ISSN- O: 2458 - 868X, ISSN–P: 2458 – 8687
Index Copernicus Value: 68 . 16
PubMed - National Library of Medicine - ID: 101731606

International Journal of Medical Science and Innovative Research (IJMSIR)
IJMSIR : A Medical Publication Hub
Available Online at: www.ijmsir.com
Volume – 4, Issue – 5, October - 2019, Page No. : 87 - 91

Biochemical study of Correlation between thyroid dysfunction and severity of renal disease

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Type of Publication: Original Research Paper

Conflicts of Interest: Nil

Abstract

Background – Thyroid hormones (TH) are necessary for the growth and development of the kidney and for maintenance of water and electrolyte homeostasis.[1] This study was conducted to investigate the impact of thyroid dysfunction on serum creatinine and urea level as well as electrolytes like sodium and potassium that reflect kidney status. The two main hormones produced by the thyroid are triiodothyronine (T3) and thyroxine (T4) and also TSH hormone have significant impact on kidney disease so it is important to consider the correlation of thyroid dysfunction in relation to kidney disorders. Hyperthyroidism is usually not associated with Kidney Disease but has been known to accelerate it.[2] So, aim of this study is to study the correlation between Thyroid hormone dysfunction and severity of renal diseases.

Materials & Methods: This Observational study included about 100 patients attending the outpatient department of clinical Biochemistry, IGGMC, Nagpur. All patients who were attending biochemistry OPD for thyroid hormonal tests ie estimation of T3, T4 & TSH were selected for this study. History was taken as per designed proforma and consent form was obtained. Their Blood samples was analysed for thyroid profile as well as renal function test ie Serum creatinine, urea, sodium & potassium (electrolytes) in clinical Biochemistry Laboratory . Thyroid tests was run on Elisa reader & washer while Urea , creatinine tests was done on Autoanalyser EM 460. Electrolytes serum Sodium & Potassium was estimated on Easylyte Electrolyte Analyser. Serum values of Thyroid stimulating hormone (TSH), thyroxine (T4) and tri-iodo thyronine (T3) were assayed by ELISA tests and compared with kidney tests and values were compared & correlated. The data was analysed & Student's T-test was used for the calculation. $P < 0.05$ was considered significant.

Result: Our results shows positive correlation between Serum TSH (Mean=4.63) and serum creatinine level (Mean= 1.014) as well as serum TSH and serum urea level (Mean 37.95) while TSH shows negative correlation with Sodium(Mean=137.72) and potassium level(Mean3.99).This positive correlation was found to be statistically significant between TSH and Creatinine, Urea, Sodium but not for potassium . Similarly vice versa with T3 and T4

Conclusion: The data presented here clearly indicates how the biochemical markers of renal function may be affected by alteration in the level of Thyroid hormones

in the body. This study showed a significant increase in creatinine in patients with hypothyroidism. These changes in kidney function tests may be a result of physiological effects, including alterations in renal hemodynamics.[9],[10] Our study shows that hypothyroidism(increased TSH) significantly increases serum creatinine levels and urea level and may results in renal dysfunction. So early screening of thyroid patients for renal function tests must be advised to prevent future kidney related disorders & further complications.

Key words: Renal function Tests, Thyroid dysfunction

Introduction

The function of the thyroid gland is one of the most important in the human body as it regulates majority of the body's physiological actions.[3] The thyroid produces hormones (T3 and T4) that have many actions including metabolism, development, protein synthesis, and the regulation of many other important hormones. Any dysfunction in the thyroid can affect the production of thyroid hormones (T3 and T4) which can be linked to various pathologies throughout the body. Thyroid hormones required for the growth and development of the kidney and for the maintenance of water and electrolyte homeostasis.[4] On the other hand, the kidney is involved in the metabolism and elimination of TH.

In hypothyroidism, there is a reduction in renal blood flow and glomerular filtration rate (GFR) and, hence, reduced clearance of creatinine and urea.[4] Thyroid dysfunction causes significant changes in kidney function; both hypothyroidism and hyperthyroidism affect renal blood flow, GFR, tubular function, electrolyte homeostasis and kidney structure.[5,6] Hyperthyroidism is characterized by an increase in renal plasma flow and GFR, resulting in a reduction of serum creatinine levels (Syme, 2007). Thyroid hormones affect renal function by both pre-renal and direct renal effects.

1. Pre-renal effects are mediated by the influence of thyroid hormones on the cardiovascular system and the renal blood flow (RBF).
2. The direct renal effects are mediated by the effect of thyroid hormones on

a. Glomerular filtration rate (GFR),
b. Tubular secretory and re-absorptive processes, as well as the
c. Hormonal influences on renal tubular physiology.

Thyroid hormones affect renal clearance of water load by their effects on the GFR. [7] The primacy of Na/K ATPase in solute transport of the PCT is well known. Thyroid hormones influence Na reabsorption at the PCT primarily by increasing the activity of the Na/K ATPase [8] and tubular potassium permeability. They have been shown to affect the renin – angiotensin – aldosterone axis by adrenergic regulation, renin release as well as influencing the angiotensinase activity [9]

Serum creatinine, an inverse marker of GFR, is significantly decreased in hyperthyroid patients, not only due to an increase in GFR but also due to the reduction in overall muscle mass.[10] . So thyroid dysfunction definitely lead to alterations in renal function tests like serum urea,creatinine which is sensitive marker of kidney disease as well as electrolyte imbalance ie sodium ,potassium level. So,clinicians, including nephrologists, must consider the dangers of thyroid disease and its appropriate treatment in conjunction to treating renal disorders & CKD.[11] Patients who receive appropriate treatment for their thyroid disease have a decreased chance of developing or exacerbating renal dysfunction.[12]

