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Mini Review

Diet and Thyroid Disease

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Abstract

The prevalence of thyroid disorders is increasing day by day. The thyroid is the butterfly gland located at the neck region which produces two hormones, thyroxine (T4) and triiodothyronine (T3). These hormones regulate the metabolic functions of the cells. The thyroid regulating hormone (TRH) and thyroid stimulating hormone (TSH) regulates the level of T3 and T4. The reduced level of TSH is an indication of hyperthyroidism and the increased level of TSH leads to hypothyroidism. Although in most cases these hormonal disorders are non-curable, this short review suggests a diet plan to alleviate the symptoms associated with the ailment.

The Thyroid hormones and disorders

The thyroid gland makes two hormones, thyroxine (T4) and triiodothyronine (T3). The former is a prohormone and the latter is an active hormone [1]. The deiodination of T4 by the 5'deiodinase (5'D) enzyme, which removes a iodine molecule from T4 to form T3 or rT3 in liver and kidney releases major proportion of T3 and about 20% of T3 is secreted in thyroid gland itself. These hormones perform same function but differ in speed and intensity of action [2]. T3, although present in lesser amount in blood stream, is more active than T4 [3]. The level of T3 and T4 is regulated by hypothalamus and hypophysis in brain. The hypothalamus produces thyroid regulating hormone (TRH) which regulates the production of thyroid stimulating hormone (TSH) by hypophysis. TSH controls thyroid gland to produce T3 and T4. T3 negatively regulates hypophys and T4 negatively affects hypothalamus [3]. The major function of thyroid hormones (THs) is to control the metabolism of fat and carbohydrate by the body cells. In addition, they have significant role in respiration, heart and nervous system, maintaining the body temperature, blood calcium levels, menstrual cycles, and skin integrity, brain development. THs also control cholesterol levels by regulating the cholesterol synthesis, cholesterol receptors, and the rate of cholesterol degradation [4]. Low levels of THs lead to a higher blood lipid profile, increased blood pressure, and elevated levels of the amino acid homocysteine and the inflammatory marker C-reactive protein. Thyroid disorders have a link with impaired glucose control, and diabetes [4].

Thyroid disorders affects about 10-15% of the population [2]. Around 20% suffers from temporary or permanent thyroid disorder. Majority of population affected with either hypothyroidism or hyperthyroidism. Hypothyroidism is a complication associated with the autoimmune disorder, Hashimoto's disease. Low levels of thyroid hormones T3 and T4 leads to slow down in thyroid controlled functions of the body. The symptoms are described in table 1. Hyperthyroidism (Table 2) on the other hand is a consequence of overproduction of thyroid hormones. It is usually related to autoimmune Grave's disease. Another category of thyroid dysfunction is subclinical hypothyroidism in which T3 and T4 levels are normal but with high TSH concentration with or without non-specific symptoms. To be specific TSH raised above 5-6 mU/L is considered as abnormal condition. It generally affects women than men and is directly proportional to age of the individual [5]. Pregnant women are more prone to subclinical hypothyroidism [6] since there is increase in requirement of THs for fetal development during pregnancy [8]. Cardiovascular failure is another consequence of subclinical hypothyroidism [7].

	Hypothyroid	
Symptoms	What to eat	What not to eat
Dry skin, cold sensitivity, fatigue, muscle cramps, voice changes, and constipation	Fish, dairy, grains, brazil nuts, crab, lobster, mollusks, sardines, salmon, organ meats such as liver, muscle meat. Vegan sources include fortified cereals and nutritional yeast	Fast-food meals, salty processed foods, sugary treats, such as pastry, cake, cookies, and ice cream, and excessive alcohol, soy-based foods, broccoli,cabbage, brussels sprouts, cauliflower, kale, turnips, gluten-containing foods

Table 1: Hypothyroidism.

	Hyperthyroid	
Symptoms	What to eat	What not to eat
Weight loss, high pressure, blood rapid diarrhea, heartbeat	Non-iodized salt, egg whites, fresh or canned fruit, nuts, breads, dairy, oats, potatoes, honey, bamboo shoots, bok choy, broccoli, brussels sprouts, cassava, cauliflower, collard greens, kale, mustard, rutabaga, dried beans, green leafy vegetables, lentils, poultry, red meat, seeds, whole grains, mushrooms, meat, beef, chickpeas, spinach, collard greens, white beans, kale, okra	Fish, seaweed, sushi, carrageen, alginate, nori, kelp, cheese, egg yolks, iodized salt, iodized water, food colorings, cough syrups, medical contrast dyes, herbal or vitamin supplements, soy milk, soy sauce, soy-based creamers

Table 2: Hyperthyroidism.

Studies indicated that the body fat content is associated with thyroid status. In other words thyroid dysfunction may result in obesity [9] underscoring the relevance of balanced diet and following healthy lifestyle. With respect of obesity or thyroid disease, it would be ideal to have carbohydrate-controlled meal. Other than carbohydrates, one can eat more vegetables, beans, fiber, fluids. The intake of sugar, fats, fast food should be controlled. As nutritionist Schneider notes, "It's eating for prevention of all these diseases that accompany thyroid disease: heart disease, diabetes, cancer, and more."Fiber rich diet can relieve constipation as well associated with hypothyroidism.

What to Eat?

