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Nutritional Support for the Thyroid Gland

Thyroid function

The thyroid is a double-lobed gland located below the larynx in the anterior region of the neck. It is actually a collection of small individual glands called follicles, where newly synthesized hormones are secreted into a central lumen prior to release into the bloodstream. Thyroid hormones refer to T3 (triiodothyronine) and T4 (thyroxine), the primary constituent. T3 is 3-4- fold more active than T4. Peripheral tissues, especially the liver and lung, convert T4 to T3. Small amounts of T2 and T1 are also formed, but their function is not clear.

In addition, parafollicular thyroid cells secrete calcitonin, a hormone employed in calcium and phosphate homeostasis. Calcitonin inhibits bone breakdown and accelerates bone calcium and phosphate uptake. Blood calcium levels control the secretion of calcitonin by a pathway independent of the pituitary gland. Thyroid hormones regulate metabolism and energy balance, growth and development and activity of the nervous system.[1]

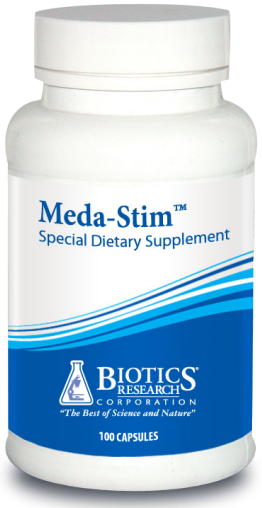
Thyroid hormones stimulate carbohydrate and fat breakdown, they increase protein synthesis, and they increase the basal metabolic rate. Increased activity of the nervous system increases blood pressure, nervousness and GI motility. In children, thyroid hormones work with growth hormone to accelerate body growth and development of the nervous system. T3 is required for normal fetal development.

Secretion of thyroid hormones is stimulated by several factors, including low metabolic rate and falling blood thyroid hormone levels. Stimulus for thyroid function begins in the hypothalamus and pituitary with the production of thyrotrophin releasing hormone, a neuro-hormone that stimulates the release of TSH (thyroid-stimulating hormone) from the anterior pituitary. TSH in turn triggers the release of thyroid hormones from follicles of the thyroid. Conditions that increase the need for energy such as a cold environment, hypoglycemia, pregnancy or high altitude-increase the secretion of thyroid hormones. TSH secretion follows a circadian pattern. Thyroid hormones regulate their production via feedback mechanisms on the hypothalamus. Thyroxine completes a negative feedback loop by binding to receptors in the anterior pituitary to block the release of the tropic hormone. High blood levels of estrogens and androgens decrease TSH production and thus thyroid function. Aging generally decreases glandular processes.

Synthesis of thyroid hormones

Synthesis of thyroid hormones begins with the uptake of iodine by the thyroid gland. An individual typically consumes up to 500 mcg of iodine per day. One third of the dietary intake is absorbed by the thyroid gland and the remainder is excreted. Incoming iodine is rapidly oxidized by the thyroid to organic iodine via iodoperoxidase, an enzyme requiring hydrogen peroxide. The addition of iodide occurs at the 2 and 5 positions of tyrosine residues of thyroglobulin, a protein which acts as a working platform to assemble thyroid hormone. Two diiodotyrosine residues are then coupled to form a thyroxine precursor on thyroglobulin.

Secretion of thyroid hormones is initiated by the lysosomal degradation of thyroglobulin to release T3 and T4. In the bloodstream, T3 and T4 are carried by thyroxine-binding globulin, thyroxine binding prealbumin and serum albumin. It is the concentration of free (unbound) hormone that is important. T4 is converted to T3 by the liver and lung, kidney and heart by a selenium-dependent enzyme, Iodothyronine 5'-monodeiodinase. T3 then is taken up by appropriate target cells, where it is transported to the nucleus to activate transcription. Increased hyroid hormone production in the adult is a function of the adrenergic nervous system. To the degree that adrenergic stimulation occurs, thyroid hormone stimulates catabolic activity, by promoting the degradation of amino acids in muscle and mobilization of fat. Thyroid hormone regulates transcription Thyroid hormones pass through the cell membrane of target tissues and form a cytoplasmic hormone-protein complex. The actual thyroid hormone receptor is a chromosomal protein locked into the nucleus. Hormone binding activates the receptor as a transcription factor, resulting in the synthesis of multiple metabolic enzymes. Thyroid hormone receptors also occur in mitochondria, so that thyroid hormones regulate oxygen consumption and ATP production directly. Brown fat-induced reactions to hypothermia are triggered by thyroid hormones via such mechanisms.



