Severe Atopic Eczema: Exploring the Link Between Skin Barrier Dysfunction and Bone Density

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Abstract

Vitamin D deficiency is a common factor in the pathogenesis of both rickets and atopic eczema. Vitamin D is necessary for calcium and phosphorus absorption, which are essential for mineralization, and it is also essential for immune and allergic responses. This case report will highlight the relationship between atopic eczema and rickets and the approach to managing both conditions when they occur simultaneously in children.

We report a 4-year -old boy who presented to our clinic with severe atopic eczema, hypocalcemic tetany, rickets and developmental delay and was successfully managed.

Keywords: Atopic eczema, Rickets, Skin Barrier Dysfunction, Bone density, developmental delay.

Résumé

La carence en vitamine D est un facteur commun à la pathogenèse du rachitisme et de l'eczéma atopique. La vitamine D est nécessaire à l'absorption du calcium et du phosphore, essentiels à la minéralisation osseuse, et joue également un rôle crucial dans les réponses immunitaires et allergiques. Ce cas clinique met en lumière la relation entre l'eczéma atopique et le rachitisme, ainsi que la prise en charge de ces deux affections lorsqu'elles surviennent simultanément chez l'enfant.

Nous rapportons le cas d'un garçon de 4 ans, admis dans notre service pour un eczéma atopique sévère, une tétanie hypocalcémique, un rachitisme et un retard de développement, et dont la prise en charge a été couronnée de succès.

Mots-clés : Eczéma atopique, Rachitisme, Dysfonctionnement de la barrière cutanée, Densité osseuse, Retard de développement.

Introduction

Rickets typically affects children during the period of rapid growth due to impaired bone mineralization.[1] Rickets is a common disease worldwide with a prevalence of 10-20%. [2] It affected over a quarter of children in Northern Europe during the early 20th century. Although its prevalence has significantly decreased in developed countries, it remains endemic in low-income developing countries.[3] The skin plays a significant role in vitamin D synthesis, as a result of which many skin disorders could lead to abnormal vitamin D metabolism and vitamin D-deficient rickets. Hence, the association between Rickets and skin diseases, especially those skin diseases that are associated with keratinization disorders like ichthyosis, xeroderma pigmentosum, psoriasis, etc.[4] Vitamin D plays an important role in calcium and phosphorus absorption in the gastrointestinal tract, and together with parathyroid hormone, it is important for calcium homeostasis. Rickets is usually classified into calcipenic and phosphopenic forms. Calcipenic rickets is usually due to a diet deficient in vitamin D and/or calcium. Phosphopenic rickets is usually due to renal phosphorus wastage. Rickets presents with genu varum, abnormal gait, frontal bossing, dental abnormalities, craniotabes, wrist widening, Rachitic rosary, muscle weakness, and gross motor delay.

Atopic dermatitis (AD) is a common inflammatory skin disorder characterized by intense itching and recurrent eczematous lesions.[5] It is the leading cause of the global burden of skin diseases.[5] It affects 10-20% of children.[5] Atopic eczema has a significant psychological impact on patients and their relatives.

Factors associated with atopic eczema flare include food allergies and Ultraviolet B (UVB) exposure.[6] Some food allergens, like fish, also contain a lot of vitamin D.[7] Therefore, if strict strategies are taken to reduce these factors in the management of atopic eczema, such as restriction of fish in the diet, it can put the child at risk of developing rickets. Reduced sun exposure could increase the risk of developing rickets.[8] Vitamin D is also found to be essential in immune and allergic response, and hence its deficiency can cause increased severity among patients who are prone to atopic eczema, and it was found that prolonged Vitamin D supplementation could be important among some patients with AD and can drastically improve the symptoms of AD.[6]

Rickets is due to inadequate extracellular concentration of calcium and phosphate ions.[9]

Atopic eczema has a prevalence rate of 10-20% in children in the developing world. There is a paucity of data on the prevalence of AD in developing countries, especially among children.[5] However, in a study carried out in Kano, Nigeria, among children,[10] they reported atopic eczema as the third most common skin disorder seen, accounting for 1.8% of the skin disorders. It is slightly more common among females and among people living in urban areas. [11] Absence of uniform diagnostic criteria for AD has contributed to the differences in prevalence worldwide.

