothyroidism and hypothyroid patients have frequent muscle complaints⁵. Proximal muscle weakness, preferentially affecting the legs, muscle pains or cramps and delayed tendon jerk relaxation represented the commonest feature of hypothyroid myopathy¹⁶. Beyer et al.¹² stated that even in subclinical hypothyroidism there is some degree of dysfunction in skeletal metabolism. Burnett et al.¹⁷ suggested that the clinical diagnosis of hypothyroidism should be considered in patients with unexplained persistent elevations of serum creatine kinase. Gianpietro et al.¹⁸ have proved that the creatine kinase activity is one of the best indicators of the hypothyroid myopathy. Since it is sensitive for the early detection of muscle involvement due to the metabolic disorders and is closely correlate to the metabolic conditions of patients.

Various explanations have been suggested as possible mechanisms for elevation of creatine kinase activity in hypothyroidism. Some stated that the cause has not been established¹⁷, while other suggested that the increased membrane permeability in relation to variations in high energy phosphate levels¹⁹, increased muscle bulk¹⁰, and diminished clearance⁹ are the most likely explanations.

Although hyperthyroid patients had significantly lower creatine kinase activity values as compared to control subjects ($P < 0.005$), the creatine kinase levels were within the normal range. The presented finding were in accordance

with other studies regarding serum creatine kinase activities hyperthyroidism^{9,20,21}.

Thyrotoxic patients commonly have proximal muscle weakness and atrophy on examination, but rarely complain of the deficit, however, on rare occasion generalized thyrotoxic myopathy could occur⁶. There is an inverse relationship of serum creatine kinase activity with thyroid status^{22,23}. In hyperthyroidism, the serum creatine kinase activity tends to be at the end of the reference interval^{22,24}. The lower level of creatine kinase activity in hyperthyroidism had been attributed to muscle wasting²⁴ rather than to be due to a direct inhibitory effect of the thyroid hormones on the enzyme²⁵.

From the study, it is evident that hypothyroidism can cause significant increases in creatine kinase activity. Since hypothyroid patients may present with symptoms suggestive of cardiovascular disease¹⁴. The diagnosis of hypothyroidism should bear in mind in any patient with persistent elevation of creatine kinase activity associated with cardiovascular symptoms but without demonstrable myocardial damage.

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References

1. Tsung S.W: Creatine kinase isoenzyme patterns in human tissue obtained at surgery. Clin Chem 1976; 22:173-175.
2. Ward KM, and Lott JA. Creatine kinase. In: Pesce AJ, and Kaplan LA, eds. Methods in clinical chemistry. ST. Louis; The C.V. Mosby Company. 882, 1987.
3. Griffiths PD: CK-Mg: A valuable test. Asn Clin Biochem 1986- 23:238-242.
4. Lang H. Creatine kinase

- isoenzyme: Pathophysiology and clinical application. Berlin, Spacger Verlag, 1981.
5. Murray RK. Muscle. In: Murray RK, Crranner DK, Mayes PA et al. eds. Harper's Biochemisuy, 24th ed. Los Altos: Appleton and Lange. 701, 1996.
6. Mendell JR, Criggs RC, and Ptacek Lf. Diseases of muscle. In: Fauci AS, Braunwald E, and Isselbacher KJ, eds. Harrison's, principles of internal medicine. Volume 2, 14th. New York: McGraw-Hill, 2480, 1998.
7. Lengfelder W, and Kihm WD: Differential diagnosis of creatine kinase elevation: Hypothyroid myopathy. Dtsch Med Wochenschr 1891; 106: 304-306.
8. Khaleeli AA Gohil K, McPhail L G et al. Muscle MorphoLogy and metabolism in hypothyroid myopathy: Effects of treatment. J Clin Pathol 1983; 36: 519-26.
9. Docherty I, Harrop JS, Hine KR et al. Myoglobin concentration, creatine kinase activity, and creatine kinase B subunit concentration in serum during thyroid disease. Clin Ghim Acta 1984; 30: 42-45.
10. Khaleeli AA, and Edwards RH: Effect of treatment on skeletal muscle dysfunction in hypothyroidism. Clin Sci 1984; 66: 63-68.
11. Fonda M, Feruglio FS. Hypothyroid Myopathy in a young adult. Ann Ital Med Int 1993; 8: 129-131.
12. Beyer IW, Karmali R, Demeester MN, et al. Serum creatine kinase level in overt and subclinical hypothyroidism. Thyroid 1998; 8: 1029-1031.
13. Gotto I. serum creatine phosphokinase isoenzymes in hypothyroidism, myocardial infarction and other diseases. Clip Clin Acta 1974; 52: 27-30.
14. LeMar HJ Jr, West SG, Gazrett CR et al. Overt hypothyroidism presenting as a cardiovascular event. Am J Med 1991; 91: 549-552.
15. Minntiello L. The enzymatic and electrocardiographic changes falsely indicative of an acute myocardial infarction during hypothyroidism. Minerva cardioangiol 1993; 41: 597-602.
16. Khaleeli AA, Griffith DG, and Edwards RH. The clinical presentation of hypothyroid myopathy and its relationship to abnormalities in structure and function of skeletal muscle. Clin Endocrinal (Ox F) 1983; 19: 365-376.
17. Burnett JR, Crooke MJ, Delahunt JW et al. Serum enzymes in hypothyroidism. NZ Med J 1994; 107: 355-356.
18. Giampietro O Glerico A Buzzigoli G et al. Detection of hypothyroid myopathy by measurement of various serum muscle markers-myoglobin, creatine kinase, lactate dehydrogenase and their isoenzymes. Correlation with thyroid hormone levels (free and total) and clinical usefulness. Horm Res 1984; 19: 232-342.
19. Doran GR, and Wilkinson JH: The origin of elevated activities of creatine kinase and other enzymes in the sera of patients with myxoedema. Clin Chim Acta 1975; 62: 203-211.
20. Shimoda SI, and Kasai K: A clinical evaluation of the increased serum myoglobin creatine phosphokinase and lactate dehydrogenase in patients with thyroid disorders: Nippon Naibunpi Gakkai Zasshi 1980; 56: 1096-1106.
21. Roti E, Bandini P Robuschi G et al.: Serum concentrations of myoglobin, creatine kinase, lactate dehydrogenase and cardiac isoenzymes in euthyroid, hypothyroid and hyperthyroid subjects. Ric Clin Lab 1980; 10: 609-617.
22. Moss DW, and Henderson R. Enzymes. In: Burtis CA, and Ashwood ER, eds. Tietz textbook of clinical chemistry, 2nd ed. Philadelphia, W. B. Saunders Co. 801, 1994.
23. Peschke E, Peschl Se D, Ruzsas C et al. Creatine kinase in. hypo- and hyperthyroid rats under consideration of the circadian oscillations. Exp Clin Endocrinol 1988; 29: 91-96.
24. Doran GR, and Wilkinson JH: Serum creatine kinase and adenylate kinase in thyroid disease. Clin Chim Acta 1971; 35: 115-119.
25. Smith DP. The relationship between serum creatine kinase and thyroid hormones: In vivo and vitro studies. Clin Chim Acta 1976; 68: 333-338.