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Study on significant changes in calcium, phosphorus and thyroid hormones level in hypothyroidism patients

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Abstract

Background: Thyroid hormones have a vital role in metabolism of lipids, cholesterol etc. They also have an important role in phosphorous and calcium homeostasis by their direct effect on bone turnover. The objective of present study was to find the significant differences of T3, T4, TSH, lipid profile (HDL, LDL, vLDL, TG, Cholesterol), electrolytes and minerals (sodium, potassium, chloride, phosphorus, calcium) between control group and hypothyroidism patients.

Methods: Blood samples were collected from 72 patients and 12 control after their consent. Serum was used to determine biochemical parameters using standard protocol. Data obtained were statistically analyzed using "t" student test.

Results: The level of TSH was significantly higher in female and male hypothyroidism patients ($p < 0.01$) as compared to control and it was inversely related to the level of T3 and T4. Patients with hypothyroidism have increased level of LFTs profile especially cholesterol and Triglycerides levels both in males and females. In hypothyroidism, the level of glomerulus filtrate rate decrease especially sodium level but thyroid hormonal disturbance does not affect serum electrolyte level. The serum phosphorus and calcium levels change significantly in thyroid disorder.

Conclusion: Hypothyroidism is associated with increased TSH level and decreased T3 and T4 levels but does not appear to be associated with abnormalities in lipid profile. The serum phosphorus and calcium levels change significantly in thyroid disorder, Treatments of its primary causes should be given and if it is possible minerals can be added to avoid further bone complications.



Introduction

Thyroid disorders prevail strongly in the South Asian community mainly due to iodine deficiency and goitrogen consumption. In Pakistan male thyroid disorders are more common than female [1]. Hypothyroidism results from beneath secretion of internal secretion from the endocrine. It's 5-10 times a lot of common in females as compared to males [2]. The clinical presentation of glandular disease could vary from well to, rarely, with multisystem organ failure resulting in hypothyroidism coma [3]. Determining the precise incidence and prevalence rates for Hashimoto's rubor has been tough as a result of variable expression of this sickness. Some studies estimate that the present prevalence rate within the United States ranges between 0.3%-1.2% [4]. Primary glandular disorder is indicated once hormone level is high $>10\text{mIU/L}$ with diminished T3 and T4 levels. Secondary glandular disorder is diagnosed once hormone level is low $<0.4\text{mIU/L}$ with diminished T3 and T4 levels whereas the diagnosis of subclinical glandular disorder is especially supported with increased hormone level between $(4.5\text{-}10\text{mIU/L})$ with T4 and T3 inside the [5]. Lipoproteins profile is another fact affected in hypothyroidism [6]. Thyroid hormones play an important role in homeostasis of calcium and phosphorus levels by their direct action on bone turnover [7]. Study carried out by Suneel et and found that serum levels of calcium were significantly decreased in patients with hypothyroid ($p<0.001$) and phosphorus levels were significantly increased as compared to control [8]. Study carried out by Christopher Schwarza *et al.*, and found that level of phosphate was higher with elevated TSH in patients as compared to control TSH. The level of serum calcium was significantly lower with high TSH than with control TSH ($p<0.01$). The level of calcium and phosphate was significantly correlate with TSH as $p<0.0$ [9].

Serum HDL were significantly lower in patients as compared to control as $p<0.001$. It was found that level of LDL, HDL, VLDL, LDL, triglycerides was significantly higher as compared to control [10].

Patients with clinical or unconcealed glandular disorder exhibit reduced free T4 estimates and inflated thyroid-stimulating hormone levels [11]. Varied morphological and physiological changes of the thyroid throughout the method of aging square measure well-known [12]. The objective of this study was to find the Pleiotropic effects of hypothyroidism and level of T3, T4, TSH, lipid profile, electrolytes and minerals in human serum of patients as compared to control group.

Methods

Samples Collection: Blood samples were collected from 72 in vacutainer from patients and 12 control samples after their consent. Serum samples were used to determine the different biochemical parameters.

Determination of T3, T4 and TSH: Radioimmunoassay were carried out for the determination of T3 and T4 (IM1699 T3 RIA kit) and TSH (IM1699 TSH RIA kit) in human serum.

Biochemical analysis: A semi-automated clinical analyzer was used to estimate the biochemical parameters from serum containing HDL, LDL, TG, vLDL and cholesterol and results were compared between patients and in control. Its level was estimated using biochemical analyzer (Microlab 300). The concentration of Sodium, Calcium, and Potassium were also determined using standard methods.

