Improper Use of a Plant-Based Vitamin C–Deficient Beverage Causes Scurvy in an Infant

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abstract

Scurvy is a rare disease in developed countries. Risk groups include children with restricted diets, mainly patients who are autistic or have cerebral palsy. Furthermore, consumption of plant-based beverages has increased in recent years, especially in developed countries. When plant-based beverages are the exclusive diet in the first year of life and not consumed as a supplement to formula or breastfeeding, it can result in severe nutritional problems. We report a case of scurvy after exclusive intake of almond beverages and almond flour from 2.5 to 11.0 months of life. The patient was referred for pathologic fractures of the femur, irritability, and failure to thrive. He had typical radiologic signs of scurvy, such as osteopenia, cortical thinning, Wimberger ring, Frankel line, fracture, and periosteal reaction. Moreover, his plasmatic vitamin C level was very low. The child was diagnosed with scurvy and was started on vitamin C replacement therapy at a dose of 300 mg per day. Over the following 3 months, his general condition, the pain in the legs, and the radiologic features improved; the plasmatic vitamin C level was normalized; and the child started walking. In summary, this case demonstrates that scurvy is a new and severe complication of improper use of almond drinks in the first year of life. Manufacturers should indicate that these beverages are inappropriate for infants who consume a vitamin C–deficient diet.

The intake of plant-based beverages, including infant formulas, has increased in recent years, especially in developed countries. However, the use of plant-based beverages as an alternative to infant formula or breastfeeding carries nutritional risks.[1] Thus, improper use of plant-based drinks has been associated with a range of nutritional deficiencies, including kwashiorkor,[2] rickets,[3] or failure to thrive.[4] In particular, prolonged use of almond-based beverages has resulted in severe metabolic alkalosis due to insufficient intake of chloride,[5,6] as in chloride-deficient formulas,[7] carnitine deficiency,[8] failure to thrive, and rickets.[9]

On the other hand, scurvy is a rare disease in developed countries. Occurrence in the pediatric population is very low. Populations at risk include (1) elderly subjects with poor nutrition, food faddism, and/or alcoholism[10]; (2) infants who regularly drink boiled milk; and (3) children with restricted diets, particularly those with autism and cerebral palsy.[11,12]

This case report presents scurvy as a complication of exclusive use of almond beverages in the first year of

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life, due to deficient intake of vitamin C.

CASE REPORT

The patient ,11 months old, had been tired and irritable for 1 month before examination. At 7 months of age, he could sit without support. From 8 months of age onward, he showed less interest in interacting and was more unstable when sitting. At 9 months of age, his weight was 9 kg (*z* –0.28 DS) and his length was 68 cm (*z* –1.81 DS). At 11 months, the child was fairly healthy but was irritable, his weight was 8.5 kg (*z* –1.23 DS), his length was 71 cm (*z* –1.92 DS) (Fig 1), and his blood pressure was 98/56 mm Hg. He refused to support his legs on a solid surface and he cried during passive mobility of both lower limbs. There was no joint effusion and he had no gingival bleeding.

The patient was born at term after an uneventful pregnancy (G2P2) and his birth weight was 3100 g. He was vaccinated according to the recommended Spanish guidelines. For the first 2.5 months of his life, the infant was fed with a cow's milk–based proprietary formula, in the absence of human breast milk. At this age, the infant developed dermatitis, and for this reason, feeding was changed based on recommendations from a medical doctor. His daily intake from age 2.5 to 11.0 months was approximately 900 to 960 mL of a prepared mixture. From 6 months of age onward, the mother had offered pureed fruits and vegetables in vain. The daily mixture consisted of ~680 g almond drink (EcoMil Mandorla; Nutriops, SL, Murcia, Spain), 60 g almond flour (EcoMil Almond Instant; Nutriops, SL), 20 g sesame powder (EcoMil Sesamo; Nutriops, SL), a teaspoon of brown rice malt, 60 to 80 g of a cream of cereals (from brown rice and millet), and a sachet of Lactosul

