

ORIGINAL ARTICLE

Assessment of variations in serum Phosphorus, Calcium, Sodium and Potassium levels in hypothyroid patients

Gagandeep Kaur Sidhu^{1*}, Rahima Malek², Asha Khubchandani¹, Sohil Mansuri³, Pankaj Gaadhe², Anuja Adarsh²¹Associate Professor, Biochemistry Department, B.J. Medical College and Civil Hospital, Ahmedabad²Post-graduate student, Biochemistry Department, B.J. Medical College and Civil Hospital, Ahmedabad³MD PSM, SMO, WHO, Hamirpur

ABSTRACT

BACKGROUND: The thyroid hormones have an important role in homeostasis of Calcium and Phosphorous levels by their direct action on bone turnover. They also influence water and electrolytes homeostasis in the body. Disorders of thyroid function could be a cause of mineral and electrolyte disorders. Hypothyroidism is a common metabolic disorder in the general population. This study was done to know the effects of thyroid dysfunction on serum values of Phosphorus, Calcium, Sodium and Potassium and monitor any changes in hypothyroid patients.

MATERIALS AND METHODS: A cross-sectional study was done and included 100 individuals (50 hypothyroid cases and 50 normal controls). Serum TSH levels were estimated by Chemiluminescent Microparticle Immunoassay (CMIA) method to assess the hypothyroid cases. Serum Phosphorus, Calcium levels were measured by colorimetric method and Sodium & Potassium levels were estimated by Ion selective electrode method on fully automated chemistry analyser. **RESULTS:** Serum Phosphorus levels were significantly elevated, while Serum Calcium, Sodium and Potassium levels were significantly lowered in hypothyroid patients' group as compared to euthyroid controls. **CONCLUSION:** Evaluation of these parameters in hypothyroid patients will help in early detection and treatment of any imbalances. This can prevent complications and benefit in the management of hypothyroid patients.

Keywords: Hypothyroid, TSH, Phosphorus, Calcium, Sodium, Potassium

INTRODUCTION

Thyroid hormones play a key role in basic metabolic rate and whole metabolism in general. Thyroid hormones perform a wide array of metabolic functions including regulation of lipid, carbohydrate, protein, electrolyte and mineral metabolisms^{1,2}. Thyroid hormones are central regulator of body haemodynamics, thermoregulation and metabolism and have influence on renal haemodynamics, glomerular filtration, the renin angiotensin aldosterone system and renal electrolyte handling. Thyroid hormones are essential for normal growth and maturation of skeletal system. Thyroid dysfunction is frequently associated with disturbances of calcium and phosphorous homeostasis. Thyroid disorders are important cause of secondary osteoporosis^{3,4}. Hypothyroidism is accompanied by remarkable alterations in the metabolism of water and electrolytes. Electrolytes play an important role

in many body processes, such as controlling fluid levels, acid-base balance (pH), nerve conduction, blood clotting and muscle contraction^{5,6}.

This study was aimed to assess the variations in serum levels of Phosphorus, Calcium, Sodium and Potassium and study any significant difference in hypothyroid patients when compared to these parameters in euthyroid controls.

MATERIALS AND METHODS

Study setting and study type: The study was a Cross sectional study conducted at Civil Hospital, Ahmedabad during March-2016 to July-2016.

Sample size: The study sample included 50 hypothyroid cases and 50 euthyroid persons. Case group had a mean age of 41.94 ± 21.9 years; of which, 20% were men and 80% were women. The control group had mean age of 44.74 ± 5.66 years; of which, 26% were men and 74% were women.

Diagnostic test and criteria: Venous blood samples were collected in fasting state and samples were tested for the parameters. Diagnostic criterion for hypothyroidism was based on TSH level (Normal: 0.4- 4 μ IU/ ml).

***Corresponding Author:**

Gagandeep Kaur Sidhu

Associate Professor, Biochemistry Department,
B.J. Medical College and Civil Hospital,
Ahmedabad

Email: drgagandeepsidhu@rediffmail.com

The test methodology for Serum TSH level was by Chemiluminescent Microparticle Immunoassay (CMIA) method (Reference range: 0.4-4 μ IU/ml). Serum Phosphorus was estimated by Ammonium Molybdate method (Reference range:2.5-4.5mg/dl), Serum Calcium by Arsenazo III method (Reference range:8.4-10.4mg/dl), Serum Sodium and Serum Potassium by Ion Selective Electrode- Direct Method. (Reference range of sodium: 136-145mEq/L and potassium: 3.5-5.1mEq/L) in fully auto chemistry analyser.

