Thyroid hormones parameters of patients with thyroid disorders attending special out-patient clinic at Murtala Muhammad Specialist Hospital, Kano, Nigeria

1*Abdulhadi Sale Kumurya and 2Sadiya Ashiru Auta

1Department of Medical Laboratory Science, Faculty of Allied Health Sciences, Bayero University, P.M.B. 3011, Kano, Nigeria
2Department of Biochemistry, Faculty of Basic Medical Science, Bayero University, P.M.B. 3011, Kano, Nigeria

Thyroid hormones, triiodothyronine (T3) and Thyroxin (T4), affect almost all metabolic activities of tissues and are produced under influence of the interior pituitary hormone, the thyroid stimulating hormone (TSH), which stimulates secretion of thyroid releasing hormone (TRH). The present study was conducted to observe the effect of non-detectable levels of TSH on thyroid hormones, on the basis of gender and age. A total of 88 patients (50 patients with hyperthyroidism and hypothyroidism and 33 healthy people as control) attending special out-patient clinic were involved in the study. Serums T3, T4 and TSH were measured using the commercially available kits (Aabbott Laboratories) through Enzyme Immune Assay (EIA) technique (Roche Diagnostics GmbH). Analysis of data using SPSS software version 15.0 revealed that prevalence of thyroid disorders in the studied group was more among female population. However, the disorders were not age dependent. Most common conditions associated with sub-clinical hyperthyroidism. As males are equally exposed to these environmental factors, hence further investigations are required to know why these factors affect females more than the males. In our opinion, TSH and FT4 are the most valuable indicators in assessing thyroid function in a healthy population and TSH and TT4 are the most meaningful in hyperthyroidism and hypothyroidism.

Keywords: Thyroid, Hyperthyroidism, Non-detectable TSH, Kano.

INTRODUCTION

The thyroid is an important gland involved in the metabolism, growth, development, and maintenance of the internal environment (Meir et al., 1998; Lewandowski et al., 2012). Thyroid hormones, thyroxine (T4) and triiodothyronine (T3), are secreted from thyroid gland, located immediately below the larynx on either side of, or interior to, the trachea. These hormones increase the metabolic activity of all the tissues (Guyton, 1991). T3 and T4 are under influence of the anterior pituitary hormone, the thyroid stimulating hormone (TSH), which in turn is regulated by TRH, The hypothalmic thyroid realising hormone (Fulton, 1965). Iodine is an essential substrate required for the formation of T3 and T4. About 50mg/year of 1mg/week ingested iodine is required to meet the normal requirements for the production of T3 and T4 (Guyton, 1991).

*Correspondence: Dr. Abdulhadi Sale Kumurya, Department of Medical Laboratory Science, Faculty of Allied Health Sciences, Bayero University, P.M.B. 3011, Kano-Nigeria. Email: askumurya.med@buk.edu.ng, Tel.: +2347032153561
Different disorders may be seen due to inappropriate secretion of thyroid hormones e.g. hypothyroidism (a condition in which TSH concentration is high and T3 and T4 secretion is suppressed) which may cause non-toxic colloid goitre myxedema, arteriosclerosis and criticism, while hyperthyroidism (a condition in which TSH is suppressed and T3, T4 levels are high) results in toxic goitre, thyrotoxicosis, Grave’s disease and Thyroiditis, thyroid inflammation (Bayliss, 1983).

Thyroid disorders are becoming common complaint in Kano; 64% of School children suffer from Thyroid disorders due to iodine inadequacy (UNICEF, 1994). Increased activity of thyroid gland increases the vasodilation rate of the heart beat and blood flow in skin and may cause increase of almost 60% of cardiac output. It also increases the rate and depth of respiration, utilization of oxygen and formation of carbondioxide. Secretion of digestive juices, and increase in motility of gastrointestinal tract often results in diarrhoea. Lack of thyroid hormones causes constipation (Guyton, 1991). Any abnormality in the secretion of TSH results in abnormal secretion of T3 and T4, thus affecting the entire metabolic activity. In hyposecretion, the patient feels extreme nervousness, worry and anxiety complexes. It also causes extreme somnolence with 12-14 hours/day sleep, while hypersecretion causes difficulty to sleep (Guyton, 1991). For diagnosis and treatment of thyroid disorders, all possible complications should be comprehended completely. One of these disorders is suppressed TSH to the non-detectable level. This study was carried out to study the effect of non-detectable levels of TSH on Thyroid hormones, and to identify the extent of the problem on the basis of gender and age.

MATERIAL AND METHOD

Sample collection

Fresh blood (5ml) was drawn from the subjects in sterile disposable syringe. The blood was transferred to clean test tubes and serum was allowed to retract. Once retracted, serum was separated by centrifugation and kept frozen till assayed.

Setting

The study was carried out at the special out-patient clinic (SOPD) of Murtala Muhammad Specialist Hospital (MMSH), Kano a specialist Hospital of the Kano state government. It is the largest hospital serving a large numbers of patients of diver’s socio-economic states from within and outside the metropolis.

