Correlation of intact parathormone levels with serum calcium, serum phosphorus and serum vitamin D levels in surgical patients

Kumar N.1, Garg N.2, Gupta I.3

1Dr. Nilkamal Kumar, Associate Professor, Department of Surgery, 2Dr. Nita Garg, Professor & Head, Biochemistry, 3Dr. Ishita Gupta, Post Graduate Resident, Biochemistry, all authors are affiliated with SGRR Medical College, Dehradun, Uttarakhand, India.

Address of Correspondence: Dr. Nita Garg, Professor & Head, Department of Biochemistry, SGRR Medical College, Patel Nagar, Dehradun. Uttarakhand, India. E-mail: dmitagarg@yahoo.com

Abstract

Aim: The aim of our study was to determine a correlation between hyper parathyroidism and Serum Calcium, Phosphorus and Vitamin D levels. Study Design: A Hospital based cross-sectional study was conducted on the patients attending the Outpatient Department of Surgery, of SGRR Medical College, Dehradun (UK), during a period of 6 months from November 2016 to April 2017. A total number of 66 cases (32 male + 34 female) and 45 controls (20 male + 25 female) in the age group of 20-60 years were selected randomly for this study. Exclusion criteria were age less than 20 years and more than 60 years, pregnancy, diabetes, tuberculosis etc. Methodology: The blood samples were collected in fasting state and Serum iPTH, Vitamin-D, Calcium & Phosphorus levels were estimated on a fully automated machine 5600 of Ortho diagnostics. Results: The levels of iPTH were found to be higher in female cases than male cases and much higher when compared with controls both male & female. Both male & female hyper parathyroid cases were normocalcemic. Vitamin D levels were found to be lower in both male & female cases as compared to their normal counterparts. Serum Phosphorus levels were found to be on the lower side in both cases as compared with normal controls.

Keywords: Parathormone, Vitamin D, Calcium, Phosphorus.

Introduction

Parathyroid hormone is secreted by parathyroid gland that is important for bone remodeling, which is an ongoing process in which bone tissue is alternately resorbed and rebuilt over time. It increases blood calcium levels. The chief cells of the parathyroid glands secrete it as a polypeptide containing 84 amino acids, which is a prohormone. Parathormone essentially acts to increase the concentration of calcium in blood by acting upon parathyroid hormone 1 receptor, which is present at high levels in bone and kidney, and the parathyroid hormone 2 receptor that is present at high levels in the CNS, pancreas, testis and placenta [1]. Parathormone regulates Sr. Calcium through its effects on bone kidney and intestines [2]. Parathormone increases activity of 1α-hydroxylase enzyme, which converts 25-OH-cholecalciferol to 1,25 Dihydroxy cholecalciferol (the active form of vitamin D in kidney). Parathormone reduces the reabsorption of PO4 from the proximal tubule of the kidney [3].

The most wellknown function of Vitamin D/Parathormone axis is to maintain extracellular Calcium homeostasis [4]. Vitamin D, obtained largely from exposure to U.V B radiation and to a lesser extent from dietary and supplemental sources, increases the efficiency of intestinal calcium absorption, while parathormone is released in response to low circulating Calcium concentrations.

The release of Parathormone stimulates the reabsorption of Calcium in the kidney, the resorption of calcium from the skeleton and enhances the production of Calcitriol. Hypovitaminosis D is associated with increased parathormone secretion, increased bone turnover, Osteoporosis, Osteomalacia and an increased risk of fracture [5, 6, 7, 8].

Although the biological activities of Vitamin D are mainly manifested in the regulation of Calcium-Phosphorus metabolism, studies in the past 30 yrs indicate that vitamin D may play an important role in the immune system [9, 10].

Manuscript Received: 10th November 2017
Reviewed: 20th November 2017
Author Corrected: 28th November 2017
Accepted for Publication: 4th December 2017
Data regarding the relationship between hyperparathyroidism and Vitamin D, Calcium and Phosphorus levels is scarce and relationship between particular causes has not been analyzed, so we thought of conducting this study.

**Material & Method:** An hospital based cross sectional study was conducted on patients attending the Outpatient Department of Surgery of SGRR Medical College, Dehradun (U.K.), during a period of 6 months from Nov 2016 to April 2017.

A total number of 66 cases (32 male + 34 female) and 45 controls (20 male+ 25 female) in the age group 20-60 years were selected randomly for the study. **Exclusion criteria** were age less than 20 yrs and more than 60 yrs, pregnancy, Diabetes, Tuberculosis etc.

