Original Article

Evaluation of thyroid function in type 2 diabetes in north-eastern part of India: A hospital-based study

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Abstract

Background: Diabetes mellitus (DM) and thyroid dysfunctions are the two most common endocrine disorders to come across in any clinical practice. Both thyroid hormones and insulin act antagonistically in metabolic pathways or cycles of cells. The aim of our study is to look for thyroid dysfunction in patients with type 2 DM and its correlation with insulin resistance (IR). **Methods:** A cross-sectional study was carried out among 80 newly diagnosed type 2 diabetic patients. Thyroid-stimulating hormone (TSH), free triiodothyronine, free thyroxine, and insulin were measured in fasting serum sample. Homeostasis model assessment for IR was calculated as per formula. **Results:** Among 80 diabetic patients, 20 were hypothyroid, 4 were hyperthyroid, and 56 were found to be euthyroid. IR was found to be significantly higher in hypothyroid as compared to euthyroid patients. A positive association was found between TSH and IR ($r = 0.230$) among hypothyroid patients though association was not significant. In hyperthyroid patients, a strong negative correlation ($r = -0.94933$) was found between TSH and IR, but no association was found among euthyroid patients. **Conclusion**: The inability to recognize the presence of thyroid hormone dysfunction may be one of the important causes of poor management of type 2 DM. Therefore, there is a need for routine assay of thyroid hormones in type 2 diabetic patients to improve the medical management as well as to reduce the morbidity in them.

Keywords: Diabetes mellitus, insulin resistance, thyroid hormones, thyroid-stimulating hormone

Introduction

Type 2 diabetes and thyroid disorders are the two most common endocrine diseases to be recognized in clinical practice. Thyroid hormones are found to influence almost all the metabolic pathways including carbohydrate metabolism. On the other hand, in type 2 DM, there are variable degrees of insulin resistance (IR) and/or impaired insulin secretion and increased glucose production. Hence, there is derangement of metabolism, especially the carbohydrate in both the conditions that are in thyroid disorders and type 2 DM.[1-3]

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Access this article online

Quick Response Code:

Website: www.jfmpc.com

DOI: 10.4103/jfmpc.jfmpc_292_17

Thyroid hormones and insulin both are involved in cellular metabolism antagonistically. Therefore, excess or deficit of any one of them may result in metabolic derangement.[3] Recently, interest has been raised for the influence of thyroid hormone action on insulin levels. Conflicting data are available on influence of insulin levels on thyroid dysfunction. The development of IR may also lead to many metabolic abnormalities.[4]

Various studies have reported different prevalence rates of thyroid hormone disorders in type 2 diabetes. Compared to normal population, diabetic patients have higher prevalence of thyroid disorder, with hypothyroidism being the most common disorder. In areas with endemic goiter, iodine deficiency is the major cause of hypothyroidism. Since the prevalence rate of

How to cite this article: Chutia H, Bhattacharyya H, Ruram AA, Bora K, Chakraborty M. Evaluation of thyroid function in type 2 diabetes in north-eastern part of India: A hospital-based study. J Family Med Prim Care 2018;7:752-5.

hypo- or hyperthyroidism in various parts of the world differed, the prevalence rates of thyroid dysfunction in diabetes still remain controversial. Unidentified thyroid dysfunction may alter the metabolic controls in patients with diabetes and may also exaggerate already existing cardiovascular risk. Recognition and treatment of thyroid disorder in patients with diabetes may benefit glycemic control, attenuate cardiovascular risk, and improve general well-being.[5]

With this background, we intended to do a study to look for thyroid dysfunction in diabetic patients and to find the correlation between thyroid hormones and IR, if any.

Methods

This cross-sectional study was carried out among 80 type 2 diabetic patients above 20 years of age who attended our hospital within a period of 4 months (June–September 2016). Thyroid-stimulating hormone (TSH), free triiodothyronine (fT3), free thyroxine (fT4), and IR were measured among all the patients. Diabetes status was determined as per the American Diabetes Association criteria. The participants were then divided as hypothyroid, hyperthyroid, and euthyroid depending on the thyroid profiles. Patients suffering from chronic inflammatory diseases and infections, liver disease, kidney disease, heart failure, ascites, abdominal hernias, tumors, complications of diabetes, previous history of thyroid disorders, and pregnant ladies were excluded from the study. Consecutive sampling was done to collect subjects for study. Whoever, newly diagnosed type 2 DM patients without any complication came to hospital during that period of time who met inclusion criteria were included in the study.

Blood samples for glucose, insulin, and thyroid profile (fT3, fT4, and TSH) estimations were collected after 10–12 h fast. Blood chemistry analysis was done with the Beckman Coulter autoanalyzer AU2700. Serum fasting insulin, fT3, fT4, and TSH levels were assayed by chemiluminescence method (Access 2, Beckman Coulter).

Index of IR and homeostasis model assessment (HOMA) was calculated using following formula:

HOMA-IR = (fasting insulin [μIU/ml] × fasting glucose [mg/dl])/405

Patients were considered as insulin resistant when HOMA-IR ≥2.6.[6-8]

Statistical analysis

A database was constructed on Microsoft Excel 2007, and statistical analysis was done using Statistical Package for the Social Sciences (SPSS) Windows version 20 (SPSS Inc., Illinois, USA). *t*-test and Pearson's correlation test were done to analyze the data. $P < 0.05$ was considered statistically significant.

Results

In this study comprising 80 participants, 42 (52.5%) were female and 38 (47.5%) were male. The mean age of participants is 56.5 years.

