ORIGINAL RESEARCH PAPER

Biochemistry

EFFECT OF FASTING AND POST-PRANDIAL STATE ON THYROID HORMONES - A CASE CONTROL STUDY

KEY WORDS: Postprandially, fasting, TSH, Hypothyroidism, SCH

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ABSTRACT

Introduction: Thyroid hormone produced by thyroid glands, which plays a vital role in human body. Thyroid stimulating hormone (TSH) levels vary with time of the day and probably in relation to food. In this study, we aimed to assess whether a fasting or post-prandial state affect thyroid hormones in both euthyroid people and patients with thyroid dysfunction (Hypothyroid Patients). **Materials and Methods:** This study was conducted at Osmania General Hospital. A total of 100 Patients were included and divided into 2 groups. Group 1 – Patients with no prior history of thyroid dysfunction. Group 2 – Patients with known diagnosis of thyroid dysfunction and on medication(Hypothyroid Patients). TSH and free T4, T3 and T4 were done in fasting and 2 hours postprandially and were measured by using Siemens Chemiluminiscence immunoassays. **Results:** TSH levels were found to be significantly lowered after food in two groups. Free T4, T4, T3 and T4 levels did not show any statistically significant alteration after food. **Conclusion:** There was a significant decline in TSH values post-prandially in comparison to fasting values . This may be useful in the diagnosis and management of hypothyroidism, especially in cases of sub clinical hypothyroidism(SCH). Hence our study recommends Preferable time blood sample collection for TSH estimation is in fasting state.

INTRODUCTION

- Thyroid hormones regulate metabolism, brain development, breathing , heart & nervous system function, temperature, muscle strength, weight and cholestrol levels (1)(12) .
- The major form of thyroid hormone in the blood is Thyroxine (T4), whose half-life is around 5-7 days. T4 exists in two forms, one is free form(not bound) and second one is Protein bound(bound to mainly thyroxine binding globulin).
- A Total T4 measures the both bound and free form (fT4). A Free T4 measures only unbound form and able enter and the affect the body tissues.
- T3(Triiodothyronine) is four times more active than more abundant T4. The half-life of T3 is 1 -2 days.
- Primary hypothyroidism is defined as low free thyroxin(free T4) and elevated TSH. Most common endocrine disorder affecting many millions around the world .
- Hypothyroidism in pregnancy is usually asymptomatic, especially when subclinical. Symptoms which suggest hypothyroidism include inappropriate weight gain, cold intolerance and , dry skin. Other features like fatigue, constipation and somnolence are usually attributed to pregnancy.
- In pregnant women, thyroid binding globulin(TGB) production is increased because of estrogen and beta-HCG. More freeT4 will be bound to TGB, leading to increased production of T4.TSH levels and fT4 will normalize and total T4 will increase. Therefore, laboratory values show normal TSH, normal free T4, and elevated T4.
- In pregnant women, undiagnosed hypothyroidism can lead to both maternal and fetal complications. maternal complications include gestational hypertension, gestational diabetes, abruptio placentia, eclampsia and post-partum hemmorhage. Fetal complications include miscarriage, premature births, still births and low birth weight.
- Congenital hypothyroidism is defined as thyroid hormone deficiency present at birth due to thyroid dysgenesis or disorder of thyroid hormone biosynthesis. This results in primary hypothyroidism.
- Initially they are asymptomatic for 1st few weeks of life because they are protected by fraction of maternal thyroid hormone which crosses placenta. Later they may present with decreased activity, increased sleep, feeding difficulty, constipation, hoarse cry and prolonged jaundice.
- Hypothyroidism in adults manifests with variety of symptoms such as fatigue, weight gain, constipation, dry skin and cold intolereance (11) .
- Sub clinical hypothyroidism is defined as Normal free thyroxin(free T4) and elevated TSH with or without clinical symptoms (2).
- SCH is associated with several long term effects including dyslipidemia, hypertension, infertility and may be independent risk factor for cardiovascular morbidity (3).
- Circulating TSH shows a normal circadian rhythm with a peak between 11PM -5AM and nadir between 5PM-8PM(4).
- Secretory pulses occurs every 2-3 hours and are interspersed with periods of tonic non-pulsatile TSH secretion.
- It is generally observed that TSH in early morning fasting levels were higher than TSH levels measured in later in the same day (1)(6)(8). However entity like SCH which heavily relies on TSH values may be underdiagnosed or overdiagnosed based on a single value (5).
- Objective of our study is to evaluate whether fasting or post prandial state affect thyroid hormones in both euthyroid people and patients with thyroid dysfunction.

