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ORIGINAL ARTICLE

PREVALENCE AND PROFILE OF VITAMIN D IN INFANTS

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ABSTRACT

Aim: To determine the prevalence and profile of vitamin D in infants.

Methods: This cross-sectional analysis was done over a period of 6 months in 29 infants admitted in our pediatric ward at a tertiary referral hospital. Their serum 25 hydroxyvitamin D, calcium, phosphorous, alkaline phosphatase and hemoglobin levels were noted. Association of vitamin D levels with various clinical and laboratory markers were analyzed.

Results: Mean age of presentation was 6.1 ± 3 months. Male to female ratio was 15:14. Mean serum calcium was 9.2 ± 1.7 mg/dl, alkaline phosphatase was 501.6 ± 427.3 IU/ml and phosphorus was 5.1 ± 1.4 and mean serum vitamin D levels were 15.7 ± 10.9 ng/ml. Vitamin D was deficient in 10 (34.5%) patients and insufficient in 11 patients (37.9%). Lower respiratory tract infection (LRTI) was present in 17 (58.6%) patients, hypocalcemic seizures were present in 7 (20.7%), anemia was seen in 25 (86.2%) and 16 (55.2%) patients were malnourished. Gender (p=0.46), anemia (p=0.608), malnutrition (p=0.184), LRTI (p=0.514), hypocalcemia (p=0.0.7), elevated alkaline phosphatase (p=0.11) had no association with vitamin D levels whereas low serum phosphorous levels (p=0.031) was more common in those with insufficient vitamin D levels and seizures were common in those with vitamin D deficiency.

Conclusion: Vitamin D insufficiency and deficiency is highly prevalent in infants less than 1 year of age. Low serum phosphorus is seen in vitamin D insufficiency. Seizures occur in patients with vitamin D deficiency.

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KEYWORDS
Vitamin D deficiency, vitamin D insufficiency, infants.

Introduction

There is a high prevalence of Vitamin D deficiency worldwide amongst infants and toddlers.[1] Studies have proven that exclusively breast-fed infants have a higher risk of developing vitamin D deficiency.[2] A comparative study carried out in Delhi showed that vitamin D deficiency was found universally in both low birth weight and normal birth weight infants thus emphasizing on the high prevalence of vitamin D deficiency in infants.[3] Vitamin D deficiency has been found to occur in several cases with acute respiratory tract infections. Moreover, vitamin D receptor (VDR) polymorphisms have been associated with acute lower respiratory tract infections (LRTIs), predominantlyrespiratory syncitial virus (RSV) bronchiolitis in infants.[4] In a study carried out in Ethiopia, 42% of children below 5 years of age suffering from pneumonia were found to have vitamin D deficiency.[5] According to a study carried out in India there is a definitive correlation between subclinical vitamin D deficiency and acute LRTIs.[6] The possible cause for vitamin D deficiency being a risk factor for LRTI is that vitamin D is required for the optimum functioning of the immune system and has the potential to provide protection against infections.[7,8] There have been several attempts to prevent or cure LRTI by using Vitamin D supplementations. In a trial carried out in Afghanistan,Vitamin D supplementation in patients with LRTI was found to only decrease the chances of "relapse" but not the period of pneumonia[9] thus supporting the immunity-based function of Vitamin D.

We undertook this study to determine the prevalence and biochemical profile of vitamin D in infants. We also tried to establish whether there was a significant relation between infants with LRTI and vitamin D deficiency.

