

A case of lethal kwashiorkor caused by feeding only with cereal grain

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= Abstract =

Kwashiorkor is a syndrome of severe protein malnutrition, which manifests itself in hypoalbuminemia, diarrhea, dermatitis, and edema. It can be life-threatening due to associated immune deficiency and an increased susceptibility to infections. Kwashiorkor should be treated early with nutritional support and the control of infection. Dilated cardiomyopathy may develop during the treatment and in such cases a poor prognosis is expected. Kwashiorkor has been known as a common disease of poor countries. To date, in fact, there has been no report of kwashiorkor leading to death in technically advanced countries. We here report a fatal case of a baby girl admitted with kwashiorkor. She had been fed only with cereal grain mixed with juice, without any protein supplement, for 2 months. This diet was deficient not because of poverty, but due to the illiteracy of her parents. The patient suffered from diarrhea, whole body edema, hypothermia, and dermatitis. Laboratory findings revealed an immune-deficient state featuring leukopenia and decreased immunoglobulin. Blood and urine cultures revealed *Alcaligenes xylosoxidans* growth. The patient was fed frequent small amounts of protein-containing formula and intravenous albumin and micronutrients were administered for nutritional support. She was also treated with intravenous immunoglobulin and antibiotics in order to control infection. Nevertheless, she developed dilated cardiomyopathy and multi-organ failure and died. We review this case in light of the literature. (**Korean J Pediatr 2008;51:329-334**)

Key Words : Kwashiorkor, Infection, Immune deficiency, Dilated cardiomyopathy

Introduction

Kwashiorkor is a type of protein-energy malnutrition that results from an inadequate dietary intake of protein, despite normal carbohydrate intake^{1, 2)}.

Classically, kwashiorkor develops in children living in poor circumstances, mainly in the tropics. Children are commonly affected at weaning age when breast milk is replaced by an inadequate and often unbalanced diet, particularly one deficient in protein^{1, 2)}. These children often develop an immunodeficient state and can have multiple infections, such as tuberculosis and gastroenteritis²⁾.

In this report, we describe a fatal course of kwashiorkor occurring in a 4-month-old baby girl. She manifested a

variety of kwashiorkor symptoms, such as edema, dermatitis, infection, and cardiomyopathy aggravating to congestive heart failure. She had suffered from kwashiorkor for 2 months before admission. We treated her with a protein-containing diet and antibiotics, but ultimately she expired. We also discuss features of kwashiorkor and suggest a course of action to combat this syndrome.

Case Report

A four-month-old female infant was admitted to our hospital with whole body edema occurring over the prior two days. She had suffered from atopic dermatitis since the age of 2 months, and had been fed with powder of roast grain for the past month because her parents were afraid of aggravating dermatitis with protein intake. Within two weeks of the onset of symptoms, watery diarrhea had begun to occur seven or eight times a day, which persisted for two months until admission. At one day prior to admission, she had an apparent whole body edema, purpuric skin rash, and

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decreased urine output. The baby's gestational age at birth was 38 weeks, and her birth weight 3.2 kg. She was delivered by caesarean section, which her mother had previously undergone with a sibling. Her vaccination history included, hepatitis B and bacillus Calmette-Gurin's vaccination, *Hemophilus influenza B* vaccination, and polio vaccination. Her vital signs at admission, were: body temperature 34.7°C, blood pressure 108/66 mmHg, pulse rate 110 beats/min, and respiratory rate 44 breaths/min; and she looked acutely ill. Her weight at admission was 6 kg, the same as her body weight 2 weeks previously.

On examination, the baby's breathing sound was coarse without wheezing or rales, the heart-beat was regular without murmur and mild subcostal retraction was detected. Her abdomen was distended and slightly rigid, bowel sounds were decreased, the liver was palpable 3 fingers breadths and the spleen was not palpable. Pitting edema was detected at the extremities, and the child's eyelids were swollen. The skin over her whole body, including her face was xerotic and erythematous and sparsely chapped. In particular, there was purpuric rash both in the pelvic area and on the right knee (Fig. 1).

