

Correlation Study of Thyroid Disorders in Patients with Diabetes Mellitus (Type I and II) from Pakistan

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Abstract:

Diabetes mellitus and thyroid hormonal imbalance are the two most common endocrine disorders which run parallel in clinical pattern due to malfunctioning of insulin hormone and thyroid hormones. Diabetes mellitus (DM) is the most prevailing carbohydrate metabolic disorder where 463 million adults suffering with type 2 diabetes. This study comprised a survey of thyroid disorders in diabetic subjects and the estimation of thyroid hormones including triiodothyronine T3, thyroxine T4 and thyroid stimulating hormones TSH in diabetic patients. The data was compared with healthy controls. The study group consisted of 100 diabetic patients with mean age 45 years (± 10.5), mean height 166 cm (± 10.42) and average weight 70 kg (± 16.9). 40 healthy subjects without these endocrine disorders were selected as controls. For study purpose diabetic patients were divided in three groups having type I, type II diabetes and non-diabetic controls. The status of diabetes and thyroid function status including hyperthyroidism and hypothyroidism was analyzed by study Performa along with other facts like age, gender, body mass index, blood pressure etc. among study participants. The study showed that both disorders were correlated with each other where diabetic females were at high risk of thyroid dysfunction. The results demonstrates the positive correlation of both endocrine disorders in our local community which would help the clinicians in treatment of patients suffering with health issues.

Keywords: *Thyroid dysfunction, diabetes mellitus, thyroid hormones, endocrine disorders.*

Introduction:

Diabetes mellitus (DM) has become a universal health problem and a well-known endocrine disorder. According to World Health Organization report, globally half billion population is suffering from diabetes and in 2050 the expected number

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may exceed 1.3 billion (The Lancet June 22, 2023). Currently, diabetes has become the top ten leading cause of health disabilities with 6.1% prevalence rate. Diabetic patients are mainly at risk when they have poor blood glucose control. Another important endocrinal disorder is the thyroid dysfunction with prevalence rate of 2.2 to 17% in association with diabetes (Smithson, 1998). Thyroid hormones and insulin intricate in cell metabolism. In diabetic patients with thyroid disease blood glucose is different to control (Yang, Yang, Zhang, An, & Lu, 2010). Diabetes and thyroid disorders both include dysfunction of system, which control the body metabolism. Both disorders have a tendency to appear equally and influence each other in patients. In type I diabetes, almost one third patients have common thyroid disease and reason is both have common autoimmune origin.

Hypothyroidism is linked with high blood glucose, higher triglycerides, and low density lipoprotein and cholesterol concentration. This in turn cause the reduction in insulin half-life and immature destruction of insulin molecules (Chen, Wu, & Jap, 2007). There is another report which suggest the increase in glucose absorption in the presence of high T3 and T4 level (Levin & Smyth, 1963). Presence of hyperthyroidism in diabetes patients may have impenetrable weight loss, high body warmth, supraventricular tachycardia, intolerant heat, high insulin necessity etc. A study indicates that out of 5,000 diabetic patients 113 patients were having abnormal thyroid including 56 were hyperthyroid and 57 hypothyroid (Badman & Chowdhury, 2002).

Hypothyroidism may exaggerate the coinciding dyslipidemia which is normally found in type II diabetic patients with much increase risk of cardiovascular disorder. It may increase LDL cholesterol and breakdown prior to dyslipidemia (Levin & Smyth, 1963). This condition also drop the insulin level and effect peripheral and renal tissues function (Den Hollander, Wulkan, Mantel, & Berghout, 2005).

Due to connection between diabetes and thyroid disease, the American Diabetic Association has suggested that diabetic patients must be tested for thyroid disorder. The major test for this is thyroid stimulating hormone (TSH) blood test (Tietz, Burtis, Ashwood, & Border, 2000). In diabetic patients with thyroid disorder it is useful to estimate the level of T3, T4 and TSH to establish correlation between thyroid disorders and diabetes mellitus (Singer, 2001). Although there are numerous reports on thyroid disorder along with diabetes, the current study was used to find it in our local population

Keeping in view the significance of this, a study was designed to check correlation of thyroid disorders with diabetes mellitus patients in Lahore with the objectives to establish the correlation between thyroid disorder and diabetes mellitus and to estimate the level of thyroid hormones T3, T4 in serum and effect of thyroid stimulating hormone (TSH) on diabetic patients' health.