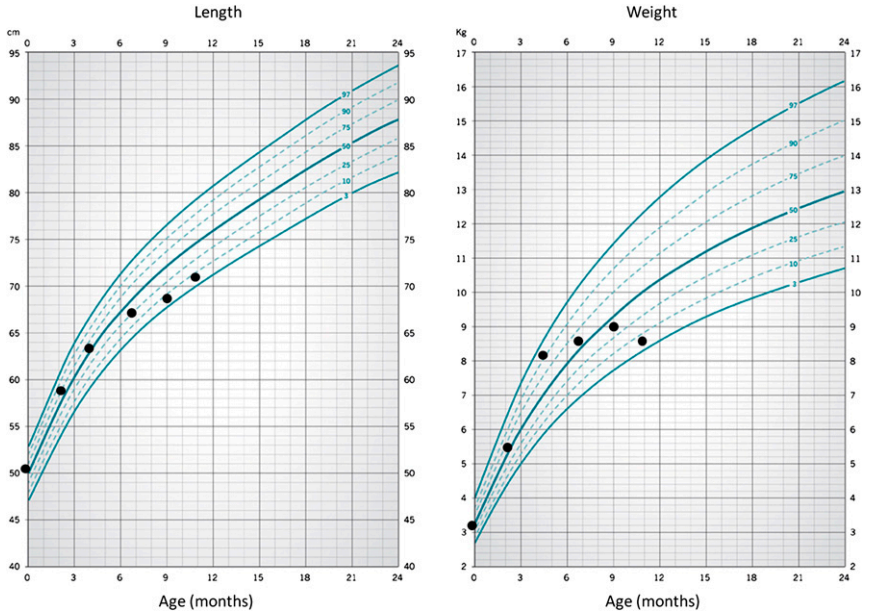

FIGURE 1
Growth chart of the patient.

TABLE 1 Composition of Consumed Food According to the Information on the Label, per 100 g

Parameter	EcoMil Mandorla Beverage	EcoMil Instant Flavor	EcoMil Sesame
Energy, kcal	46	463	446
Lipids, g	2.10	15.2	11.2
Carbohydrates, g	5.4	68	72
Protein, g	0.9	13	12.7
Salt, g	0.25	0.4	0.25
Calcium, mg	—[a]	172	—[a]
Phosphorus, mg	—[a]	364	—[a]

[a] No content.

GG (Natysal Laboratories, Madrid, Spain) (*Lactobacillus rhamnosus*, fructooligosaccharides, and inulin). Mean energy intake during this period was 97 kcal/kg per day (Table 1).

Radiographs of the lower limbs showed osteopenia, cortical thinning, Wimberger ring, Frankel line, fracture, and periosteal reaction (Fig 2). The x-ray column showed that there were vertebral fractures and wide intervertebral spaces (data not shown).

The following laboratory data results were abnormal: zinc 64 µg/dL (65–110), thyroid-stimulating hormone 7.47 µIU/mL (0.27–4.84), 25-OH-vitamin D_3 12.3 ng/mL (30–100), and ascorbic acid (AA) level <10.0 µmol/L (23–113).

The following were in the normal range: sodium, potassium, chloride, magnesium, pH, bicarbonate, calcium, phosphate, alkaline phosphatase, parathyroid hormone, free T4, anti-thyroglobulin and anti-microsomal antibodies, albumin, total protein, hemoglobin, mean cell volume, serum iron, transferrine, ferritine, folic acid, vitamin B_{12}, and vitamin E.

Clinical, laboratory, and radiologic findings along with the nutritional history were suggestive of infantile scurvy, failure to thrive, and vitamin D insufficiency.

The child was started on oral vitamins C and D replacement therapy at respective doses of 300 mg per day and 600 UI per day for 3 months.[13,14] He was fed with infant

formula, cereals, meat, fruits, and vegetables. The daily mixture that was previously fed was stopped. Follow-up radiographs carried out 4 weeks later confirmed an improvement in radiologic features. After 45 days, plasma vitamin C, vitamin D, zinc, and thyroid-stimulating hormone levels were normalized. On follow-up visits, he showed progressive improvement in the pain in his legs and he started walking after 8 weeks.

DISCUSSION

Vitamin C, or AA, is a thermolabile and essential nutrient involved in many biological and biochemical functions. It is a potent antioxidant and a cofactor in collagen and neurotransmitter biosynthesis.[15] In the first year of life, the recommended dietary allowance is 50 to 60 mg per day.[16] The recommended content of vitamin C in formula is 10 to 30 mg per 100 kcal[17] and the content of breast milk in European women is 63 ± 14 mg/kg.[18] Fruits such as oranges, strawberries, and kiwis contain 60 to 100 mg/100 g.[19] Therefore, as applied to this particular pediatric case, complementary feeding with fruits and formula or breast milk could have help to meet AA needs. It is important to note that during the industrial processing of almond beverages, thermolabile vitamins like AA lose their biological activity.[20] Some plant-based beverages in Spain are supplemented with calcium, magnesium, vitamins D, B_{12}, and E.[21] The consequences of nonexclusive use of such plant-based beverages in infant feeding depends on the quantities consumed and eventual compensation of nutrients from other foods in the diet.[22] An analysis of the actual nutrition intake as reported by the mother is presented in Table 2.[23] The intake of calcium, iron, zinc, and vitamins C and D was much lower than the corresponding dietary allowances for that age.