Statistical Analysis: Data was entered under Microsoft Excel 2007 and epi info 7. Demographic data analysis was performed and unpaired t-test was used to show the significance of serum TSH, Phosphorus, Calcium, Sodium and Potassium levels between cases and controls. The entire data were analyzed using the software Graphpad. A p-value of <0.05 was considered to be statistically significant and p-value <0.001 was considered to be statistically highly significant.

RESULTS

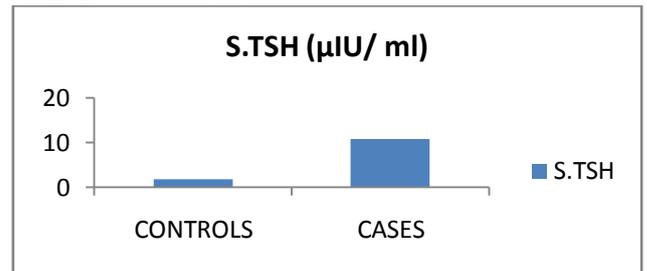
Table 1: Comparison of S.TSH, Phosphorus, Calcium, Sodium and Potassium in hypothyroid cases and normal controls

S.TSH(μ IU/ ml)	1.81 \pm 1.2	10
S.PHOSPHORUS(mg/dl)	4.29 \pm 3.3	6
S.CALCIUM(mg/dl)	8.69 \pm 0.07	7
S.SODIUM (mEq/L)	137.05 \pm 5.5	13
S.POTASSIUM (mEq/L)	4.15 \pm 0.18	3

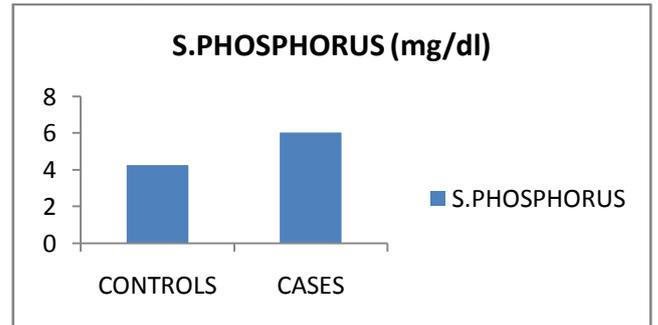
The table shows the values of TSH for hypothyroid cases (10.8 \pm 0.2 μ IU/ ml) in comparison to the value of controls in the study (1.81 \pm 1.2 μ IU/ ml), the p-value is <0.001. In this study the mean serum phosphorus level is higher in hypothyroid cases (6.06 \pm 0.2 mg/dl) as compared to euthyroid controls (4.29 \pm 3.3 mg/dl) and the p value is 0.02. The mean serum Calcium level is significantly lower in cases (7.7 \pm 0.89 mg/dl) as compared to controls (8.69 \pm 0.07 mg/dl) and p value is <0.001. The mean Sodium level is also significantly lower in cases (131.4 \pm 0.07 mEq/L) as compared to the controls (137.05 \pm 5.5 mEq/) with p value <0.001. Serum Potassium level mean is also significantly lower in cases (3.5 \pm 0.14 mEq/L) as compared to controls (4.15 \pm 0.18 mEq/L) with p value <0.001.

The graphs show significant difference in each parameter in cases & controls.

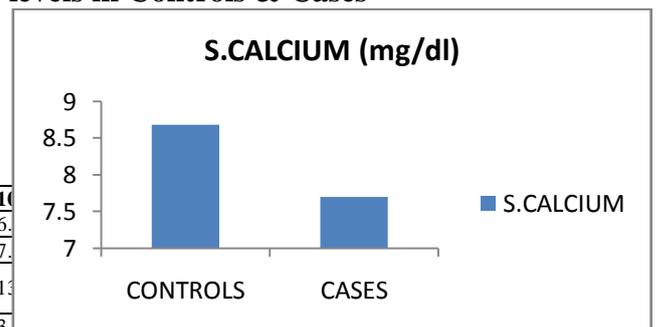
Graph 1: Comparison of Serum TSH levels in Controls & Cases