Iodine

Modifications in the intake of micronutrients can cause structural and functional alterations in thyroid function [2]. Iodine is an essential ingredient for the synthesis of THs. The outer layer of thyroid gland is covered with follicular cells which absorbs and stores iodine. The sources of iodine are dairy products, seafood and eggs. Iodized salt and multivitamin tablets are other sources of iodine. One teaspoon of iodized salt contains 284 ug of iodine and one gram of seaweed contains around 2 mg of iodine. Recommended dietary intake of iodine for adult men and women is 150 ug and for pregnant and lactating women is 220 ug and 290 ug respectively [2]. Hypothyroidism and developmental brain damage is found in iodine deficient population. Mild iodine deficiency leads to hyperfunctioning of thyroid gland. The safe upper limit of iodine intake is around 1.1 mg per day [10].

Selenium and Iron

Selenium forms the antioxidants, selenocysteine compounds and protects the thyroid from free radical damage due to hydrogen peroxide and reactive oxygen species [2]. The major selenoproteins are glutathione peroxidase and thioredoxin reductase. Another important selenoprotein, iodothyronine deiodinases regulates the activation and inactivation of THs. Selenium also has role in the immune system, cognitive function, and fertility in both men and women. Selenium deficiency exacerbates the iodine deficiency thereby emphasize the thyroid dysfunction. Mushrooms, garlic, onions, eggs, beef liver, shellfish, wheat germ, sunflower seeds and sesame seeds are good sources of selenium. Iron deficiency impairs the synthesis of THs by reducing the activity of heme-dependent thyroid peroxidase [2].

Vitamins

Vitamins have vital role in maintaining the homeostasis of body functions. The major vitamins that have impact on the thyroid function include vitamin D and B12. Sun light, fatty fish, milk, dairy, eggs, and mushrooms are rich sources of vitamin D. Studies have shown that about 30% of people with autoimmune thyroiditis experience a vitamin B12 deficiency. Mollusks, sardines, salmon, organ meats such as liver, muscle meat, dairy, fortified cereals, and nutritional yeast are the sources of vitamin B12 [3].

Zinc

Zinc is another important micronutrient in thyroid function since it acts as a cofactor of deiodination reaction in T4 to T3 conversion. Reports are there on subclinical hypothyroidism as a consequence of zinc deficiency. The recommended intake of zinc is 15mg/day which can be accomplished by eating meat and fish, with amounts varying from 4 and 7.7mg/100g of food and in all kinds of nuts with concentrations from 2.1 to 4.7mg/100g [3].

It's a NO to these foods!

Soy

Soy has role in the prevention of cancer, cardiovascular diseases, reduction of menopause symptoms, increased bone-mineral density and decreased insulin resistance. However, soy can in-

terrupt absorption of thyroid drugs so that patients with subclinical hypothyroidism are prone to develop hypothyroidism with 16mg/day of soy phytostrogens [3]. The isoflavones in soy can lower THs synthesis. The major soy isoflavone, genistein has estrogenic and goitrogenic activity in conditions of iodine deficiency. Reports suggest a dose dependent reduced activity of thyroid peroxidase with genistein [2].

Flavonoids

Flavonoids in fruits, vegetables, and tea have antioxidant properties and cardiovascular benefits. However, the high levels of flavonoid supplements may suppress the thyroid function. They interfere with the metabolism of THs by reducing the T4 levels in serum and inhibiting both the conversion of T4 to T3 and metabolic clearance of T3r by Se. Catechins, an important flavonoid with antioxidant potential in green tea reduces thyroid peroxidase, the enzyme responsible for the oxidation of iodide and formation of thyroid hormones, T3 and T4 levels with a concomitant raise of TSH [3].

Glucosinolates

Glucosinolates interfere with the iodine uptake and the activity of thyroid peroxidase [2]. The sources of glucosinolates include brassicas, broccoli, cauliflower, brussels sprouts, kale, turnip, radish, cabbage, and garlic and onion. When these vegetables are cut raw, thiocyanate, isothiocyanate and nitrile compounds are released. The former compounds compete with iodite and induce the onset of goiter and hypothyroidism in patients with low iodine intake. Direct thiocyanate sources include cassava, bean, flaxseed, bamboo sprouts, sweet potato mustard, turnip, radish and tobacco [3]. Beans, soybean, maize, pine nut, broccoli and canola inhibit thyroid peroxidase by hindering the iodine incorporation. When hydrolysed, broccoli, cauliflower, and cabbage naturally release goitrin and affects the synthesis of THs. However, cooking can denatures this goitrogenic effect.

Perchlorate

Perchlorate affects the synthesis of THs by competitively inhibiting the iodine uptake into the thyroid gland. The perchlorate containing foods are vegetables, dairy products, drinking water and infant food products. Iodine induced hyperthyroidism is the consequence of thyroid inhibitory actions of perchlorate. In sufficient iodine concentrations, perchlorate does not cause significant changes in thyroid function [2].

Misclaneous

Millet, a gluten-free grain suppresses the thyroid function even with adequate iodine intake. Calcium supplements, chromium picolinate, coffee and fiber supplements interfere with the absorption of thyroid medications. Hence, it would be ideal to take a break between calcium and thyroid medication [4].

Conclusion

There's no hard and fast rule for controlling the thyroid disorders thereby no specific diet plan one can follow for managing it. Still, a balanced life style with good diet, regular physical activity and proper medication can help to alleviate the symptoms associated with the disease. To conclude, for better absorption, it would be ideal to have 30 min to one hour gap between thyroid medication and meals.

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