Relation between glycosylated hemoglobin and lipid and thyroid hormone among patients with type 2 diabetes mellitus at King Abdulaziz Medical City, Riyadh

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Abstract

Background: The main objectives of this study were to: (1) Evaluate the levels of thyroid hormones and glycosylated hemoglobin (HbA1c) among patients, (2) correlate between thyroid hormones and HbA1c and different types of lipids and HbA1c among diabetic patients. **Materials and Methods:** A retrospective chart review study was conducted at Department of Clinical Chemistry, King Abdulaziz Medical City (KAMC) in Riyadh, Saudi Arabia, during the period from August 2014 to December 2014, including 100 male and female patients diagnosed with diabetes mellitus (DM) type 2 and excluding patients with DM type 1. These patients were admitted to the hospital in 2013. Biochemical laboratory results were retrieved from biochemistry laboratory database while age and sex of patients were retrieved from patient files. Statistical analysis was performed using SPSS software conducting frequency analysis and correlation test. **Results:** The result showed increased mean levels of HbA1c (8.4%) and normal level of thyroid stimulating hormone (TSH) (4.5 mlU/L) and T4 (14.1 pmol/L). The results also showed a weak positive correlation between HbA1c and TSH ($r = 0.212$, $P = 0.034$) and insignificant correlation with thyroxin T4 ($r = -0.018$, $P = 0.855$). There was a weak positive correlation between HbA1c and total cholesterol and low density lipoprotein ($r = 0.258$, $P = 0.001$), ($r = 0.297$, $P = 0.003$), respectively. **Conclusion:** It is concluded that increased blood glucose could trigger anterior pituitary gland to increase secretion of TSH, whereas there was no direct correlation between increased glycemic index and the rate of thyroxine secretion. Furthermore, it is concluded that there is an association between blood glucose and some lipid markers.

Key words: Correlation, glycosylated hemoglobin, thyroid hormones, types of lipids

INTRODUCTION

Diabetes mellitus (DM) is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both.[1] Recent estimates indicate there were 171 million people in the world with diabetes in the year 2000 and this is projected to increase to 366 million by 2030.[2] The risk of chronic complications in

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patients of DM depends on the duration of hyperglycemia, and they usually become manifest in the second decade of the development of DM.[3] A survey done in Kingdom of Saudi Arabia shows the presence of DM in epidemic areas throughout the country and a high average is mainly affecting the urban areas.[4]

Thyroid dysfunction is one of the commonest endocrine dysfunction that is, rampant in most of the populations around the world, especially the diabetics. The frequency of thyroid dysfunction is higher, both in the aged and the females.[5-7]

A study on 1301 patients with diabetes (type 1 and type 2) showed that the occurrence of thyroid diseases is around 13.4%.[7] Another study showed a dominance of thyroid disorder approximately 10.8% in 223 diabetic patients.[8] The thyroid dysfunction is more common in type 1 as compared to type 2 diabetic patients, approximately one-third of the diabetics with type 1 are affected by thyroid diseases and 25% of the females with type 1 diabetes will develop postpartum thyroid dysfunction.[9,10] Nevertheless, some literature reports suggest an increase in the frequency of thyroid disorder in type 2 diabetic patients equals that of type 1 diabetic patients.[11]

Hypothyroidism is the most predominant type of thyroid disease; the features of the disease are similar in both the diabetics and nondiabetics. It can lower the glucose level in blood, in addition, to increasing insulin resistance.[12] In some conditions, diabetes is also related to abnormal thyroid function, involving very low glucose level in the blood and also renal disorders.[13,14] The presence of diabetes is also related to the insufficiency of the replacement of thyroid hormone in elderly patients with hypothyroidism.[15]

Since, adequate glycemic control can delay development of diabetic complication, the purpose of this study was to measure HbA1c in diabetic patients and bring out a possible correlation between thyroid hormones, HbA1c and different types of lipids, in order to highlight the significance of such a correlation which can prevent exacerbation of cardiovascular risk-related mortality.

MATERIALS AND METHODS

Age and sex of patients
This study was conducted on 100 patients diagnosed with type 2 DM, age of patients constituted three groups; 9 patients between 30 and 50 years, 56 patients between 51 and 70 years and 35 above 70 years. The sex wise ratio was males 47% ($n = 47$) while females 53% ($n = 53$) as illustrated in Table 1.

