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**The Thistle QA CEU No is: MTS 17/013**

Each attendee should claim ONE CEU point for completing this Quality Control Journal Club exercise, and retain a copy of the relevant Thistle QA Participation Certificate as proof of registration on a Thistle QA EQA.

## CHEMISTRY LEGEND

June 2017

### Hypothyroidism

Hypothyroidism, also called underactive thyroid or low thyroid, is a common disorder of the endocrine system in which the thyroid gland does not produce enough thyroid hormone. Hypothyroidism is characterized by insufficient thyroid gland stimulation by TSH. It is rarely isolated, and occurs more commonly in conjunction with other pituitary hormone deficiencies as well as neurological symptoms and signs resulting from hypothalamic and/or pituitary dysfunction.

Hypothyroidism is divided into primary, caused by failure of thyroid function and secondary (central) due to the failure of adequate thyroid-stimulating hormone (TSH) secretion from the pituitary gland or thyrotrophin-releasing hormone (TRH) from the hypothalamus. Secondary hypothyroidism can be differentiated in pituitary and hypothalamic by the use of TRH test.

#### Signs and symptoms

People with hypothyroidism often have no or only mild symptoms. Numerous symptoms and signs are associated with hypothyroidism, and can be related to the underlying cause, or a direct effect of not having enough thyroid hormones.

Symptoms	Signs
Fatigue	Dry, coarse skin
Feeling cold	Cool extremities
Poor memory and concentration	Myxedema (mucopolysaccharide deposits in the skin)
Weight gain with poor appetite	Slow pulse rate
Shortness of breath	Swelling of the limbs/feet
Abnormal sensation	Pleural effusion, ascites, pericardial effusion
Nervousness and tremor	Delayed relaxation after testing the ankle jerk reflex

**Table 1** : Table showing signs and symptoms of Hypothyroidism



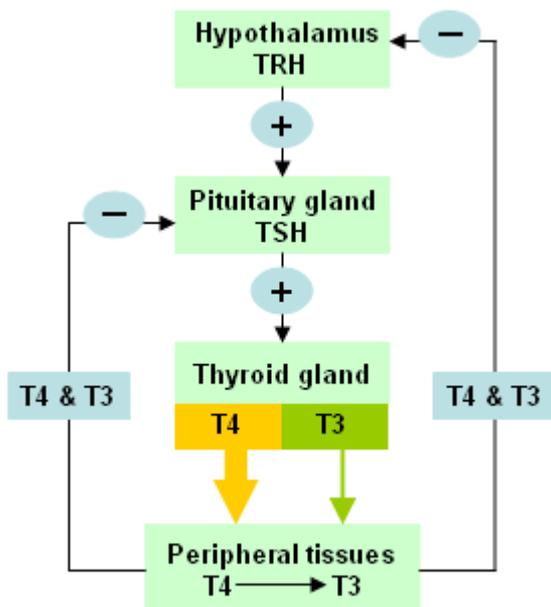
**Figure 1** : Swollen foot as a sign of Hypothyroidism

## Pathophysiology

Hypothyroidism is broadly classified as a primary, secondary, or tertiary disease depending on the underlying cause. In primary disease there is impaired hormone release from the thyroid gland; in secondary disease, there is defective TSH signalling from the pituitary; in tertiary or central disease, the hypothalamus fails to stimulate thyroid hormone release. The thyroid gland is the only source of thyroid hormone in the body. The process requires iodine and the amino acid tyrosine. Iodine in the bloodstream is taken up by the gland and incorporated into thyroglobulin molecules. The process is controlled by the thyroid-stimulating hormone (TSH, thyrotropin), which is secreted by the pituitary. Not enough iodine, or not enough TSH, can result in decreased production of thyroid hormones.

The hypothalamic–pituitary–thyroid axis plays a key role in maintaining thyroid hormone levels within normal limits. Production of TSH by the anterior pituitary gland is stimulated by thyrotropin-releasing hormone (TRH), released from the hypothalamus. Production of TSH and TRH is decreased by thyroxine ( $T_4$ ) and triiodothyronine ( $T_3$ ) through a negative feedback process. Not enough TRH, which is uncommon, can lead to not enough TSH and thereby to not enough thyroid hormone production.

The thyroid gland predominantly secretes thyroxine ( $T_4$ ), which is converted into triiodothyronine ( $T_3$ ) in other organs by the selenium-dependent enzyme iodothyronine deiodinase.  $T_4$  is the main hormone produced by the thyroid gland. It is converted to  $T_3$  in target tissues.  $T_3$  mediates the main actions of thyroid hormone, which include stimulation of cellular oxygen consumption and energy generation, by binding to nuclear receptors and modulating gene expression. [5] Through a negative feedback mechanism, failure of the thyroid to produce its hormones, resulting in low  $T_4$  and  $T_3$ , stimulates the pituitary to increase production of TSH.



**Figure 2:** The hypothalamic-pituitary-thyroid axis. Levels of circulating thyroid hormones are regulated by a complex feedback system involving the hypothalamus and pituitary gland

## Diagnosis

Diagnosis of hypothyroidism is highly dependent on laboratory testing. The frontline laboratory test for hypothyroidism is thyroid-stimulating hormone (TSH),  $T_4$  and  $T_3$ . TSH is elevated in primary hypothyroidism as the pituitary responds to the relative lack of circulating  $T_3$  and  $T_4$ ; TSH is abnormal in all clinical and subclinical cases of primary hypothyroidism. As the disease progresses toward clinical or overt hypothyroidism,  $T_4$  and  $T_3$  become measurably decreased. In secondary and tertiary hypothyroidism, TSH,  $T_4$ , and  $T_3$  levels are variably abnormal depending on the duration, cause, and severity of disease.

## **Prevention**

Hypothyroidism may be prevented in a population by adding iodine to commonly used foods. In addition to promoting the consumption of iodine-rich foods such as dairy and fish, many countries with moderate iodine deficiency have implemented universal salt iodization. Pregnant and breastfeeding women, who require 66% more daily iodine requirement than non-pregnant women, may still not be getting enough iodine. The World Health Organization recommends a daily intake of 250 µg for pregnant and breastfeeding women. As many women will not achieve this from dietary sources alone, the American Thyroid Association recommends a 150 µg daily supplement by mouth.

## **Treatment**

The usual treatment for hypothyroidism is thyroid hormone replacement therapy which is performed with the administration of levothyroxine (for example, Levothroid, Levoxyl, or Synthroid). In young and otherwise healthy people with overt hypothyroidism, a full replacement dose (adjusted by weight) can be started immediately; in the elderly and people with heart disease a lower starting dose is recommended to prevent over supplementation and risk of complications. Lower doses may be sufficient in those with subclinical hypothyroidism, while people with central hypothyroidism may require a higher than average dose.

Most people treated with thyroid hormone develop symptoms again if their medicine is stopped. If this occurs, medicine needs to be restarted. While taking thyroid hormone medicine, you need to see your doctor once a year for checkups. You will have a blood test (thyroid-stimulating hormone [TSH] test) to make sure you have a normal hormone level.

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## **References**

1. <http://en.wikipedia.org/wiki/Hypothyroidism>.
2. Hypothyroidism - New aspects of an old disease, I [Kostoglou-Athanassiou](#) and K [Ntalles](#) 2010 Apr-Jun; 14(2): 82–87.

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## **Questions**

1. Define the term Hypothyroidism.
  2. Discuss the pathophysiology of hypothyroidism including signs and symptoms.
  3. How is Hypothyroidism treated?
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