Upon admission, serum glucose was 32 mg/dL. Complete blood count results showed a total white blood cell count of 3,100/mm³, hemoglobin (Hb) 11.7 g/dL; platelets 326,000/mm³; and C-reactive protein (CRP) 15.8 mg/dL. A arterial blood gas analysis indicated that the pH was 7.325; PaCO₂ 23.3 mm Hg; PaO₂ 123.5 mm Hg; HCO₃ 11.9 mmol/L; and

SaO₂ 98.3% in room air. Sodium was 126 mEq/L; potassium 3.1 mEq/L; chloride 103 mEq/L; aspartate aminotransferase (AST) 59 IU/L; and alanine aminotransferase (ALT) 210 IU/L. Hepatitis viral marker was non-specific, prothrombin time was 27.1 sec, partial thromboplastin time 50.5 sec, total protein 1.9 g/dL, pro-brain natriuretic peptide (pro-BNP) 5,644 pg/mL, albumin 0.8 g/dL and urine albumin 30 mg/dL. Immunoglobulin (Ig) G was 83.1 mg/dL (normal: 176-601 mg/dL), but IgA and IgE were increased. With respect to micronutrients, zinc and selenium were decreased but thiamine was not decreased. Plasma amino acids-isoleucine, serine, asparagine, glutamine were decreased, but leucine, valine, and methionine were within normal limits. Urine culture and blood culture revealed *Alcaligenes xylosoxidans* 5 × 10⁴/mL growth. Herpes IgM was negative, *cytomegalovirus* IgM was negative, and PCR and AFB staining for tuberculosis were negative. A stool examination for giardiasis was non-specific.

An infantogram at admission showed a decreased cardiothoracic (CT) ratio (46%) for her age. Abdomen ultrasonography revealed mild wall edema in the terminal ileum and ascites in the gallbladder. The patient was put on protein hydrolysate formula (HA[®], Maeil, Korea) at 10 mL every 2 hours and was administered intravenous immunoglobulin at 400 mg/kg/day with intravenous antibiotics, intravenous albumin, vitamin K, and fresh frozen plasma transfusion. She was also administered selenium orally at 4.7 µg/kg/day for the prevention of cardiomyopathy. However, her symptoms did not improve and hypothermia persisted.

By the third day of the child's hospital stay, hypokalemia was aggravated and thrombocytopenia and direct hyperbilirubinemia developed. Further, the purpuric rash in the pelvic area and on the right knee had become cyanotic, with bullae formation and a foul odor. An echocardiogram on the fifth day of hospital day revealed mild dilatation of both ventricles and the both atria and diffuse thinning of the septum, although the ejection fraction was borderline normal at 64.6% and the fractional shortening of the left ventricle was in the normal range at 33.3%. The purpuric rash had by this time necrotic (Fig. 2).

By the eighth day from admission, tachypnea had developed and subcostal retraction was worsened. Cardiomegaly was evident and hepatomegaly was aggravated, and a follow-up echocardiogram revealed heart failure. A chest X-ray showed that the CT ratio had increased up to 56%,



Fig. 1. At admission, the patient had a purpuric rash throughout the pelvic area.



Fig. 2. By hospital day 5, the pelvic area had become necrotic.

and there was atelectasis on the right upper lung field. Pro-BNP was at 25,000 pg/mL, and a follow-up echocardiogram revealed that the ejection fraction of the left ventricle had decreased to 34% and the fractional shortening was 13%. Hepatomegaly was further exacerbated and the liver was palpable for a 5-FB width. AST was 1,278 IU/L, ALT was 580 IU/L, total bilirubin was at 6.4 mg/dL, and direct bilirubin was 3.7 mg/dL. A chest examination revealed that there was a decreased breathing sound in the right lung field, but still without rales or wheezing. The patient was dyspneic despite applying 5 L O₂/min through a mask, so she was given mechanical ventilatory support.

On the 13th day in the hospital, dyspnea persisted despite ventilatory support. Hypotension and bradycardia persisted despite the use of intravenous inotropic agents. Cardiopulmonary resuscitation was performed but the child expired on the 13th day.

Discusson

In a 1935 Lancet article, Jamaican pediatrician Williams CD³ introduced the West African name kwashiorkor into the scientific literature of nutritional disease. The name is derived from one of the Kwa languages of coastal Ghana and means “the one who is displaced”. Williams described the typical development of the disease, with the critical age being the second year of life during weaning when other

foods are introduced and breast milk is gradually replaced by a diet of foods suitable for intake and digestion by young children⁴. Kwashiorkor is a preventable nutritional deficiency associated with high mortality and morbidity if not adequately treated⁵. Inadequate protein intake is considered to be a primary cause of kwashiorkor¹.

The initial endocrine responses in kwashiorkor are high insulin and low plasma cortisol levels, which promote uptake of amino acids by muscle, thus diverting them from the liver. As a consequence, there is reduced synthesis of albumin (resulting in hypoalbuminemia, which further leads to edema) and apoproteins, predisposing the subject to fatty liver². Because aflatoxin and its metabolites are found in children with kwashiorkor, a relationship between aflatoxin and kwashiorkor has been suggested¹. Recently, injury to tissues caused by free radicals plus other deficiencies of essential nutrients and coexisting infections, have been postulated as important reasons why some malnourished children develop edema¹.