**Results**

The serum iPTH levels were found to be high in both hyper parathyroid males (208.88 ± 167.01 ±29.59pg/ml) and hyper parathyroid females (225.36±155.44±28.78 pg/ml) as compared to normal males (32.54±13.23±2.96 pg/ml) and normal females (23.09±1.88±0.38 pg/ml) respectively, p value was found to be <0.0001 which is highly significant. The serum iPTH levels were only slightly high in cases of hyper parathyroid female cases as compared to hyper parathyroid males, p value was not significant.

Both male and female hyper parathyroid cases were normocalcaemic (9.85±1.44 ±0.25 mg/dl) and (10.04±1.04±0.19 mg/dl) respectively, p value was not significant.

Vitamin D levels were found to be much lower in both male (12.52±1.09±0.20ng/ml) and female (11.75±3.36±0.62 ng/ml) hyper parathyroid cases as compared to normal males (27.05±11.25±2.50ng/ml) and normal females (19.52±6.05±1.21ng/ml) p value was found to be < 0.0001 which was highly significant. The serum vitamin D levels were only slightly high in cases of hyper parathyroid male cases as compared to hyper parathyroid female, p value was not significant.

Serum Phosphorus levels were found to be on the lower side in both male cases (2.80± 0.73 ±0.13mg/dl) and female cases (2.81±0.39±0.07mg/dl) as compared with normal male controls (32.54±13.23±2.96 mg/dl) and female controls (3.33±0.62±0.12mg/dl) respectively, p value was < 0.0007 which was highly significant.

There is almost no difference in the levels of Phosphorus in both male and female hyper parathyroid cases. Results are tabulated in Table (i) (ii) and (iii) and depicted graphically in Fig. 1, 2 & 3.

### Table-1: Comparison of male hyper parathyroid cases with their controls.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Males</th>
<th>Control</th>
<th>t-value</th>
<th>P-value</th>
<th>Significant/ Non-significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>iPTH</td>
<td>208.88 ± 167.01 ±29.59pg/ml</td>
<td>32.54±13.23±2.96pg/ml</td>
<td>4.68</td>
<td>&lt;0.0001</td>
<td>Significant</td>
</tr>
<tr>
<td>Calcium</td>
<td>9.85±1.44 ±0.25 mg/dl</td>
<td>9.68±0.67±0.15 mg/dl</td>
<td>0.50</td>
<td>0.6178</td>
<td>Non-significant</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>12.52±1.13±0.20 ng/ml</td>
<td>27.05 ± 11.28 ±2.50 ng/ml</td>
<td>7.33</td>
<td>&lt;0.0001</td>
<td>Significant</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>2.80± 0.73 ±0.13 mg/dl</td>
<td>3.52±0.62 ±0.14 mg/dl</td>
<td>3.63</td>
<td>&lt;0.0007</td>
<td>Significant</td>
</tr>
</tbody>
</table>
Figure-1: Comparison of male hyper parathyroid cases with their controls.

Table-2: Comparison of female hyper parathyroid cases with their controls.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Females Cases (34)</th>
<th>Control (25)</th>
<th>t-value</th>
<th>p-value</th>
<th>Significant/ Non-significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>iPTH</td>
<td>225.36±155.44±28.78 pg/ml</td>
<td>23.09±1.88±0.38 pg/ml</td>
<td>6.01</td>
<td>&lt;0.0001</td>
<td>Significant</td>
</tr>
<tr>
<td>Calcium</td>
<td>10.04±1.04±0.19 mg/dl</td>
<td>9.94±2.54±0.51 mg/dl</td>
<td>1.41</td>
<td>&lt;0.1580</td>
<td>Non-Significant</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>11.75±3.36±0.62 ng/ml</td>
<td>19.52±6.05±1.21 ng/ml</td>
<td>6.15</td>
<td>&lt;0.0001</td>
<td>Significant</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>2.81±0.39±0.07 mg/dl</td>
<td>3.33±0.62±0.12 mg/dl</td>
<td>3.98</td>
<td>&lt;0.0002</td>
<td>Significant</td>
</tr>
</tbody>
</table>