Abnormal levels of thyroid hormones

Varying degrees of hypothyroid function are routinely detected by laboratory tests and other measures. Hypothyroidism is characterized by obesity, feeling cold, dry skin, brittle nails, joint pain, low blood pressure, fatigue, and weight gain[2], while hyperthyroidism has opposite effects. Goiter, thyroid hyperplasia, is the consequences of abnormally low dietary iodine.

Nutritional support for the thyroid

Minerals

Iodine. The common form of iodine in foods is iodide, the reduced form of iodine. In thyroid tissue, follicles normally concentrate iodide 40-fold greater than blood concentrations. At maximal activity, the thyroid can contain up to 300-fold greater concentrations of iodide than blood levels. Cells oxidize iodide to organically bound iodine, which is then chemically combined with tyrosine. Kelp is a natural source of iodine.

Selenium. This trace mineral in the form of selenocysteine is required by a family of antioxidant enzymes, the glutathione peroxidases. These enzymes reduce peroxidized fatty acids in membranes to safe byproducts and they reduce cytoplasmic hydrogen peroxide. On the other hand, selenium is also required for Iodothyronine 5'-monodeiodinase, the enzyme located in peripheral tissues required to convert T4 to T3. Selenium deficiency decreases the de-iodinase activity. High iodine intake when selenium intake is low can lead to thyroid damage, because thyroid glutathione peroxidase activity is reduced.[3] Worldwide, dietary intakes of selenium vary by two orders of magnitude. Regions of marginal selenium include the Eastern Piedmont of the U.S. In such regions dietary selenium intake may be below the physiological required level, even with a well balanced diet.[4]

Magnesium. Thyroid hormone is intimately associated with regulation of energy production and mitochondrial function. Indeed, mitochondria possess thyroidhormone receptors. Enzyme utilization of ATP generated by mitochondria requires complex formation with magnesium, generally in a 1:1 ratio. Magnesium is essential for protein synthesis, cell replication and activation of the sodium-potassium pump, as well as the regulation of calcitonin and

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parathyroid hormone. The usual American diet often does not supply enough magnesium to meet the RDA of 350 mg.[5] Because of increased consumption of processed foods, the average consumption of magnesium for adults in the U.S. ranges between 143 and 266 mg/day.

Rubidium. This alkali metal resembles potassium in its physiologic properties. A variety of anecdotal reports and case studies suggest that rubidium promotes thyroid metabolism. The mechanism is unknown. A low rubidium diet in rats lowered zinc in plasma and testes, lowered copper in heart, liver and spleen, and increased potassium in plasma, kidney and tibia.[6]

Zinc. This transition metal functions in diverse metabolic pathways as an essential enzyme cofactor. DNA and RNA polymerase are zinc dependent enzymes, thus zinc is essential for cell growth. Zinc also functions as an antioxidant. It is an essential cofactor for cytoplasmic superoxide dismutase, designed specifically to inactivate the free radical, Superoxide. Zinc also affects the formation of thyroid hormones. In zinc- deficient rats, the concentrations of T3 and free T4 were decreased by 30%. The activity of iodothyronine 5′-monodeiodinase was decreased by 67%.[7] Marginal zinc deficiency is very common in the U.S. in one survey, 68% of respondents were getting less than 66% of the RDA for zinc.[8]

Amino Acids

L-Tyrosine. This amino acid is a protein building block and the foundation of T3 and T4. In particular many tyrosine residues of thyroglobulin are iodinated. Each molecule of a thyroid hormone contains the equivalent of two tyrosine molecules. The uptake of tyrosine decreases with age.[9]

L-Glutamate and L-Aspartate. TSH given to hypophysectomized rats restored levels of monamine oxidase (MAO) and aspartate aminotransferase (AST) in thyroid mitochondria. TSH did not reverse the related decline in microsomal monamine oxidase activity.[10] The authors hypothesized MAO and AST in thyroid mitochondria generate hydrogen peroxide for thyroid hormone synthesis by iodoperoxidase. Glutamate participates in intermediary metabolism as a detoxication mechanism to dispose of ammonia via glutamine synthetase, and as a source of alpha ketoglutarate, a mitochondrial fuel source for the citric acid cycle. On the other hand, excessive amounts of glutamate are detrimental to the thyroid gland.[11]

Glutathione. This tripeptide functions as a major intracellular redox agent and free radical scavenger. Typically glutath one concentrations are in the millimolar range. Reduced glutathione is a substrate for glutathione peroxidase, which degrades cytoplasmic hydrogen peroxide and membrane associated lipid peroxides. Glutathione and other radical scavengers help protect iodothyronine 5′-monodeiodinase activity, responsible for the conversion of thyroxine to the more active T3.[12]

B Complex Vitamins

Riboflavin. The universal redox coenzyme, flavin adenine dinucleotide FAD, functions as a redox agent in the oxidation of succinate by mitochondria, and as a cofactor for cytochrome P450 detoxication enzymes. Thyroid hormone status is reported to be sensitive to riboflavin status. Female acute psychiatric patients with riboflavin deficiency had significantly lower thyroxine levels. Drug exposure did not correlate with thyroxine levels.[13] Many factors affect brain function and the endocrine system and psychiatric problems undoubtedly involve a variety of biochemical pathways.

