International Journal of Health Sciences and Research
Vol.13; Issue: 9; September 2023
Website: www.ijhsr.org
Original Research Article *ISSN: 2249-9571*

Study of Glycaemic Control in Thyroid Patients

Karanpal Singh[1], Dr. Sushil Yadav[2], Dr. Sangeeta Kapoor[3], Dr. Harekrishna Sharma[4]

[1]M.Sc. Medical Biochemistry[3rd] year, Department of Biochemistry, Teerthanker Mahaveer Medical College and Research Centre, Teerthanker Mahaveer University, Moradabad-244001, (U.P), India
[2]Assistant Professor, Department of Biochemistry, Teerthanker Mahaveer Medical College and Research Centre, Teerthanker Mahaveer University, Moradabad-244001, (U.P), India
[3]Professor & H.O.D, Department of Biochemistry, Teerthanker Mahaveer Medical College and Research Centre, Teerthanker Mahaveer University, Moradabad-244001, (U.P), India
[4]Associate Professor, Department of Medicine, Teerthanker Mahaveer Medical College and Research Centre, Teerthanker Mahaveer University, Moradabad-244001, (U.P), India

Corresponding Author: Dr. Sushil Yadav

DOI: https://doi.org/10.52403/ijhsr.20230901

ABSTRACT

Introduction: Thyroid gland produces and secretes thyroid hormones, tri-iodothyronine (T3) and thyroxine (T4). Increased levels of thyroid hormones among hyperthyroid cases lead to hyperglycaemia by promoting absorption of glucose through gastrointestinal tract and also increasing glycogenolysis. On the other hand, reduced thyroid hormone levels in hypothyroidism lead to decreased gastrointestinal glucose uptake, delayed peripheral glucose assimilation, and reduced gluconeogenesis. Due to this altered state of metabolism seen in thyroid complications, serum FPG & HbA1c levels are significantly affected.
Objectives: To estimate levels of fasting plasma glucose (FPG) and HbA1c among patients of thyroid dysfunction and compare F.P.G & HbA1c with thyroid parameters, meanwhile to correlate glycaemic parameters with thyroid parameters.
Methods: Diagnosed cases of Thyroid disorder Patients under the consultation of medicine department attending medicine OPD of TMMC&RC with Age group 18- 65 years were taken as the study group following up on inclusion & exclusion criteria.
Results: There was a significant difference in mean values of HbA1c in euthyroid & hypothyroid cases. Also, a significant difference in mean HbA1c values was seen in comparison of euthyroid and hyperthyroid cases. Also, a significant difference in mean values of FPG in euthyroid & hypothyroid cases was observed.
Conclusion: Patients with thyroid disorders are vulnerable to impaired glycaemic control, specifically hypothyroid patients. Regular monitoring of FPG and HbA1c is required along with assessment of thyroid parameters of T3 T4 & TSH levels.

Keywords: glycaemic control, hypothyroid, hyperthyroid, F.P.G, HbA1c

INTRODUCTION

Thyroid gland produces and secretes two important thyroid hormones. These are triiodothyronine (T3) and thyroxine (T4). They are tyrosine-based hormones whose main function is to control and influence metabolism. T3 has higher biological action than T4 [1]. Thyroid hormones act on liver, white adipose tissue, skeletal muscles and pancreas, by affecting insulin sensitivity and influencing carbohydrate metabolism. T3 hormone stimulates gluconeogenesis in the body affecting plasma glucose levels, especially in hyperthyroid patients. T4 hormone increases alanine transport into hepatocytes, thus increasing gluconeogenic

intermediates in liver cells and promoting more conversion of alanine into glucose [2]. Excessive thyroid hormones among hyperthyroid cases lead to hyperglycaemia by promoting absorption by the gastrointestinal tract and by increasing glycogenolysis. Reduced thyroid hormone levels in hypothyroidism lead to decreased gastrointestinal glucose uptake, delayed peripheral glucose assimilation, and reduced gluconeogenesis. Skeletal muscle and adipose tissue are less sensitive to insulin, as insulin resistance in hypothyroidism is linked to reduced glucose uptake. Due to this altered state of metabolism brought on by thyroid complications, serum FPG & HbA1c levels are significantly affected [3].

