

Case Report

Goiter and Multiple Food Allergies

Stefanie Leniszewski¹ and Richard Mauseth^{1,2}

¹ Woodinville Pediatrics, Woodinville, WA 98072, USA

² Department of Pediatrics, University of Washington, Seattle, WA 98195, USA

Correspondence should be addressed to Richard Mauseth, richardmausethmd@msn.com

Received 5 January 2009; Accepted 17 March 2009

Recommended by Gary Francis

Severe iodine deficiency results in impaired thyroid hormone synthesis and thyroid enlargement. In the United States, adequate iodine intake is a concern for women of childbearing age and pregnant women. Beyond this high risk group iodine deficiency is not considered to be a significant problem. This case report describes a 12-year-old male with severe iodine deficiency disorder (IDD) resulting from restricted dietary intake due to multiple food allergies. We describe iodine replacement for this patient and continued monitoring for iodine sufficiency. Children with multiple food allergies, in particular those with restrictions to iodized salt and seafood, should be considered high risk for severe iodine deficiency.

Copyright © 2009 S. Leniszewski and R. Mauseth. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

1. Background

Iodine is an essential component of thyroid hormones and critical to normal brain development in newborn infants and children. Severe iodine deficiency results in impaired thyroid hormone synthesis and thyroid enlargement. Iodine nutrition in the United States is considered to be sufficient for most populations despite significant reductions in urinary iodine values between the early 1970s and the early 1990s [1]. The 2001-2002 US National Health and Nutrition Examination Survey (NHANES) results suggest that iodine nutrition has stabilized, [2] but levels are barely above the recommendation for the average which means that a significant number of people remain at risk. Women of childbearing age and pregnant women are widely accepted as high-risk groups for inadequate iodine intake, but there is valid concern that additional high-risk groups remain [3, 4]. Three cases of iodine deficiency as a result of restrictive diets in children have been reported in the literature [5-7]. This case report illustrates a unique case of iodine deficiency in the US and suggests the need for a greater emphasis on promoting and evaluating the nutritional adequacy of the diets of children with multiple food allergies or perceived food allergies or sensitivities.

2. Case Report

A 12-year-old Caucasian male presented with a neck mass. He had no recent illnesses or changes in health status. He had developmental delay diagnosed at approximately 2 years of age and was thought to have some form in the autism spectrum. His family history was positive for a brother with life-threatening peanut allergies. His past medical history was significant for multiple food allergies, including four anaphylactic episodes. He was tested at 6 months of age and was found to be allergic to peanuts and soy. Additional allergy tests determined allergies to soy, eggs, dairy, wheat, seafood, peanuts, legumes, white potatoes, corn, spinach, and strawberries. All fish was eliminated from his diet at 6 years of age. The patient had a nutrition evaluation with a registered dietitian at this time, which did not reveal any significant nutrition concerns. At age 10, due to concerns about iodized table salt containing cornstarch, the family switched to using sea salt. His diet is further restricted from citrus fruits, pork due to concern regarding additives, and beef due to potential processing with milk. His current dietary intake includes almost exclusively chicken and turkey, rice cakes, apples, applesauce, apple juice, bananas, raisins, blueberries, carrots, broccoli, sweet potatoes, olive oil, and sea salt. He takes calcium citrate supplements. Multivitamins

are avoided due to bulking agents, which sometimes contain cornstarch.

On initial examination, he had no signs or symptoms of hyperthyroidism or hypothyroidism. He had a significantly enlarged smooth thyroid gland. A thyroid ultrasound showed thyromegaly without underlying mass. The right lobe measured $7.4 \times 4.0 \times 2.6$ cm for a total volume of 41 cc. The left lobe measured $7.8 \times 3.2 \times 2.9$ for a total volume of 38 cc. His thyroid function was as follows: free triiodothyronine (free T_3) 476 pg/dL (normal 335–480), free tetraiodothyronine (free T_4) 0.2 ng/dL (normal 0.8–2.0), total tetraiodothyronine (total T_4) 1.6 μ g/dL (normal 4.5–10.0), and thyrotropin (TSH) 16.5 μ IU/mL (normal 0.50–4.50). His thyroid antibodies were negative. A 24-hour urine collection for iodine was less than 10 μ g (normal 100–460 μ g/specimen).