Table 1: Frequency of sex among patients

Variable	Number	Percentage
Male	47	47
Female	53	53

Settings and duration of study
This study was conducted at Department of Clinical Chemistry, KAMC in Riyadh, Saudi Arabia, during the period from August 2014 to December 2014.

Study design
This is a retrospective chart review study.

Inclusion and exclusion criteria
Male and female patients diagnosed with DM type 2, of all age groups, admitted at (KAMC) in 2013 and excluding patients with type 1 DM.

Sample size
The sample size was 100 subjects based on previous auditing institutional report and on the calculated prevalence of DM type 2 in Riyadh region.

Sampling technique
Patients of both the genders of different age groups who were discharged from KAMC with a diagnosis of DM type 2 at any point in time during the study period were enrolled in this study.

Data collection methods
After getting approval from Institutional Review Board of National Guard, relevant data for study population was obtained from biochemistry laboratory database, computer printout of demographic data, discharge clinical events and outcomes were collected from medical records department at KAMC. All data were tabulated in a master sheet before analysis.

Data management and analysis plan
The statistical analyses were performed using SPSS version 20 (The International Business Machines Corporation, New York). The descriptive results were expressed as mean ± standard deviation and percentage. Variables of the patients group were correlated with each other by Pearson correlation test.

RESULTS

The mean concentration values of patients for T4, thyroid stimulating hormone (TSH) and HbA1c were 14.1 pmol/L, 4.5 mIU/L, and 8.4% respectively. These values were found to be increased as compared to the reference values, while cholesterol, triglycerides, low-density lipoprotein

(LDL) and high-density lipoprotein were in the range of the reference values [Table 2]. A significantly positive correlation was found between HbA1c and TSH ($r = 0.212$ $P = 0.034$) [Figure 1], while the correlation between HbA1c and fT4 was insignificantly negative ($r = −0.018$, $P = 0.855$) [Figure 2]. The correlation results between HbA1c and LDL were significantly positive ($r = 2.97$, $P = 0.003$) [Figure 3]. A positively significantly correlation was found between HbA1c and cholesterol ($r = 0.258$, $P = 0.001$) [Figure 4].

Negative significant correlations were observed between cholesterol and LDL with age ($r = −0.337$, $P = 0.000$) and ($r = −0.368$, $P = 0.001$) [Figures 5 and 6], respectively.

Also, a significant strong positive correlation was observed between cholesterol and triglycerides ($r = 0.737$, $P = 0.000$) [Figure 7].

DISCUSSION

Since the measurement of HbA1c levels is important not only for monitoring of diabetes, the results of our study showed an obvious elevation of HbA1c levels in patients diagnosed with DM are in corroboration with the results of Vikhe *et al.*, and Saha *et al.*[16,17] Consequently impaired lipid metabolism resulting from uncontrolled hyperglycemia has been implicated in cardiovascular complications in diabetes patients, this fact support our result which showed a relation between HbA1c, total cholesterol and LDL in patients with DM, which are also confirmed by Khan *et al.*,[18] who stated that HbA1c exhibited direct correlations with cholesterol and LDL.

Previous studies reported that DM type 2 do not affect fT4, therefor observed normal level of fT4 in diabetic patients when compared with reference range, hypothesize that medication of DM type 2 may influence the thyroid hormone profile thus observed normal results of fT4.[19] However, our observation on the lack of variation in TSH level is not in harmony with the results of Cappelli *et al.*,[19] these differences appear to be also due to DM medications.

Table 2: Baseline parameter among patients

Variable	Mean ± SD	Reference value
T4	14.0±3.1	9.0-19.0 (mIU/L)
TSH	4.5±4.0	0.35-4.94 (pmol/L)
HbA1c	8.4±2.2	4.4-6.4%
Total cholesterol	4.1±1.1	<5.18 (mmol/L)
Triglycerides	1.7±1.0	<1.70 (mmol/L)
HDL	1.0±0.3	>1.55 (mmol/L)
LDL	2.3±0.9	<2.60 (mmol/L)

The table shows mean ± SD, reference range and unit between brackets.
TSH: Thyroid stimulating hormone, HbA1c: Glycosylated hemoglobin, HDL: High density lipoprotein, LDL: Low density lipoprotein, SD: Standard deviation