Objectives of the study

The aim of this study is

i) To study the correlation between Serum T3, T4 & TSH with Renal function test ie Serum Creatinine,urea & sodium ,potassium level

ii) To study correlation of Thyroid hormone dysfunction and severity of renal diseases so that early screening and prevention of renal disorders in thyroid patients can be advised

Method of collection of data &selection of subjects

100 patients attending the outpatient department of clinical Biochemistry, IGGMC, Nagpur were selected for study. 5 ml of Fasting blood sample was drawn from patients who were attending biochemistry OPD for thyroid hormonal tests ie estimation of T3, T4 & TSH. History was taken as per designed proforma and consent form was obtained. Their Blood samples was analysed for thyroid profile as well as renal function test ie Serum creatinine, urea, sodium & potassium (electrolytes) in clinical Biochemistry Laboratory to know status of kidney function tests .

Exclusion criteria: Patients who underwent peritoneal dialysis or hemodialysis, nephrotic range of proteinuria, other conditions such as acute illness, recent surgery, trauma or burns, and diabetes mellitus. Patients with liver diseases, patients taking drugs altering thyroid profile like amiodarone, steroids, dopamine, phenytoin, estrogen pills, and iodine containing drugs were excluded. Thyroid profile would be done in all patients who fulfill the inclusion criteria. Informed consent was obtained from all patients. Detailed clinical history and clinical examination were undertaken with preference to thyroid and renal diseases.

Thyroid tests was run on Elisa reader & washer while Urea , creatinine tests was done on Autoanalyser EM 460. Electrolytes serum Sodium & Potassium was estimated on Easylyte Electrolyte Analyser. Serum values of Thyroid stimulating hormone (TSH), thyroxine (T4) and tri-iodo thyronine (T3) were assayed by ELISA tests and compared with kidney tests and values were compared & correlated. The data was analysed & Student's T-test was used for the calculation. $P < 0.05$ was considered significant.

Methods

For Serum Creatinine Estimation: Kit based on Jaffes method (Autoanalyser)

(Normal range – 0.8 to 1.5 mg%)

For Blood Urea Estimation: Kit based on GLDH method (Autoanalyser)

Normal range – 10 to 50 mg%)

For Serum Na & K Estimation: Easylyte Electrolyte Analyser

(Normal range: Na – 135 to 145 meq/lit , K – 3.5 to 5.2 meq/lt)

For T3, T4, TSH: Immunoassay Elisa kit method on Elisa Reader & Washer

Normal Range: T3 - 0.52 to 1.85 ng/ml, T4 - 5 to 15 ug/dl , TSH – 0.39 to 6.16 uIU/ml

Analysis was carried on Autoanalyser EM – 460 in clinical Biochemistry lab,IGGMC for Urea & Creatinine & Easylyte Machine for Na & K,Elisa Reader for Thyroid tests . All estimations was done & their values were compared & correlated.

Results

Table 1 : Mean Values of thyroid test & Kidney test

Total (100)	T3	T4	TSH	Na	K	Creatinine	Urea
Mean	1.0427	6.611	4.634	137.72	3.994	1.014	37.95
S. D	0.340982	2.605	4.706	5.083	0.301	0.297	9.154

Table 2: Positive & Negative Correlation of Thyroid test with kidney test

Correlation	Na	K	Creat	Urea
T3	0.647359	0.075251	-0.65225	-0.52366
T4	0.710509	0.038431	-0.73599	-0.55039

Table 3: Student's T test (P <0.05 was considered significant.)

P value	Na	K	Creat	Urea
T3	<0.0001	0.4571,NS	<.0001	<0.0001
T4	<0.0001	0.7042,NS	<.0001	<0.0001
TSH	<0.0001	0.775,NS	<.0001	<0.0001

Discussion

Our results shows (Table 2) positive correlation between Serum TSH (Mean=4.63) and serum creatinine level (Mean= 1.014) as well as serum TSH and serum urea level (Mean 37.95) while TSH shows negative correlation with Sodium(Mean=137.72) and potassium level(Mean3.99).

This positive correlation was found to be statistically significant (Table 3) between TSH and Creatinine, Urea, Sodium but not for potassium . Similarly vice versa with T3 and T4. These findings similar to Den Hollander JG, Wulkan RW, Mantel MJet al [2]

The data presented here clearly indicates how the biochemical markers of renal function may be affected by alteration in the level of TH in the body. This study showed a significant increase in creatinine in patients with hypothyroidism. Findings of our study correlate with Kimmel M, Braun N, Alscher et al [13]

These changes in kidney function tests in humans may be a result of physiological effects, including alterations in renal hemodynamics.[14] In hypothyroidism, there is a reduction in renal blood flow and glomerular filtration rate (GFR) and, hence, reduced clearance of creatinine and urea. [14] Thyroid dysfunction causes significant changes in kidney function; both hypothyroidism and hyperthyroidism affect renal blood flow, GFR, tubular function, electrolyte homeostasis and kidney structure.

Hyperthyroidism is characterized by an increase in renal plasma flow and GFR, resulting in a reduction of serum creatinine levels Our study shows that hypothyroidism significantly increases serum creatinine levels .

Conclusion

This study is done to simplify the importance of interactions between thyroid function and kidney disease. This information is essential as it shows a link between two separate conditions. Information obtained from this paper will help to increase clinical knowledge and enable clinicians to provide better management for their patients who have thyroid or kidney dysfunction.

Patients who receive appropriate treatment for their thyroid disease have a decreased chance of developing or exacerbating renal dysfunction.

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