Materials and Methods:

For study purpose blood samples were taken from Sheikh Zaid hospital, Lahore. Hundred diabetic patients (including males and females) with ages 45 years (± 10.5), average height 166 cm (± 10.42) and mean weight of 70 kg (± 16.9) were selected. Other information of collected samples like diabetes with type, treatment and background of diabetes, patient's family history about diabetes and other diseases were also recorded. All focuses were under treatment or diet control. Risk factor information like blood pressure, body mass index (BMI) were also noted. Apparently 40 healthy (non-diabetic) people were chosen as control with mean age 36 years (± 10.4), mean height 168 cm (± 8.6) and mean weight 68 kg (± 7.4). All of them were not suffering from any endocrine diseases and those with indication of abnormality were excluded before sample collection. Samples from patients and control were taken from under observation of consultant physician and endocrinologist.

After obtaining informed consent from each subject venous blood (5ml) was taken in dry syringe collected after 12 hours overnight fasting period from each subject. Blood was divided into three tubes and allowed to clot, immediately centrifuged at 2000 r.p.m for 10 minutes and serum was stored at -20 c° until analyzed. All serum samples were stored in refrigerator in tightly closed vials. The analysis was done at pathology laboratory, Inmol hospital Lahore. The level of TSH was assessed by immunoradiometric assay kit, thyroid hormones total T4, T3 were assessed by Radio immunoassay (RIA) kits.

Software SPSS (statistical package for social sciences, Version 27.0.1) was used for statistical analysis. To analyze the distribution characteristics of variables one way ANOVA test (analysis of continuous variable with normal distribution) was used. Chi-square test was used to evaluate the null and test hypothesis from the categorical data of our study where the significant value was placed at 0.05 position. Numeric values less than 0.05 were considered as statistically significant and more than 0.05 were concluded non-significant and results were analyzed as mean \pm SD.

Results

The current research was conducted to find association of thyroid hormones profile in diabetic type I and II subjects and comparison with non-diabetic controls. Comparison study analysis was performed to see the difference between control and study groups. Study groups were further sub-divided into type I and type II insulin dependent and non-insulin dependent diabetic patients to find out the T3, T4 and TSH level.

As the study covered the 100 diabetic and 40 healthy subjects as control. All study cases were selected from Sheikh Zaid hospital Lahore in which 58% were females and 42% were males. However, for the control group each gender was 50%. Their mean ages were $45 (\pm 10.5)$ and $36 (\pm 10.42)$ years for diabetic and non-diabetic subjects, respectively.

The data collected from diabetic patients showed that type I DM represents 43% and type II represents 57% of participants. Moreover, their other demographic features were 65% of these participants were have past family history of diabetes. The mean weight was found to be 74.48 ± 15.00 kg and 72.94 ± 8.40 kg for the patients and control groups, respectively. The calculated BMI shown that 60% of patients were obese. 160.06 ± 0.04 cm and 164 ± 8.68 cm was found to be the mean height among the study and the control groups, respectively. 57% of the patients were found to have hypertension.

Out of 100 diabetes patients, the association of diabetes and thyroid disorder was found in 15 patients (included 12 female and 3 males). Overall occurrence of thyroid disorder was found 15%, with highest frequency including 12% in female's diabetic patients (table 1). To assess the thyroid status and diagnosis the Wayn's classification index was used (J. Crooks, I.P.C. Murray, E.J. Wayne, 1959). As common thyroid problems were identified as hyperthyroidism and hypothyroidism. In this study female patients showed the highest risk of thyroid disorder where T3 and TSH level were found to be more significant in this respect (table 3 and 4).

Table 3 is representing the level of total thyroid hormones, thyroid stimulating hormones (TSH) in diabetic and non-diabetic patients. Level of total triiodothyronine T3 (nmol/L) in diabetic patients (1.922 ± 0.60) was lower than the mean level of non-diabetic subjects (2.113 ± 0.51). A significant statistical difference ($p=0.03$) was observed between them.

No significant variation was found when compared the level of total thyroxin T4 nmol/L in diabetic patients (102.78 ± 23.01) and in non-diabetic subjects ($99.79 \pm$

18.15) with a p-value 0.481. This showed the non-significant differences in T4 hormone level. The mean value of thyroid stimulating hormone TSH in diabetic patients was $1.116 \text{ mIU/L} (\pm 0.939)$ which was significantly lower ($p=0.028$) than the TSH level in non-diabetic subjects (1.443 ± 0.641) (Table 3).

The serum level of thyroid hormones in diabetes type I and type II participants were also analyzed (table 4) in comparison of control group. The mean serum level of total thyroxin T4 in diabetic type I patients were 102.73 ± 21.80 which was higher than the mean values of type II patients (100.95 ± 21.64) and non-diabetic (99.79 ± 18.15) subjects. Non-significant association ($p=0.64$) was observed for T4 level.

