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Nutrition in Infancy and Childhood

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Introduction

The diffusion of hypoallergenic diets for both preventive and therapeutic aims poses many questions to nutritionists, for the long-term use of special diets. Growth and biochemical parameters should approach standards of reference for all these subjects, not to add untoward effects due to nutritional deficiencies. Unfortunately, very few studies are available to address these questions. Moreover, a deeper knowledge about cross-reactivity between different food items is needed in order to prevent the overtreatment of food-allergic children and many allergy-related 'food fads'. Finally, the recent interest in the dietary modulation of the lipid mediators of immunoallergic reactions represent a new challenge for both nutritionists and immunoallergologists.

Nutrition in Healthy Infants Fed Preventive Diets

Antigen-reduced infant formulas (based on hydrolysates of milk or soy-collagen proteins) are currently being investigated for the prevention of allergic symptoms in bottle-fed infants at risk of early atopy [1, 2]. Formulas designed for infant nutrition when human milk is not available should 'achieve both an acceptable growth rate and blood proteins and amino acid profile that approach a reference standard, presumably that based on metabolic data from breast-fed infants' [3].

Preliminary data about nutritional adequacy of special formulas were published by Rigo and Senterre [4]. The first follow-up focusing the nutritional effects of a special formula has been reported by Vandenplas et al. [5].

In our study comparing growth indices of infants fed special formulas for atopy prevention to those of breast-fed infants [6], 82 infants with family history of IgE-mediated diseases completed a 6-month nutritional follow-up. Artificially-fed infants were randomly allocated to 4 groups: soy formula (SF) group, 15 infants; whey-based low-degree hydrolysate (WHy) group, 15 infants; casein-based high-degree hydrolysate (CHy) group, 13 infants; soy plus collagen high-degree hydrolysate group, 10 infants. Twenty-nine infants fed human milk (HM) constituted the reference group. The type of feeding (HM or formula) was maintained up to the 6th month of life, at the beginning of weaning. Anthropometric indices were determined at 0, 3 and 6 months of life and a fasting blood sample for haematochemical parameters was obtained at 5 months before beginning the introduction of solid foods. Lower values of body mass index and higher blood urea nitrogen were displayed by the CHy group at 3 months. Plasma amino-acidograms showed higher essential aminoacids (AA)/total AA ratio in SF, WHy and CHy groups but lower branched chain AA/essential AA in all formula-fed infants in comparison with the HM group.

We conclude that special formulas (in particular high-degree hydrolysates, originally designed for the therapy of clinical conditions) should be carefully evaluated when used for prolonged periods of time in healthy infants at familial risk of atopy.

Nutrition in Children fed Elimination Diets

Elimination diets can be divided into two types: (1) single food elimination diets and (2) extensive elimination diets. Unfortunately, all foods commonly involved in allergic reactions represent the main dietary sources of nutrients essential for the growing children (wheat, corn, eggs, and particularly milk). Allergy to poorly nutritive foods, as single fruits and vegetables, is rare in pediatrics.

The literature on food allergy is full of statements as 'Extensive diets should be used as a diagnostic tool only for a short period of time' [7] or 'It is crucial to provide a balanced diet which contains sufficient proteins, calories, trace elements, and vitamins' [8]. Despite this, studies intended to verify the nutritional impact of both single foods and extensive diets are surprisingly rare. For example, the risk of calcium deficiency in milk-free diets was described 10 years ago [9].

The knowledge of cross-reactions between different proteins is crucial in order to propose a correct elimination diet to allergic children while leaving unaltered the nutritive value of the dietary schedules. Cereals, legumes and fish represent typical examples of food groups whose unnecessary complete elimination of all items for each group should be avoided.

Probably the most puzzling field for a nutritionist is represented by those children allergic to cow's milk and beef. Milk, dairy products and meat represent the main sources of proteins in the Western world. Using an open challenge with 180 g of cooked beef, we were able to confirm milk allergy in 38/134 (28.4%) and meat allergy in 12/134 (8.9%) children with atopic dermatitis. While cow's milk allergy, therefore, is frequent, meat allergy is not so infrequent as previously thought [10]. Moreover, both cooking and technological treatments can modify the individual reaction to foods. We evaluated the influence of cooking and technological treatments on the cutaneous and clinical reactivity to beef and its major allergen, that is bovine serum albumin (BSA) [11]. While all beef-allergic children in our group were also milk-allergic, 26 milk-allergic children were found to tolerate beef. Therefore, although these foods share one or more common antigens [12], elimination of beef is not necessary in the majority of cow's milk-allergic children. We showed also that technological treatments, more than domestic cooking, may modify skin prick tests (SPT) and allergic reactivity in beef-sensitive children. Cooking reduces SPT positivity to beef, but all children had their allergy confirmed at an open challenge test with cooked meat. Heating on the contrary reduces SPT positivity to BSA and eliminates allergic reactivity to it in double-blind placebo-controlled food challenges (DBPCFC). We speculate that domestic cooking does not achieve complete homogenous heating of beef proteins. Technologically treated beef may reproduce SPT positivity in a minority of cases, and it is well tolerated as oral challenge in all children. In a second study, we showed that in beef-allergic children 100% resulted SPT-positive to ovine meat, 66.7% to pork, 50% to horse, 41.7% to chicken, 33.3% to rabbit and 25% to turkey meat [13]. The cross-reactivity could be justified by the homology of the aminoacidic sequences of two serum albumins [14, 15]. Therefore, in the event that an exclusion of bovine meat from the diet of allergic children is necessary, the administration of freeze-dried or homogenized beef – eventually from different species – could be safely considered.

The Lipidic Pathway

Epidemiological data suggest that an increase of marine fat consumption in a dietary context more balanced in the ratio between the two main families (n-6 and n-3) of polyunsaturated fatty acids has favourable effects in counteracting the expression of allergic symptoms [16]. From a therapeutical viewpoint, clinical trials have focused the effects of γ -linolenic acid and n-3 long-chain polyunsaturated fatty acids in patients suffering from atopic eczema [17]. Essential fatty acids (EFA) take an important part in promoting the renewal of the protective hydrolipidic film layer of the skin. An altered EFA metabolism has been associated with the pathogenesis of atopic dermatitis (AD). Reduced levels of γ -linolenic acid (18:3 n-6) and of dihomio- γ -linolenic acid (20:3 n-6) have been found in the plasma phospholipids and in the erythrocyte membranes of patients with AD [18, 19], supporting the hypothesis of a defective Δ -6-desaturase activity. The 20:3 n-6 chain is the direct precursor of prostaglandin (PG) E_1 and probably competes with PGE_2 , a potent phlogogen derived from arachidonic acid. Moreover, both PGE_1 and PGE_2 could be involved in more complex T-cell-mediated regulatory mechanisms.

Treatment with γ -linolenic acid has been successfully attempted [17] but has also been called into question by a recent trial [20] on which there is as yet no interpretative consensus [21]. Other authors are still evaluating the efficacy of 20:5 n-3 supplementations on the modulation of the synthesis of arachidonic acid end products [22].

Conclusions

Nutritionists should carefully interact with allergologists to carefully consider: (a) the nutritional consequences of special diets; (b) the planning of a balanced diet also in children treated for food allergy, and (c) the use of dietary compounds in modulating the clinical expression of allergy.

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