Furthermore, the result of correlation test showed a positive correlation between HbA1C and TSH in type 2 DM, these observations are consistent with previous studies Udiong *et al.*,[20]
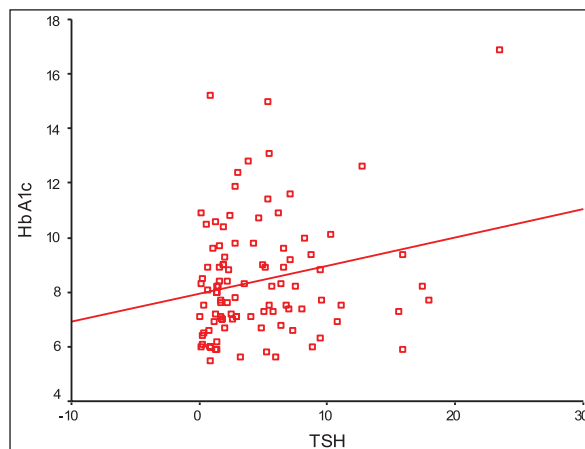

Figure 1: A scatter plot shows the relationship between levels of thyroid stimulating hormone in pmol/L and glycosylated hemoglobin in % ($r = 0.212$ and $P > 0.05$)
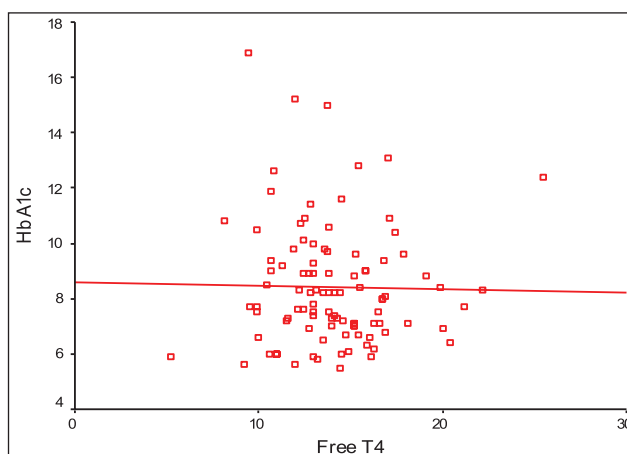

Figure 2: A scatter plot shows the relationship between levels of T4 in mIU/L and glycosylated hemoglobin in % ($r = −0.018$ and $P < 0.05$)
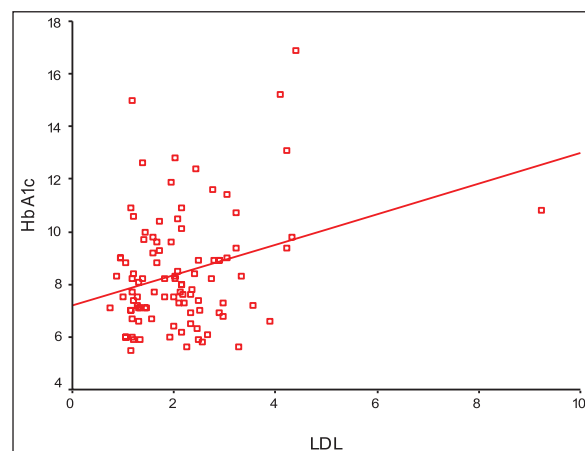