Case Report

We report a 4-year-old Nigerian boy who presented to our clinic with severe, persistent itching that prevented him from sleeping. The symptoms started when the child was 5 months old and have been recurrent but worsened in the last 1 year before presentation. There was also a history of skin dryness, and the itching mostly affects the flexor surfaces and the face. The itching was worse during hot weather. There is a positive family history of asthma (maternal grandmother). His symptoms were usually worse after taking fish, eggs, and milk; therefore, the mother always avoided giving those foods. There was a history of occasional abnormal stiffening of the hands and legs. There was no history of fever. He was breastfed exclusively for 15 months, after which plain pap was added. He was weaned at 24 months onto a diet that is mainly carbohydrate with low vitamin D-containing food. He had been prescribed an antihistamine in many health centres with no improvement. He had delayed milestones as he was unable to walk at 4 years. There was a history of recurrent respiratory tract infection. He was a product of term gestation delivered via spontaneous vaginal delivery. Mother was a full-time housewife who hardly left their 2-bedroom flat. No history suggestive of maternal vitamin D deficiency during pregnancy. On physical examination, the weight was 13kg (normal). His length was also normal. He continuously scratched his skin due to dryness, especially on the cheeks and flexural areas. He was not on any other medication at presentation.

There was also widening of the wrist, caput quadratum and genu varum. He was unable to walk, and other examination findings were essentially normal. Figure 1 shows the child at presentation. The laboratory findings were consistent with vitamin D deficiency and hypocalcemia, as shown in Table 1 below. His full blood count, liver function tests and renal function tests were normal. His celiac serology was normal, ruling out malabsorption. Electrocardiography (ECG) showed a prolonged QTc interval in sinus rhythm, consistent with hypocalcemia. Clinical diagnosis of atopic dermatitis using the UK working party's criteria for the diagnosis of AD, complicated by nutritional rickets, was made.

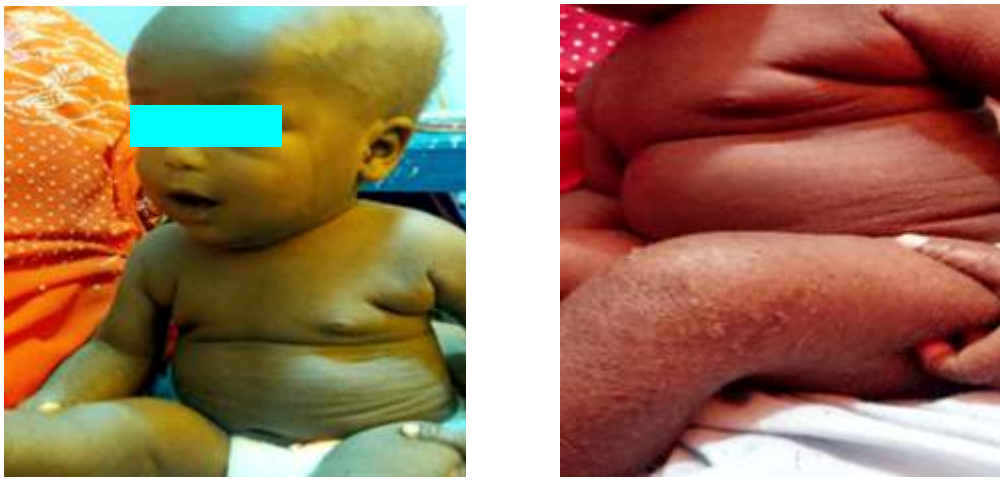

Figure 1: Picture of the child continuously scratching his skin due to itching of the skin

Table 1: Laboratory findings at presentation

	Value	Reference range
Total calcium (mmol/l)	1.45	2.02-2.60
Ionized calcium (mmol/l)	0.60	1.1-1.36
Inorganic phosphate (mg/dl)	1.2	2.50-4.50
Alkaline phosphatase (U/L)	750	150-350
25 (OH) vitamin D (ng/ml)	6	>20
PTH (pg. /ml)	300	15-65

The child was given an intravenous calcium (75mg/kg), and oral replacement of Vitamin D at a dose of 4000 IU daily for 2months (recommended dose is 2000-5000IU daily or intramuscular injection of vitamin D at a dose of 150,000 IU/dose with repeated dosing as required). His AD was managed with emollients and topical steroids.