Statistical Analysis: The data obtained from this study were analyzed by using Student "t" test to find out statistically significant differences between different variables.

Results

In patients with hypothyroidism, there is an inverse relation between T3, T4 and TSH. The study compromised 84 subjects within the age limit of 10 to 80. Among 84 subjects, there were 45 females and 39 males. Statistical analysis was carried out using the SPSS software. The results were reported as mean \pm S.D. student's t-test was used to determine whether differences between means were significant.

Comparison of T3, T4 and TSH in female patients with hypothyroidism and control: The results of the study showed that the mean values of T3 ($1.3882 \pm 0.51879\text{mIU/L}$) and T4 ($32.9345 \pm 14.18329\text{mIU/L}$) decreases in female patients with hypothyroidism as compared to control T3 ($1.8657 \pm 0.28924\text{mIU/L}$), control T4 ($116.4714 \pm 20.39074\text{mIU/L}$), but the level of TSH increases as compared to control samples (92.02 ± 26.99208 VS 1.9357 ± 0.6349) respectively (Table 1).

The mean values of T3 ($1.2509 \pm 0.59568\text{mIU/L}$) and T4 ($35.2912 \pm 18.7644\text{mIU/L}$) decreases in male patients with hypothyroidism as compared to control T3 ($1.71 \pm 0.35553\text{mIU/L}$) and control T4 ($119 \pm 26.9568\text{mIU/L}$), but the level of TSH increases in patients samples as compared to control samples (84.3544 ± 31.9564 VS 1.7733 ± 1.05097) as presented in Table 1.

Serum Lipid Profile levels in female and male hypothyroidism patients as compared to control: Full serum lipid profile tests was conducted on 72 hypothyroidism patients. Table 2 shows that Patients with hypothyroidism have statistically increased level of LFTs profile especially cholesterol, Triglycerides levels, vLDL and HDL both in males and females except HDL which was statistically non-significant.

Serum Electrolytes in female and male hypothyroidism patients as compared to control: Patients with hypothyroidism has decreased sodium level of 139.3526 ± 4.72759 in females and 139.6853 ± 6.34594 in males as compared to control samples. The level of Potassium are also statistically significant at $P<0.05$ in female but results were non-significant in male when compared to control (Table 3).

Serum minerals levels in female and male hypothyroidism patients as compared to control: Level of calcium and phosphorus were determined in the patients with hypothyroidism. The level of calcium

decreases in female hypothyroid patients (3.1263 ± 0.56122) as compared to control (8.7714 ± 0.23604) but the level of phosphorus (8.3316 ± 0.35037) in female patients with hypothyroidism was increased than the control (3.3143 ± 0.49473) (Table 4). The same trends were observed in the male when calcium and phosphorus levels were determined in hypothyroidism patients. Results were statistically significant at $p < 0.01$.

	Group	Female				Male			
		N	Mean	Std. Deviation	P value	N	Mean	Std. Deviation	P value
T3	Control	7	1.8657	0.28924	0.003	5	1.71	0.35553	0.04
	Patients	38	1.3882	0.51879		34	1.2509	0.59568	
T4	Control	7	116.4714	20.39074	0.000	5	119	26.9568	0.002
	Patients	38	32.9345	14.18329		34	35.2912	18.7644	
TSH	Control	7	1.9357	0.6349	0.000	5	1.7733	1.05097	0.000
	Patients	38	92.02	26.99208		34	84.3544	31.9564	

Table 1: Serum T3, T4 and TSH levels in female and male hypothyroidism patients as compared to control.

	Group	Female				Male			
		N	Mean	Std. Deviation	P value	N	Mean	Std. Deviation	p value
Cholesterol	control	7	175.5714	18.7248	0.004	3	154.666	8.02081	0.000
	Patients	38	217.138	72.4189		34	302.137	135.643	
TG	control	7	142.857	24.4637	0.00	3	129	4	0.000
	Patients	38	216.558	102.302		34	540.619	499.237	
HDL	control	7	41.1429	1.77281	0.48	3	41	1.73205	0.09
	Patients	38	40.5526	2.81595		34	38.2941	3.03045	
vLDL	control	7	25.1429	1.46385	0.000	3	24.3333	1.1547	0.000
	Patients	38	37.4737	10.1201		34	47.7353	4.44023	
LDL	control	7	109.714	19.0413	0.01	3	88	10.1488	0.000
	Patients	38	144.973	67.0298		34	213.35	101.394	

Table 2: Serum Lipid Profile levels in female and male hypothyroidism patients as compared to control.

