The Effects of A Gluten and Casein-free Diet in Children with Autism: A Case Report

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A boy with autism, growth and developmental retardation was brought to our clinic. He was diagnosed with CHARGE syndrome. Subsequently, various therapies were introduced when he was 5 months old yet the developmental delays persisted. Gastrointestinal problems such as frequent post-prandial vomiting and severe constipation were noted as well. At the age of 42 months, the boy was subjected to a gluten and casein-free diet. Soybean milk and rice were substituted for cow's milk, bread and noodles. After 2.5 months, interpersonal relations including eye to eye contact and verbal communication improved. At 5.5 months the boy was capable of playing and sharing toys with his sibling and other children, behavior noted to be closer to that of an unaffected child. In addition, the decreased frequency of postprandial vomiting led to a significant increment in body weight, body height (from below the third percentile to the tenth percentile) and vitality after 11 months on the diet. In view of the lack of consensus on the benefits of dietary intervention in patients with autism, we are suggesting an adjuvant therapy that is simple, safe and economical. In addition, the therapy may be more feasible in Taiwan as opposed to western countries because of cultural factors such as dietary preference and product availability. *(Chang Gung Med J 2009;32:459-65)*

Key words: autism, dietary intervention, gluten, casein-free diet

Autism is a disability that profoundly affects the way children relate and communicate with people around them. Children with autistic spectrum disorder (ASD) are characterized by impaired social interaction, absent or impaired communication skills and impaired development of imagination. These impairments may persist from childhood to adulthood and thus negatively impact learning and social integration. An epidemiological study conducted by Fombonne in 1999 reported that these disorders affect 0.7 to 21.1 per 10,000 children and the prevalence is rising. As a result of the rising prevalence, the disorder has attracted much attention.[1,2] It is well accepted that the disorder, or spectrum of disorders, is extremely complex and multifaceted.[3] Peptides from gluten and casein may play an etiological role in the pathogenesis.[4] There is evidence indicating that foods containing casein and gluten contribute significantly to ASD and should be eliminated from the diet. In well-conducted studies, as many as 80 percent of ASD patients improved following the strict dietary exclusion of these substances.[5,6] Reichelt and his colleagues also reported that 13 of 15 ASD patients showed behavioral improvement after one-year of casein and gluten restriction.[7]

Modifications in the diet and gastrointestinal

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system set the stage for the success of other treatments for the disorder, and should therefore be done first.[8] By reporting this case, we hope to show that in addition to traditional therapies, a gluten and casein- free diet may be of help in improving learning, cognitive function and communication skills in children with autism.

CASE REPORT

We report on a boy with ASD and CHARGE syndrome. CHARGE syndrome is an acronym for coloboma of the eye, heart defects, atresia of the choanae, retardation of growth and/or development, genital and/or urinary abnormalities, and ear abnormalities and deafness, which are some of the congenital features seen in this disorder. Cleft palate and microtia were found at birth for which he had surgical intervention. There was no specific family history relevant to autistic disorders. Multiple developmental delays were diagnosed at 5 months. He received physical therapy, occupational therapy, speech therapy and sensory integration therapy. At the age of 24 months, growth and developmental delays persisted. His body height and weight fell below the 3rd percentile level of typically developed peers. A Chinese Child Developmental Inventory (CCDI) revealed a gross motor (GM) development equivalent to 13 months old, fine motor (FM) development equivalent to 18 months, expressive language (EL) development 13 months, concept comprehension (CC) development 15 months, social comprehension (SC) 18 months, self help (SH) development 20 months, personal social (PS) development 13 months, and general development (GD) 17 months. The development quotient (developmental months/age months) for GM, FM, EL, CC, SC, SH, PS, and GD were 0.56, 0.75, 0.54, 0.63, 0.75, 0.83, 0.54 and 0.71, respectively.

At the age of 36 months, the Bayley Scales of Infant Development, second edition, showed that the mental developmental index (MDI) and psychomotor developmental index (PDI) were all below 50, which translates to a 19-month-old mental and a 21-month-old developmental age. The development quotients were 0.53 and 0.58 respectively and he was classified as having a moderate developmental delay. During this period, meaningless sounds with poor body language were observed. Compared to children within the normal developmental range, he had poor ability to make facial expressions and to coordinate his vocalization with his intentions. Poor comprehension of verbal commands resulted in his frequently ignoring surrounding voices and body contact, accompanied by little eye contact with other people. He often played alone and the lack of communication skills resulted in his frequently getting lost. According to his mother, his favorite foods were made from wheat, such as noodles and bread; he drank milk several times a day as well, although this often contributed to postprandial vomiting and long-term constipation.