AIM & OBJECTIVES

The objectives of our study were to estimate levels of fasting plasma glucose (FPG) and HbA1c among patients of thyroid dysfunction and to compare the levels of FPG, HbA1c and thyroid parameters (T3, T4, TSH) among thyroid dysfunction. Also, we attempted to find out correlation of FPG & HbA1c with thyroid parameters (T3, T4 and TSH) among thyroid dysfunction subjects.

MATERIALS & METHODS

A total of 160 patients were included in our study group during the study period, which spanned a year after ethical clearance from the institute was granted. The subjects included were age- and sex-matched individuals. Individuals with diagnosed thyroid disorders under the consultation of the experts of the medicine department who attended OPD and IPD at Teerthanker Mahaveer Hospital were considered for the study.

Overt hypothyroidism is defined as condition of high serum TSH, above accepted range with low values of serum T3 and T4 levels [4]. Hyperthyroidism is defined as thyrotoxicosis condition with raised production and discharge of thyroid hormone by the thyroid. Serum level of thyroid stimulating hormone is low or undetectable with elevated levels of T3 & T4 [5]. American Diabetes Association has accepted HbA1c as important parameter of measuring glycaemic control, for screening & diagnosis of Diabetes, pre diabetes. American Diabetes Association has standardised the norms to screen diabetic cases: Glycated haemoglobin (HbA1c) ≥ 5.6%, Fasting Plasma Glucose ≥ 126 mg/dl, Post prandial plasma glucose (PG) ≥ 200 mg/dl, Random plasma glucose ≥ 200 mg/dL [6].

The following subjects were included in the present study: diagnosed cases of thyroid disorder Patients under the consultation of medicine department attending medicine OPD of TMMC&RC with age group 18- 65 years were taken as the study group. All the subjects were informed about the study protocol and their consent was taken prior to the inclusion. The exclusion criteria for the subject selection were as such: Those having steroid medications affecting plasma glucose levels [7], those suffering from Hepatic diseases – NAFLD, primary biliary cirrhosis and hepatitis C [8], those suffering from Adrenal disorders [9], pregnancy [10], those suffering from chronic disorders like cancers, tuberculosis, etc [10].

Sample collection of all the subjects was done under aseptic condition and venous blood was collected for the assay purpose from patients after their consent. An overnight fasting serum sample was preferred for the assay. The separated samples were then processed in the Central clinical Biochemistry laboratory at hospital.

The collected samples were analysed as such: Estimation of serum TSH was done by Immunoassay ELFA technique using Vidas auto Analyzer [11], Serum T3 hormone was determined using the Vidas auto analyser using the ELFA technique [12]. Serum T4 hormone was determined using the ELFA technique [13]. FPG estimation was done by glucose oxidase peroxidase method using semi auto- analyser [14]. HbA1c estimation was done by HPLC based D10 auto analyser [15].

SPSS statistical tools and Microsoft Excel were used to conduct the data analysis. MS Word and MS Excel were used to create the graphs. A cross-sectional study design with a total of 160 thyroid patients was chosen. For statistical analysis of the data, pearson's correlation coefficient test and student t test were employed

RESULT

Table 1 shows baseline characteristics of patients initially selected:

Parameter	Hypothyroid N = 85	Hyperthyroid N = 35	Euthyroid N = 40
Age (years)	44±10.8	49.8±11.1	36.2±10.6
Gender (M/F)	25/60	10/25	16/24
F.P.G (mg/dl)	133.5±65.1	130.6±33.6	104.9±14.9
HbA1c (%)	6.6±1.9	6.6±1.6	5.4±0.5

Table 2 shows results of multiple comparison of glycaemic parameters among different thyroid status:

Parameters	Thyroid Status	Compared with	Mean Difference	p-value
HbA1c %	Euthyroid	Hypothyroid	-1.16	0.001*
	Hypothyroid	Hyperthyroid	-0.02	0.997
	Hyperthyroid	Euthyroid	1.18	0.005*
FPG (mg/dl)	Euthyroid	Hypothyroid	-28.51	0.009*
	Hypothyroid	Hyperthyroid	2.83	0.072
	Hyperthyroid	Euthyroid	25.68	0.958

Figure 1: Comparison of HbA1c values among different thyroid disorder

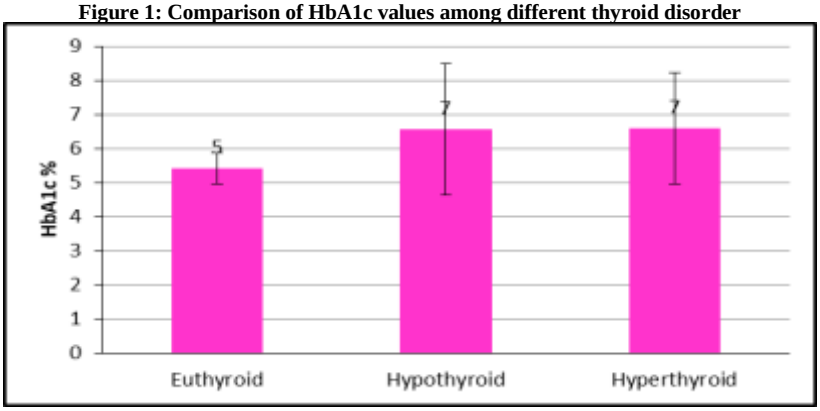
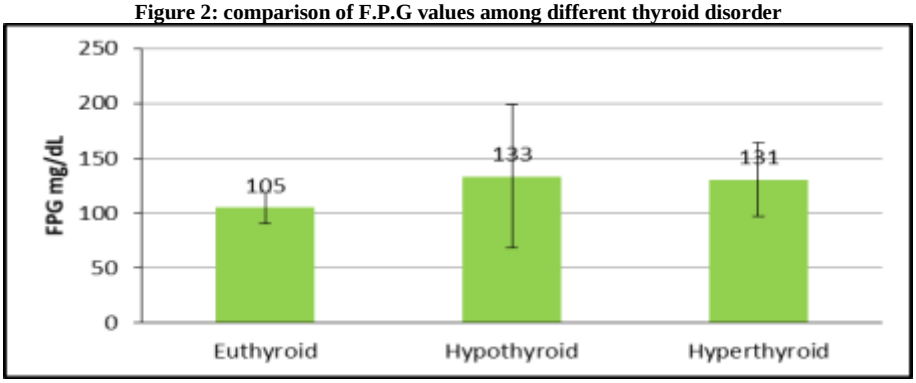


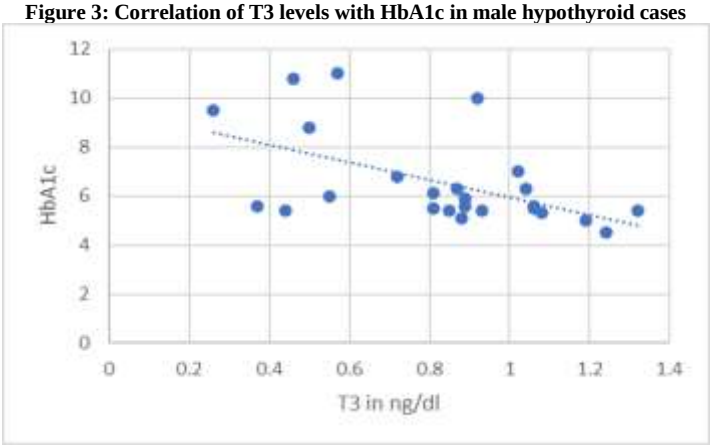
Figure 2: comparison of F.P.G values among different thyroid disorder



A significant mean difference of 1.18 % in HbA1c values was seen on comparing between euthyroid and hyperthyroid cases ($p<0.05$) & similarly when HbA1c values were compared between euthyroid and hypothyroid a highly significant result of -1.16% was seen ($p=0.001$).