MATERIALS AND METHODS

- This study was conducted at Osmania General Hospital.
- Sample size: 100
- Our Study Included 2 groups

Group 1 - normal patients(no prior history of thyroid dysfunction) Group 2 - patients with known diagnosis of thyroid dysfunction and on medication(hypothyroid patients) Exclusion criteria: patients operated for pituitary lesions or thyroidectomy were excluded

METHODOLOGY

- Venous blood(3ml) was taken in red capped plain vacutainer in the morning between 9:00AM – 9:30AM, after 8 to 12hrs overnight fast.
- Then patients were instructed to come after breakfast, 2hrs later, another sample was taken.
- Serum samples were analyzed by Siemens chemilu minesence immunoassays. Statistical methods
- Data was analyzed by paired student – t test to determine the level of significance.
- SPSS software was utilised to analyze the data.
- $P < 0.05$ was considered statistically significant

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Biological reference Interval values followed in Osmania general hospital are

1) T3- 0.87 -1.78ng/ml
2) T4 - 6.09 – 12.23µg/dl
3) Free T4 - 0.61 -1.12ng/dl
4) TSH- 0.34 – 5.60uIU/ml

	TSH	FREE T4	T3	T4
EUTHYROID	NORMAL	NORMAL	NORMAL	NORMAL
HYPOTHYROIDISM	HIGH	LOW	LOW	LOW
SUB CLINICAL HYPOTHYROIDISM	HIGH	NORMAL	NORMAL	NORMAL
HYPERTHYROIDISM	LOW	HIGH	HIGH	HIGH

	FASTING (MEAN VALUE)	POST-PRANDIAL (MEAN VALUE)	PERCENTAGE DIFFERENCE
GROUP 1			
FREE T4	1.02	1.00	1.9%
TSH	3.02	2.68	11.9%
T3	1.16	1.15	0.8%
T4	7.21	7.12	1.25%
GROUP 2			
FREE T4	0.67	0.64	4.5%
TSH	4.12	3.58	14.02%
T3	0.81	0.82	1.22%
T4	5.96	5.91	0.84%

GROUP	FASTING (MEAN ± SD)	2 HOUR – POST PRANDIAL (MEAN ± SD)	P value
GROUP1 (n=36)			
FREE T4 (ng/ml)	1.02 ± 0.14	1.00 ± 0.12	0.08
TSH (mIU/L)	3.02 ± 1.60	2.68 ± 1.20	0.00*
T3 (ng/ml)	1.16 ± 0.72	1.15 ± 0.84	0.09
T4 (µg/dl)	7.21 ± 2.45	7.12 ± 2.29	0.07
GROUP 2 (n=64)			
FREE T4 (ng/ml)	0.67 ± 0.22	0.64 ± 0.18	0.07
TSH (mIU/L)	4.12 ± 2.12	3.58 ± 2.05	0.00*
T3 (ng/ml)	0.81 ± 0.37	0.82 ± 0.28	0.06
T4 (µg/dl)	5.96 ± 2.96	5.94 ± 2.73	0.08

- Our study population consists of 100 subjects aged between 18 -50 years.
- 64 subjects were known cases of hypothyroidism(on medication)-GROUP 2 and
- 36 subjects had no history of thyroid dysfunction- GROUP 1
- In group 1, Four patients in our study in were classified as SCH according to the fasting sample but again reclassified into euthyroid according to the post-prandial sample.
- In group 2, Seven patients in our study in were classified as SCH.
- TSH values decreased after food consumption in 92 patients, remains unchanged in 8 patients.

DISCUSSION

- We observed a significant decline in TSH values after food consumption in both groups while mean decline was relatively more in group 2 patients, the difference was statistically insignificant
- Among the Individual groups, fasting and post prandial TSH values showed a significant `P' value.
- In my study, T3, T4 and fT4 in between the study groups and within the group didn't have any statistical significance.
- Fasting or Post Prandial might not alter these hormones i.e T3,T4 and fT4.
- The precise mechanism behind this remains unclear. But possible explanation is that food consumption causes an increase in circulating Somatostatin levels which inturn, supresses TSH secretion from the pituitary (6).

DISCUSSION

- Thyrotropin releasing hormone(TRH) stimulates TSH secretion (7).TRH is a peptide hormone created by the cell bodies in the periventricular nucleus of hypothalamus.
- Somatostatin inhibits TSH secretion
- Food induced elevation of circulating somatostatin might reduce post-prandial TSH (OR). Changes in TSH level due to this diurnal ryhthm may be also the physiological reason for post prandial TSH fall seen in our study.. SCH and maternal hypothyroidism are mainly diagnosed based on TSH values. SCH in pregnancy can lead to serious complications, including miscarriage, preterm delivery, gestational diabetes, hypertension, low birthweight and impaired brain development in the fetus (10).
- Even in euthyroid patients, precision in TSH measurement can be important as recent evidence suggests that dynamic TSH changes correlate with increased risk of chronic kidney disease (9).

CONCLUSION

- Free T4, T3 and T4 did not show any statistical significance.
- TSH levels showed a statistically significant decline post prandially in comparison to fasting values. This may be clinical useful in the diagnosis and management of sub-clinical hypothyroidism(SCH).
- Hence our study recommends Preferable time of blood sample collection for TSH estimation is in fasting state.

Limitations:

- large sample size may be required to confirm our findings.
- Environment factors like cold ,stress , hypoxia etc may also have indirect effect on thyroid hormones. Hence further research can be done on environmental factors influence on thyroid hormones.
- This study was approved by Institutional Ethics Committe.

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