Methods

This cross-sectional analysis was done over a period of 6 months at a tertiary referral center. All infants admitted in the pediatric ward were included in the study. Patients above 1 year of age were excluded from the study. Serum 25 hydroxy vitamin D, calcium, phosphorous, alkaline phosphatase and hemoglobin levels were noted and markers for insufficiency and deficiency were analysed. Association with LRTI was looked for. Growth records were noted and patients with weight less than the 5th centile as per Agarwal's charts were considered malnourished.[10] The normal laboratory range of serum calcium levels were 9-11 mg/ml, serum

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Table 1. Biochemical profile of the patients

Parameter	Mean + SD	Range
Serum Calcium (mg/dl)	9.2 + 1.7	5 -11.6
Serum Phosphorous (mg/dl)	5.1 + 1.4	2.6-8.5
Alkaline phosphatase (IU/L)	501.6 + 427.3	123-1627
Vitamin D (ng/ml)	15.7 + 10.9	5-43
Hemoglobin (gm/dl)	9.1 + 2.4	4.4-16
Recovery Days	5.4 + 2	4-12

Table 2. Association of deficient and insufficient vitamin D levels and various clinical parameters

	Vitamin D insufficient (n=11)	Vitamin D deficient (n=10)	Vitamin D sufficient (n=8)	p value
Male Female	4 (36.4%) 7 (63.6%)	6 (60%) 4 (40%)	5 (62.5%) 3 (37.5%)	0.46
LRTI	8 (72.7%)	5 (50%)	4 (50%)	0.514
Low serum calcium levels	2 (18.2%)	6 (60%)	1 (12.5%)	0.0.7
Elevated Alkaline phospha-tase levels	11 (100%)	7 (70%)	7 (87.5%)	0.11
Anemia	10 (90.9%)	8 (80%)	8 (100%)	0.608
Malnour-ished	7 (63.6%)	3 (30%)	6 (75%)	0.184
Low serum phospho-rous levels	8 (72.7%)	2 (20%)	2 (25%)	0.031
Seizures	1 (9%)	6 (60%)	0	0.023

phosphorous were 5-7 mg/ml, alkaline phosphatase was up to 180 IU/L and hemoglobin less than 11 mg/dl were low. 25 hydroxy vitamin D levels were recorded as sufficient if greater than 20 ng/ml, insufficient if found to be between 11-20 ng/ml and deficient if less than 11 ng/ml.[11] Patients presenting with seizures and hypocalcemia were labeled as hypocalcemic convulsions and those presenting with cough and breathlessness with or without fever were labeled as LRTIs. Days to recovery were recorded

Statistical analysis: Data was analyzed using Graph pad software. The biochemical parameters were recorded as Mean Standard deviation and unpaired' test was applied. The association between vitamin D levels and gender, LRTI, anemia, alkaline phosphatase levels, serum calcium levels, malnourishment and serum phosphorous levels were found by calculation of p-value by Chi Square Test or by Fishers exact test. The association was considered statistically significant if the p value was <0.05.

Results

A total of 30 children underwent estimation of 25 hydroxy (OH) vitamin D levels but only 29 were included in the study as one child was above 1 year of age. Mean age of presentation was 6.1 ± 3 months with a range of 0.16–12 months. Male to female ratio was 15:14. The various biochemical parameters are depicted in Table 1. Low serum calcium was found in 8 (27.6%) patients, low serum phosphorous levels were found in 12 (41.3%) patients and high alkaline phosphatase levels were found in 24 (82.8%) patients. 25 OH vitamin D levels were deficient in 10 (34.5%) patients, insufficient in 11 (37.9%) patients and sufficient in 8 (27.6%) patients. Twenty-five patients (86.2%) were found to have anemia, 16 (55.2%) patients were malnourished, and 6 (20.7%) patients had associated hypocalcemic seizures. LRTI was seen in 17 (58.6%) patients. Association of vitamin D levels with various clinical and biochemical parameters are depicted in Table 2.

Discussion

A high prevalence of vitamin D deficiency has been recorded in the Indian population especially amongst newborns and their mothers.[9] The prevalence of vitamin D deficiency in pregnant women in India was found to be 84% which "correlated significantly" with the vitamin D levels of their newborn infants.[9] In our study also, we found that 89% of infants either had low or insufficient vitamin D levels suggestive that Vitamin D levels are low in infants in Indian population.

