HUMAN GROWTH FOUNDATION

Vitamin D Deficiency Rickets in a Toddler on a Vegan Diet

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Introduction

Vitamin D is crucial for maintaining serum calcium and phosphate levels to promote bone mineralization. It can be synthesized in the skin with sunlight exposure or ingested in the inactive form. The active form calcitriol is formed by 1-alpha-hydroxylase, which is primarily found in the kidney. When vitamin D levels are low, intestinal calcium absorption decreases and parathyroid hormone (PTH) secretion increases to release calcium and phosphorus from bone. Alkaline phosphatase levels (ALP) start to rise once vitamin D levels decrease. Vitamin D deficiency in children can cause rickets, which leads to skeletal deformities. A review of rickets cases from 1986 to 2003 found that 83% of children with rickets were African American or black, 96% were breastfed, and it was common for the children to be receiving a vegetarian diet (1). Without proper vitamin D supplementation, children on vegan diet are at risk of developing severe vitamin D deficiency rickets.

Case Description

This case report details a 21-month-old boy who was referred to a pediatric endocrinologist by his pediatrician for failure to thrive and treatment of vitamin D deficiency rickets. He initially presented to the emergency department due to a fall. X-rays were suggestive of rickets. The child was discharged with a diagnosis of vitamin D deficiency rickets and advised to report to his pediatrician.

Clinical Report

Patient is a male who was born full term with a birth weight of 7 pounds via nonspontaneous normal vaginal delivery. Mother is Caribbean, from the Dominican Republic and Cuba, and father is from Ghana. Mother has a prior history of a molar pregnancy that developed into choriocarcinoma, which resolved with treatment. When she was diagnosed with a molar pregnancy, she started a vegan diet. Patient was exclusively breastfed for 6 months but did not receive consistent vitamin D supplementation. Vegan solid foods were introduced at 6 months in accordance with his mother's diet. He was diagnosed with failure to thrive at 6 months of age, and parents noticed bowing of the legs at 6 months of age. Mother limited sun exposure because it exacerbated his eczema. Patient fell at 21 months of age, received an x-ray, and was diagnosed with rickets. Labs at the time of the fall revealed high ALP >2500 U/l, low calcium of 8.3 mg/dL and low 25-hydroxyvitamin D of 7.2 ng/mL. Repeat labs after a week showed that his calcium was 9.2 mg/dL, his phosphate was 2.8 mg/dL, his ALP remained elevated at 2854 U/l, 25-hydroxyvitamin D increased to 10.7 ng/mL, 1,25 dihydroxyvitamin D was elevated at 280.5 pg/mL and PTH was elevated at 263.7 pg/mL. On exam, height and weight were <1st percentile, he had widening of his wrists, rachitic rosary, and genu varum. Patient had developmental delays in language, fine motor skills and gross motor skills. He was seeing a chiropractor, working with early intervention, and participating in physical therapy twice weekly. Patient was started on vitamin D3 2000 IU per day and calcium carbonate 30 mg/kg/day. Repeat labs one month later showed that 25-hydroxyvitamin D levels increased to 32 ng/ml and subsequently vitamin D3 supplementation was decreased to 1000 units per day. Patient continued a vegan diet. After 2 months of consistent treatment, ALP decreased to 776 U/l, serum phosphate was 4.8 mg/dL, serum calcium was 9.3 mg/dL, PTH decreased to 90 pg/mL and 25-hydroxyvitamin D level was 33 ng/mL. Skeletal deformities have improved significantly. He continues to follow a vegan diet and follows up with a nutritionist to ensure a balanced diet.

Lab Results

Lab Test	Reference Range	3/1/21	3/8/21	3/23/21	5/18/21	7/22/21	10/26/21	3/28/22
Alkaline Phosphate	125-320 U/L	>2500	2854	2131	776	436	515	425
Phosphate	2.5-4.5 mg/dL		2.8	3.7	4.8	5		
Calcium	8.4-10.6 mg/dL	8.3	9.2	9.3	9.3	9.2	9.6	10.6
Parathyroid Hormone	15-65 pg/mL		263.7	104	90	62	42	8
25-hydroxyvitamin D total	30-100 ng/mL	7.2	10.7	32.6	33	32		42
1, 25-dihydroxyvitamin D	19.9-73.9 pg/mL		280.5					

Imaging

XR Pelvis and Hips AP and Lateral

Report: There is a prominent distance between the apophysis and metaphysis of the proximal femurs bilaterally which appears symmetric and is likely developmentally related to an ossified cartilage.

XR Right Upper Extremity AP and Lateral

Report: Slight metaphyseal irregularity seen in the proximal and distal humerus.

Impression: Slight irregularity in the metaphyses identified a nonspecific finding but concerning for underlying metabolic bone disease such as rickets.

Conclusion

Alternative dietary patterns like vegan diet are gaining popularity across the world. This case highlights the importance of consistent vitamin D supplementation in children who are exclusively breastfeeding, as per recommendations by the American Academy of Pediatrics. Children who begin a vegan diet after weaning should get supplements to prevent many nutritional deficiencies. Vitamin D levels should be monitored in children who are receiving a vegan diet. Pediatricians should be cognizant of the risk associated with alternative diets and counsel the caregivers on how to prevent nutritional deficiencies.

Bibliography

1. Weisberg P, Scanlon KS, Li R, Cogswell ME. Nutritional rickets among children in the United States: review of cases reported between 1986 and 2003. Am J Clin Nutr. 2004;80(6 Suppl):1697S-705S.