After consultation with our medical staff, strict dietary restrictions to foods free of gluten and casein were initiated at the age of 42 months. Milk, noodles and bread were replaced by soybean milk, rice and associated products. His initial resistance to dietary change gradually decreased after repeated encouragement and support from the family. Previous rehabilitation interventions were continued.

Noticeable behavioral changes appeared 2.5 months later, mainly comprised of improvement in eye contact, appetite and reduction of postprandial vomiting and constipation. Moreover, the boy began actively asking for rice. Improved physiological biometry, interpersonal relations and role simulation after 5 months provide additional evidence of the benefits of dietary modification. The remaining symptoms were poor verbal communication skills, which may be a result of the post- surgical cleft palate- related dysarthria and speaking in a monotone voice. He also made friends with more children than before.

In the long- term follow up, the differences seen after dietary restriction were more evident in the CCDI rating. When he was 53 months old, his gross motor development scores increased to the equivalent of 36 months, fine motor development to 36 months, expressive language development to 36 months, concept comprehension development to 28 months, social comprehension to 34.5 months, self help development to 45 months, personal social development to 27 months, and general development to 34.5 months (Fig. 1). The Bayley scales tested at that time were still below the 50th percentile but translated mental and motor developmental ages had reached 27 and 33 months, respectively, which showed improved mental and motor scores (Fig. 2).

The development quotient of the CCDI and Bayley scales for GM, FM, EL, CC, SC, SH, PS, GD, MDI and PDI were 0.68, 0.68, 0.68, 0.53, 0.65, 0.85, 0.51, 0.65, 0.51 and 0.62, respectively. The development quotient revealed improvement in GM (0.54 to 0.68), EL (0.54 to 0.68), and SH (0.83 to 0.85) in the CCDI and the PDI (0.58 to 0.62) in the Bayley scales. In addition, with improvement in gastrointestinal symptoms, his nutrition status improved. His body height and weight were no longer below the third percentile level of typically developed peers (Fig. 3, 4). His mother also reported that his spirit and vitality had markedly improved.

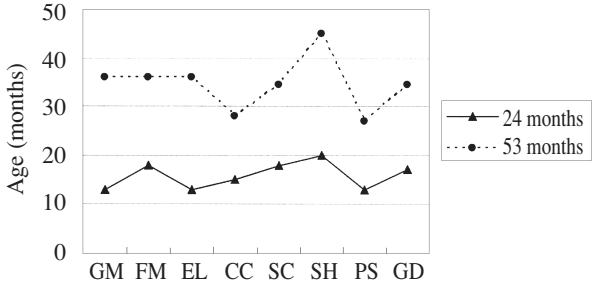

Fig. 1 Chinese Child Developmental Inventory. Abbreviations used: GM: gross motor; FM: fine motor; EL: expressive language; CC: concept comprehension; SC: social comprehension; SH: self help; PS: personal social; GD: general development.

DISCUSSION

The report presents a child with ASD who exhibited improvement in his daily behavior after being subjected to dietary restrictions of gluten/casein- free food. Although he still has autism, he showed improved emotional reactivity, social communication and fewer gastrointestinal -associated symptoms such as postprandial vomiting and constipation. Objective measurements, including the CCDI

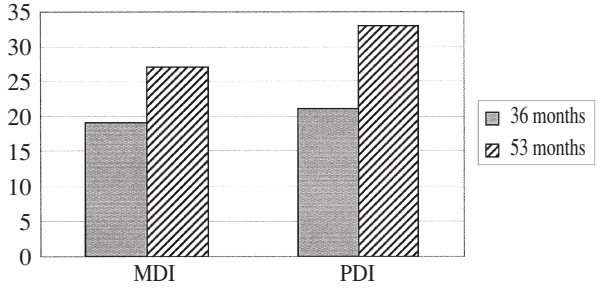

Fig. 2 Bayley II Scales. Abbreviations used: MDI: mental developmental index; PDI: psychomotor developmental index.