Children who are suffering from kwashiorkor often have multiple infections. The disease may initially present as vague manifestations that include lethargy, apathy, or irritability, dystrophic changes of hair and skin, and edema¹. Specially—the skin—becomes dry, thin, shiny, or wrinkled (“crazy-paving” dermatosis) and the hair is thin, sparse and easily pulled out². Depigmentation may occur on skin exposed to sunlight, and darkening of the skin may occur in irritated areas¹. Depigmentation is possibly mediated by zinc deficiency².

We reviewed seven cases of kwashiorkor, which are summarized in Table 1. These patients were primarily of the age –six months to two years, the so-called age of weaning. We found no sex differences. All cases featured edema, dermatitis, and hypoalbuminemia, but the presence and extent of hepatitis, hepatomegaly, and ascites were found to be related to the duration of symptoms. All seven of these cases resulted in full recovery after institution of an adequate diet. However, severe cases may result in stupor or coma; fatal outcomes are usually caused by infection⁶ as in a case reported here.

Immediate treatment for kwashiorkor includes resuscitation (correction of fluid and electrolyte disturbances such as acidosis, hypoglycemia, hypothermia) and treatment of localized or generalized infection (e.g. bronchopneumonia, septicemia). In kwashiorkor, an acute illness often compounds chronic infections such as tuberculosis, and chest infections

are common. Eradicating infection takes priority, as nutritional support is ineffective in the presence of active sepsis. Because malnourished children do not exhibit the classical signs of infection (fever and leukocytosis), routine administration of antibiotics is recommended.

Re-feeding must be initiated early on, but gradually—too vigorous feeding may lead to death from heart failure. Overfeeding may also lead to acute fatty liver. Micronutrients, such as potassium, zinc, phosphate, iron may be needed in amounts greater than the normal daily require-

Table 1. Review of 7 Reported Cases of Kwashiorkor Caused by Feeding only with Cereal Grain

Age	Sex	Food	Onset (PTA)	Symptom	Lab	Treatment
8 mo. ¹⁰⁾	F	cream soda supplemented only with calcium powder (1.5–5 mo.)	2 mo.	periorbital swelling, rash angular stomatitis ascites	Hb 9.1 g/dL Hct 29.3% hypoglycemia (-) albumin 0.9 g/dL electrolyte: normal AST/ALT 68/32 (U/L) zinc 8.26 μ mol/L heart : normal	oral therapy with cow's milk infant formula with multi-vitamin, zinc
2 yr. ¹¹⁾	F	farina	unknown	apathy facial edema lank, straight, orange-colored hair rash hepatomegaly	unknown	juice from cooked beans in small regular doses
5 yr. ¹²⁾	M	bread, risks, crisps, biscuits, vitamin pills, Lucozade 1L/D	4 wk.	swelling of legs pitting edema pale appearance hepatomegaly	Hb 8.3 g/dL Albumin 1.6 g/dL aminoacid:decreased CRP 14 mg/L electrolyte: normal	milk, fish, egg
14 mo. ¹³⁾	F	rice dream, vegetables, meat	2 wk.	diaper rash generalized edema light hair pallid skin color alopecia	Hct 26.7% albumin 1.4 g/dL alopecia AST 109 U/L ALT 48U/L zinc 28 μ g/dL	Enfanmil Nutramigen LIPIL formula (Mead Johnson, Evansville, Ind)
7 mo. ¹³⁾	M	rice dream	several wk.	irritability decreased appetite swelling rash	Hct 24.6% albumin 1.5 g/dL AST 109 U/L ALT 67 U/L zinc 31 μ g/dL	Enfanmil Nutramigen LIPIL with zinc supplementation
2 yr. ¹⁴⁾	M	food deficient in protein, herb medication	3 mo.	rash edema ascites irritability itching easily pulling of hair pleural effusions	Hb 13.3 g/dL albumin 1.3 g/dL ALT, AST: normal IgG 368 mg/dL IgA 53 μ g/dL IgE >1,000 IU/mL	
9 mo. ¹³⁾	F	a thin gruel of rice, soybean milk, rice	unknown	atopic-dermatitis edema deformity of pelvic bone	Hb 10.7 g/dL Hct 34.1% albumin 2.9 g/dL total calcium: decreased IgE 10230	

