A Study on Serum Calcium Level in Resistant Hypertension

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ABSTRACT

Introduction: Hypertension is one of the common public health problem in the world and gradually increasing in Nepal. Serum calcium level has shown to be associated with cardiovascular disease. Disturbed calcium metabolism plays important role in pathogenesis of essential hypertension.

Methods: Four hundred people including 200 normotensives and 200 hypertensives were enrolled in the study, their blood pressure and total serum calcium were measured. Hypertensive group was divided into two: Hypertensives on Calcium channel blockers (CCBs) and hypertensive other than CCBs. Serum Calcium level was measured with calcium-O- Cresophalein complex(OCPC) reaction. All other baseline investigations including blood sugar, renal function tests, complete blood counts, thyroid function tests were done to exclude secondary causes in hypertensive group. Statistical analysis was done using SPSS version 21. Differences between the groups were analyzed with independent “t” test.

Results: Significant difference in serum calcium level was found in between normotensive and hypertensive. Difference in serum calcium level between hypertensive on CCBs and hypertensive other than CCBs were insignificant.

Conclusion: Significantly reduced serum calcium level is found in hypertensive individuals as compared to normotensive group. Lower level of serum calcium level affects the blood pressure. Essential Hypertension is associated with significant familial predisposition.

Key words: Essential Hypertension, JNC VII, OCPC complex, Serum calcium

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INTRODUCTION
Hypertension is one of the leading causes of death and disability among adults all over the world. It remains the major risk factor for coronary, cerebral and peripheral vascular disease. Essential hypertension comprises more than 90% of hypertension. Hypertension is an emerging health problem in Nepal. The burden of hypertension is 6% to 32% worldwide. According to an estimate overall 26.4% of the adult population in year 2000 had hypertension and 29.2% will be projected to have this condition by year 2025. Approximately 54% of all strokes and 47% of all ischemic heart disease were attributed to high blood pressure.

Disturbed calcium metabolism plays important role in pathophysiology of essential hypertension. Calcium acts as an intracellular second messenger in excitation-contraction coupling in vascular smooth muscle cells (VSM). The free intracellular calcium concentration determines the tension in VSM cells, thereby contributing to peripheral vascular resistance (PVR). Increased PVR is found in HTN. In one hypothesis a primary calcium deficiency in essential hypertension has been linked to subsequent membrane instability and altered intracellular free calcium concentrations. In a country like Nepal, people tend to have a diet rich in Sodium and poor in Potassium, and Calcium. JNC 7 classification is used for grading of hypertension.

METHODS
This is a cross sectional study on the total serum calcium level on essential hypertensive patients which was conducted in Cardiology department of Manmohan Cardiothoracic Vascular and Transplant Centre (MCTVS), Tribhuvan University Teaching hospital for a period of 6 months (Sept 2012 to Feb 2013). Total of 400 Patients were enrolled in the study visiting cardiology department of MCTVS, divided into experimental group is divided into 2 main groups: Normotensive group (control) comprising 200 subjects visiting for nonspecific chest pain and non-hypertensive between 20 to 70 years. Hypertensive group (Case) comprising 200 patients, between 20 to 70 years. Hypertensive group (Case) comprising 200 patients, between 20 to 70 years. Two patients were already diagnosed or newly diagnosed to have essential hypertension.

RESULTS
Among 198 patients enrolled in hypertensive cases, male population of 59.4% were affected. 82 patients of age group 40-50 years had highest incidence of Hypertension. Most common risk factor was familial found in 55 patients.