Thiamine. As the coenzyme, thiamine pyrophosphate, thiamine is essential for pyruvate dehydrogenase in the degradation of glucose for alpha ketoglutarate dehydrogenase to oxidize fats, and amino acids as well as glucose via the citric acid cycle, and fortransketolase for the pentose phosphate pathway of glucose metabolism. Thiamine deficiency impaired thyroid status in rats fed a thiamine deficient diet.[14]

Vitamin B_6. Most amino acids are deaminated via transminases prior to their interconversion with keto acids, and subsequent catabolism via the Kreb's cycle. This enzyme family requires pyridoxal 5-phosphate as the cofactor, which is derived from vitamin B_6. Vitamin B_6 is required for normal endocrine function.[15]

Botanical Support

Sage (*Salvia officinalis)*. Diterpene antioxidants isolated from sage provides strong antioxidant activity, exceeding α-tocopherol, BHA and BHT in terms of stabilizing polyunsaturated fatty acids.[16]

Bladderwrack (*Fucus vesiculosus*). A sea vegetable common to the coastal regions of Europe and America. Bladderwrack is a rich source of iodine, representing 0.2% of the mineral ash of this plant.

Pellitory (*Anacyclus pyrethrum*). Extracts that contain polyunsaturated alkamides can inhibit cyclooxygenase and lipoxygenase *in vitro*.[17]

References

1. Surks MI, Fevert R. Drugs and Thyroid Function. *New Engl J Med 1995; 333: 1688-1694.*
2. Lindsay RS. Hypothyroidism. *Lancet 1997; 349: 413-417.*
3. Hotz CS *et al.* Dietary iodine and selenium interact to affect thyroid hormone metabolism of rats. *J Nutr 1997; 127: 1214-1218.*
4. Schrauzer GN, Sacher J. Selenium in the maintenance and therapy of HIV-infected patients. *Chemico-Biological Interactions 1994; 91: 199-205.*
5. Morgan KJ *et al.* Magnesium and calcium dietary intakes of the U.S. population. *J Am Cell Nutr 1985; 4: 195-206.*
6. Yokoi K *et al.* Effect of low rubidium diet on mineral status in rats. *Paper presented at the Second International Congress on Vitamins and Biofactors in Life Science Feb. 16-19, 1995. San Diego, CA.*
7. Kralike A *et al.* Influence of zinc and selenium deficiency on parameters relating to thyroid hormone metabolism. *Hormone Metabolism Research 1996; 28: 223-226.*
8. Dronfield MW *et al.* Zinc in ulcerative colitis: a therapeutic trial and report on plasma levels. *Gut 1977; 18: 33-36.*
9. Chen TS *et al.* Intestinal transport during the life span of the mouse. J Gerantol 1990; 45: B129-B133. 10. Knopp J, Orlicky J. Monamine oxidase and aspartate amino transferase in cellular fractions of thyroid gland in rats.
10. Knopp J, Orlicky J. Monamine oxidase and aspartate amino transferase in cellular fractions of thyroid gland in rats after hypophysectomy and TSH stimulation. *Biochem Exp Biol 1979; 15: 257-261.*
11. Dhindsa KS *et al.* Histological changes in the thyroid gland induced by monosodium glutamate. *Acta Anat 1981; 109: 97-102.*
12. Brzezinska-Slebodzinska E, Pietras B. The protective role of some antioxidants and scavengers on the free radicals - induced inhibition of liver iodothyronine 5′-monode-iodinase activity and thiol content. *J Physiol Pharmacol 1997; 48: 451-459.*
13. Bell IR *et al.* Low thyroxine levels in female psychiatric patients with riboflavin deficiency. *Acta Psychiatr Scand 1992; 85: 360-363.*
14. Appledorff H et al. Influence of altered thyroid status on the food intake and growth of rats fed a thiamine-deficient diet. *J Nutr 1969; 97: 271-279.*
15. Rose DP. The interactions between vitamin B6 and hormones. *Vitamins Hormones 1978; 36: 53-99.*
16. Nakatani N. Chemistry of antioxidants from Labiatal Herbs. Food Phytochemicals for Cancer Prevention II. C-T Ho *et al.*, eds. *ACS Symposium Series 547, (1994) pp 144-153.*
17. Muller-Jakic B *et al. In vitro* inhibition of cyclooxygenase and lipoxygenase by alkamides from Echinacea and Achillea species. *Planta Medica 1994; 60: 37-40.*

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