Figure 3: A scatter plot shows the relationship between levels of low density lipoprotein in mmol/L and glycosylated hemoglobin in % ($r = 0.297$ and $P > 0.01$)
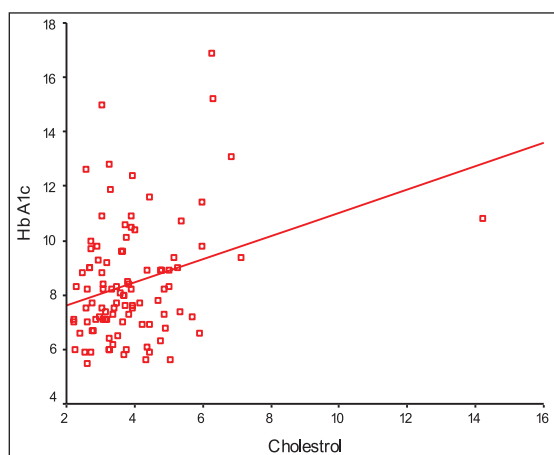
Figure 4: A scatter plot shows the relationship between levels of cholesterol in mmol/L and glycosylated hemoglobin in % ($r = 0.258$ and $P > 0.05$)
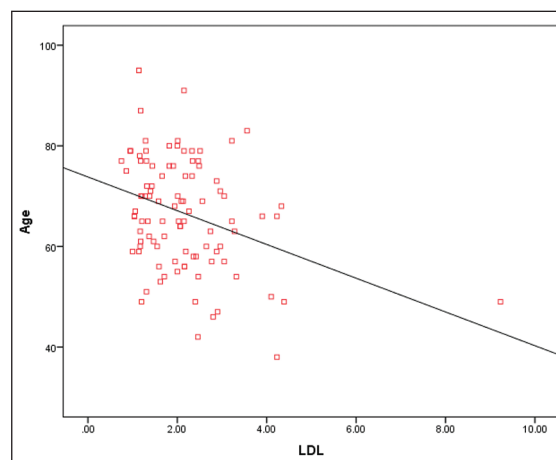

Figure 5: A scatter plot shows the relationship between levels of low density lipoprotein in mmol/L and age in years ($r = -0.337$ and $P > 0.05$)
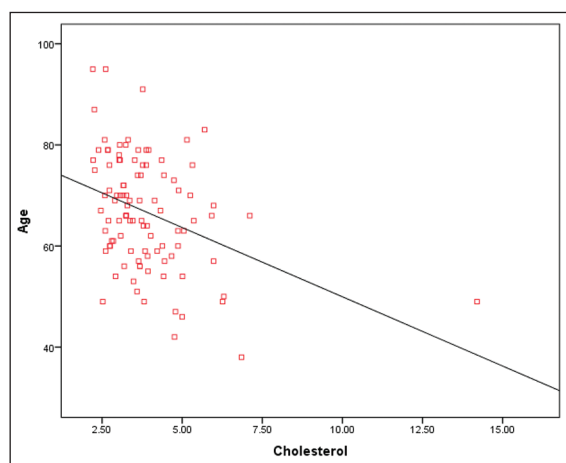

Figure 6: A scatter plot shows the relationship between levels of cholesterol in mmol/L and age in years ($r = -0.368$ and $P > 0.05$)
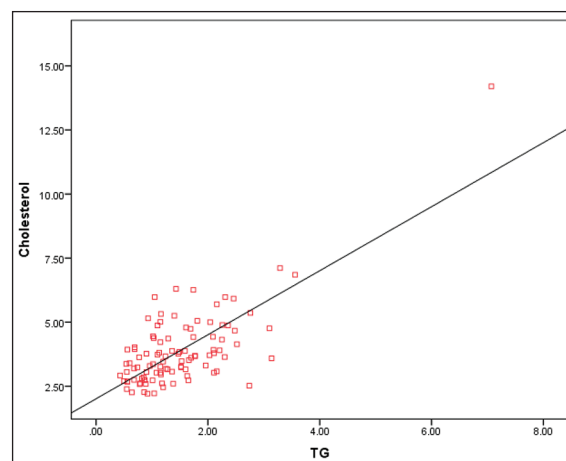

Figure 7: A scatter plot shows the relationship between levels of triglycerides in mmol/L and cholesterol in in mmol/L ($r = 0.737$ and $P > 0.05$)

who reported significant association between HbA1C and TSH. In contrast the results of HbA1c and fT4 showed no correlation, this finding was agreed with studies performed in Bangladesh by Saha *et al.*[17] which showed no correlation between HbA1c and FT4 among diabetic patient with type 2 DM.

Previous study suggest that cholesterol and LDL levels decrease age increase this suggestion approved by by Volpato *et al.*,[21] who observed that there is a relation being stronger with increase in age, total cholesterol and LDL, these findings support our observation that there is inverse relation between cholesterol and LDL levels with increase age.

Moreover, we observe a strong positive correlation between cholesterol and triglycerides.

RECOMMENDATIONS

It is recommended that blood glucose for the diabetic patient should be maintained within the reference value in order to avoid the complications. Furthermore, regular check for lipid profile and thyroid function test should be requested every 3 months for all diabetic patients as recommended by many diabetic associations.

Conflicts of interest
There are no conflicts of interest.