Specific dosing information for treating iodine deficiency was difficult to find since prevention is strongly encouraged. The Dietary Reference Intake for males 9–13 years is 120 μ g daily and the Tolerable Upper Intake Level is 600 μ g daily [8]. In dosing potassium iodine, the saturated solution of potassium iodine contains 50 mg or 50,000 μ g per drop. This form of iodine replacement was chosen to avoid allergic reaction to other ingredients that may be included in other multivitamin-mineral supplements. The patient was treated with one drop of 10% solution potassium iodine in the allergists' office to provide 5 mg of iodine. After the patient tolerated this, the dose was increased to 15 mg per day because of the slow response to his thyroid function tests. After three months of supplementation, his thyroid function tests have normalized and his goiter has decreased dramatically in size to almost normal. The patient also reports an increase in energy level and better school performance. The patient's iodine intake is maintained on a supplement containing 3.6 mg iodine taken once per month and urinary iodine is being monitored.

3. Discussion

In the US, iodized table salt is considered to be a primary food source for iodine. Other food sources include saltwater fish, seaweed, and to a lesser extent egg yolks, dairy products, commercially baked breads, meat, and poultry. Iodination of salt is not mandatory in the United States, and recent tests of iodized table salt samples found that 53% did not meet the US Food and Drug Administration's recommendation for iodine levels [9]. Additionally, Americans have reduced their overall salt consumption for health reasons such as preventing hypertension; are using designer table salts more frequently, such as sea salt or Kosher salt which do not contain significant amounts of iodine; and are consuming a significant amount of processed and fast foods which may not be prepared with iodized salt. The iodine content of dairy products and commercially baked bread is dependent on the use of iodophors (iodine containing substances, such as dairy cleansers or bread dough conditioners) in processing, making iodine levels in these foods highly variable [10, 11]. Iodine in meat and poultry is also highly

TABLE 1: Iodine content of allergy formulas.

Beverage	Iodine content (mcg/100 cal)
Elecare	8.4
Neocate infant	15.4
Neocate junior	17.8–18.9
Nutramigen AA	15

variable depending on the amount of iodine added to animal feed [4]. Multivitamins are also not a reliable source for iodine. Only 50% of adult multivitamins, 45% of children multivitamins, and no infant liquid multivitamins contain iodine [12]. Furthermore, only 1/3 of over-the-counter and 2/3 of prescription prenatal vitamins contain iodine [12]. With all of these factors present, valid concerns regarding iodine intake remain for high-risk groups despite the most recent NHANES report.

This patient developed severe iodine deficiency disorder (IDD) due to his extremely restricted dietary intake from multiple food allergies, particularly the elimination of seafood and finally iodized salt. Food allergies occur in an estimated 6–8% of children, and perceived prevalence of food allergy may lead to the use of some form of elimination diet in an estimated 20% of children [13]. Children with multiple food allergies have been found to be shorter than those with one food allergy and to have less than adequate intakes of calcium, vitamin D, and vitamin E [14]. The use of allergy formulas may help to supplement iodine in children with multiple food allergies (see Table 1), but additional supplementation may still be necessary depending on the restrictions of the diet. This patient would not have tolerated these formulas due to his corn allergy. Additionally, quantities sufficient to prevent iodine deficiency are often difficult to consume by small children. Children with multiple food allergies or those following elimination diets due to a perceived food allergy should have regular nutrition assessments by a registered dietitian. Another evaluation after the elimination of iodized salt at age 10 may have identified a lack of iodine in the diet. These children should also be added as a high-risk group for IDD in the US.

In presenting this case study at a recent regional pediatric endocrinology meeting, concerns were raised regarding an increase in newborn TSH values among infants born in the state. Similar results have been found across the US and coincide with declining urinary iodine status of pregnant women [15]. In a recent study by Moleti et al., maternal iodine insufficiency was significantly lower in women consuming iodized salt for at least 2 years compared with women consuming iodized salt upon becoming pregnant [16]. These results further stress the importance of adequate iodine intake prior to and during pregnancy and the potential long-term consequence to children born to iodine insufficient mothers. The National Academy of Sciences recently made the recommendation for the addition of iodine to all prenatal vitamins, and The American Thyroid Association also

recommends daily iodine supplementation for all pregnant and lactating women [17].

Public health efforts for adequate iodine nutrition should be increased in all children and pregnant and breastfeeding women, particularly among high-risk populations and anyone who does not use iodized salt or consume seafood regularly. Research efforts should focus on the effects of suboptimal iodine nutrition in high-risk groups and identification of additional high-risk groups. Continued and routine monitoring of iodine nutrition in the US may also prove prudent given the limited number of iodine rich food sources.