For T3 hormone the mean values found in type I, II were 1.992 ± 0.60 and 1.75 ± 0.63 , respectively in comparison with non-diabetic subjects (2.113 ± 0.51). The significant statistical association was observed for T3 level ($p=0.000$). Moreover, the serum level of T3 showed the possibility of hypothyroidism in diabetic subjects according to the Wayn's classification index (table 1). Although the data showed that the hormones level was not disturbed significantly in diabetic patients.

Mean value of TSH found in diabetic type I and II was 1.116 ± 0.939 and 0.95 ± 0.47 , respectively which showed a statistically significant difference with non-diabetic subjects (1.443 ± 0.641) with p value 0.001.

Discussion

Several studies have been reported on the association of diabetes mellitus and thyroid disorders which showed their complex interactions in controlling metabolic activities and glycemic profile of patients (Patricia 2000; Kordonouri, R. Hartmann; Deiss; Wilms; Gruters, 2005; , Tunbridge, Evered, Hall, Appleton, Brewis, 1997). This research study revealed that 15% diabetic subjects were suffering with thyroid hormones issue from patients from Lahore. This study showed the occurrence of thyroid disorder was found to be 15% and highest in females 12% who were having type I diabetes which was quite significant impact in comparison to study of Smithson who reported that almost 6% diabetic patients having thyroid issue (Smithson, 1998).

In current study 5% patients have TSH level more than 4.0 mIU/L but T3 and T4 level was within the normal range. Similar studies (Perros, McCrimmon, Shaw, & Frier, (1995) reported the T3 and T4 showed sub-clinical hyperthyroidism among diabetic patients. They reported 6.8% prevalence of thyroid dysfunction in diabetic conditions where hyperthyroidism was 0.5% and hypothyroidism was 4.8%. This difference is due to poorly controlled diabetes in a result of low T3 (R. Sathish, & V. Mohan, 2003). Our findings showed the low in T3 value than T4 where the same

finding has been reported by Badman and Chowdhury (200) and they also reported this tendency in young adults as well. Same results were reported by (Giampietro, et al., 1985) and Hamid, Farbod, & Fereidoun, 1998) who observed no difference of T4 level in diabetic patients and non-diabetic patients.

Conclusions

The present study concludes that thyroid issue is occurring in diabetic patients but with low frequency, where the type I diabetic subjects having abnormal T3 and TSH level than controls which showed the chances of hypothyroidism in those subjects. As hypothyroidism is also associated with impairment in glucose metabolism which would be an issue in controlling glucose level along with diabetic medications or hormonal therapy in effected individuals. Furthermore, this imbalance in T3 and TSH level could disturb the action of leptin, adiponectin and ghrelin (a gut hormone) in diabetic subjects. If thyroid dysfunction increases it can produce major metabolic disturbances if it is not treated. For thyroid disturbances in all diabetics there should permit prior treatment of thyroid disorder. Timely diagnosis and cure of thyroid disturbance is important for diabetic patients to enhance their medications effect.

Recommendations

In this study a significant correlation of diabetes and thyroid disorder has been observed in our local population and there is a necessity for basic studies to find correlation from other cities and provinces of Pakistan as well. There is still unlimited need for more research and studies in this area. Limited observations, small time period and small sample size could not permit certain inference from this data. So there is a need of comprehensive study with large inhabitant and long time period to get more precise evidence.

Table 1: Demographic features of patients.

Demographic Features	%age occurrence
Males participants	42
Females participants	58
Diabetic type I	43
Diabetic type II	57
Obese	60
Non-obese	40

hypertension	57
Thyroid dysfunction	15
female	12
Make	3

Table 2: Classification for clinical status of thyroid function.

Thyroid Status	T4 nmol/L	T3 nmol/L	TSH mIU/L
Euthyroid	50-150	0.8-3.0	0.5-5.0
Hyperthyroidism	>150	>3.0	<0.4
Hypothyroidism	<50	<0.3	>4.0

Table 3: Level of total thyroid hormones, thyroid stimulating hormone (TSH) in diabetic and non-diabetic patients.

Thyroid Hormones	Diabetic Subjects	Control Group	p-Value
T4 nmol/L	102.78±23.01	99.79±18.15	0.481
T3 nmol/L	1.922±0.60	2.113±0.51	0.03
TSH mol/L	1.116±0.939	1.443±0.641	0.028

Means values with ± Standard deviations

Table 4: Comparison of total thyroid hormones, thyroid stimulating hormone (TSH) in diabetic types (I and II) along with non-diabetic subjects.

Measurement	Type I	Type II	Non-Diabetic	p-Value
T4 nmol/L	102.73 ± 21.8	100.95 ± 21.64	99.79 ± 18.15	0.64

T3 nmol/L	1.992 ± 0.60	1.75 ± 0.63	2.113 ± 0.51	0.000
TSH mIU/L	1.116 ± 0.939	0.95 ± 0.47	1.443 ± 0.641	0.001

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