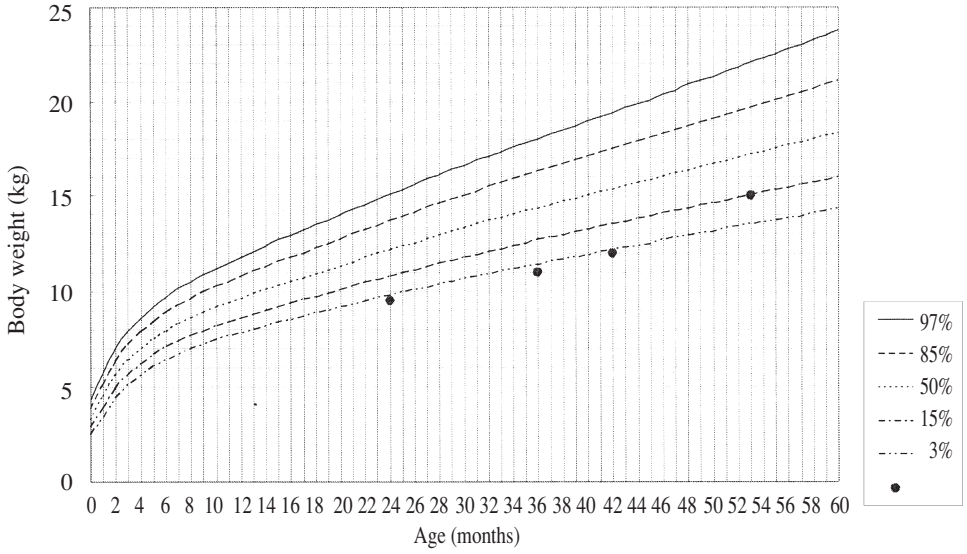

Fig. 3 Boys Growth Chart (Weight-for-Age Percentiles). The boy's growth improved after the gluten and casein-free diet intervention which started at the age of 36 months.

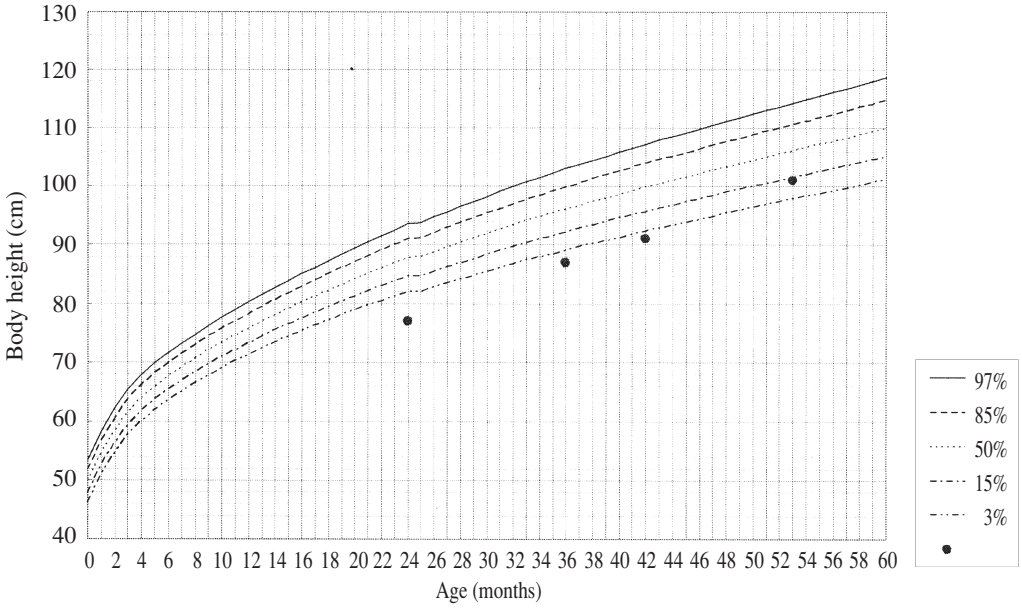

Fig. 4 Boys Growth Chart (Height-for-Age Percentiles). The boy's growth improved after the gluten and casein-free diet intervention which started at the age of 36 months.

rating and Bayley scales revealed relative increment in developmental age levels. In addition, improved nutrition status based on improvement in gastrointestinal symptoms resulted in noticeable advances in growth development. The improvements in body weight, height and vitality were especially noted by his family because the improvement considerably influenced his ability and desire to learn. To the best of our knowledge, this is the first formal medical report concerning dietary therapy in children with autism in Taiwan. In light of the above we report this case for educational purposes and reference to diet therapy in children.

The gluten-free/casein-free diet is currently one of the most commonly used non-educational and non-developmental based treatments for symptoms of autism.[9] It remains popular since it is a simple and non-invasive approach among various traditional or complementary options. The implementation of a diet excluding gluten and casein protein is widespread and reports of success are common in the non-medical literature.[10,11] One particular theory explains that autism symptoms improve because the autistic child's digestive tract is thought to function sub-optimally. During digestion, pre-opioid type compounds from casein and gluten in the diet are thought to be activated because of an incomplete breakdown of proteins.[12,13] These exorphins (i.e. casomorphins and gluteomorphins) are then absorbed into the circulation where they exert an opioid-type action on the brain. The transfer of peptides across the lumen of the gut is thought to occur due to the 'leaky' nature of the gastrointestinal tract in autistic individuals. However, this theory remains controversial.[14-17] Associated concerns, including withdrawal symptoms and a negative impact on nutritional status, have been documented as well.[12] Therefore, caution must be taken before applying this intervention in autistic children.

