

Case Report

Food allergy as a risk factor for nutritional rickets

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The case of a 14-month-old boy with vitamin D deficiency rickets as a result of unsupervised dietary manipulation in the context of cow's milk allergy is presented. Adequate supervision by a qualified dietician, coupled with appropriate supplementation, is essential if nutritional compromise is to be avoided in children with food allergy.

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The prevalence of allergic disorders, including food allergy in childhood, is increasing (1) with 6–8% of children younger than 3 yr experiencing adverse reactions to foods. Few foods account for the majority of food allergic reactions in young children; these include: hen's egg, cow's milk, peanut, and less commonly wheat, and soy. Population-based studies of infants and young children document the prevalence of hen's egg, cow's milk and peanut allergy to be 2.4%, 1.9–3.2% and 1.5%, respectively (2). All these food allergens are characterized by both high nutritional value and affordability.

Despite the sustained increase in the prevalence of food allergies, there is currently an unacceptable paucity of specialized allergy centres in the UK. As a consequence, the available services do not meet the requirements of allergic children (3), and infants and children with food allergy may be at risk of unsupervised dietary interventions. The cornerstone of established food allergy management remains avoidance of the offending allergen. Although dietary exclusions may facilitate better control of allergic disease, such as atopic eczema dermatitis syndrome (AEDS), unsupervised diets may be nutritionally incomplete. Even with increasing

public awareness of food allergy, many patients are ill prepared to successfully implement nutritionally adequate allergen avoidance diets without expert help.

We describe a case that highlights the nutritional consequences of unsupervised dietary modification in a child with cow's milk protein allergy (CMPA).

Case report

The patient is a boy who first attended the allergy clinic at 14 months of age. He was born at 36 wk gestation, weighing 1.94 kg (<3rd centile) to parents of Moroccan descent, both of whom suffer from allergic rhinitis. The family lives in a crowded inner city, London apartment with no garden. He was exclusively breast-fed for 5 months until solid foods such as rice and different vegetables were slowly introduced. At 6 months of age, the introduction of an infant formula containing cow's milk protein led to an immediate, generalized, urticarial reaction. Similar reactions were noted after the ingestion of yoghurt containing cow's milk as well as that containing goat's milk; however, soya milk was well tolerated. At this time he developed

generalized AEDS. His mother continued to breast-feed, but carefully restricted cow's milk products from her diet, as she noted an association between her ingestion of cow's milk and deteriorating AEDS.

At his first attendance at the allergy clinic with his mother, it was noted that she was modestly dressed with her head covered by traditional attire (*hajib*). Dietary history revealed that he was still breast-fed every 2–3 h. Having had no previous contact with a dietician, his mother felt this would be more nutritionally complete than soya milk. Fear of further allergic reactions had severely limited the expansion of solids in his diet beyond fruit and vegetables. The few solids taken were deficient in both iron and calcium. Notably, egg and fish were excluded in both infant and maternal diet because of fear of exacerbation of AEDS or immediate hypersensitivity. Both of these are important sources of vitamin D.

Clinical examination

Anthropometrical data revealed growth along the 3rd centile for weight and height. Positive findings included pallor, weakness and signs of chronic AEDS. Features suggestive of rickets were present, as evidenced by swollen wrists and a 'rachitic rosary' (Fig. 1). There was no evidence of limb deformity.

His motor development was delayed in that he was unable to 'pull to stand', let alone walk at the age of 14 months. Clinical assessment of his skin, nails and cardiovascular system were normal.



Fig. 1. Swollen wrist at presentation.

