



PNEUMONIA AND ROLE OF VITAMIN D IN CHILDREN

Dr. Kavita Lall

Professor & HOD Dept. of Paediatrics Chandulal Chandrakar Memorial Medical College, Kachandur, Durg (CG).

Conflicts of Interest: Nil

Corresponding author: Dr. Kavita Lall

Abstract:

INTRODUCTION: And vitamin D deficiency might substantially increase the risk of severe pneumonia in children of under 5 years age group. Vitamin D has important role in development and maintenance of the skeleton, it has been shown there is increasing evidence that vitamin D has a beneficial effect on extraskeletal tissues such as the brain, heart, stomach, pancreas, lymphatics, skin, gonads, and prostate tissue are composed of cells, including T and B lymphocytes, that express the vitamin D receptor (VDR). In these tissues, vitamin D is thought to have roles in the improvement of immune function and the reduction of inflammation. The consumption of vitamin D may reduce respiratory tract infection (RTI) susceptibility in children such as acute otitis media (AOM), pharyngotonsillitis, rhinosinusitis, bronchiolitis and pneumonia.

MATERIAL AND METHODS: Children between 6 months to 5 years with a clinical diagnosis of severe pneumonia were included in the study. Children having a history or clinical features suggestive of rickets, malnutrition, asthma, hypertension, tuberculosis complicated pneumonia such as lung abscess, pleural effusion, empyema or illness severe enough to require ventilation, chronic respiratory disease, heart disease, renal or hepatic diseases, neurological diseases resulting in abnormalities of muscle tone/power were excluded. Eligible candidates for the study were given 100,000 IU of vitamin D i.e. cholecalciferol. At home, participants were followed for 180 days (from day of enrolment) to document the recurrence of episodes of pneumonia. Serum 25(OH)D of each patient was estimated:

RESULTS: 117 participants were included in the study. Mean age of the study group was 17.2 ± 16.4 months ranging from 8 months to 49 months. There was higher percentage of male children (60.7%) as compared to female (39.3%). Mean weight of the children was 8.2 ± 3.4 . Mean duration of illness in days was 3.2 ± 1.1 . oxygen saturation in percentage was 95 ± 3.1 . After vitamin D supplementation in all 117 subjects 22 (18.8%) children had single episode of pneumonia. In 7 (5.9%) of cases there were 2 episodes in six months and in 1 (0.9%) case there was more than 2 episodes of pneumonia it was found that serum vitamin D levels were higher in patients with no episodes of pneumonia as compared to patients with 2 or more episodes of pneumonia.

CONCLUSION: It was found that patients with higher serum vitamin D levels had less recurrence of pneumonia episodes and vitamin D supplementation can reduce the recurrence episodes of pneumonia in children.

Keywords: Vit D, pharyngotonsillitis, rhinosinusitis, bronchiolitis and pneumonia

Introduction

Vitamin D is a prohormone with numerous functions in the bodyⁱ. "Prohormone" refers to a group of fat-soluble secosteroids of which the two major forms are vitamin D₂, or ergocalciferol, and vitamin D₃, or cholecalciferolⁱⁱ. also vitamin D paracrine system enhances the innate immunityⁱⁱⁱ. And vitamin D deficiency might substantially increase the risk of severe pneumonia in children of under 5 years age

group^{iv}. Acute lower respiratory tract infection is a leading cause of mortality in children less than 5 years old^v and more than 90% of the cases are in developing countries. The management of Acute lower respiratory tract infection includes intravenous antibiotics, oxygen, or assisted ventilation can be given in severe cases, along with these treatment modalities, nutritional supplementations such as zinc and vitamin A supplementation have also been tried^{vi}. In studies it has been found that deficiency in

vitamin D may predispose people to infection, and therefore vitamin D has been known as antibiotic vitamin^{vii}.

There is activation of Toll-like receptors on monocytes and macrophages by microbial pathogens which can result in increased expression of *CYP27B1* and vitamin D receptor i.e. *VDR* genes within these cells. Due to this adequate concentrations of calcifediol (25-hydroxyvitamin D), *CYP27B1* leads to an increase synthesis of intracellular calcitriol (1,25-dihydroxyvitamin D) and binding of this to vitamin D receptors in turn results in increased intracellular formation of antimicrobial compounds, such as cathelicidins^{viii}. Patients who are vitamin D deficient the generation of intracellular antimicrobial compounds is impaired. It has been suggested that vitamin D might be used in the treatment of opportunistic and antibiotic-resistant infections^{ix}. Vitamin D has an important role in development and maintenance of the skeleton, it has been shown there is increasing evidence that vitamin D has a beneficial effect on extra skeletal tissues such as the brain, heart, stomach, pancreas, lymphatics, skin, gonads, and prostate tissue are composed of cells, including T and B lymphocytes, that express the vitamin D receptor (VDR). In these tissues, vitamin D is thought to have roles in the improvement of immune function and the reduction of inflammation^x. The consumption of vitamin D may reduce respiratory tract infection (RTI) susceptibility in children such as acute otitis media (AOM), pharyngotonsillitis, rhinosinusitis, bronchiolitis and pneumonia^{xi, xii}.

MATERIAL AND METHODS

The present study was conducted in the Dept. of Paediatrics at Chandulal Chandrakar Memorial Medical College, Kachandur, Durg. This was a prospective study. Children between 6 months to 5 years with a clinical diagnosis of severe pneumonia which is defined as presence of lower chest in drawing in children presenting with cough or difficult breathing were included in the study. Children having a history or clinical features suggestive of rickets, malnutrition, asthma, hypertension, tuberculosis complicated pneumonia such as lung abscess, pleural effusion, empyema or illness severe enough to require ventilation, chronic respiratory disease, heart disease, renal or hepatic diseases, neurological diseases resulting in abnormalities of muscle tone/power were excluded. Children which are immune compromised such as HIV positive cases

were also included from the study. Children having received vitamin D or calcium supplements within four weeks prior to enrolment were also excluded.