Study design and Study population

A total of 88 participants (50 patients with hyperthyroidism and hypothyroidism and 33 healthy people as control) were enrolled in the study. Only patients who have the levels below detectable limits were included in the study. Healthy, age and Sex matched controls were included in the study. The subjects were divided into different groups on the basis of combinations of total T3 and Total T4 levels, i.e. normal, depressed and elevated.

Hormonal Analysis

The serum hormones, namely TSH, Total T3 and Total T4 were quantified for all subjects, using the commercially available kits (Abbot Laboratories) using IMX system, through Enzyme Immune Assay (EIA) technique (Roche Diagnostics GmbH). The manufacturer’s reference limits are T3 (1.2–3.4 nmol/L), T4 (54–174 nmol/L), and TSH (0.35–5.5 mIU/L). The subjects were divided into different groups on the basis of different combinations of Total T3 and Total T4 levels, i.e. normal, depressed and elevated. Quality control samples represent the lower, middle and upper ranges of the assay were used for quality control of the results. Results ± 1SD of the target value were considered acceptable. Only the batches with all the controls being within permissible limits were accepted.

Data Analysis

We used SPSS software version 15.0 for data analysis (IBM SPSS 15, Inc., Chicago, IL). The results are presented as the mean ± SD. The Pearson correlation was adopted to identify the most important indicator besides TSH, excluding the interference of aging at the same time. The correlation was considered statistically significant and more relevant when and the absolute value of the -value was close to 1.

RESULTS

During the course of the study, serum of 88 patients was analysed for evaluation of the thyroid axis hormones. Out of these, 51.69% were exhibiting disturbances in thyroid activity, while 7.1% of the patients with thyroid pathology stowed depression of TSH to non-detectable levels. This study group comprised of 23% male and 77% female subjects.

Among the 50 patients diagnosed with hyperthyroidism and hypothyroidism and 33 healthy persons, we analyzed the Pearson correlations for serums T3, T4, and T4 with TSH. T4 is found to be associated with TSH at the maximum level in healthy people. The correlation between T4 and TSH in patients diagnosed with hyperthyroidism or hypothyroidism is the maximum, which suggests that T4 and TSH are the most valuable indicators to consider in a healthy population and hyperthyroidism or hypothyroidism.
Table 1. Thyroid Gland Activity in Different Groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Age(years)</th>
<th>T3(ng/ml)</th>
<th>T4(ug/dL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>35.00 ± 2.61</td>
<td>1.15 ± 0.05</td>
<td>8.34 ± 0.30</td>
</tr>
<tr>
<td>T3↑T4↑</td>
<td>47.00 ± 5.39</td>
<td>2.48 ± 0.64*</td>
<td>16.10 ± 0.96*</td>
</tr>
<tr>
<td>T3↑T4↑</td>
<td>20.00 ± 0.00*</td>
<td>5.39 ± 0.58*</td>
<td>&gt;24.00 ± 0.00*</td>
</tr>
<tr>
<td>T3→T4→</td>
<td>45.12 ± 7.17</td>
<td>1.54 ± 0.37</td>
<td>9.77 ± 0.43*</td>
</tr>
<tr>
<td>T3→T4↓</td>
<td>69.00 ± 8.99*</td>
<td>0.72 ± 0.06*</td>
<td>&gt;8.00 ±0.00*</td>
</tr>
<tr>
<td>T3→T4↓</td>
<td>25.00 ± 0.00a</td>
<td>1.60 ± 0.00*</td>
<td>2.13 ± 0.00a</td>
</tr>
</tbody>
</table>

a = statistically significant difference (p<0.05)
→ = within normal range
↑ = Elevated levels
↓ = Depressed levels
↑↑ = Beyond upper detectable levels

Normal Range:
T3 (ng/ml): 0.80 – 1.80
T4 (ug/dL): 4.50 – 12.00

Table 2. Showing the results of T3, T4, and TSH of the studied population

<table>
<thead>
<tr>
<th>T3 (nmol/L)</th>
<th>T4 (pmol/L)</th>
<th>TSH (mIU/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy population</td>
<td>1.63 ± 0.429</td>
<td>15.07 ± 2.528</td>
</tr>
<tr>
<td>Hyperthyroidism</td>
<td>6.20 ± 3.415</td>
<td>51.94 ± 28.175</td>
</tr>
<tr>
<td>Hypothyroidism</td>
<td>1.02 ± 0.984</td>
<td>7.79 ± 2.822</td>
</tr>
</tbody>
</table>

Normal range 1.2–3.4 10.2–31 0.35–5.5

In all conditions when T3 levels were pathologic variation from the control was statistically significant. However, T3 levels of patients with T3 within permissible levels, exhibited non-significant variation with the control group (Table 1). It was also observed that increased of T3 and T4 always occurred in tandem. However, depression in one resulted in the evaluation of the other. Independently, 54% cases of T3 showed elevated levels, followed by normal T3 levels (34%). Depressed levels were seen in 8%, while 4% had T3 levels beyond the upper detectable limit. Similarly, with respect to T4, it was found that elevation occurred in 46% cases, 31% cases had T4 levels within reference values. Incidence of depressed levels was recorded as 4%, while 19% were higher than the upper detectable levels.

