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INSTRUCTIVE CASE

Iodine-induced neonatal hypothyroidism secondary to maternal seaweed consumption: A common practice in some Asian cultures to promote breast milk supply

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Abstract: Mild iodine deficiency is a recognised problem in Australia and New Zealand. However, iodine excess can cause hypothyroidism in some infants. We highlight two cases which illustrate the risks of excess dietary iodine intake during pregnancy and breastfeeding. They also describe a cultural practice of consuming seaweed soup to promote breast milk supply. Although most attention recently has been on the inadequacy of iodine in Australian diets, the reverse situation should not be overlooked. Neither feast nor famine is desirable.

Key words: breastfeeding; hypothyroidism; iodine; thyroid.

Introduction

Mild iodine deficiency is a recognised problem in Australia and New Zealand, leading to the recent mandatory fortification of bread with iodine and the National Health and Medical Research Council (NHMRC) recommendation for all women who are pregnant or breastfeeding to take an iodine supplement of 150 mcg per day.[1] However, iodine excess can cause hypothyroidism in some infants. These cases illustrate the risks of excess dietary iodine intake during pregnancy and breastfeeding. They also highlight a common practice in women from Korea and Northern China who consume large amounts of seaweed soup to promote their breast milk supply.

Key Points

1. The recent NHMRC recommendation for routine supplementation of pregnant women with iodine may result in an increased number of cases of iodine toxicity in infants of women who have high dietary iodine intake.
2. Pregnant women should be cautious about consuming large amounts of seaweed during and after pregnancy. Adverse effects on the foetal and neonatal thyroid gland may occur with risk to neurodevelopmental outcome.
3. Although most attention recently has been on the inadequacy of iodine in Australian diets, the reverse situation should not be overlooked. Neither feast nor famine is desirable.

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Case 1

Following a normal pregnancy, a female baby was born at 36 weeks by normal delivery weighing 2.66 kg. The infant was well and discharged on day four but returned after one week with increasing jaundice. The total bilirubin was measured at 386 micromol/L with a direct bilirubin of 19 micromol/L. Tests for causes of haemolytic jaundice were negative. The baby may have been exposed to mothballs used in stored clothing, and this was thought to have been a possible cause of persistent haemolytic jaundice due to oxidative stress.

Phototherapy was commenced and the jaundice slowly diminished with levels less than 300 micromol/L. TSH (thyroid stimulating hormone) measurements were normal on the initial screening test on day three of life. The jaundice persisted, and at three weeks of age, thyroid function tests unexpectedly showed a raised TSH level of 39 mIU/L (NR 0.4–5.0) and a low free thyroxine 9.7 pmol/L. (normal range, NR 13–30). A repeat newborn screening blood sample obtained on day 10 of life was retrospectively tested, and the TSH was in the normal range. No goitre was observed.

A nuclear thyroid scan showed a normally situated thyroid gland with normal tracer uptake. Repeat tests confirmed hypothyroidism and 25 mcg daily of thyroxine was commenced. Thyroid function rapidly normalised and remained normal after cessation of thyroxine.

The mother of the baby was Korean, and on specific questioning about her diet, she stated that she consumed a moderate amount of seaweed imported from Korea during pregnancy and a much larger amount during the puerperium. It appeared that her main food for several weeks was seaweed soup, known as *miyeok*, and boiled rice. The possibility of iodine intoxication was considered and the amount of ingested seaweed was reduced but not eliminated as advised. The baby's urinary iodine at one month of age was 391 mcg/L and the mother's was 436 mcg/L (NR 100–300). Repeat urinary iodine levels on the baby were 690 mcg/L one month later. Maternal anti-thyroid antibodies were negative. Dried samples of the two different seaweeds consumed were analysed. One sample contained 291 mcg iodine/g and the other 424 mcg/g. Breast milk iodine levels were not measured.

Case 2

A female baby was delivered by caesarean section at 27 weeks gestation, weighing 1035 grams after a pregnancy complicated by cervical incompetence and an infected cervical stitch. The delivery was complicated by maternal hypotension. The infant required respiratory support for hyaline membrane disease with a single dose of surfactant and CPAP (continuous positive airways pressure) from birth to 2 weeks of age. Initial newborn screening on day two showed a normal TSH of 0.9 mIU/L. The infant followed a relatively uncomplicated neonatal cause for its gestational age. As is routine in very low birthweight infants, a repeat newborn screening test was performed at four weeks of age. The TSH was elevated at 28 mIU/L. Formal thyroid function tests showed hypothyroidism with FT4 (free T4, free thyroxine level) 6.8 pmol/L (12.6–21.4) and TSH 24.2 mIU/L (0.06–7.14). The infant had mild jaundice but did not require phototherapy. No goitre was found. Maternal anti-thyroid antibodies were negative. Technetium scan showed avid uptake of isotope in the thyroid bed with a neck-to-thigh ratio of 11, which was increased. Ultrasound showed a slightly bulky thyroid gland with increased vascularity and a 3-mm cystic nodule consistent with a colloid cyst.