After 2 months, we observed excellent improvement in his AD symptoms and milestones, as well as in his biochemical parameters (calcium levels gradually increased, and the 25OHD and parathyroid hormone levels normalized).

Discussion

Atopic dermatitis is a component of the atopic tetrad; other components include asthma, allergic rhinitis, food allergies, and a family history of a similar condition. Its diagnosis is mainly from history and physical examination. It is one of the leading causes of the global burden of skin disease.[12] There are different criteria for the diagnosis of AD, but the one that is valid for population-based studies is the UK Working Party's diagnostic criteria.[13] These criteria include a history of itching involving the flexural area, history of xerosis, onset before two years of age, history of asthma, and visible dermatitis involving the flexural area.

The patient fulfilled this criterion and, hence, the diagnosis of AD. In our patient, the cheeks, scalp, trunk, and flexural areas were affected, which are the classical areas involved in these age groups. Whereas among adolescents, the extensor surfaces are typically affected. Borzutzky A *et al*[14] reported a 14-year-old adolescent with rickets and atopic dermatitis. Their patient lived at a high altitude with less sun exposure, similar to this patient. Their patient has had a fish allergy since early childhood and has avoided fish.

The pathogenesis of AD is multifactorial, but the main factor involved is skin barrier dysfunction, which leads to skin dryness, allowing pathogen entry and triggering an inflammatory response

among people who are genetically predisposed.[15] Food allergy may worsen a child's symptoms of AD, as it was observed in the patient we presented. Prevalence of food allergy in children with AD is up to 40% when compared to only 5% observed among children without AD.[12] Routine food allergy screening is recommended in AD patients, but when suspected, it may be performed using an oral food challenge.[16]

In our patient, an oral food challenge was not performed due to the urgent need for treatment at presentation. The relationship between food allergy and AD is not causative. It requires sensitization (evidenced by elevated IgE) followed by the development of symptoms after exposure to that food. Therefore, sensitization alone is insufficient for diagnosing food allergy.[16]

Rickets results from impaired bone mineralization and affects children during periods of accelerated growth.[1] It manifests mostly during infancy and early childhood, and sometimes occurs during the adolescent growth spurt.[16] Clinical presentation of rickets includes genu varum, abnormalities in gait, frontal bossing, widening of the wrist, rachitic rosary due to costochondral junction enlargement, muscle weakness and gross motor delay.[1] Our patient presented in early childhood with some of the above features. Shafee S *et al* [17] reported a 14-month-old child who presented with atopic dermatitis associated with rickets. The patient also presented during early childhood with developmental delay. The exact pathogenesis of this presentation is not fully understood, but it is believed to be a result of muscle dysfunction caused by hypocalcaemia and hypophosphataemia.[18]

More than 90% of human vitamin D comes from the photoconversion of 7-dehydrocholesterol in the skin to cholecalciferol (vitamin D3) by ultraviolet B radiation. Fortified dairy products, Cereals, eggs, fish, and liver are dietary sources of vitamin D. While prolonged exclusive breastfeeding without vitamin D supplementation, prematurity, limited sun exposure, living at high altitudes, gut malabsorption, and dietary restriction are risk factors for rickets. Our patient's diet was restricted to vitamin D-containing food because the mother noticed worsening of his AD symptoms whenever he was given dairy products, similar to the patient reported by Shafee S *et al* [17]. He was also exclusively breastfed for 15 months without any vitamin D supplementation (the recommended daily intake for exclusively breastfed children and children consuming less than 1 litre of milk per day is 400 IU). The mother is a full-time housewife living in a closed, two-bedroom flat with limited sunlight exposure, and the child is dark-skinned. All the factors above are the risk factors that predisposed the child to developing rickets. People with dark skin colour are at risk of vitamin D deficiency because melanin acts as a natural sunscreen.[19]

Conclusion

There is a link between atopic eczema and nutritional rickets. When both conditions occur in the same child, they should be properly addressed during management to improve the quality of life of the affected patient and their family.

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