DISCUSSION

TSH is regarded as the most important marker for the assessment of thyroid function (Ismail et al., 2002). T3 and T4 are the active biological state in plasma, and therefore, T3 and T4 are considered to be sensitive and meaningful indicators for the diagnosis of thyroid disease. However, the determination of free thyroxine is not very reliable and stable; it may be affected by several factors, such as thyroglobulin (TGB), serious illness, or certain drugs that interfere with the binding of hormones. In addition, the measuring of T3 and T4 is indirect, with no direct quantitative determination. Therefore, the suggestion that TSH combined with T4 is the basis of estimation of thyroid function is not reliable enough for both clinicians and patients. Based on this deliberation, we analysed the estimation of serums T3, T4, and TSH in patients with thyroid disorders attending special out-patient clinic at Murtala Muhammad Specialist Hospital, Kano, Nigeria in order to provide more suitable and important parameters for thyroid function.

The 7.1% of the patients with thyroid pathology stowed depression of TSH to non-detectable levels (which comprised of 23% male and 77% female subjects), indicating variety of this condition. In order to restore the
confidence of the population in the medical science, and to save innocent clients from quacks, all patients are to be treated significantly for alleviation of their complaints (Tahir et al., 2005).

Incidence of thyroid pathology was more in female subjects (70%), which is in line with the findings of Hendrick et al. (1988). Most common condition seen was the elevated levels of T3 and T4, the possible reason being possible mutations in activating TSHR resulting in increased second messenger signal, without stimulating TSH, causing an autonomous growth of Thyroid cells. Other possible reason for that condition is feedback inhibition of TSH by increased levels of thyroid hormones. Increased Thyroid hormones inhibit anterior pituitary secretion of TSH in two ways, a direct effect of anterior pituitary and by indirect effect acting through hypothalamus (Guyton, 1991).

Sub-clinical hyperthyroidism (isolated suppression of TSH) is caused due to abnormality in thyroid stimulating antibodies (TSAB). It has been reported by Kasagi et al. (1997) that sub-clinical hyperthyroidism in euthyroid subjects, with subnormal TSH, could be detected by the measurement of TSAB.

As age of patients varied from 16-78 years, it indicates that age factor does not account for the incidence of the problem. However, according to the findings of Meir et al. (1998), prevalence of thyroid disorders, including clinical hypo and hyperthyroidism, was more in women of age over 40 years. In a case report, a 59-year-old woman diagnosed with hypothyroidism was treated with L-T4, and TSH concentrations expectedly fell three months later however, after stopping L-T4 treatment, TSH level increased quickly with a still higher FT4 and FT3 status (Castellano et al., 2013). This might be explained by the fact that nonspecific binding of the blood sample and assay reagent affected the measurement result of FT4 and FT3 [13]. However, the fact that serums FT4 and FT3 do not match the clinical manifestations is to some extent caused by the interference of the measurement method (Lewandowski et al., 2012; Mingote et al., 2012; Ohba et al., 2012). From clinical practice, the measurement of serum FT4 is an indirect assessed value and is less stable and repeatable compared with TT4. Evelin Mingote and other scholars thought that patients with elevated levels of TSH and decreased TT4 but not FT4 levels in hypothyroidism had a worse prognosis (Mingote et al., 2012). Therefore, the clinical value of TT4 may be greater than FT4 in the evaluation of thyroid function in hypothyroidism.

Findings of this study revealed that suppression of TSH causes abnormal secretion of thyroid hormones, which in turn is enhanced by an increase in thyroid gland activity through feedback mechanism. Abnormality in TSAB and TSHR also causes suppression of TSH. Conditions with different behaviour of T3 and T4 indicate that levels of all three hormones should be evaluated for effective diagnosis. As the thyroid picture varies from patient to patient, thus efficient therapeutic management is also specific (Tahir et al., 2005).

CONCLUSION

Prevalence of thyroid disorders is more within female population. Dietary iodine and stress are known to be environmental factors that are responsible for causing the disorders more within female population. As males are equally exposed to these environmental factors, hence further investigations are required to know why these factors affect females more than the males.

RECOMMENDATIONS

- It is recommend using TSH and T4 as measuring indicators to assess thyroid function in healthy people.
- It is recommend using T4 and TSH as measuring indicators to assess hypothyroidism and hyperthyroidism.
- We think such a permutation is an accurate, convenient, and economic recommendation for clinicians.
- The significance of properly assessing thyroid function is that it can effectively guide the dose adjustments of antithyroid drugs or hormone replacement therapy.

Authors’ Contribution

Abdulhadi Sale Kumurya and Sadiya Ashiru Auta equally contributed to this work.

Conflict of Interest

We declared that we don’t have any conflict of interest.

Ethical Issues

Ethical permission was obtained from the Ethical Committee of the two health institutions.

ACKNOWLEDGEMENT

We acknowledge the management of Murtala Muhammad Specialist Hospital for giving us permission to conduct this work. Our appreciation also goes to the management of Decent Medical Laboratories, Kano for their permission to use their facilities.

REFERENCES