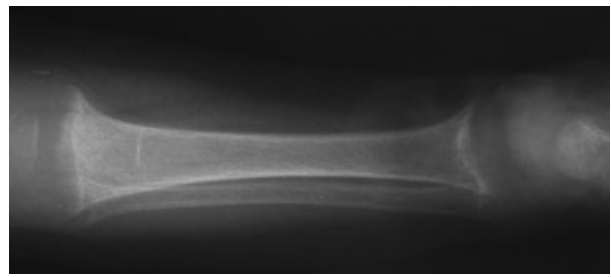


Fig. 2. Radiograph of left lower limb shows classic features of rickets (marked osteopenia, splaying, fraying and cupping of the proximal and distal metaphyses).

Special investigations

Skin prick testing confirmed allergy to both cow's and goat's milk proteins with the appearance of 6 mm wheals. Positive control was 3 mm. Specific IgE to cow's milk was 28 kUA/l.

Further investigations revealed a raised alkaline phosphatase of 2054 U/l (normal range 250–800 U/l) and parathyroid hormone (PTH) of 416 pg/ml (normal range 1–43 pg/ml) in conjunction with low serum calcium of 1.71 mmol/l (normal range 2.25–2.6 mmol/l), phosphate of 1.06 mmol/l (normal range 1.2–2.2 mmol/l) and 25-hydroxyvitamin D of 15 nmol/l (normal range 25–40 nmol/l). His plasma bicarbonate was normal which excluded Fanconi's syndrome and there were no findings suggestive of renal tubular acidosis. Haematological parameters revealed a microcytic, hypochromic anaemia with low iron stores. Haemoglobin electrophoresis was normal. Maternal blood tests revealed low vitamin D levels, raised PTH, and iron deficiency but normal calcium levels.

Radiographs of the long bones confirmed the clinical findings of rickets (Fig. 2).

Further management focused on intensive dietary counselling, aimed at reducing the child's reliance on breast milk and improving the nutritional balance of his diet. Solid food intake was strongly encouraged with a view to broadening the diet to include a variety of family foods. Soya formula was used as a milk substitute. Additional calcium, iron and vitamin D supplements were also prescribed and advice given regarding sunlight exposure. His biochemical markers of rickets were observed over a 2-month period where after they normalized. Developmental assessment demonstrated a marked improvement in motor milestones.

Discussion

Our case presentation adds to a body of evidence which describes food allergic children who pre-

sent with specific nutritional deficiencies such as anaemia and rickets (4), and in more extreme scenarios with protein energy malnutrition states such as failure to thrive and Kwashiorkor (5).

There are many reasons as to why the diets of infants and young children may be lacking in one or more essential components, even in developing countries where food security is seldom compromised. Children at risk of developing nutritional deficiencies include babies born prematurely, children with chronic illness and infants with or at risk of developing food allergies. As our case illustrates, unsupervised dietary manipulation, fear of introducing complementary foods and doubts over which foods to introduce are common problems for mothers and carers of food allergic infants. Given the rising prevalence of food allergies it is anticipated that nutritional deficiencies in this subgroup of patients will be an increasingly common presentation.

Rickets is a disorder of growing children in which the newly formed bone matrix is not adequately mineralized. It reflects a deficiency of the important bone constituents, calcium and/or phosphate. Rickets can be classified into three main groups: vitamin D deficiency, calcium deficiency or phosphate deficiency. Although the World Health Organization recommendations on breast-feeding advocate weaning to ideally occur at 6 months or beyond, it is not uncommon for cow's milk allergic infants to rely exclusively upon breast-feeding beyond the first year of life. Breast milk typically contains a vitamin D concentration of 25 IU/l or less; thus large quantities of breast milk are required to meet the recommended vitamin D intake of 200 IU/day, if vitamin D synthesis from ultraviolet irradiation of 7-dehydrocholesterol in the skin is limited. This particularly applies to infants born to mothers who themselves have risk factors for vitamin D deficiency such as dark skins. Cultural attire may further prevent sun exposure and practices such as keeping the mother and infant indoors for the first 40 days of life also increase the chance of vitamin D deficiency developing. Supplementation of breast milk with vitamin D has therefore been recommended (6). Most available infant formulae are now supplemented with a minimum vitamin D concentration of 40 IU/100 kcal or approximately 400 IU/l; thus for infants ingesting at least 500 ml/day of formula (vitamin D concentration of 400 IU/l), the recommended vitamin D intake of 200 IU/day will be achieved. Additional risk factors for vitamin D deficiency were also present in our case, such as a pigmented skin, low birth weight, lack of

supplemental vitamin D and inadequate sunlight exposure.