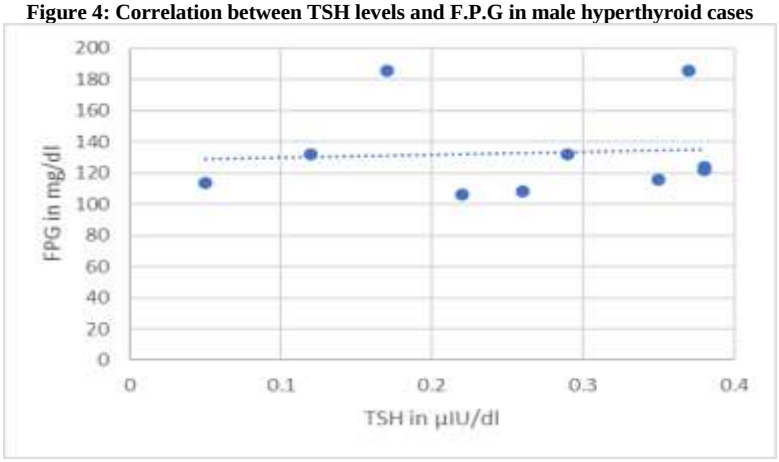
The mean value of FPG in euthyroid was 104.9±14.7 mg/dl, among hypothyroid subjects was 133.5±65.5 mg/dl & in hyperthyroid was 130.6±33.6 mg/dl respectively. There was a significant difference of 28.51 mg/dl in mean values of FPG between euthyroid & hypothyroid ($p<0.009$).

Figure 3: Correlation of T3 levels with HbA1c in male hypothyroid cases



Serum T3 showed a negative correlation with HbA1c among male hypothyroid cases, r = -0.534 (p = 0.002)

Figure 4: Correlation between TSH levels and F.P.G in male hyperthyroid cases



Serum TSH showed a positive co relation with FPG among male hyperthyroid cases, r = 0.72 (p = 0.012)

DISCUSSION

The results of our study have shown that the frequency of thyroid disorders increases as the age advances. Among the study population, female subjects were more prone to develop thyroid pathologies as depicted by the data in table 1. In this study, we found that mean HbA1c values were greater in the hypothyroid group 6.6±1.9% than in euthyroid cases which was 5.4±0.5%. When comparison was made between the two groups in our study, statistically significant mean difference was observed (p< 0.001). The findings of this study are comparable to that of the research conducted by Rana Bhattacharya and colleagues. In that particular research, they concluded that the HbA1c level among thyroid patients was substantially higher in the hypothyroid group (5.60±0.7% vs. 5.20±0.4% with p 0.001) than in the euthyroid cases (5.20±0.4%). However, when fasting plasma glucose of euthyroid, hypothyroid, and hyperthyroid individuals was compared, no statistically significant result was found [16]. This can be explained possibly due to low RBC turnover in hypothyroid patient as mentioned in the study. Thyroid hormones are known to increase blood glucose level. Thyroid hormones increase the uptake of glucose into peripheral tissues, especially skeletal muscles [17]. However, our study found a significant result when FPG of euthyroid cases was compared with hypothyroid cases (p = 0.009). This result emphasizes the role of elevated TSH involvement in peripheral mobilization of carbohydrates especially glucose, thus affecting glycaemic status of individual.

Scientist Ismail M et al studied glycaemic control in thyroid dysfunctions. In their study, they concluded that mean value of HbA1c among hypothyroid cases was

5.58% while in euthyroid cases, it was 5.4%. The result was not statistically significant when the findings were compared [18]. However, in our study, we found a significant result when comparing mean observation of HbA1c between hypothyroid & euthyroid cases with p<0.001. Similarly, HbA1c comparison done between hyperthyroid cases and euthyroid subjects was also observed to be statistically significant (p <0.05). Researcher Abbas Ali Tam et al in their study also confirmed the elevated levels of HbA1c in hyperthyroid cases on comparing the mean values between hypothyroid and euthyroid cases [19]. This result can be attributed to high levels of serum T3 & T4 which enhances metabolic rate of the body, thus raising plasma glucose levels which is reflected as an increased value of HbA1c. In the study, they showed that fasting blood sugar are significantly higher in cases with hyperthyroidism when results were compared with hypothyroid & euthyroid cases p = 0.018.

