Japanese seaweed and thyroid problems

A W C Kung 龔慧慈

Question:

A mother with a past medical history of thyrotoxicosis brought her 10-year-old son to see me last week because the boy liked eating Japanese seaweed very much but his mother was worried that he might develop a thyroid problem. How should I advise them?

See page 44 for the comments

Comments to this month Clinical Challenge

Comments:

There are two clinical issues in this situation: firstly, the risk of thyrotoxicosis, presumably due to Graves' disease (GD) in the offspring of these patients; and secondly the possibility of consuming seaweed causing hyperthyroidism.

In general, the risk of offspring of patients with GD having the disease is about 3-fold higher than the general population. The incidence of autoimmune thyroid disease is much more common in iodine sufficient areas than in iodine-deficient areas. Epidemiology studies on the prevalence of thyroid antibodies in iodine-sufficient areas demonstrate higher values than in iodine-deficient areas.

GD is generally thought of as a multifactorial disorder in which genetic susceptibility interacts with environmental and endogenous factors to cause the disease.[1] A number of candidate genes have been found to be associated with a higher risk of GD, these include human leukocyte antigen (HLA) DQ and DR region and non-HLA genes, including tumour necrosis factor – β (TNF-β), cytotoxic T lymphocyte antigen 4 (CTLA 4), and TSH receptor. However recent family and twin studies revealed that the magnitude of each genetic component seems to be small.

Although the underlying mechanism for developing the disease is still unclear, the cause of the hyperthyroidism is due to the presence of circulating autoantibodies against the TSH receptor. Numerous studies confirm the existence of heterogeneous TSH receptor antibodies in a single patient. At any one time, there may be different kinds of stimulating and blocking antibodies which possess diverse behaviour with respect to their ability to bind to the TSH receptor and their ability to stimulate thyroid cell function.

The underlying cause is the presence of different clones of lymphocytes developing against the various parts of the TSH receptor. Antibodies directed against the N terminal of the extracellular portion of the TSH receptor are likely to be stimulatory, and those against the C terminal are likely to be inhibitory or blocking in character. Thus it seems likely that GD, as with other organ-specific autoimmune diseases, is polygenic and the effects of the genes, and hence clinical precipitation of the disease, are modified by environmental interaction, which includes stress, smoking and certain infectious agents.[2]

The second issue of the case is whether consuming seaweed will induce hyperthyroidism. There has been a lot of confusion about the issue of iodine-induced hyperthyroidism (IIH) in Hong Kong recently. It has long been known that thyrotoxicosis may develop in persons with clinically normal thyroid glands when they are exposed to large amounts of iodine and that the thyroid function may return to normal when the iodine is withdrawn.[3] Thyrotoxicosis may be induced in certain individuals when they are exposed to an intake of iodine that is more then customary, especially when the basic intake of iodine is low, and particularly when there are nodular changes in the thyroid gland. Thus IIH is most commonly encountered in older persons with long standing nodular goitre and in regions of chronic iodine deficiency, but instances in the young have been recorded. It customarily occurs after an incremental rise in mean iodine intake in the course of programs for the prevention of iodine deficiency, or when iodine-containing drugs such as radio-contrast media or amiodarone are administered. The incidence of IIH during national iodine prophylaxis program in many countries has been low, and usually will disappear several years after the initiation of the program. Hence IIH is regarded as one of the iodine-deficiency disorders, and it is not regarded as a contraindication to iodization program in view of the enormous benefits the correction of iodine deficiency has for the whole population, particularly improvement in child learning and health, women's health, economic productivity and quality of life.

The biological basis for IIH appears most often to be mutational events in the thyroid cells that lead to autonomy of function. In the presence of a nodular thyroid when the mass of cells becomes sufficient and iodine supply is increased, the subject may become thyrotoxic. IIH may also occur with an increase in iodine intake in those whose hyperthyroidism is not expressed because of iodine deficiency.

A W C Kung, MD, FRCP(Lond, Edin)
Professor,
Division of Endocrinology and Metabolism, Department of Medicine, The University of Hong Kong.

