Seasonal Variation of Vitamin D in Ischemic Stroke

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Abstract
This study aimed to investigate the seasonal variation of serum vitamin D level in ischemic stroke patients. 217 patients with ischemic stroke were selected for analysis between ages 45 and 80 yrs admitted at our hospital from Jan 2014 to Dec 2015. Measurements of serum vitamin D concentration was made by electrochemiluminescence immunoassay. Confounding variables like diabetes, hypertension, smoking, alcohol, tobacco, dyslipidemia, BMI, CRP, S. uric acid, duration of sunlight exposure, prior history of drug intake or fracture and S. calcium were considered. 200 age and sex matched controls were taken. The mean serum level of vitamin D was 19.14 +/- 9.45 SD ng/mL. Highest vitamin D levels were seen in the month of July and low levels were seen during August and September. Vitamin D levels varied according to duration of sunlight exposure and season in ischemic stroke patients.

Keywords- Vitamin D, cerebral infarction, seasonal variation

Introduction
Low vitamin D levels were observed in majority of patients of ischemic stroke¹. With change of season the duration for which the UV-B rays are incident on earth changes² also with increasing latitude there is more slanting of incident sunlight³. Cholecalciferol is synthesized in the skin when the UV B rays fall on it⁴. Increase in melanin was associated with low vitamin D synthesis⁵. Low vitamin D levels have been linked to several cancers⁶, diabetes⁷, hypertension⁸ and cardiovascular diseases⁹. Vitamin D has been shown to have paracrine and autocrine effects on various tissues of the body¹⁰. It has pleiotropic effects on the cell and modulates cell differentiation and proliferation¹¹.

Methods
217 cases and 200 age and sex matched controls were selected from the outpatient department and medicine wards from January 2014 to December 2015. The cases satisfying the definition of ischemic
stroke were chosen and stroke was defined as rapidly developed signs of focal (or global) disturbance of cerebral function lasting >24 hours (unless interrupted by surgery or death), with no apparent nonvascular cause. Patients with clinical diagnosis of stroke aged > 30 years irrespective of sex were included in the study if their CT scan of head or MRI Brain showed features of ischemic stroke while known cases of congenital heart disease, valvular heart disease, cardiomyopathies and connective tissue disorders were excluded. Questionnaires were used for recording history and examination including total number of hours spent in sun. Serum vitamin D (25-hydroxy vitamin D) levels were measured by chemiluminescence method by Architect i1000SR Machine (Abbott laboratories, Abbott park, IL 60064 USA) from morning fasting sample. Serum uric acid, serum calcium, phosphorus, CRP, complete blood count, serum creatinine, BUN, Liver function tests, serum electrolytes, blood sugar (fasting and post prandial) and lipid profile of patients were measured by fully automated analysers. CT scan of Head (plain) and MRI Brain (wherever feasible and indicated) were done.

Results

Table 1: Characteristics of ischemic stroke patients

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>140(65%)</td>
<td>77(35%)</td>
</tr>
<tr>
<td>Average Weight(kg)</td>
<td>62.25</td>
<td></td>
</tr>
<tr>
<td>Average Height (cm)</td>
<td>160.67</td>
<td></td>
</tr>
<tr>
<td>Average BMI (kg/m²)</td>
<td>24.12</td>
<td></td>
</tr>
</tbody>
</table>

12.9% cases had adequate vitamin D levels whereas 70.04% cases had vitamin D deficiency. 22% controls had adequate vitamin D levels whereas 43% controls had vitamin D deficiency. Highest vitamin D levels were seen in the month of July as during this period most of the days were sunny and low levels were seen during August and September as most of the days were cloudy. (fig 1)

Figure 1: Month wise average vitamin D levels in cases

The variation of vitamin D levels with change in months was not statistically significant. (KW=12.73, p = 0.31) Vitamin D deficiency was higher in cases(87%) as compared to controls(78%) and this association was found to be statistically significant(Chi square = 5.409, df=1, P = 0.02 and Odds Ratio=0.5253(95% CI:0.3125 to 0.8828)) (table 2)

Table 2: Comparison of deficiency of vitamin D in cases and controls

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Vitamin D (ng/ml) in cases</th>
<th>Vitamin D (ng/ml) in controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>19.142</td>
<td>23.974</td>
</tr>
<tr>
<td>N</td>
<td>217</td>
<td>200</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>9.453</td>
<td>13.125</td>
</tr>
</tbody>
</table>

Mean vitamin D level in cases was 19.142 +/- 9.453 SD ng/ml whereas in controls it was 23.974 +/- 13.125 SD ng/ml. This association was found to be statistically significant (t = 4.338 df=415 P=<0.0001) (table 3)

Table 3: Vitamin D levels in cases and controls

<table>
<thead>
<tr>
<th>Vitamin D (ng/ml)</th>
<th>Cases</th>
<th>Controls</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;30</td>
<td>189(87%)</td>
<td>156(78%)</td>
<td>345</td>
</tr>
<tr>
<td>&gt;30</td>
<td>28(12.9%)</td>
<td>44(22%)</td>
<td>72</td>
</tr>
<tr>
<td>Total</td>
<td>217</td>
<td>200</td>
<td>417</td>
</tr>
</tbody>
</table>
Discussion
Among the stroke patients seasonal variation was seen contrary to Chaudhary et al\textsuperscript{12} who found no seasonal variation of vitamin D. Most of the cases and controls in our study were deficient in vitamin D similar to that stated by Lips P et al\textsuperscript{13} where serum 25(OH)D was lower with higher latitudes and with darker skin types. Low vitamin D levels were observed in 83\% subjects in our study whereas 70.4\% patients were deficient in the study done by Verdoia M et al\textsuperscript{14}. They included patients undergoing elective coronary angiography whereas we included ischemic stroke and non stroke individuals. Hsu JJ et al\textsuperscript{15} found that there is a narrow range of vitamin D levels in which vascular function is optimized. Levels above or below this range seem to confer a significant increase in risk for cardiovascular disease. With increased distance from the equator there were higher mortality rates as recognized by Fleck \textsuperscript{16}. In the United Kingdom Grimes et al\textsuperscript{12} also recognized that mortality from IHD was inversely proportional to the amount of hours of sunlight. He proposed vitamin D as a protective factor by regulating serum cholesterol levels or by inhibiting \textit{Chlamydia pneumoniae}, once thought to be a cause of coronary heart disease. Douglas et al\textsuperscript{18} recognized that incidence and mortality rates from coronary heart disease demonstrated a strong seasonal pattern with higher rates in the winter, when vitamin D levels are lowest. Rostand\textsuperscript{19} reported that with increasing distance from the equator the blood pressure increased and suggested that cutaneously synthesized vitamin D could be playing a role in the regulation of blood pressure.

Conclusion
Majority of the population is deficient in vitamin D levels.

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References