	Group	Female				Male			
		N	Mean	Std. Deviation	P value	N	Mean	Std. Deviation	P value
Na	Control	7	140	2.70801	0.621	3	140.6667	5.03322	0.781
	Patients	38	139.3526	4.72759		34	139.6853	6.34594	
K	Control	7	3.9571	0.15119	0.015	3	4	0.36056	0.145
	Patients	38	4.1789	0.40855		34	4.4647	1.08315	
	Patients	38	105.3816	4.6044		34	103.4088	17.66747	

Table 3: Serum electrolytes in female and male hypothyroidism patients as compared to control.

	Group	Female				Male			
		N	Mean	Std. Deviation	P value	N	Mean	Std. Deviation	P value
PO ₄	control	7	3.3143	0.49473	0.368	3	2.9333	1.06927	0.932
	Patients	38	3.1263	0.35037		34	2.8735	0.33707	
Ca	control	7	8.7714	0.23604	0.002	3	8.9	0.2	0.01
	Patients	38	8.3315	.56122		34	8.1176	.40625	

Table 4: Serum minerals levels in female hypothyroidism patients as compared to control.

Discussion

The thyroid is amongst glands that store and release hormone into blood. Thyroid hormones then travel and affect the body cells. It is influenced by biochemical and other factors including sex, fruit, diet etc. of the person. During this study, different biochemical parameters were determined in order to find statistically differences between hypothyroidism patient and control group.

Result of thyroid hormone showed that decreased in the mean values of T3 and T4 whereas increased in TSH

when compared female patients with control group. It was supported by the study as carried out by Mohamed in which the same results were observed that significant increased TSH levels ($p=0.046$) in patients while there was significant decrease in T3 ($p=0.040$) and T4 (0.029) levels when compared with Control group [13].

The level of T3 and T4 also decreased whereas increased in level of TSH in male patients with hypothyroidism as compared to control level of T3, T4 and TSH. Our findings are in strong agreement with the previous study carried out by Chuang in 1998 that TSH is inversely correlated with T3 and T4 levels hypothyroidism [14]. Serum TSH levels in patients (3.33 ± 0.78) were significantly higher ($p < 0.001$) as compared to control group (2.30 ± 0.91) and significantly lower levels of T4 ($p < 0.001$) in the patients of metabolic syndrome (117.45) than in controls [15].

Patients with hypothyroidism have statistically increased level of LFTs profile especially cholesteol, Triglycerides levels, vLDL and HDL both in males and females except HDL which was statistically non-significant. According to Gutch, the serum HDL was significantly lower ($p < 0.001$) in cases (41.28 ± 8.81) as compared to controls (54.00 ± 6.31). The serum LDL, vLDL, triglyceride levels and total cholesterol were significantly higher ($p < 0.001$) as compared to controls [10] and our study supported this.

Patients with hypothyroidism has decreased sodium level of 139.3526 ± 4.72759 in females and 139.6853 ± 6.34594 in males as compared to control samples which are in agreement with finding described by Hassan that the level of sodium was significantly decrease in hypothyroid patients as compared to control group [16].

Our Results shows that Potassium are statistically significant at $P < 0.05$ in female but results were non-significant in male when compared to control. The level of electrolytes including potassium, sodium and chloride were reduced in hypothyroidism as compared to controls.

Level of calcium and Phophorus were determined in the patients with hypothyroidism. The level of calcium decreases in female hypothyroid patients but the level of phosphorus was increased than the control. Our outcomes are in agreement with the past examination directed by Shivaleela that the mean serum calcium levels were fundamentally lower in hypothyroidism patients ($9.14 \pm 0.51\text{mg/dl}$, $p < 0.01$) when contrasted with controls ($9.41 \pm 0.45\text{mg/dl}$) [17]. The finding proposes that there is critical changes in the degrees of serum calcium and phosphorus in thyroid disorder that is significant reason for secondary osteoporosis and can be utilized as an index of bone desorption.

Hypothyroidism is associated with increased TSH level and decreased T3 and T4 levels but does not appear to be associated with abnormalities in lipid profile. The serum calcium and phosphorus levels are significantly altered in thyroid disorder, Treatments of primary cause and if necessary supplementation of minerals should be done in order to prevent further bone complications.

Author Contributions

All authors contributed equally in designing, conducting, compiling and drafting of this study.

Conflict of Interest Statement

It is declare by the authors that they have no conflict of interest about the research paper or any of its part.

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