Correspondence to: Prof A W C Kung, Department of Medicine, The University of Hong Kong, Queen Mary Hospital, Pokfulam Road, Hong Kong.

Thus, whether taking seaweed will cause a clinical manifestation of hyperthyroidism in children at risk of GD really depends on the amount of seaweed ingested on a regular basis and on the habitual dietary iodine intake of the population. In Hong Kong, the lack of detailed information on iodine content of most Chinese food items makes estimation of dietary intake difficult. Urinary iodine estimation is an alternative method to determine the iodine intake of an area. The median urine iodine excretion in healthy adults in Hong Kong was 0.77 μmol/l, which was close to the World Health Organization cutoff value of 0.79 μmol/l for iodine sufficiency.[4] This borderline iodine intake becomes clinically important in situations of stress such as during pregnancy, when the recommended daily iodine intake should be at least 200 μg/day. As for children, the local median urine iodine excretion was 0.96 μmol/l, which was higher than adults. This is probably related to a change in the eating habits resulting in an improvement in iodine intake e.g. through fortification of iodine in the drinking milk or milk power of 40-50 ppm, taking seaweed as snacks, as well as an increase in the popularity of Japanese food in Hong Kong. The recommended daily intake for children is at least 90 μg for 6-9 years, and 120 μg for 10 to 12 years, and 150 μg for adults.[5]

Unlike most other countries in South East Asia which have national programs to increase iodine intake, most of the salt in Hong Kong is still uniodized. Japan is unique in this region because of the peculiar eating habits of its nation that adequate iodine is being consumed in the daily diet through seaweed intake. There has not been any report from Japan of thyrotoxicosis through eating excessive seaweed. Searching through the literature for the past 30 years, there were only 2 case reports of seaweed induced-hyperthyroidism through taking sea-kelp tablets.[6] Contrarily, iodine-induced hypothyroidism, not hyperthyroidism, through habitual intake of huge loads of seaweed (1-43 mg/day of iodine i.e. 10-4300 times the daily requirement) was reported in Japan.[7,8] Most of the hypothyroidism is reversible but severe cases may be irreversible. Histologically, the thyroid gland developed focal lymphocytic thyroiditis through to more severe degree of destruction.

Thus taking seaweed in the form of Japanese sushi or seaweed roll, or small packs of seaweed as snacks is safe and should not give rise to any alarm. However, regular daily consumption of huge doses of seaweed should be discouraged to avoid iodine toxicity or thyroid dysfunction.

Acknowledgement

This work is supported by UGC grant 460/96M. ■

References

1. Brix TH, Kyvik KO, Hegedus L. What is the evidence of genetic factors in the etiology of Graves' disease? A brief review. *Thyroid* 1998;8:627-634.
2. Kung AWC. Life events, daily stresses and coping in patients with Grave's disease. *Clin Endocrinol* 1995;42:303-308.
3. Stanburg JB, Ermans AE, Bourdoux P, *et al.* Iodine-induced hyperthyroidism: occurrence and epidemiology. *Thyroid* 1998;8:83-100.
4. Kung AWC, Chan LWL, Low LCK, *et al.* Existence of iodine deficiency in Hong Kong – a coastal city in southern China. *Eur J Clin Nutri* 1996; 50:569-572.
5. WHO/UNICEF/ICC IDD. Indicators for assessing iodine deficiency disorders and their control through salt iodisation. WHO/NUT/94.6 Geneva: WHO, 1994.
6. Shilo S, Hirsh HJ. Iodine-induced hyperthyroidism in a patient with a normal thyroid gland. *Postgrad Med J* 1986;62:661-662.
7. Konno N, Iizuka N, Kawasaki K, *et al.* Association between dietary iodine intake and prevalence of subclinical hypothyroidism in the coastal regions of Japan. *J Clin Endocrinol Metab* 1994;78:393-397.
8. Tajiri J, Higashi K, Morita M, *et al.* Studies of hypothyroidism in patients with high iodine intake. *J Clin Endocrinol Metab* 1986;63:412-417.