Figure-2: Comparison of female hyper parathyroid cases with their controls

Table-3 Comparison of male and female hyper parathyroid cases.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Male Cases (32)</th>
<th>Female Cases (34)</th>
<th>t-value</th>
<th>P-value</th>
<th>Significant/ Non-significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>iPTH</td>
<td>208.88 ± 167.01 ±29.59 pg/ml</td>
<td>225.36±155.44±28.78 pg/ml</td>
<td>0.39</td>
<td>0.6911</td>
<td>Non-significant</td>
</tr>
<tr>
<td>Calcium</td>
<td>9.85±1.44 ±0.25 mg/dl</td>
<td>10.64±1.04±0.19 mg/dl</td>
<td>2.53</td>
<td>0.0137</td>
<td>Non-significant</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>12.52±1.13±0.20 ng/ml</td>
<td>11.75±3.36±0.62 ng/ml</td>
<td>1.15</td>
<td>0.2534</td>
<td>Non-significant</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>2.80± 0.73 ±0.13 mg/dl</td>
<td>2.81±0.39±0.07 mg/dl</td>
<td>0.06</td>
<td>0.945</td>
<td>Non-significant</td>
</tr>
</tbody>
</table>
Discussion

According to the population-based surveys, hyperparathyroidism is now considered as the third most frequent endocrinopathy (after Diabetes mellitus and thyroid disease), with a prevalence of approximately 1/1000 in the general population [15].

In our study Vitamin D deficiency was the most common cause of elevated Parathormone levels in presence of normal serum calcium. Vitamin D deficiency is a well-known cause of secondary Hyperparathyroidism [16]. An inverse relationship exists between 25OH Vitamin D and parathormone [17]. When Vitamin D decreases below the normal range, the parathyroid gland responds with increased synthesis and secretion of parathormone. However, the mechanism by which Vitamin D deficiency increases parathormone levels is not clear, at least it does not seem to be mediated through serum calcium levels because serum calcium levels are normal and yet parathormone levels are elevated.

The diagnosis of Hyperparathyroidism is usually based on the measurement of serum calcium or parathormone levels [18]. Less obvious presentations such as normocalcaemic hyperparathyroidism is more and more frequently detected [19]. It is of note that, due to more systematic measurement of serum calcium, Hyperparathyroidism has shifted from a rare disease with severe bone and/or renal complications to a frequent, mostly asymptomatic disease.

Our study supports others which indicate the inverse correlation of Vitamin D and parathormone [20, 21, 22, 23] even though Kilicarslan, Cenolaslan, and Gezgen [24] reported that in their study 75% of Vitamin D deficient patients had normal levels of parathormone.

Arabì et al stated that the negative relationship between vitamin D & parathormone is modulated by age but not by gender. Reports from the Middle Eastern countries indicate that an inverse relationship exists between vitamin D and parathormone levels in all age groups. [25]

Adrawì et al in their study found that the inverse relationship between vitamin D and parathormone was not influenced by the level of vitamin D and could not pinpoint the levels of vitamin D at which parathormone levels will plateau [26]. From the studies cited above, it appears that various factors play a role in raising the parathormone levels, but one important factor that increases the parathormone is a level of vitamin D below 20ng/ml. We also observed a strong inverse correlation of Phosphorus levels with hyperparathyroidism. Phelan et al found no relationship between parathormone above & below 300pg/ml and mortality. A low calcium levels, low phosphorus levels and a high Parathormone level seem to increase the risk of mortality. [27]

Limitation of the study is that analyses were based on observational data and therefore, no causal inference can be made from the study results. Another limitation was that results could not be stratified due to the relatively small sample size.

Conclusion

In conclusion we report the co-existence of Vitamin D deficiency and hyperparathyroidism, with depletion of vitamin D masking the biochemical diagnosis of hyperparathyroidism. Above all it will be of paramount importance to prescribe Vitamin D supplementation in order to increase the Vitamin D serum levels when it is
initially low (even marginally). Patients started on Vitamin D therapy for low Vitamin D and elevated Parathormone levels, should be monitored periodically to ensure that Parathormone levels return to normal. If Parathormone remains elevated despite successful Vitamin D replacement, then hyperparathyroidism needs to be considered as a concurrent diagnosis.

Acknowledgement: All the authors provided medical writing support and there is no conflict of interest that would prejudice the scientific impartiality of this work.

Conflict of interest: None declared.

Funding: Nil. Permission from IRB: Yes

References

1. Physiology: 5/5 ch.6/S 5ch-11-Essentials of Human Physiology.


How to cite this article?