TABLE 2 Daily Intake of the Patient

	Patient's Daily Intake Before Vitamin Replacement Therapy	AI-RDA[a] 0–6 mo/6–12 mo
Energy, kcal	933	—
Protein, g	23.5	9.1/11[a]
Carbohydrate, g	146.6	60/95
Fat, g	28.1	31/30
Calcium, mg	43	200/260
Phosphorus, mg	343.9	100/275
Iron, mg	1.2	0.27/11[a]
Magnesium, mg	75.1	30/75
Zinc, mg	0.4	2/3[a]
Iodine, µg	395	110/130
Vitamin C, mg	Traces	40/50
Vitamin D, µg	0.0	10/10

[a] AI, adequate intake according to Food and Nutrition Board, Institute of Medicine; RDA, recommended dietary allowances.[16]

Signs of scurvy develop after 1 to 3 months of insufficient intake of AA.[24] In this patient, at the age of 7 to 8 months, old motor regression signs appeared, and 1 to 3 months later there was failure to thrive, in

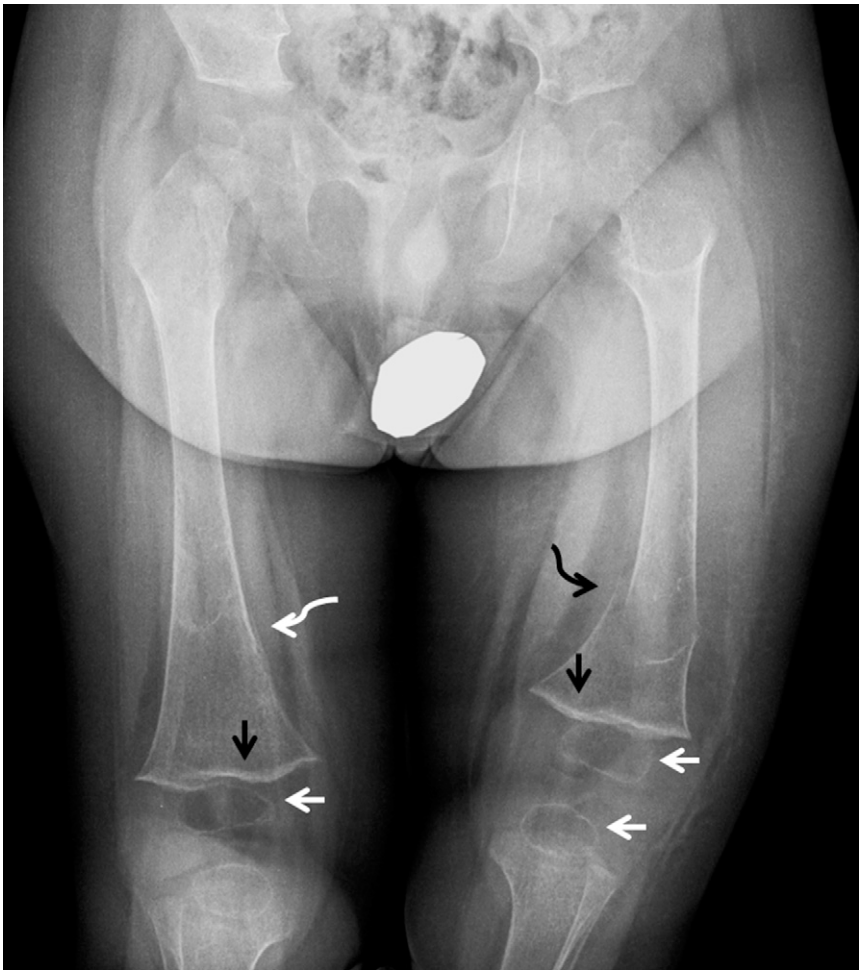

FIGURE 2
The anteroposterior view of bilateral lower limbs shows osteopenia, cortical thinning, a white line around the epiphyses (Wimberger ring) (white arrows) and metaphyses (Frankel line) (black arrows), fracture of the distal left femur (curved black arrow), and periosteal reaction in the right femur (curved white arrow).

addition to pathologic fractures at the age of 11 months. Some signs of scurvy result from decreased synthesis of collagen. Although the manifestations of scurvy are highly variable,[25] bone disease is much more frequent in children than in adults. Hemorrhages occurring beneath the periosteum and fractures around the growth plate cause bone pain.[26] In addition to fractures and subperiosteal hematomas, the radiologic features in the present case report are typical of scurvy: osteopenia, cortical thinning, Wimberger ring, Frankel line, and adjacent transverse metaphyseal bands of decreased density. Differential diagnosis should be made to rule out rickets (presents with metaphyseal fraying and cupping with physical widening, which is not present in this case), osteogenesis imperfecta, leukemia and metastatic neuroblastoma, child abuse, osteomyelitis, and tumors, but the Wimberger ring and Frankel line are virtually pathognomonic of scurvy.[27] The diagnosis of scurvy is based on a history of poor intake of vitamin C, characteristic radiologic and clinical findings, and the response to treatment. Infants and children are usually treated with 100 to 300 mg daily for 1 to 4 months.[13]

CONCLUSION AND RECOMMENDATION

This case presents scurvy as a new and severe complication of improper use of almond beverage in the first year of life. Pediatricians and parents should be aware that plant-based beverages are not a complete food and they may not replace breastfeeding or infant formula.

ABBREVIATION

AA: ascorbic acid

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