Table 1: Demographic and test parameters of the participants in both groups. All are noted to be mean values taken from the statistical analysis.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Normotensive (N= 200)</th>
<th>Treatment with CCB</th>
<th>Treatment without CCB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>37.9 ± 9.16</td>
<td>49.8 ±9.83</td>
<td>50.7 ± 9.959</td>
</tr>
<tr>
<td>BMI (Kg/m2)</td>
<td>23.14 ± 2.12</td>
<td>24.66 ± 1.81</td>
<td>24.48 ± 1.78</td>
</tr>
<tr>
<td>Serum calcium level (mmol/L)</td>
<td>2.39 ± 0.08</td>
<td>2.12 ± 0.16</td>
<td>2.13 ± 0.11</td>
</tr>
<tr>
<td>SBP (mmHg)</td>
<td>121.29 ± 7.62</td>
<td>133.52 ± 11.41</td>
<td>140.42 ± 16.72</td>
</tr>
<tr>
<td>DBP (mmHg)</td>
<td>76.59 ± 6.76</td>
<td>85.07 ± 10.64</td>
<td>89.32 ± 13.98</td>
</tr>
<tr>
<td>MAP (mmHg)</td>
<td>91.49 ± 5.82</td>
<td>101.22 ± 9.08</td>
<td>106.35 ± 13.30</td>
</tr>
<tr>
<td>Duration of treatment (Years)</td>
<td>-</td>
<td>2.95 ± 2.66</td>
<td>1.35 ± 1.87</td>
</tr>
</tbody>
</table>

Table 2: Differences in serum calcium level between normotensives and hypertensive

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Normotensive (N= 200)</th>
<th>Hypertensive (N= 198)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum calcium level (mmol/L)</td>
<td>2.39±0.08</td>
<td>2.13±0.14</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

There was significant difference in serum calcium level noted in 2 groups.
Grade II hypertension was associated with lower level of serum calcium level as compare to grade I hypertension, but was not statistically significant.

**DISCUSSION**

This study shows significant decrease in total serum calcium level in hypertensive patients than normotensive controls and the results are in close agreement with that of Sudhakar, Sujhata, Babu, Padmanathi and Reddy. Though there are not enough study describing the relation of serum calcium and hypertension, but the findings of the present study are in agreement with that of Sudhakar, Sujhata, Babu, Padmanathi and Reddy. Toyuz et al also reported reduced serum calcium level in hypertensive individuals. However, Kosch et al did not find any changes in serum calcium levels in hypertensive individuals. In approximately two third of the studies based on this subject done by 1994, increase in calcium intake produced a mild antihypertensive response, with an average decrease of 4-7 mm Hg systolic and 2-4 mm Hg diastolic blood pressure.

Serum total calcium is the total sum of 3 forms, ionized or free, protein-bound and soluble form complexed with anions such as bicarbonate and phosphate. Around 50% of total serum calcium is in the ionized form, 40% in the bound form mainly to albumin, and 10% bound to anions. Ionized calcium, the physiologically active form in the blood, is an accurate indicator of calcium homeostasis. However, ionized calcium measurement is more expensive and is affected by a number of factors including method of collection, choice of anticoagulant, pH changes, and variability of reference range used by different laboratories using different analyzers. Total calcium measurement is least affected by these changes, correlates well with ionized calcium measurement, and is routinely used in clinical practice to assess calcium status in health and disease.

**CONCLUSION**

Decreased level of serum calcium level is associated with essential hypertension. There is no significant variation in serum calcium level in hypertensive treated with Calcium Channel blockers and without CCBs. Essential hypertension has significant genetic predisposition. It also can be concluded that serum calcium may be used as a diagnostic and prognostic marker for essential hypertension. Further, the study also reveals a state of hypocalcemia in hypertensives, so the study therefore opens avenues for prevention and treatment of hypertension and fatal complications like stroke, myocardial infarction and renal failure by serum calcium estimation and their therapeutic supplementation.

**REFERENCES**

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<table>
<thead>
<tr>
<th>Parameter</th>
<th>Grade I Hypertension N= 37</th>
<th>Grade II Hypertension N= 15</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum Calcium Level(mmol/L)</td>
<td>2.13±0.10</td>
<td>2.11±0.11</td>
<td>0.702</td>
</tr>
</tbody>
</table>

Table 3: Serum calcium level in grade I and grade II hypertensive subjects.