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Original Research Article

Study of Serum Magnesium, Calcium and Phosphorus Levels in Subclinical and Overt Hypothyroidism

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Abstract

Background: Hypothyroidism is one of the most common forms of hormonal dysfunction resulting from deficiency of thyroid hormone or its impaired activity. Various electrolyte and mineral disturbances have been observed in many studies. The role of thyroid hormones on mineral metabolism and its complications have not been established. ***Objective:*** To assess the alterations in the levels of serum magnesium, calcium and phosphorous levels in subclinical hypothyroidism. ***Materials and Methods:*** A descriptive case control study was done with a total 100 subjects in the department of Internal Medicine, Rangpur Medical College Hospital, Rangpur, Bangladesh from January 2008 to December 2008. 25 subclinical hypothyroidism cases, 25 overt hypothyroidism cases and 50 controls were taken. Blood sample for analyzing serum free T3, free T4, TSH, calcium, magnesium and phosphorus was taken and estimated in all subjects. ***Results:*** In this study the mean age of hypothyroidism (subclinical and overt) cases was 35.46 ± 7.26. A significant hypocalcaemia (P = 0.002) was observed in cases with overt hypothyroidism and a significant (P = 0.01) hyperphosphatemia was observed in cases with subclinical hypothyroidism. ***Conclusion:*** The present study showed a significant hypocalcaemia in overt hypothyroidism cases than controls and showed significant hyperphosphatemia in subclinical hypothyroidism. It can be concluded that there are various electrolyte disturbances in both subclinical and overt hypothyroidism, hence such disturbances need to be monitored prospectively to avoid further complications and needs to be treated accordingly.

Keywords: Subclinical Hypothyroidism, Overt Hypothyroidism, Serum Calcium, Magnesium, Phosphorus, TSH.

INTRODUCTION

The first description of thyroid diseases as they are known today was that of Graves disease by Caleb Parry in 1786. Thomas Curling first described hypothyroidism (myxedema) in 1850 and the cause and suitable treatment were established after 1883 [1]. Hypothyroidism is one of the most common forms of hormonal dysfunction resulting from deficiency of thyroid hormone or its impaired activity [2]. The mean annual incidence of autoimmune hypothyroidism is up to 4 per 1000 women and 1 per 1000 men. Subclinical hypothyroidism is found in 6-8% of women and 3% of men [3]. Subclinical hypothyroidism is defined as an elevated serum thyroid stimulating hormone (TSH) level associated with serum total free thyroxine (T4) and triiodothyronine (T3) concentrations within the reference range with few or no symptoms of hypothyroidism [4, 5]. Overt hypothyroidism is defined as low T4 levels and elevated serum TSH with evident clinical features. Thyroid gland is involved in a wide array of metabolic functions like regulation of lipid, carbohydrate and mineral metabolism. Mineral metabolism likes calcium, magnesium and phosphorous is frequently disturbed in thyroid dysfunctions [6]. Electrolytes pay an important role in many body processes, such as controlling fluid levels, acid-base balance, nerve conduction, and blood clotting and muscle contraction [2]. Studies have revealed that metabolic syndrome and cardiovascular diseases are related to disturbances in metabolism of magnesium and calcium in hypothyroidism [7-9]. Although hypothyroidism is very common in rural areas, studies on electrolyte imbalance in subclinical and overt hypothyroidism patients from rural India are lacking [2]. With this background, the present study was taken up to assess the levels of serum calcium, magnesium

and phosphorous in subclinical and overt hypothyroidism.

MATERIALS AND METHODS

A descriptive case control study was done with a total 100 subjects in the department of Internal Medicine, Rangpur Medical College Hospital, Rangpur, Bangladesh from January 2008 to December 2008. 25 subclinical hypothyroidism cases, 25 overt hypothyroidism cases and 50 controls were taken. Blood sample for analyzing serum free T3, free T4, TSH, calcium, magnesium and phosphorus was taken and estimated in all subjects.

Inclusion criteria: Subclinical and overt hypothyroidism patients, Age >18yrs, patients willing to participate in the study, age and sex matched normal subjects.

Exclusion criteria: Patients with Diabetes mellitus, patients with chronic kidney disease, patients with hepatic diseases, alcoholism, patients on drugs like phenytoin, diuretics, amiodarone, patients on mineral supplementation, severely ill patients.