Eligible candidates for the study were given 100,000 IU of vitamin D i.e. cholecalciferol). Socio-demographic variables such as age, sex, socio-economic status, feeding practices were recorded, immunization status of the children, past history of respiratory illnesses and nebulisation. Vital signs like temperature, heart rate, respiratory rate, blood pressure, oxygen saturation, pallor, cyanosis, grunt, and mental status were recorded. Respiratory rate was measured, and considered as fast if RR >50/min for 6 months–1 year and >40/min for 1–5 years^{xiii}. It was measured again and the two readings were averaged. All vitals were measured when the child was quiet. Body temperature was measured. Baseline oxygen saturation was measured using a pulse oximeter with a probe on a finger or toe, in room air. Chest was auscultated for presence of any abnormal sounds like wheeze and/or crepitations. Weight, length/height, mid-upper arm circumference, and head circumference were recorded for all participants as per standard techniques. On the day of enrolment, a single dose of 100,000 IU of vitamin D (cholecalciferol) was dissolved in milk and administered orally or by nasogastric tube to the participant. At home, participants were followed for 180 days (from day of enrolment) to document the recurrence of episodes of pneumonia. Every fortnight starting from the day of discharge and enquired about episodes of cough or/and difficult breathing. An episode of cough associated with fast/difficult breathing which warranted medical attention was regarded as an episode of pneumonia.

Serum 25(OH)D of each patient was estimated. The primary outcome variable was the time to resolution of severe pneumonia i.e. the duration from the enrolment till there is no chest in drawing for up to 24 hours and children having no recurrence of pneumonia in next six months.

OBSERVATIONS AND RESULTS

Total of 234 patients were screened for the study of which 128 were eligible as per inclusion criteria and of which 11 participants were lost during follow-up so finally 117 participants were included in the study.

TABLE 1: Demographic variables

Variable	n=117
Age months(mean± SD)	17.2 ±16.4
Male (%)	71(60.7%)
Female (%)	46 (39.3%)
Weight (mean± SD) KG	8.2±3.4
Duration of illness days (mean± SD)	3.2±1.1
Respiratory rate/ min (mean± SD)	56±7
Oxygen saturation (%) (mean± SD)	95±3.1
SD: Standard deviation	

Mean age of the study group was 17.2 ±16.4months ranging from 8 months to 49 months. There was higher percentage of male children (60.7%) as compared to female (39.3%). Mean weight of the children was 8.2±3.4. Mean duration of illness in days was 3.2±1.1. Oxygen saturation in percentage was 95±3.1.

Table 2: recurrence of pneumonia in 6 months

Recurrence of pneumonia	N=117	%
1 episode	22	18.8
2 episodes	7	5.9
More than 2 episodes	1	0.9

After vitamin D supplementation in all 117 subjects 22 (18.8%) children had single episode of pneumonia. In 7 (5.9%) of cases there were 2 episodes in six months and in 1 (0.9%) case there was more than 2 episodes of pneumonia. it was found that serum vitamin D levels were higher in patients with no episodes of pneumonia as compared to patients with 2 or more episodes of pneumonia.

DISCUSSION

Vitamin D can be obtained from different types of food, or they can be synthesized through exposure to ultraviolet radiation B (UVB)^{xiv}. Vitamin D has an important influence on the immune system and can modulate both innate and acquired immunity and regulate the inflammatory cascade^{xv, xvi}. Vitamin D can

diminish the function of human dendritic cells by decreasing maturation, antigen presentation and the production of cytokines such as interleukin (IL)-12 and IL-23^{xvii}. Studies have shown an association between inadequate vitamin D concentrations and RTIs in children^{xviii}.

In our study it was observed that vitamin D (cholecalciferol, vitamin D3) administered in a single oral dose of 100,000 IU to children aged 6 months to 5 years with severe pneumonia hastens the resolution of lower chest in drawing. Further, the supplementation can prevent the recurrence of pneumonia in next six months and it was observed that patients with higher concentrations of serum vitamin D levels in their blood had less incidence of recurrence. Studies have shown that enhanced rate of vitamin D deficiency or rickets in children with pneumonia and the increasing evidence suggesting that calcitriol, the biologically active metabolite of vitamin D, has an important role in the human immune system³. In a case–control study of the Gujarati Indian population it was found that serum vitamin D deficiency was more common in patients with active TB (67 %) than in their uninfected co-inhabitants^{xix}.Najada et al. studied a hospitalized infants with respiratory diseases and found a higher incidence of nutritional rickets thus importance of vitamin D in respiratory tract infections was associated^{xx}. A meta-analysis of randomized controlled trials showed that prophylactic vitamin D supplementation in paediatric subjects significantly reduced the odds of contracting respiratory tract infections^{xxi}. Also it has been proposed that to avoid neonatal deficiency and enhance new-borns’ respiratory health, vitamin D supplementation should be administered during pregnancy and early childhood^{xxii}.

In our study frequency of recurrence was reduced in patients with higher vitamin D levels before supplementation of vitamin D and supplementation also reduces the recurrence. Similar results were shown in Kabul study of reducing the frequency of recurrence of pneumonia by vitamin D supplementation^{xxiii}.

CONCLUSION

It was found that patients with higher serum vitamin D levels had less recurrence of pneumonia episodes and vitamin D supplementation can reduce the recurrence episodes of pneumonia in children. Even though Vitamin D does not prevent the occurrence of

pneumonia but can reduce the episodes by supplementation of Vitamin D.

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