

Hyperthyroidism in Children and Adolescents

WHAT IS THE THYROID GLAND?

The thyroid gland is a butterfly-shaped gland that is located in the lower front of the neck, just above the collarbone. The role of the thyroid is to make thyroid hormones, which are released into the blood and then carried to every tissue in the body. In children, thyroid hormone helps to ensure that growth and development occur normally and that the body's energy, metabolism, heart, muscles, and other organs are working properly.

WHAT IS HYPERTHYROIDISM?

The term hyperthyroidism refers to any condition in which there is too much thyroid hormone produced by the thyroid gland. Thyrotoxicosis is another term that is sometimes used to describe this condition.

WHAT ARE THE SYMPTOMS OF HYPERTHYROIDISM?

Too much thyroid hormone speeds up most functions of the body. Symptoms include anxiousness, nervousness, decreased ability to concentrate (attention-deficit like symptoms), decreased school or work performance, moodiness and irritability, always feeling warm, heart racing (palpitations), tremors (shaky hands), frequent bowel movements, and weight loss despite a good, or even increased, appetite. Difficulty sleeping, tiredness, decreased strength, and decreased ability to tolerate exercise are also common. Even going up and down stairs may be more tiring than usual. Younger children may show increased growth (increased height), however, the onset of puberty may be delayed until treatment is started.

WHAT CAUSES HYPERTHYROIDISM?

The most common cause of hyperthyroidism in children and adolescents is a condition named after the physician who first described it, *Graves' disease* (GD). GD accounts for roughly 95% of hyperthyroidism in children. In this condition, the immune system produces an antibody that stimulates the thyroid gland to release excess thyroid hormone. This condition is more frequent in families that have other autoimmune diseases, including *Hashimoto's thyroiditis* (*hypothyroidism*), Celiac disease, type 1 diabetes, and others.

Other causes include an autonomously functioning thyroid nodule (a 'hot' nodule) or multiple nodules.

Medications can also cause hyperthyroidism, including amiodarone, a drug used to treat heart problems.

Some dietary supplements may also affect the thyroid gland function or laboratory tests used in the evaluation of thyroid abnormalities. You should inform your endocrinologist of any over-the-counter supplement you are taking, or considering, to ensure there is no potential interaction with your thyroid disease.

Less common causes include: (1) a condition called 'neonatal Graves' disease, in which antibodies from a mom with Graves' disease cross the placenta and stimulate the baby's thyroid cells, (2) a change in the TSH receptor gene causing it to be switched on all the time and (3) a brain tumor in the pituitary gland that is making too much Thyroid Stimulating Hormone (TSH).

HOW IS HYPERTHYROIDISM DIAGNOSED?

Typically patients will present with a combination of symptoms, an increased heart rate, restlessness, hand tremor, prominent eyes (found in about 1/3 of patients with GD), and an enlarged thyroid. An enlarged thyroid is called a 'goiter' and it may be found in hypothyroidism, hyperthyroidism, and even in some people with normal thyroid hormone levels.

Blood tests will reveal a low level of TSH combined with high levels of T3 and T4. Since there are several different causes of hyperthyroidism, additional tests might be necessary to determine the cause of your hyperthyroidism. Additional blood tests include thyroid auto-antibody levels (thyrotropin receptor antibody (TRAb), thyroid stimulating antibody (TSI). Thyroid imaging may include thyroid ultrasound and/or a nuclear medicine study called thyroid scintigraphy to see if the thyroid is over- or underactive (thyroid uptake) as well as what part of the thyroid is overactive (thyroid scan).



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HOW IS HYPERTHYROIDISM TREATED?

In the majority of cases, treatment is needed to reduce the amount of thyroid hormone being produced. The goal of treatment is to normalize the thyroid hormone levels (T3 and T4) and to make the signs and symptoms go away. The treatment choices include: (1) an anti-thyroid drug (described below), (2) radioactive iodine ablation and (3) thyroid surgery. A medication to slow down the heart rate (a **beta-blocker**) may also be used at first while the evaluation is being completed or until the treatment lowers the T3 and T4. Over time the approach may change either because one approach has not achieved the goal of therapy or if there is an adverse reaction to the medicine.

Graves' disease may go away over time (called remission), however, this occurs in less than 25% of patients. Thus, more than 75% of patients with Graves' disease will eventually need to consider either radioactive iodine ablation or surgery in order to cure their hyperthyroidism.

It is important to note that many patients demonstrate initial weight gain after achieving control of their thyroid function. This is not a side-effect of treatment, but a recovery of weight that had been lost when the person was hyperthyroid.

ANTITHYROID DRUGS

These drugs block the thyroid gland's ability to make new thyroid hormone. In the United States and Canada, only methimazole –MMI- (trade name Tapazole®) is approved for the treatment of children and adolescents. Methimazole is very effective and the majority of patients tolerate the medication.