Information was collected through a pre tested and structured proforma for each subject. In all the selected subjects, a detailed history and physical examination was noted. Every patient was subjected to relevant investigations after taking an informed consent. Data was collected as per the proforma. Free T3, Free T4, TSH, Serum calcium, Serum magnesium, Serum phosphorus, FNAC (Whenever ever required), USG Neck (Whenever required). CBC, RBS, Blood urea, Serum creatinine, Serum electrolytes, ECG. All data analysis SPSS windows Version 19.

RESULTS

A total of 100 patients, 50 hypothyroid patients (25 subclinical and 25 overt) and 50 controls who were attending Adichunchanagiri hospital and research center fulfilling the criteria were analyzed and results were tabulated accordingly. This study the mean age of hypothyroidism (subclinical and overt) cases was 35.46 ± 7.26. A significant hypocalcaemia (P=0.002) was observed in cases with overt hypothyroidism and a significant (P=0.01) hyperphosphatemia was observed in cases with subclinical hypothyroidism. In the study the mean age of cases is 35.78±8.91 and controls is 35.68±8.85. The present study showed a mean value of 10.40 ± 4.022 in cases and 2.86 ± 0.94 in controls. Mean of S. Magnesium in cases was 2.05 ± 0.15 and controls was 2.05 ± 0.15. Mean of S. Phosphorus levels in cases was 4.01 ± 0.14 and in controls was 3.80 ± 0.14. In the present study mean of S. calcium levels was 9.02 ± 0.74 and in controls was 9.35 ± 0.57. Mean of S. Magnesium levels in cases was 2.24 ± 0.28 and controls was 2.14 ± 0.21. The mean of S. Phosphorus levels in cases was 3.44 ± 0.94 and in controls was 4.05 ± 0.63.

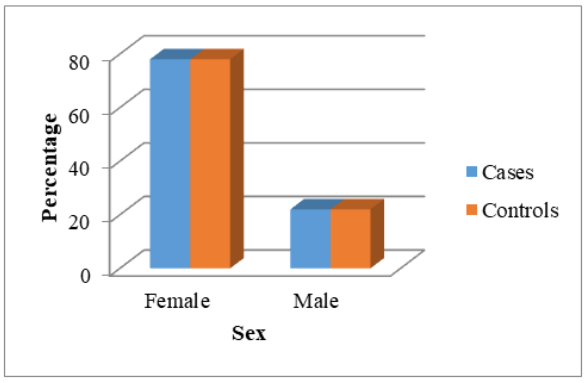

Fig 1: Sex distribution of the study.

Table 1: Age distribution of the study (N=100)

		Age in Years			Total	P value
		≤30 N (%)	31-40 N (%)	41-50 N (%)		
Group	Cases	18(36.0)	22(44.0)	10(20.0)	50	0.802
	Controls	17(34.0)	25(50.0)	8(16.0)	50	

Table 2: Correlation of TSH with S. Calcium, S. Magnesium and S. Phosphorus (N=100)

		S. CALCIUM	S. MAGNESIUM	S. PHOSPHORUS
TSH	Correlation Coefficient	-.270	.136	-.099
	p value	.007	.179	.325

Table 3: Correlation of Free T4 with S. Calcium, S. Magnesium and S. Phosphorus (N=100)

		S. CALCIUM	S. MAGNESIUM	S. PHOSPHORUS
Free T4	Correlation Coefficient	.391	-.042	.003
	p value	.000	.680	.979

Table 4: Correlation of S. calcium, S. magnesium and S. phosphorus with 25 cases of overt hypothyroidism and 25 controls (N=100)

	Group	N	Mean	Std. Deviation	p value	95% Confidence Interval of the Difference	
						Lower	Upper
S. CALCIUM	Overt Hypothyroidism	25	8.636	.9543	.002	-1.1698	-.2702
	Controls	25	9.356	.5709			
S. MAGNESIUM	Overt Hypothyroidism	25	2.200	.3742	.549	-.1214	.2254
	Controls	25	2.148	.2143			
S. PHOSPHORUS	Overt Hypothyroidism	25	4.044	.9408	.972	-.4637	.4477
	Controls	25	4.052	.6319			