References

- [1] J. G. Hollowell, N. W. Staehling, W. H. Hannon, et al., "Iodine nutrition in the United States. Trends and public health implications: iodine excretion data from National Health and Nutrition Examination Surveys I and III (1971–1974 and 1988–1994)," *The Journal of Clinical Endocrinology & Metabolism*, vol. 83, no. 10, pp. 3401–3408, 1998.
- [2] K. L. Caldwell, R. Jones, and J. G. Hollowell, "Urinary iodine concentration: United States National Health and Nutrition Examination Survey 2001–2002," *Thyroid*, vol. 15, no. 7, pp. 692–699, 2005.
- [3] J. G. Hollowell and J. E. Haddow, "The prevalence of iodine deficiency in women of reproductive age in the United States of America," *Public Health Nutrition*, vol. 10, no. 12A, pp. 1532–1539, 2007.
- [4] E. N. Pearce, "National trends in iodine nutrition: is everyone getting enough?" *Thyroid*, vol. 17, no. 9, pp. 823–827, 2007.
- [5] M. Labib, R. Gama, J. Wright, V. Marks, and D. Robins, "Dietary maladvice as a cause of hypothyroidism and short stature," *British Medical Journal*, vol. 298, no. 6668, pp. 232–233, 1989.
- [6] F. Krull and K. Ohlendorf, "Hypothyroid iodine deficiency struma in 2 siblings as a sequela of alternative nutrition," *Monatsschr Kinderheilkd*, vol. 141, no. 6, pp. 481–482, 1993.
- [7] D. Pacaud, G. Van Vliet, E. Delvin, et al., "A Third World endocrine disease in a 6-year-old North American boy," *Journal of Clinical Endocrinology & Metabolism*, vol. 80, no. 9, pp. 2574–2576, 1995.
- [8] Food and Nutrition Board and Institute of Medicine, *Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc*, National Academy Press, Washington, DC, USA, 2000.
- [9] P. K. Dasgupta, Y. Liu, and J. V. Dyke, "Iodine nutrition: iodine content of iodized salt in the United States," *Environmental Science and Technology*, vol. 42, no. 4, pp. 1315–1323, 2008.
- [10] A. B. Kirk, P. K. Marinellano, K. Tian, A. Dutta, E. E. Smith, and P. K. Dasgupta, "Perchlorate and iodine in dairy and breast milk," *Environmental Science & Technology*, vol. 39, no. 7, pp. 2011–2017, 2005.
- [11] E. N. Pearce, S. Pino, X. He, H. R. Bazrafshan, S. L. Lee, and L. E. Braverman, "Sources of dietary iodine: bread, cow's milk, and infant formula in the Boston area," *Journal of Clinical Endocrinology & Metabolism*, vol. 89, no. 7, pp. 3421–3424, 2004.
- [12] S. L. Lee and J. Roper, "Inadequate iodine supplementation in American multivitamins," *Endocrine Practice*, vol. 10, supplement 1, p. 46, 2004.
- [13] L. Noimark and H. E. Cox, "Nutritional problems related to food allergy in childhood," *Pediatric Allergy and Immunology*, vol. 19, no. 2, pp. 188–195, 2008.
- [14] L. Christie, R. Jean Hine, J. G. Parker, and W. Burks, "Food allergies in children affect nutrient intake and growth," *Journal of the American Dietetic Association*, vol. 102, no. 11, pp. 1648–1651, 2002.
- [15] K. M. Sullivan, "Increase in congenital hypothyroidism due to inadequate iodine nutrition?" *Molecular Genetics and Metabolism*, vol. 93, no. 4, p. 485, 2008.
- [16] M. Moleti, V. P. Lo Presti, M. C. Campolo, et al., "Iodine prophylaxis using iodized salt and risk of maternal thyroid failure in conditions of mild iodine deficiency," *The Journal of Clinical Endocrinology & Metabolism*, vol. 93, no. 7, pp. 2616–2621, 2008.
- [17] D. V. Becker, L. E. Braverman, F. Delange, et al., "Iodine supplementation for pregnancy and lactation—United States and Canada: recommendations of the American Thyroid Association," *Thyroid*, vol. 16, no. 10, pp. 949–951, 2006.