Abbreviations : PTA, prior to admission; Hb, hemoglobin; Hct, hematocrit; AST, aspartate aminotransferase; ALT, alanine aminotransferase; CRP, C-reactive protein

ment in order to replenish stores and avoid further depletion related to tissue growth. Without these, re-feeding can deplete circulating concentrations and may lead to death^{2, 7)}. Intravenous fluid infusion may cause overhydration and heart failure and should be used only when there are definite signs of shock. Children with kwashiorkor have leaky cell membranes and do not maintain normal sodium and potassium⁸⁾. The potassium deficit, present in all malnourished children, adversely affects cardiac function and gastric emptying and magnesium is essential for potassium to enter cells and be retained. Congestive heart failure is usually a complication of overhydration, very severe anemia, blood or plasma transfusion, or giving a diet with a high sodium content⁷⁾. Life-threatening congestive heart failure is seen during recovery from kwashiorkor in 10-20% of cases, and has been associated with excessive sodium intake. Additionally, selenium deficiency is associated with cardiomyopathy leading to congestive heart failure, so dietary selenium supplementation may prevent cardiomyopathy and has been demonstrated to successfully reverse heart failure that occurs in patients receiving selenium-deficient, total parenteral nutrition. When heart failure is caused by fluid overload, it is important to stop all oral intake and intravenous fluids: no fluid should be administered until the heart failure is improved, and an intravenously administered diuretic is indicated⁷⁾. Kwashiorkor is a preventable nutritional deficiency with associated mortality and morbidity that can be high if not adequately treated⁵⁾. Early mortality in classical kwashiorkor has been very high, especially when signs of hypoglycemia and hypothermia are present⁶⁾: multiple infections, including complications from measles and tuberculosis⁹⁾, are principally responsible for death in these cases. Even for those who recover from kwashiorkor, the long-term prognosis remains poor due to deprived social conditions and lack of education²⁾. In spite of treatment, affected children rarely "catch up" to their age mates. Even if a child is able to recover well from the physical-retardation, the effects on psychomotor development may well be more long-lasting^{5, 9)}.

Social support and alleviation of physical disabilities are essential in combating the effects of under-nutrition in the community²⁾. In Africa, significant numbers of children die from kwashiorkor due to poverty, despite the efforts of many people who are endeavoring to help them. In contrast to children from underdeveloped countries, though, children in developed countries suffer from kwashiorkor primarily

because of poor parental knowledge about proper nutrition.

In the present case, kwashiorkor developed not because of poverty but due to ignorance of proper nutrition. Parents of the patient had wrong knowledge about nutrition. They thought that if their baby had been fed with protein-contained diet, then her dermatitis have been worsen. So they fed her with protein-free diet for a long time. Nowadays, many people suffer from atopic dermatitis. It is a fact that people can contact with various informations, whether they are true or not. The wrong knowledge can result in tragedy as in this case.

Thus it is necessary that people have an ability to pick up a correct idea in the flood of informations. To do this, it is vital that people raising children are educated in providing suitable diets for their children.

한 글 요약

미음 수유만으로 발생한 치명적인 Kwashiorkor 1례

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이현주 · 금경혜 · 박혜진 · 이계향 · 이경훈
최은진 · 김진경 · 정혜리 · 김우택

Kwashiorkor는 단백질 결핍으로 인한 영양실조로 저알부민혈증, 설사, 피부염, 부종을 증상으로 나타낸다. 단백질-열량 결핍은 면역결핍을 초래하고 이는 감염에 대한 감수성을 높임으로써 생명을 위협하는 상태가 될 수 있다. 치료는 조기 영양공급, 감염증 치료가 주이며, 치료 경과 중 확장성 심근증이 나타날 수 있으며 이 경우 예후가 안 좋다. Kwashiorkor는 주로 빈곤한 나라에서 생긴다고 알려져 왔으며, 기술적으로 진보한 나라에서 치명적인 결과까지 낳은 예는 보고된 바가 없었다. 치명적인 kwashiorkor 1례를 경험하였기에 보고하는 바이다. 환아는 가난때문이 아니라 부모의 잘못된 생각으로 2개월 동안 곡물에 태운 곡식가루만 먹었으며, 설사, 전신 부종, 흥반, 저체온증 등을 주소로 입원하였다. 면역 결핍이 있는 상태였으며, 혈액 배양 검사상 *Alcaligenes xylosoxidans*가 동정되었다. 단백질 보충식이 및 항생제 치료, 정주용 면역글로불린치료, 미세영양소 보충하였으나 확장성 심근병증, 다발성 장기 부전으로 사망하였다.

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