DISCUSSION

Thyroid hormones regulate the body hemodynamics, thermoregulation and metabolism. It has an influence on renal hemodynamics, glomerular filtration and electrolyte handling [2, 7, 10, 11]. Thyroid disorders play an important role in causing secondary osteoporosis [12-14]. Hypothyroidism is one of the most prevalent endocrine disease which lead to a variety of clinical situations including electrolyte and mineral disturbances, congestive heart failure and coma. Calcium, magnesium and phosphorous homeostasis have been frequently disturbed in thyroid dysfunctions. Thyroid hormones affecting the glomerular filtration rate and blood flow, have a direct effect on Calcium and Magnesium resorption [7, 15]. Clinical studies done previously have suggested an association between subclinical hypothyroidism and coronary heart disease [4, 16, 17]. According to many case reports in literature, mineral disturbances were noticed in any kind of thyroid dysfunction. Thyroid hormone is important for normal growth and maturation of the skeleton. In hypothyroidism there is a decreased turnover due to impaired mobilization of calcium into the bone that leads to a decrease in blood calcium level. In hypothyroidism, there is also an increased production of thyroid calcitonin which promotes the tubular reabsorption of phosphate and helps in tubular excretion of calcium which leads to hypocalcemia and hyperphosphatemia. In hypothyroidism there is hypomagnesaemia because of urinary output and fractional excretion of magnesium through urine. Lower serum magnesium level in hypothyroid patients is due to impaired magnesium homeostasis [2, 18]. Animal study done by Kumar and Prasad concludes that renal calcium excretion was increased in rats with high TSH levels [19]. In the study done by Sridevi D *et al*., [7], the mean age of cases is 35.78±8.91 and controls is 35.68±8.85. In the study done by Padhiary M *et al*., [20], mean age is 35.69±8.04 in cases and 40.04±8.19 in controls. In a study done by Ashmaik A S *et al*., [12], mean age of cases is 33.26± 15.76 and controls is 32± 13.18. In the present study, mean age is 35.46±7.26 in cases and 35.28±6.98 in controls. The present study is comparable with study done by Sridevi D *et al*., [7]. In Gohel M G *et al*., [2] study, the mean TSH in cases is 13.87 ± 9.78 and in control is 2.49 ± 0.99. Mani V *et al*., [21] study showed mean TSH value of 6.28±1.01 among cases and 3.61±1.13 among controls. The present study showed a mean value of 10.40 ± 4.022 in cases and 2.86 ± 0.94 in controls which is almost comparable with study done by Gohel M G *et al*., [2]. In a study done by Abbas M M *et al.*, [4], the mean of serum calcium levels in cases was 8.42 ± 0.42, in controls was 9.01 ± 0.27. Mean of S. Magnesium in cases was 2.05 ± 0.15 and controls was 2.05 ± 0.15. Mean of S. Phosphorus levels in cases was 4.01 ± 0.14 and in controls was 3.80 ± 0.14. In the present study mean of S. calcium levels was 9.02 ± 0.74 and in controls was 9.35 ± 0.57. Mean of S. Magnesium levels in cases was 2.24 ± 0.28 and controls was 2.14 ± 0.21. The mean of S. Phosphorus levels in cases was 3.44 ± 0.94 and in controls was 4.05 ± 0.63. Hence the study done by Abbas M M *et al*., was almost comparable to the present study. The present study showed a significant (P = 0.002) low level of serum calcium in overt hypothyroid cases than controls. There was a significant positive correlation between TSH and serum calcium levels and significant negative correlation between TSH and serum phosphorus and magnesium levels. This was comparable with studies done by Shivaleela *et al*., [22], Kavitha M M *et al*., [23] and Mani V *et al*., [21] which concluded that there is significant decrease in serum calcium levels in hypothyroid patients compared to controls. It also showed a significant (P value=0.01) high level of phosphorus in subclinical hypothyroid cases than controls [24]. It may be due to increased production of thyroid calcitonin which promotes the tubular reabsorption of phosphate and tubular excretion of calcium, resulting in hyperphosphatemia and hypocalcemia, respectively. This study showed non-significant (P value>0.05) level of serum magnesium with subclinical and overt hypothyroidism.

CONCLUSION

The present study showed a significant hypocalcaemia in overt hypothyroidism cases than controls and showed significant hyperphosphatemia in subclinical hypothyroidism. It can be concluded that there are various electrolyte disturbances in both subclinical and overt hypothyroidism, hence such disturbances need to be monitored prospectively to avoid further complications and needs to be treated accordingly.

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