REFERENCES

1. American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes Care 2012;35 Suppl 1:S64-71.

2. Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes: Estimates for the year 2000 and projections for 2030. Diabetes Care 2004;27:1047-53.
3. Joshi SR, Parikh RM. India — Diabetes capital of the world: Now heading towards hypertension. J Assoc Physicians India 2007;55:323-4.
4. Alzaid AA. Time to declare war on diabetes. Ann Saudi Med 1997;17:154-5.
5. Canaris GJ, Manowitz NR, Mayor G, Ridgway EC. The Colorado thyroid disease prevalence study. Arch Intern Med 2000;160:526-34.
6. Hollowell JG, Staehling NW, Flanders WD, Hannon WH, Gunter EW, Spencer CA, *et al.* Serum TSH, T(4), and thyroid antibodies in the United States population (1988 to 1994): National Health and Nutrition Examination Survey (NHANES III). J Clin Endocrinol Metab 2002;87:489-99.
7. Perros P, McCrimmon RJ, Shaw G, Frier BM. Frequency of thyroid dysfunction in diabetic patients: Value of annual screening. Diabet Med 1995;12:622-7.
8. Smithson MJ. Screening for thyroid dysfunction in a community population of diabetic patients. Diabet Med 1998;15:148-50.
9. Umpierrez GE, Latif KA, Murphy MB, Lambeth HC, Stentz F, Bush A, *et al.* Thyroid dysfunction in patients with type 1 diabetes: A longitudinal study. Diabetes Care 2003;26:1181-5.
10. Gerstein HC. Incidence of postpartum thyroid dysfunction in patients with type I diabetes mellitus. Ann Intern Med 1993;118:419-23.
11. Radaideh AR, Nusier MK, Amari FL, Bateiha AE, El-Khateeb MS, Naser AS, *et al.* Thyroid dysfunction in patients with type 2 diabetes mellitus in Jordan. Saudi Med J 2004;25:1046-50.
12. Farasat T, Cheema AM, Khan MN. Relationship of thyroid hormones with serum fasting insulin and insulin resistance in euthyroid glycemic anomalies. Pak J Zool 2011;43:379-86.
13. Celani MF, Bonati ME, Stucci N. Prevalence of abnormal thyrotropin concentrations measured by a sensitive assay in patients with type 2 diabetes mellitus. Diabetes Res 1994;27:15-25.
14. Rai S, Kumar JA, Prajna K, Shetty SK, Rai T, Shrinidhi K, *et al.* Thyroid function in type 2 diabetes mellitus and in diabetic nephropathy. J Clin Diagn Res 2013;7:1583-5.
15. Somwaru LL, Arnold AM, Joshi N, Fried LP, Cappola AR. High frequency of and factors associated with thyroid hormone over-replacement and under-replacement in men and women aged 65 and over. J Clin Endocrinol Metab 2009;94:1342-5.
16. Vikhe VB, Kanitkar SA, Tamakuwala KK, Gaikwad1 AN, Kalyan M, Agarwal RR. Thyroid dysfunction in patient with type 2 diabetes mellitus at tertiary care centre. Natl J Med Res 2013;3:377-80.
17. Saha HR, Sarkar BC, Khan SA, Sana NK, Choudhury S. A comparative study of thyroid hormone and lipid status in diabetic and non diabetic adults. Open Access Sci Rep 2012;1:1-5.
18. Khan HA, Sobki SH, Khan SA. Association between glycaemic control and serum lipids profile in type 2 diabetic patients: HbA1c predicts dyslipidaemia. Clin Exp Med 2007;7:24-9.
19. Cappelli C, Rotondi M, Pirola I, Agosti B, Gandossi E, Valentini U, *et al.* TSH-lowering effect of metformin in type 2 diabetic patients: Differences between euthyroid, untreated hypothyroid, and euthyroid on L-T4 therapy patients. Diabetes Care 2009;32:1589-90.
20. Udiong CE, Etukudoh MH, Essien OE. Thyroid hormones and glycemic indices in types 1 and 2 diabetes mellitus. J Med Lab Sci 2007;16:1192-5.
21. Volpato S, Zuliani G, Guralnik JM, Palmieri E, Fellin R. The inverse association between age and cholesterol level among older patients: The role of poor health status. Gerontology 2001;47:36-45.