Potential mild side effects include a rash (hives) and/or joint pain. These may be temporary. Rarely, in less than 1% of patients, a more severe reaction to MMI may occur, either (1) decreased production of white blood cells, the cells that fight infection, called 'neutropenia' or (2) liver inflammation, called hepatitis. The signs and symptoms of neutropenia include fever with a sore throat or mouth ulcers (such as canker or cold sores) and the signs of hepatitis include yellowing of the eyes, dark (tea-colored) urine, itchy skin, right-sided abdominal pain or severe fatigue. Your physician should review these potential risks and give you a plan for evaluation and treatment if they occur.

DEFINITIVE TREATMENT

The goal of definitive treatment (surgery or radioactive iodine) is to permanently make the thyroid stop working, to get rid of the unpredictable state of hyperthyroidism for the more stable state of hypothyroidism. Hypothyroidism is treated with thyroid hormone medication. Most patients will only need one pill per day, and will require blood tests three to four times a year to make sure the thyroid hormone levels are normal until growth is complete. Blood tests should continue one to two times per year as an adult.

1 RADIOACTIVE IODINE

Because the thyroid cells can absorb iodine, hyperthyroidism can be treated by giving a person a small amount of radioactive iodine (RAI) to permanently destroy the thyroid cells. This form of treatment has been used for more than 50 years and it is a safe and effective form of 'definitive' treatment. The RAI is usually administered as a small capsule that is taken once by mouth. Over time (weeks to months), the thyroid cells stop working. Cure rates with RAI are as high as 95%. RAI is not recommended for children younger than 5 to 10 years of age, in patients with active *thyroid-associated eye disease*, or if a patient has severe uncontrolled hyperthyroidism.

RAI may also be used to treat autonomous ('hot') thyroid nodules, but in children and adolescents, surgery is the recommended treatment for 'hot' nodules.

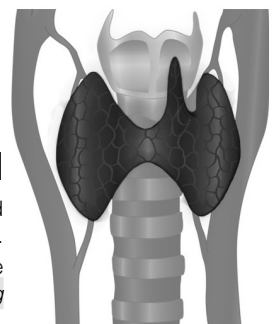
2 SURGERY

Surgical treatment of hyperthyroidism from Graves' disease involves removal of the thyroid gland (called a thyroidectomy). Surgery may be recommended over RAI in children under the age of 5 to 10 years, in children or adolescents who have a large gland (goiter) and/or a thyroid nodule, in patients with poorly controlled hyperthyroidism, and/or when a rapid cure is desired.

FURTHER INFORMATION

Further details on this and other thyroid-related topics are available in the patient thyroid information section on the American Thyroid Association® website at www.thyroid.org.

For information on thyroid patient support organizations, please visit the *Patient Support Links* section on the ATA website at www.thyroid.org





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Major complications of thyroid surgery occur in less than 2% of patients operated on by an experienced thyroid surgeon. The rate of complications is higher if the surgery is performed by a surgeon that does not regularly perform thyroid surgery. Thyroid surgery is best performed at a pediatric clinical center where all members of the team (endocrinologist, anesthetist, surgeon and post-operative care providers) are experienced in caring for children if a complication occurs.

The complications of surgery may include; (1) damage to the parathyroid glands, 4 pea-sized glands that are attached to the back of the thyroid and control the body's calcium levels and (2) damage to the nerves that control the vocal cords (called the recurrent laryngeal nerves) causing hoarseness. These complications may be temporary and improve after a short period following surgery. There is also a *scar* following surgery, but this frequently becomes very faint after healing is complete (typically takes 3 months to 1 year).

Prior to surgery, the child or adolescent may be treated with iodine drops, either Lugol's iodine or supersaturated potassium iodide (SSKI), to help normalize the thyroid hormone levels and to decrease the blood supply to the thyroid gland. Vitamin D may also be given prior to surgery to reduce the chance of post-surgery low calcium levels.

For patients that have a 'hot' (also called an autonomous) nodule, it may only be necessary to remove ½ of the thyroid (called a lobectomy). The majority of patients that have a lobectomy will not need lifelong thyroid hormone medication.

OUTCOME OF TREATMENT:

The goal of treatment for hyperthyroidism is to reduce or eliminate signs and symptoms and allow the child to return to their pre-hyperthyroid state. All three forms of treatment for Graves' disease (medication, RAI and surgery) are effective. Most pediatric patients start with the anti-thyroid pills and then decide on definitive treatment (RAI or surgery) if the hyperthyroidism is not going away, if they develop a side effect to the medication, or if the frequent lab tests and unpredictable course of the disease are disrupting their daily activities.

For patients that are fortunate to experience remission, the most common time for relapse of the Graves' disease is within the first 6 months of discontinuing methimazole. Repeat labs are typically checked with decreasing frequency over the first 6 to 12 months after methimazole is stopped.

For patients that do not achieve remission and/or do not tolerate the medication, *definitive treatment* with either RAI or surgery remain good options. For most patients, definitive treatment allows for a return to normal activities and normal social, academic, and athletic performance within several weeks.

FOR WOMEN OF CHILDBEARING AGE:

The antibodies that cause Graves' disease may be passed from mother to fetus. Even if you no longer require treatment of Graves' disease (after remission, radioactive iodine or surgery) these antibodies may remain in your blood. Thus, it is important to share your history of Graves' disease with your family physician and/or obstetrician, so that appropriate testing may be performed to help ensure a healthy pregnancy.



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