Asian Journal of Biological and Life Sciences | Original Research

Comparative study of thyroid hormone levels in diabetic and non diabetic patients of Bastar region

Farah Aziz Khan[1]*, S.K.B. Patil[2], Mohammad Fareed Khan[1], Prashant Nigam[2]

1 School of Life Sciences, MATS University, Raipur, India.
2,3 Department of Biochemistry, CIMS, Bilaspur, India.

E-mail : kashfi8@gmail.com Contact No : +91 5842 680649

Submitted : 19.02.2013 Accepted : 16.03.2013 Published : 30.04.2013

Abstract

Thyroid disorders and diabetes mellitus are the two most common endocrinopathies that frequently coexist. Unrecognized thyroid dysfunction may impair metabolic control in diabetic patients. Total of 120 subjects: 13 male and 107 female were studied. Subjects were classified into six major groups; diabetes only, hypothyroid only, hypothyroid with diabetes, hyperthyroid only, hyperthyroid with diabetes and control group. The data were statistically analyzed by ANOVA (analysis of variance) and Tukey's honest test to find difference at 0.05 level of significance respectively. Mean ± SD values of fasting sugar were increased in diabetes, hypothyroid with diabetes and hyperthyroid with diabetes without a significant difference between them. TSH mean values were increased in hypothyroid and hypothyroid with diabetes; and decreased in hyperthyroid and hyperthyroid with diabetes. No significant difference was observed between these groups. Mean values of T4 and FT4 were increased in hyperthyroid and hyperthyroid with diabetes, and also significantly differ from diabetes, hypothyroid, hypothyroid with diabetes. FT3 remain non-significant among all groups. We observed subclinical hypothyroidism, hyperthyroidism in old age females of type 2 diabetes mellitus (T2DM). The increased frequency of thyroid dysfunction in diabetic patients and its likely deleterious effects on metabolic function calls for a systematic approach to thyroid disease screening in diabetes.

INTRODUCTION

Thyroid disorders and diabetes mellitus are the two most common endocrinopathies. Both conditions frequently co-exist and the prevalence of thyroid dysfunction in diabetes patients is higher than general population. [1,2] Thyroid dysfunction is a graded phenomena, ranging from very mild cases with biochemical abnormalities, without showing any symptoms of thyroid hormone excess and deficiency to very severe cases that may end up as a life threatening thyrotoxicosis crisis or myxoedema coma. [3] The major alterations in thyroid hormone system are a reduction in the TSH stimulation of the thyroid gland, probably caused by central hypothyroidism, and in the peripheral generation of T3 from T4. [4] Diabetes mellitus is characterized by absolute or relative deficiencies in insulin secretion or action, associated with chronic hyperglycemia and disturbances in central metabolism. [2] Thyroid disease is found in both type 1 and type 2 diabetes therefore unrecognized thyroid dysfunction may also impair metabolic control in diabetic patients and accelerate glucose by most cells of the body which results in increased blood glucose concentration and increased cell utilization of fats and proteins. [5] The physiological and biochemical interrelationship between insulin and iodo thyronines on metabolism of carbohydrates, proteins, and lipids have been studied. [6] Continuing deterioration of endocrine control exacerbates the metabolic disturbances and leads to sever hyperglycemia. [4,2]

Health status of Bastar tribes is very poor. Referring the Nutritive values of Indian food and recommended dietary allowances, studies has shown dietary inadequacy and insufficiency in food consumed by the tribes. [7,8] Thyroid dysfunction and diabetes mellitus is common health problem in this region. Heavy rainfall and frequent flooding wash away the iodine from the superficial layer of soil therefore the food crops and water stays deficient in iodine. [9] Our main concern in this study is to compare thyroid hormone levels in thyroid dysfunction patients with and without diabetes.

MATERIALS AND METHODS

The study consists of 120 subjects, 13 males and 107 females, between 27-80 years of age. Subjects were divided into six major groups: diabetes only, hypothyroid only, hypothyroid with diabetes, hyperthyroid only, hyperthyroid with diabetes and normal group. Each group consists of 20 subjects.