The duration and therapeutic effect of dietary intervention varies. In our case, dramatic improvement appeared 2.5 months after initiating the diet. One report stated that the effect started after 7-9 months.[18] As mentioned in the same case series, maximal improvement can take up to 24 months of rigid dietary exclusion. Shattock and Whiteley advise not adding these foods back into the diet, since severe opioid symptoms could result.[19]

We would like to point out that this treatment option is more feasible with patients in East Asia than in western countries due to different dietary habits and food selection (Table 1-4). In Taiwan, soy

Table 1. Foods, Grains, and Additives that Generally Contain Gluten

Grains
wheat
barley
spelt
rye
Possible cross contamination grains
amaranth
buckwheat
millet
teff
oats
Foods may contain gluten
modified food starch
spices
natural flavorings
caramel
vinegar
beer

Table 2. Foods that Generally Contain Casein

Name
human milk
cow's milk
sheep milk
cream
yoghurt
other milk products

Table 3. Common Substitutions

Flour substitutions
rice flour
sorghum flour
potato flour
tapioca flour
yam flour
Milk substitutions
soybean milk
rice milk
peanut milk
Cheese substitutions
soy-based cheese
rice cheese
peanut cheese

Table 4. Gluten and Casein Free Foods & Additives

Name
agar
algin
almonds
apple cider vinegar
baking soda
buckwheat
corn
fish (fresh)
fructose
honey
lactose
milo
olive oil
peas
peanut
potato
sucrose
sunflower oil
tea
tofu
vegetables (fresh)
yam flour
brandy
wine
champagne
vodka
rum
tequila
sake

bean milk is as popular as cow's milk and rice is more widely eaten as a major source of hydrocarbons than wheat or oats. The relative availability of rice and soy products as substitutes for wheat in western countries often presents difficulties. The earlier the child can discontinue eating gluten/casein-containing food, the easier it is to alleviate these symptoms. In our experience, this adverse-effect-free therapeutic intervention is worth promotion in children with ASD.

The limitation of this case report is that a double-blind behavioral report from other observers before and after intervention was not initiated. In addition, biochemical studies such as concentration of gluten/casein derivatives in the blood and urine were not obtained. A relative strength of this report is that the child was enrolled in our outpatient clinic research protocol and had CCDI and Bayley II evaluations before and after intervention.

The development quotient showed improvement

in GM (0.54 to 0.68), EL (0.54 to 0.68), and SH (0.83 to 0.85) of the CCDI and the PDI (0.58 to 0.62) in the Bayley scales, whereas other domains showed no improvement. This irregular improvement in autistic behaviors is thought to be related to the difference in rates of development between autistic and normal children.[20] These differences are especially notable when the development of normal infants is compared with that of severely autistic children.[20,21] The trajectory of autism symptoms over time differed in different domains noticed in our case was also reported by a previous study.[22] We recognize that a single case report can not establish that gluten/casein-free dietary restriction in children with autistic spectrum disorder will improve their daily functioning and communication skills. Investigations involving a larger number of participants, as well as prospective studies, are warranted to determine the effects and the specific group of autistic children who will benefit the most. In the future, we will try to analyze underlying biochemical alterations in children successfully treated with such dietary restrictions in order to precisely define and predict the subgroups of ASD that responded positively to this therapy.

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無穀蛋白及無酪蛋白飲食對自閉症的影響：病例報告

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自閉症是一種廣泛影響社交能力，語言溝通能力和缺乏思考以及行爲變通性的疾病。自從西元 1991 年 Reichelt et al. 提出由穀蛋白 (gluten) 和酪蛋白 (casein) 分解產生的縮氨酸 (peptide) 可能是自閉症的致病因子 (etiology) 假說後，飲食對於自閉症的影響和治療就逐漸受到重視。本個案是一位患有 CHARGE syndrome 合併有自閉症的男童，自出生後五個月起即因多重發展遲緩而接受復健治療。但是一直到男童三歲時仍有顯著的發展遲緩。自三歲六個月起，母親接受醫師的建議，對男童嚴格實施無穀蛋白和無酪蛋白的飲食。兩個半月後，男童在與人眼睛的接觸、人際的互動、語言的使用以及食慾上和以前相比皆有了顯著的進展。由於飲食文化的不同，在台灣，無穀蛋白及無酪蛋白飲食相對於西方國家更容易實行。我們報告此案例，是希望提醒同儕醫師注意在自閉症孩童併有腸胃道症狀時可加以應用，這可能可以作爲一種簡單、經濟的自閉症輔助治療。(長庚醫誌 2009;32:459-65)

關鍵詞：自閉症，飲食治療，無穀蛋白飲食，無酪蛋白飲食

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