Specific questioning found that the mother, originally from Northern China, had consumed large amounts of soup made from an imported seaweed product for the first 10 days postpartum to increase her breast milk supply. Frozen breast milk was tested from the time of excess iodine intake and from four weeks after the seaweed consumption ceased. The levels were much higher during the time of consumption at 878 mcg/L total iodine versus 188 mcg/L four weeks and 144 mcg/L seven weeks later. The infant's urinary iodine was elevated at 343 mcg/L (NR 100–300) or 5055 mcg/g creatinine (NR 100–300) as the urine was very dilute as is normal in a premature infant. As in the first case, the urinary iodine increased when tested again one month later (454 mcg/L) even though the excess exposure had ceased seven weeks earlier. The mother's urinary iodine was only tested four weeks after exposure and was within the normal range of 121 mcg/L.

The infant was commenced on 10 mcg/kg/day of thyroxine, and thyroid function rapidly normalised. She required a reduction in dose after two weeks to 12.5 mcg/day. The TFTs (thyroid function tests) have remained in the normal range and the infant is currently weaning off thyroxine.

Author MJ had a recent case of thyrotoxicosis in an adolescent associated with iodine toxicity linked to Bonsoy where the source of iodine contamination was thought to be seaweed. Bonsoy was recalled after multiple cases of thyrotoxicosis in adolescents and adults and a reported case of neonatal hypothyroidism.[2] In view of the possibility of unusually high iodine content of seaweed from overseas sources, the author reported this case to the New South Wales (NSW) Health Department. The Food Authority tested the seaweed and found very high levels of iodine leading to a voluntary recall of the particular batch of this product and NSW Health issued a Health Alert. The Health alert stated that consumption of less than 0.25 grams of the particular batch of seaweed tested was likely to result in intakes at the safe upper limit for adults, including pregnant and lactating women and that for young children consumption of less than 0.05 grams could exceed the safe upper limit.[2]

Discussion

While iodine deficiency is a documented and serious concern in Australia,[1] these cases highlight the risks of excess iodine intake by pregnant and lactating mothers. Of particular concern is the extreme variability of iodine content of seaweeds. In the first case, the amount of iodine ingested by the mother, if she consumed only 30 g of the seaweed products daily, would exceed the recommended adult maximum daily intake of iodine of 1100 mcg[2] by more than 10-fold. In addition, the baby's urinary iodine levels were significantly higher than the recommended upper limit of 300 mcg/L[3] indicating iodine excess. In the second case, consumption of less than 0.25 g of the product in addition to other dietary sources of iodine would likely result in intakes at the safe upper limit for adults, including pregnant and lactating women.

Since the introduction of newborn screening, congenital hypothyroidism, transient or permanent, is generally detected on initial newborn screening and other causes of hypothyroidism usually present well after the neonatal period. Exogenous iodine has been well-documented as a cause of transient neonatal hypothyroidism, in a variety of situations, including maternal topical povidone use, maternal iodine ingestion from contaminated food or drugs and neonatal exposure.[4] The iodine may accumulate in the foetus from maternal ingestion in pregnancy, or as seems to be the case here, may be excreted in sufficient amounts in breast milk to lead to biochemical hypothyroidism. This may not always be a transient phenomenon.[5]

Large amounts of iodine may be ingested in a number of ways, including cough medicines, drugs such as amiodarone[4] and contaminated food supplement as shown in the recent recall of Bonsoy in Australia and other countries.[2] Incidental ingestion of excessive amounts of iodine is more likely to happen in cultures where consumption of seaweed is common. There are a number of species of edible seaweed, and for many decades, seaweeds were the primary medical source of iodine.[6] Japan has a National Seaweed Day on February 6, indicating the cultural importance of the plant in some Asian cultures. The average daily intake of iodine in Japan from seaweed has been estimated to average 500–1000 mcg/day, close to the recommended adult maximum daily intake of 1100 mcg (and considerably higher than the maximum recommended young child dose of 200 mcg) but can vary from 200–20 000 mcg/day.[6] The iodine content of seaweed varies greatly according to the species, ranging from 16 mcg/g for Japanese sheet nori, commonly used in sushi, to around 1500 mcg/g for American Kelp and over 8000 mcg/g for Icelandic Fingered Tangle granules.[6] Harvesting, storage and cooking methods can greatly affect iodine levels.[6]

The thyroid gland can adapt to excess iodine ingestion after initial diminution in thyroid hormone excretion (Wolff–Chaikoff effect)[4] but longer lasting suppression of the thyroid gland has been described in some individuals consuming excess seaweed.[4] The level of dietary iodine intake and iodine content of breast milk in Korean lactating mothers is known to be much higher than in other countries and a recent study found high rates of subclinical hypothyroidism in three- to six-week-old preterm Korean infants whose mothers consumed excessive amounts of iodine.[7]

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