Among 80 patients, 20 (25%) were found to be hypothyroid, 4 (5%) were hyperthyroid, and 56 (70%) were found to be euthyroid. The prevalence of thyroid dysfunction is found to be 30% among the patients with diabetes [Figure 1 and Table 1].

Among 20 hypothyroid patients, 15 (75%) were found to have IR, whereas among 56 euthyroid diabetes, 17 patients (30%) were found to have IR, respectively, according to HOMA-IR. Among 4 hyperthyroid patients, 2 (50%) were found to have IR.

When *t*-test was done, a significantly higher IR was found among hypothyroid as compared to euthyroid (t = 5.39; $P = 0.0001$). A significant relation was also observed between age and IR ($P = 0.0001$). However, there was no association observed between the sex and the IR level or the sex and TSH level.

Correlation test was done between TSH and IR among hypothyroid patients and found to be positively associated ($r = 0.23$) though association was not significant. Correlation test between TSH and IR among euthyroid patients was not significant ($r = 0.042$).In hyperthyroid patients, a strong negative correlation ($r = -0.94933$) was found between TSH and IR, but no association was found among euthyroid patients.

Discussion

The mean + SD for serum fasting glucose,fT3,fT4 ,TSH and Insulin levels among diabetic patients were 145.35 ± 79.86 mg/dl, 2.89 ± 0.53pg/ml, 0.89 ± 0.19 ng/dL, 2.12 ± 1.24 IU/ml, 7.35 ± 5.13μIU/ml respectively. For control participants, the parameters were within normal limits [Table 2]. Our findings are coinciding with the findings of Singh *et al.* and Rai *et al.*[3,9] Thyroid hormones and insulin work antagonistically in cellular metabolism. Excess or deficit of anyone can result in functional derangement of the others.

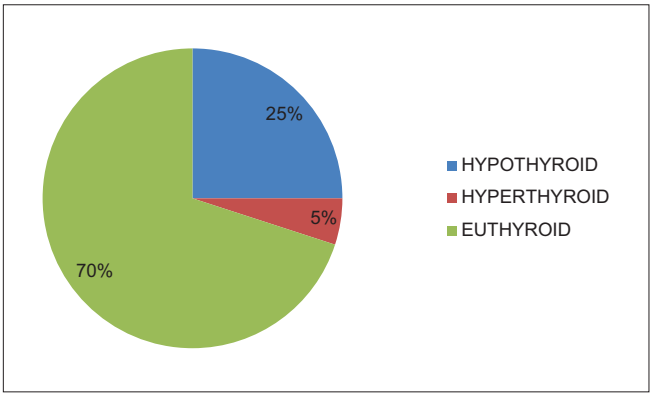

Figure 1: Distribution of cases with respect to thyroid status

Table 1: Prevalence rates of thyroid diseases in the study group

Thyroid diseases in study group	*n* (%)
Euthyroid	56 (70)
Hypothyroidism	20 (25)
Hyperthyroidism	4 (5)

Table 2: Parameters of the study group

Parameters	Mean±SD		
	Euthyroid cases (*n*=56)	Hypothyroid cases (*n*=20)	Hyperthyroid cases (*n*=4)
FT3	2.89±0.53	2.49±0.57	3.47±0.28
FT4	0.89±0.19	0.79±0.16	0.96±0.42
TSH	2.12±1.24	15.01±18.6	0.17±0.13
Insulin	7.35±5.13	13.38±8.01	9.92±2.17
Fasting glucose	145.35±79.86	204.7±63.9	149.6±74.4

FT3: Free triiodothyronine; FT4: Free thyroxine; SD: Standard deviation; TSH: Thyroid-stimulating hormone

In our study, IR was found in both hypothyroid and hyperthyroid diabetic patients. HOMA-IR is positively associated with TSH in hypothyroid patients ($r = 0.230$) and negatively associated in case of hyperthyroid patients ($r = -0.94933$). Our finding is consistent with the findings of Kapadia *et al.* and Chubb *et al.*[10,11] Focus has been raised to look for the influence of thyroid hormone action on insulin levels. Conflicting data are available for the impact of thyroid dysfunction on insulin levels. Furthermore, the development of IR leads to many metabolic abnormalities. The main pathophysiological basis underlying glucose intolerance, dyslipidemia, abdominal obesity, and hypertension has been attributed to IR.[12,13] Hyperthyroidism is typically associated with worsening glycemic control and increased insulin requirements. There is underlying increased hepatic gluconeogenesis, rapid gastrointestinal glucose absorption, and increased IR.[14]

In our study, we have found that IR has increased significantly with increase in age. Aging is associated with detrimental changes in body composition, which persists even when elderly adults are matched to younger adults for BMI.[15] Aging is associated with detrimental changes in body composition including an increase in body weight and fat mass. Not only is abdominal fat, but also visceral adiposity is also associated with hyperinsulinemia or IR. Adiposity, therefore, is well accepted as a determinant of IR and may be a key mediator for the development of age-related IR.[16,17]

The limitations of our study are as follows: the sample size is less since it is a cross-sectional study, so there is no follow-up study to see the effect on IR after the treatment of thyroid disorders.

Conclusion

The relationship between diabetes mellitus and thyroid disorders is characterized by a complex interdependent interaction. Unidentified thyroid dysfunction could negatively impact diabetes and its complications and may be one of the prime causes of poor management of type 2 DM. Therefore, there is a need for routine assay of thyroid hormones in type 2 diabetic patients to improve the medical management as well as to reduce the morbidity in them.

Acknowledgment

I am really thankful to the technicians of the Department of Clinical Biochemistry as well as blood collection center for their immense support in carrying out the study.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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