Study was carried out at Biochemistry Laboratory, School of Life Sciences, MATS University, Raipur. Permission was taken to collect samples from Maharani Hospital and associated Govt. Medical College, Jagdalpur, Bastar. The collection was done in the morning after at least 12-hour overnight fast and subjects were asked general questionnaires like age, sex, profession, smoking status, alcohol consumption, dietary habits. Institutional ethical committee approved the study protocol. For biochemical investigation serum was separated by centrifugation at 3000 rpm for 10 min and was stored at 4°C until analysis.

Patients were classified into diabetic and non diabetic groups according to fasting blood glucose level >120mg/dl. Further, criteria of separating diabetes patients type 1 from type 2 were based on clinicians report depending upon the age of onset of diabetes and dependence on insulin therapy. Both diabetic and non-diabetic subjects were screened for thyroid hormone estimation and subsequently categorized into diabetic hypothyroid, diabetic hyperthyroid, hypothyroid, and hyperthyroid.

The quantitative determination of TSH, T3, T4, FT3, FT4 in serum was estimated by a microplate immune enzymatic assay using the reagent kit by Monobind, Lake Forest USA. Serum sugar was estimated by GOD-POD glucose estimation kit from Thermo Scientific. The normal reference range according to kits

are; TSH (0.4-4 µIU/ml), T3 (0.52-1.85 ng/ml), T4 (4.0-11.0 µg/dl), FT3 (2.23-6.43 pmol/l), FT4 (10-23.81 pmol/l), fasting blood glucose >120 mg/dl, post parandial >220 mg/dl. Statistical analysis was done by using one way ANOVA test to find out the difference among the groups, followed by Tukey's honest test to find the significant difference between each pair of means.

RESULTS

Table 1 shows the Mean ±SD levels of age, fasting sugar, post prandial sugar and thyroid hormone levels in thyroid dysfunction patients with and without diabetes. Tukey's honest test showed the significant difference between the pair of means among the groups. Mean ± SD values having different superscript are significantly different at 0.05 level of significance. Levels of fasting sugar and postprandial sugar were increased in diabetic only, diabetic hypothyroid and diabetic hyperthyroid patients and there was no significant difference observed in the mean values of these groups. TSH was observed increased in hypothyroid and decreased in hyperthyroid patients, with a significant difference between them. TSH mean values of hypothyroid and hyperthyroid patients do not significantly differ from their respective diabetic patients, although groups of thyroid dysfunction (hypothyroid, hyperthyroid) patients with diabetes significantly differ from each other. Increased T3 level were observed in hyperthyroid and differ significantly from those in hypothyroid and diabetic hypothyroid; but not from diabetic and diabetic hyperthyroid patients. Mean values of T4 and FT4 were increased in hyperthyroid and diabetic hyperthyroid patients, and significantly differ from diabetes, hypothyroid, and diabetic hypothyroid patients. No significant difference was observed in FT3 mean values of any group.

Table 2 shows the significant difference among the mean values of all individual parameters except FT3 in thyroid dysfunction patients with/ without diabetes and normal groups by one way ANOVA test, at 0.05 level of significance.

DISCUSSION

Among the people of Bastar region both the endocrinopathies i.e. diabetes and thyroid dysfunction are profound. Due to illiteracy and very low socioeconomic condition people of this region are not much aware of nutrient intake. They mostly take rice, goiterogenic food and consume liquor on regular basis. Environmentally also Bastar region is affected from severe and prolonged iodine deficiency, which can be seen in the form of thyroid dysfunction in the population. [10]

Thyroid dysfunction is more common in patients with type 1 diabetes mellitus than those with type 2 diabetes mellitus. [6] In our study it was found subclinical hypothyroidism and hyperthyroidism in older women with type 2 diabetes mellitus. In an Australian study [11] type 2 diabetes mellitus women without known thyroid disease commonly show subclinical hypothyroidism. In some reports the frequency of thyroid dysfunction in T2DM equals that of T1DM because of older age group. [6] The prevalence varies according to the studied population. The Whickman survey in North England showed prevalence of overt thyrotoxicosis in 2% females and 0.2% males.[12]

Glucose metabolism is influenced by hypothyroidism by

Table 1: Mean ± SD values of serum glucose and thyroid hormone parameters in thyroid dysfunction patients with /without diabetes