A high prevalence of rickets and growth failure has been reported in infants who consume unconventional diets. For example, macrobiotic diets (organic, whole-grain foods that are not chemically processed) and vegan diets (7) may exclude vitamin D-fortified milk. The high fibre content in a vegetarian/vegan diet may also reduce the absorption of calcium. Rice-based beverages may be consumed by food allergic children, and although often fortified with vitamins A and D and calcium, their protein value is low 1.7 g/l vs. protein content of cow's milk (33 g/l) (6).

Infants with established CMPA should ideally receive human milk. However, although generally well tolerated, rare cases of anaphylaxis and several cases of cow's milk-induced proctocolitis, have been reported in breast-fed infants (8). The pathophysiology of these reactions in the breast-fed infant is not well understood but immunologically recognizable proteins from the maternal diet have been found in breast milk (9). Elimination of cow's milk, hen's eggs, fish, peanuts and tree nuts, and other foods from the maternal diet may lead to resolution of allergic symptoms in the nursing infant.

For those infants whose symptoms do not improve or whose mothers are unable to tolerate a restricted diet and for formula-fed infants with CMPA, alternative formulae can be used to relieve the symptoms. Strict guidelines have been set by the European Society of Paediatric Allergology and Clinical Immunology (ESPACI) and the American Academy of Pediatrics (AAP) for the definition of a hypoallergenic formula. Extensively hydrolysed and free amino acid based formulae have been subjected to such studies and are indeed hypoallergenic. Partially hydrolysed formulae do not meet these stringent criteria.

Soy formulae have for many years been used as alternative formulae for infants with CMPA, but do not fulfil the criteria required for hypoallergenic milk. Between 8% and 14% of infants with symptoms of IgE-associated CMPA will also react adversely to soy (10). Reports of anaphylaxis to soy are extremely rare. Those infants allergic to cow's milk and who do not have an adverse reaction at the start of feeding on a soy formula usually tolerate it very well. Soy formulae, being entirely of plant origin, are appealing to vegans and other groups who choose not to use feeds based on cow's milk. Thus, although soy formulae are not hypoallergenic, they can be fed to infants with

IgE-associated symptoms of milk allergy, particularly after the age of 6 months. As they contain high levels of phosphate and aluminium, they should be avoided in premature infants and those with renal impairment. In addition, there is a significantly higher prevalence of concomitant reactions between cow's milk and soy proteins (25–60%) among those infants with proctocolitis and enterocolitis and therefore soy is not recommended for the treatment of infants with these non-IgE-associated syndromes (10). Recently, concern has been raised about the effect of phytoestrogens contained in soy products, but despite biological activity in animals, there is currently no evidence for a parallel effect in humans.

For infants with CMPA, milk from goats and other animals or formulae containing large amounts of intact animal protein are inappropriate hypoallergenic choices.

Recommendations

1. To prevent rickets in infants and children with cow's milk allergy, an intake of 200 IU/day of vitamin D is recommended (6).
2. Infants and children with suspected symptoms of food allergy should have access to a healthcare worker who is trained in the diagnosis and management of allergic infants. The dietician has a most important and crucial role in the ongoing management of food allergies, particularly during early childhood, when achieving adequate nutrition is critical.

Conclusions

Achieving adequate nutritional intake in the food allergic infant and child is essential if easily

avoidable complications of food allergies are to be prevented. It is important that special efforts be directed towards the early identification and nutritional supplementation of children at risk of developing rickets and vitamin D deficiency.

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