RSV is the most important pathogen responsible for acute LRTIS in infants.[4] According to a study to establish the association between plasma vitamin D levels at birth and subsequent risk of RSV LRTI, concentrations of vitamin D were lower in neonates who developed LRTI as compared to those who didn't, and neonates born with vitamin D concentrations less than 50 ng/ml were found to have a six-fold increased risk of RSV LRTI in the first year of their life.[4] In our study, though 58% of children with low vitamin D levels had LRTI, we could not prove an association with LRTI and vitamin D levels.

In our study, 82.8% of the patients were found to have elevated levels of alkaline phosphatase. However, it was elevated irrespective of vitamin D status. In another study, though elevated alkaline phosphatase levels were found in 89% infants, there was a significant correlation between vitamin D levels and alkaline phosphatase ($p<0.001$).[12] In our study we found that low serum phosphorous levels found in infants with vitamin D insufficiency whereas most children with vitamin D deficiency had normal serum phosphorus levels suggestive that serum phosphorus can be taken as markers to determine vitamin D insufficiency. In vitamin D insufficiency, both alkaline phosphatase is high and serum phosphorus is low whereas in deficiency, alkaline phosphatase is still high whereas phosphorus normalizes. In our study, we did not find any association with vitamin D levels and serum calcium. Normal mean calcium and phosphorous levels have been recorded in vitamin D deficient infants and their mothers in a study carried out in India[12] suggesting that serum calcium may not be good marker to determine vitamin D insufficiency or deficiency in infants as seen in our

study. This decrease in serum phosphorus and normal serum calcium is due secondary hyperparathyroidism that occurs in vitamin D deficiency which leads to normal serum calcium and loss of phosphorus in the urine.

In a study carried out to obtain prevalence and risk factors of nutritional rickets, information about housing malnutrition and antenatal factors was collected and malnutrition was found to be an essential risk factor for the development of nutritional deficiency of vitamin D.[13] In countries with lots of sunlight, vitamin D deficiency is found to commonly occur in infants and children attributed to low dietary calcium intake and poor nutrition.[14] In our study, similarly malnutrition was seen in children with vitamin D insufficiency but was seen in only 30% with vitamin D deficiency suggestive that rickets may be a disease of growing bones and that vitamin D deficiency can exist even in children with good macronutrition. Though there was no statistically significant association between anemia and serum vitamin D levels, anemia was found in 93.8% of vitamin D insufficient patients and 80% of vitamin D deficient patients.

Vitamin D deficiency is attributed to be a major cause of hypocalcemic seizures in infants.[15] In our study only 7 patients were found to have associated seizures and 6 of them had deficient vitamin D levels and one had insufficient vitamin D levels with serum 25 OH vitamin D of 11.1 ng/ml. According to a survey carried out by the West Midlands pediatricians amongst children less than 5 years of age with symptomatic vitamin D deficiency, a quarter of the patients presented with hypocalcemic seizures below 6 months of age.[16] The "overall incidence" predicted by this survey was found to be 7.5 per 100000 children per year with notable differences per ethnic group.[16] It was also observed in this study that the group of infants who presented with hypocalcemic seizures was found to be South Asian and had maternal deficiency as a major etiological factor.[16] In our study out of the 7 patients presenting with seizures, 6 had vitamin D deficiency and the association between the occurrence of seizures and vitamin D levels was found to be significant. Thus, infants with deficient vitamin D levels are at a higher risk of seizures.

Our studies had several limitations. The number of patients included in the study was low. Also, though over 58% of patients with low vitamin D levels had LRTI, we could not establish an association of LRTI and vitamin D deficiency as this study was carried out only in infants and in our study 72.4% of infants had vitamin D insufficiency/deficiency. Thus, the age may have been a confounding factor. It would be necessary to do vitamin D levels in children above 1 year of age with LRTI and see if there is an association between low vitamin D levels and risk of LRTI.

Thus, it can be concluded that vitamin D deficiency/ insufficiency is prevalent in infants and predominantly low serum phosphorus can be indicator of vitamin D insufficiency. Children with vitamin D deficiency are more prone to get convulsions.

Compliance with Ethical Standards

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Conflict of Interest: None

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