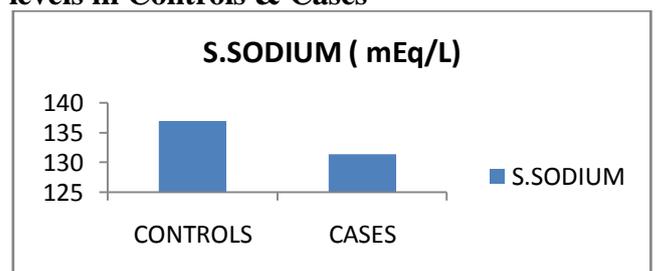
Graph 2: Comparison of Serum Phosphorus levels in Controls & Cases



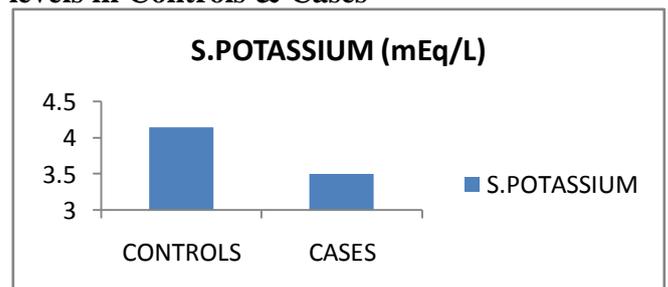
Graph 3: Comparison of Serum Calcium levels in Controls & Cases



Graph 4: Comparison of Serum Sodium levels in Controls & Cases



Graph 5: Comparison of Serum Potassium levels in Controls & Cases



DISCUSSION

This study shows that there are significant effects of hypothyroidism disorder on the minerals and electrolytes. There was significant increase in the values of serum phosphorus and highly significant decrease in the serum levels of calcium, sodium and potassium parameters.

The difference in serum phosphorus levels of hypothyroid patients was significantly higher as compared to euthyroid controls, and serum calcium values were significantly lower than the controls. Our study correlated well with studies done by Arvind Bharti et al⁷, Roopa Murgod et al⁸ and Kavitha MM et al⁹ which also demonstrated a higher phosphorus level and lower calcium levels in hypothyroid patients. However in the study done by Shivleela MB et al¹⁰, though the serum calcium levels were lower in cases but the levels of serum phosphorus were also significantly lowered in cases as opposed to our study. The increase in serum phosphorus levels may be due to increased production of thyroid calcitonin which promotes the tubular reabsorption of phosphate resulting in hyperphosphatemia and tubular excretion of calcium causing hypocalcemia¹¹. Regarding the lowering of blood calcium levels it could also be due to decreased thyroxine levels in blood stream which results in hypocalcemia because normally thyroxine has some role to regulate blood calcium levels and releases calcium from cells⁸. Hypocalcemia may result in neuromuscular irritability – peri-oral paraesthesia, tingling of toes and fingers and spontaneous or latent tetany¹², so these alterations should be corrected with mineral supplementation to avoid further complications. In our study the levels of sodium and potassium were lowered in hypothyroid cases than in normal controls. This was also observed in studies done by Hemantha Kumar et al¹³, Isha Malik et al¹⁴ and Roopa Murgod et al⁸. Our results for potassium levels were not consistent with results of the study done by Arvind Bharti et al⁷ which had significantly higher potassium levels in cases than controls. Also in the study done by Neha Sharma et al¹⁵, the difference in potassium levels was not significant between the cases and controls.

Thyroid hormones affect tubular transport of sodium via action on sodium potassium ATPase

pump and also affect potassium permeability in proximal tubules. The abnormality could be the inability to maximally suppress vasopressin(anti diuretic hormone) with normal fluid intake. Hypothyroidism causes a reversible increased insensitivity of the collecting ducts, thus increasing free water reabsorption. This increased fluid retention may not maximally suppress ADH in hypothyroidism^{16,17}.

Hyponatraemia may be associated with an increased risk of falls and fractures¹⁸ and hence it becomes important to monitor and provide corrections for electrolyte imbalances.

CONCLUSION

From this study we conclude that hypothyroid patients have elevated serum phosphorus level and low serum calcium, low serum sodium and low serum potassium levels. So it is important to regularly monitor these parameters in patients with hypothyroid disorder. In addition to treatment of the primary cause, supplementation of calcium should be done in order to prevent further bone complications. Electrolyte imbalance needs to be monitored and appropriately treated. Early detection and treatment can prevent complications and benefit in the management of thyroid patients.

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