The limitation of our current study was to assess only two glycaemic control parameters, Fasting Plasma Glucose & Glycosylated haemoglobin which restricts to figure out the root cause for the alterations of glucose metabolism in an individual. Also, postprandial glucose levels were not included in our study. Similarly, the measurement of certain parameters like free insulin levels and C peptide which are considered as important parameter of glycaemic control, were not done. The study tried to evaluate glycaemic control in thyroid cases with limited parameters only. The research topic requires more investigation with an elaborated panel of glycaemic control and associated parameters like C peptide, lipid profile, postprandial glucose values, free T3 and T4 levels and others giving an elaborated result for future studies.

CONCLUSION

In this study, we found that patients with thyroid disorders are vulnerable to impaired glycaemic control, specifically hypothyroid patients. Regular monitoring of FPG and HbA1c is required along with assessment of thyroid parameters of T3 T4 & TSH levels. With progression of age, the vulnerability of thyroid patients to develop impaired glycaemic control increases. Our study also concludes that T3 and T4 levels affect carbohydrate metabolism more in elderly as compared to young.

Declaration by Authors

Ethical Approval: Approved

Acknowledgement: Authors would like to thank the faculty and all the technical staff of the department of biochemistry.

Source of Funding: None

Conflict of Interest: The authors declare no conflict of interest.

REFERENCES

1. Tata JR. A hormone for all seasons. Perspect Biol Med. 2007 Winter;50(1):89-103. doi: 10.1353/pbm.2007.0012. PMID: 17259678.
2. Mullur R, Liu YY, Brent GA. Thyroid hormone regulation of metabolism. Physiol Rev. 2014 Apr;94(2):355-82. doi: 10.1152/physrev.00030.2013. PMID: 24692351; PMCID: PMC4044302.
3. Eom YS, Wilson JR, Bernet VJ. Links between Thyroid Disorders and Glucose Homeostasis. Diabetes Metab J. 2022 Mar;46(2):239-256. doi: 10.4093/dmj.2022.0013. Epub 2022 Mar 24. PMID: 35385635; PMCID: PMC8987680.
4. Demers LM. Thyroid disease: pathophysiology and diagnosis. Clin Lab Med. 2004 Mar;24(1):19-28. doi: 10.1016/j.cll.2004.01.002. PMID: 15157555.
5. Bahn Chair RS, Burch HB, Cooper DS, Garber JR, Greenlee MC, Klein I, Laurberg P, McDougall IR, Montori VM, Rivkees SA, Ross DS, Sosa JA, Stan MN; American Thyroid Association; American Association of Clinical Endocrinologists. Hyperthyroidism and other causes of thyrotoxicosis: management guidelines of the American Thyroid Association and American Association of Clinical Endocrinologists. Thyroid. 2011 Jun;21(6):593-646. doi:

10.1089/thy.2010.0417. Epub 2011 Apr 21. Erratum in: Thyroid. 2011 Oct;21(10):1169. Erratum in: Thyroid. 2012 Nov;22(11):1195. PMID: 21510801.
6. Barua A, Acharya J, Ghaskadbi S, Goel P. The relationship between fasting plasma glucose and HbA1c during intensive periods of glucose control in antidiabetic therapy. J Theor Biol. 2014 Dec 21; 363:158-63. doi: 10.1016/j.jtbi.2014.08.020. Epub 2014 Aug 23. PMID: 25158164.
7. Kim WH, Sim WS, Shin BS, Lee CJ, Jin HS, Lee JY, Roe HJ, Kim CS, Lee SM. Effects of two different doses of epidural steroid on blood glucose levels and pain control in patients with diabetes mellitus. Pain Physician. 2013 Nov-Dec;16(6):557-68. PMID: 24284841.
8. Tandra S, Vuppalanchi R. Use of statins in patients with liver disease. Curr Treat Options Cardiovasc Med. 2009 Aug;11(4):272-8. doi: 10.1007/s11936-009-0028-2. PMID: 19627660.
9. Meyer G, Hackemann A, Reusch J, Badenhoop K. Nocturnal hypoglycemia identified by a continuous glucose monitoring system in patients with primary adrenal insufficiency (Addison's Disease). Diabetes Technol Ther. 2012 May;14(5):386-8. doi: 10.1089/dia.2011.0158. Epub 2012 Jan 13. PMID: 22242902; PMCID: PMC3338953.
10. Gu Y, Li H, Bao X, Zhang Q, Liu L, Meng G, et al. The Relationship Between Thyroid Function and the Prevalence of Type 2 Diabetes Mellitus in Euthyroid Subjects. J Clin Endocrinol Metab. 2017 Feb 1;102(2):434-442. doi: 10.1210/jc.2016-2965. PMID: 27906594.
11. Green ED, Baenziger JU. Asparagine-linked oligosaccharides on lutropin, follitropin, and thyrotropin. I. Structural elucidation of the sulfated and sialylated oligosaccharides on bovine, ovine, and human pituitary glycoprotein hormones. J Biol Chem. 1988 Jan 5;263(1):25-35. PMID: 3121609.
12. C. B. Thyroid hormone synthesis and circulating thyroid hormones, in thyroid diseases world federation of nuclear medicine and biology. EDC Beckers Pergamon press 1-21; 1982
13. Stockigt JR. Free thyroid hormone measurement. A critical appraisal. Endocrinol Metab Clin North Am. 2001 Jun;30(2):265-89. doi: 10.1016/s0889-8529(05)70187-0. PMID: 11444163.
14. Ngo TT, Lenhoff HM. A sensitive and versatile chromogenic assay for peroxidase and peroxidase-coupled reactions. Anal Biochem. 1980 Jul 1;105(2):389-97. doi: 10.1016/0003-2697(80)90475-3. PMID: 7457843.
15. Yis O, Pehlivan M, Bugdayci G, Yuce N. Evaluation of Bio-Rad D-10® and arkray adams HA-8160® HPLC analyzers in HbA1c measurement. Med Sci (Turkey). 2019;(0):1.
16. Bhattacharjee R, Thukral A, Chakraborty PP, Roy A, Goswami S, Ghosh S, Mukhopadhyay P, Mukhopadhyay S, Chowdhury S. Effects of thyroid status on glycated hemoglobin. Indian J Endocrinol Metab. 2017 Jan-Feb;21(1):26-30. doi: 10.4103/2230-8210.196017. PMID: 28217494; PMCID: PMC5240076.
17. Christy AL, Manjrekar P, Babu RP, M S R, Hegde A. Elevation of HbA1C in Non-diabetic Hypothyroid Individuals: Is Anaemia the Connecting Link? -A Preliminary Study. J Clin Diagn Res. 2013 Nov;7(11):2442-4. doi: 10.7860/JCDR/2013/6703.3569. Epub 2013 Oct 29. PMID: 24392367; PMCID: PMC3879889.
18. Ismail M, Ahamed H B I, Rao V, Reddy M N L, Aman Jagirdar S. Effects of thyroid hormone on glycated haemoglobin in non-diabetic subjects with overt hypothyroidism. J Evol Med Dent Sci. 2017; 6(11): 882–7.
19. Tam A, Tam H, Usluogullari C, Dede I, Balkan F, Kaya C, et al. The levels of HbA1c in patients with thyroid dysfunction. Gaziantep Med J. 2015; 21(1): 5-6

How to cite this article: Karanpal Singh, Sushil Yadav, Sangeeta Kapoor, Harekrishna Sharma. Study of glycaemic control in thyroid patients. *Int J Health Sci Res.* 2023; 13(9):1-6. DOI: *https://doi.org/10.52403/ijhsr.20230901*

******