	Diabetes	Hypothyroid	Diabetic Hypothyroid	Hyperthyroid	Diabetic Hyperthyroid	Normal
Age	58.85 ^{a,c} ± 11.14	41.8 ^{a,c} ± 7.56	62 ^{a} ± 10.66	37.9 ^{a,c} ± 7	44.2 ^{b,c} ± 9.7	37.8 ^{a,c} ± 7.99
Fasting Sugar	158.15 ^{e} ± 43.6	86.25 ^{c} ± 8.4	180 ^{a,e} ± 42.8	83.2 ^{b} ± 8.43	193.85 ^{a} ± 52.8	88.75 ^{d} ± 8.88
Post Parandial Sugar	294.35 ^{a} ± 58.2	109.15 ^{c,b} ± 6.34	271.1 ^{a,e} ± 55.5	142.2 ^{d} ± 31.7	239.85 ^{e} ± 65.7	108.75 ^{b} ± 6.6
TSH	2.62 ^{e} ± 1.12	19.6 ^{a} ± 11.2	20.4 ^{a} ± 11	0.27 ^{c} ± 0.80	0.2 ^{b,c} ± 0.06	1.26 ^{d} ± 0.67
T3	1.24 ^{a} ± 0.52	0.8 ^{b} ± 0.59	0.8 ^{c} ± 0.5	2.04 ^{a} ± 2.75	0.99 ^{a,b,c} ± 0.36	1.31 ^{b,c} ± 0.08
T4	6.69 ^{e} ± 2.02	4.7 ^{b,d,c} ± 1.92	5.4 ^{c,e,d} ± 2.5	10 ^{a} ± 3.3	11.19 ^{a} ± 3.66	6.19 ^{d,e} ± 2.16
FT3	4.22 ^{a} ± 1.29	4.3 ^{a} ± 1.31	4.3 ^{a} ± 1.3	4.2 ^{a} ± 1.3	5 ^{a} ± 1.08	4.94 ^{a} ± 1.17
FT4	16.71 ^{d,e} ± 2.81	17.3 ^{e} ± 3.63	13.2 ^{b,c} ± 6.3	20.9 ^{a} ± 5.3	20.2 ^{a,e} ± 6.07	16.37 ^{c,e,d} ± 4.01

Mean ±SD values not sharing same superscripts differ significantly at 0.05 level of significance.

Table 2: ANOVA of all parameters in thyroid dysfunction patients with/ without diabetes and normal group.

Parameters	F value
Age	24.35*
Fasting Sugar	46.41*
Post Parandial Sugar	75.66*
TSH	46.52*
T3	2.719*
T4	19.08*
FT3	1.77**
FT4	6.70*

F Value at 0.05 level of significance
* Significant difference, ** Non significant

reducing hepatic glucose output, which finally leads to hypoglycaemia. [13] In the present study hypoglycaemic condition was observed in hypothyroid patients without diabetes. It was observed that patients had poor glycaemic control as evidence by high glucose levels in diabetes with thyroid dysfunction groups and it supports the report by Maratou et.al. which is known to be the first report showing that patients with subclinical hypothyroidism have hyperglycaemia. [14]

It was observed subclinical condition in both the groups of hypothyroid and diabetic hypothyroid. Celani et al reported high frequency of thyroid function abnormalities in poorly controlled diabetes. These abnormalities were mostly subclinical and reverted to normal with improvement in blood glucose control in most of the patients. [15] Our studied patients had poor diabetic control as evidence by high blood glucose levels. Co-existing diabetes may affect the treatment in thyroid dysfunction patients. A recent study in elderly patients on thyroxine treatment showed the presence of diabetes was independently associated with inadequate thyroid hormone replacement. [16]

In the present study it was observed that diabetes does not put any impact on TSH in the group of diabetes with hypothyroid and diabetes with hyperthyroid because no significant difference was found in TSH mean values between thyroid dysfunction patients with and without diabetes. The abnormal thyroid hormone levels in diabetic patients are because of various medications. It is known that insulin is an anabolic hormone which enhances the level of FT4 while suppress the level of T3 by inhibiting hepatic conversion of T4 to T3. [17] On the other hand some of the oral hypoglycaemic agents such as phenylthiourea are known to suppress the levels of FT4 and T4 while raising TSH level. [18]

CONCLUSION

The co-existence of both diabetes and thyroid disorders has been associated with increased morbidity and mortality. Presently studied patients had poor diabetic control as evidence by high blood glucose levels, and altered thyroid hormones accounts for more worsened condition. There is a little agreement on thyroid disease screening strategies in routine diabetes care. The increased frequency of thyroid dysfunction in diabetes calls for a systematic routine approach for thyroid testing.

ACKNOWLEDGEMENT

The present study is a part of PhD research of Farah Aziz Khan. The authors are thankful to the registrar and Vice Chancellor of MATS University, Raipur and to the Head Department of Biochemistry, Government Medical College and associated Maharani Hospital, Jagdalpur for providing research facilities and permission.

REFERENCES

1. Wu P. Thyroid disease and diabetes. *Clin. Diab.* 2000:18:38-42.

2. Johnson JL. Diabetes control in thyroid disease. *Diab. Spect.* 2006:19:148-153.

3. Gabriela B. Diabetes and Thyroid disorders. *Bri. J. Diab. Vas. Res*. 2010:10(4):172-177.

4. Udiong CEJA, Udoh E, Tukodoh ME. Evaluation of thyroid function in diabetes mellitus in calabar , Nigeria. *Ind. J. Clin. Biochem*. 2007:22:74-78.

5. Tiwari AK, Madhusudan R. Diabetes Mellitus and multiple therapeutic approaches of of phytochemicals. *Curr. Sci*. 2002:83:30-38.

6. Perros P, Crimmon MC, Shaw J. Frequency of thyroid function in diabetic patients: Value of annual screening. *Diab. Med.* 1995:12:622-627.

7. Indian council of medical research. Health status of primitive tribes of bastar. *ICMR Bulletin,* New Delhi, ICMR. 2003:33(10).

8. Rao HD, Rao MK, Radhaiah G, Rao PN. Nutritional status of tribal preschool children in three ecological zones of Madhya Pradesh. *Ind. Paed. Jour*. 1994:31:635-640.

9. Umesh K, Preeti S. Status of iodine content of salt and urinary iodine excretion levels in India. *Pak. J. Nutr.* 2003:2:261-273.

10. Khan FA, Patil SKB, Thakur AS, Khan MF, Murugan K. Lipid profile in thyroid dysfunction. *J. Clin. Anal. Med.* (In press)

11. Chubb SA, Davis WA, Inman Z. Prevalence and progression of subclinical hypothyroidism in women with type 2 diabetes: The Fremantle Diabetes Study. *Clin. Endocrinol*. 2005:62:480-486.

12. Boelaert K, Franklyn JA. Thyroid hormone in health and disease. *J. Endocrinol*. 2005:187: 1-15.

13. Mouradian M, Abourizk N. Diabetes mellitus and thyroid disease. Diab. Care. 1983:6:512-520.

14. Maratou E, Hadjidakis DJ, Kollias A, Tsegka K. Studies of insulin resistance in patients with clinical and subclinical hypothyroidism. Eur. J. Endocrinol. 2009:160:785-790

15. Celani MF, Bonati ME, Stucci N. Prevalence of abnormal thyrotropin concentrations measured by a sensitive assay in patients with type 2 diabetes mellitus. *Diab. Res*. 1994:27:15-25.

16. SomwaruLL, Arnold AM, Joshi N, Fried LP, Cappola AR. High frequency of factors associated with thyroid hormone over replacement and under replacement in men and women aged 65

and over. *J. Clin. Endocrinol. Metab.* 2009:94:1342-1345.

17. Johnson JL, Duick DS. Diabetes and Thyroid disease: A likely combination. Diabetes Spectrum. *Diab. Spect*. 2002:15:140-142.

18. Suzuki J, Nanno M, Gemma R, Tanaka I, Taminato T, Yoshimi T. The mechanism of thyroid hormone abnormalities in patients with diabetes mellitus. *Nippon Niabunpi. Gakki Zasshi*. 1994:7:465-470.