Thyroid Hormone Treatment in Children and Adolescents

WHAT IS THE THYROID GLAND?

The thyroid gland is a butterfly-shaped endocrine gland that is located in the lower front of the neck, just above the collarbone. The thyroid's job 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 THYROID HORMONE TREATMENT?

The goal of thyroid hormone treatment is to replace inadequate amounts of thyroid hormone. The healthy thyroid gland makes thyroid hormone all of the time. It is important, when thyroid hormone replacement is needed, that it is taken every day to keep the hormone levels steady and normal in the body.

The body makes 2 forms of thyroid hormone: levothyroxine (T4) and tri-iodothyronine (T3). T3 is the active hormone that the body uses. It converts T4 to the active form, T3. This conversion happens outside of the thyroid gland (e.g. in the liver and brain) and happens normally even in people who have thyroid disease or don't have a thyroid gland (typically, someone who doesn't have a thyroid gland will have had surgery to remove the gland. Very rarely, a person will be born without a thyroid gland). In general, when thyroid hormone treatment is needed, just the T4 form is prescribed. This medication comes in pill form and is available in generic form as levothyroxine. There are also many brand names available including Synthroid, Levothroid, Levoxyl, and Unithroid. The FDA has approved one capsule form (Tirosint) and one liquid form (Tirosint-Sol) of levothyroxine. The majority of patients, no matter their age, are still prescribed the pill form.

WHY IS THYROID HORMONE TREATMENT USED?

Thyroid hormone is used in 2 situations:

1. Thyroid hormone replacement in *hypothyroidism* (to replace thyroid hormone which the body is not making and
2. Thyroid hormone suppression (to prevent further growth of thyroid tissue, mainly in cases of *thyroid cancer*).

HOW IS THE DOSE OF THYROID HORMONE REPLACEMENT CHOSEN?

The dose of thyroid hormone replacement needed will depend on the size (weight) and age of the infant or child and the reason the thyroid hormone replacement is needed. Relative to their size, babies and young children need more thyroid hormone than older children and adults. Babies with *congenital hypothyroidism* need higher doses relative to their weight than children with acquired *hypothyroidism*. The physician uses all of these factors to choose a starting dose of thyroid hormone replacement. The dose will be adjusted based on follow-up thyroid lab tests. The dose often changes during childhood and adolescence due to growth, changes in metabolism, and if there is any further damage to the remaining thyroid gland. Follow-up testing is typically recommended 4 to 8 weeks after starting thyroid hormone medicine or after any dose change or sooner for very young infants or if there are concerns for side effects. *Thyroid tests* (TSH and sometimes also a T4 or free T4) should be checked regularly for anyone on thyroid hormone replacement, even if they feel well. The goal of therapy is to bring the TSH and T4 levels back to the normal range. Very young babies typically have their labs tested every 1 to 2 months until 6 months of age; then every 2 to 4 months until the age of 3 years; then every 3-12 months until they have finished growing and going through puberty. Adults usually have their levels checked once a year if they are doing well.

HOW IS THYROID HORMONE GIVEN?

The majority of patients of all ages will be prescribed levothyroxine pills. For babies and small children who cannot swallow or chew the pill, parents should crush up each day's tablet and mix it with about a teaspoon of liquid (e.g. water, breast milk, or formula). The mixture should be prepared just before it is given. It is not recommended that multiple doses are prepared ahead of time and stored as the dose is unreliable if stored. The mixture should be given to the baby or small child on a spoon, or from a medicine dropper or syringe. For small babies, it's a good idea to squirt the medicine into the side of the mouth against the inner cheek. Additional liquid should be

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poured onto or drawn into the spoon, dropper or syringe and given again to the baby to ensure that all of the medicine is given. Older children and adolescents should swallow or chew the tablet. Unlike the tablets, the liquid solution of levothyroxine (Tirosint-SOL) does not need to be crushed, but otherwise can be given in the same way.

It is often recommended that thyroid hormone be given on an empty stomach at least 30 minutes before food, because the presence of food in the stomach can decrease the absorption of the medication slightly. In infants and babies who feed very frequently, it is unnecessary and often not possible to take the medicine on an empty stomach. For older children and adolescents, it is far more important to take the medicine every day than it is to take it on an empty stomach. It is a good idea to be consistent about taking the medicine either on an empty stomach or with food. Some foods and supplements interfere significantly with absorption of the thyroid hormone medicine and these should not be taken at the same time as the thyroid medicine, these include: soy formula, iron supplements, and calcium supplements. If a dose is missed, it should be taken as soon possible when it is noticed. If a day's medication is missed, 2 doses can be taken the following day (one in the morning and 1 in the evening). It is often helpful to use a 7 day pillbox, filled once a week to track if any doses of thyroid hormone medication are missed. The use of other medications can cause people to need a higher or lower dose of their thyroid hormone medication, these include: birth control pills, and some anti-seizure medications. Whenever a child is on thyroid hormone replacement (or any other prescription medication), it is a good idea to talk to their physician or pharmacist about any additional medication or supplements they are using.

WHAT ARE THE SIDE EFFECTS OF THYROID HORMONE MEDICATION?

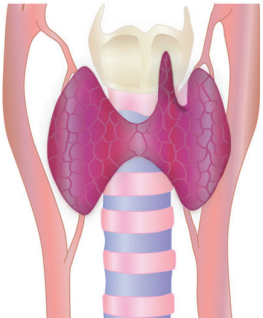
Since levothyroxine is a synthetic version of T4 which the body makes, and it is prescribed to replace hormone which the body isn't making, there should not be any side effects unless the dose is too high. If too much thyroid hormone medication is taken, the infant or child develops symptoms of hyperthyroidism, which can include rapid heart rate, excessive sweating, anxiety, diarrhea and tremors. If there are any concerns for symptoms of hyperthyroidism, the prescribing physician should be contacted who may want to check the patient's thyroid blood test.

THYROID HORMONE SUPPRESSION:

Thyroid hormone suppression is mainly used in the treatment of thyroid cancer but is also sometimes used to try to prevent growth of benign (non-cancerous) thyroid nodules. In the past, thyroid hormone treatment was used more commonly to prevent thyroid nodules or enlarged thyroid glands from growing. This practice is no longer common as it is not clear that it is very effective and there are concerns about possible side effects. Thyroid hormone suppression therapy may be more effective for certain types of thyroid nodules (e.g. nodules which grow after radiation exposure). The dose of thyroid hormone used is higher than the doses for thyroid hormone replacement, and so there are more risks of side effects from excess thyroid hormone (see above). If this treatment is considered, the physician will monitor for side effects and will check thyroid blood tests to ensure the dose is high enough but not too high.

TREATMENT OF THYROID CANCER

After surgery for thyroid cancer, it is common that some thyroid cells remain. Thyroid hormone treatment is needed to replace the thyroid hormone the body is no longer making but also to prevent further stimulation (and potential growth) of any remaining thyroid cancer cells. *Thyroid stimulating hormone* (TSH) stimulates healthy thyroid cells and many types of thyroid cancer cells. The goal of thyroid hormone suppression therapy is to keep the TSH low to prevent further growth of any remaining thyroid cancer cells. A low TSH is achieved by treating with more levothyroxine. This therapy should always occur under the guidance of a physician who understands the risks and benefits for each individual patient depending on their age, their other health conditions, the type and extent of their thyroid cancer and when it was initially treated.



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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OTHER FORMS OF THYROID HORMONE REPLACEMENT:

T3

As noted above, the thyroid gland makes both T4 and T3. Most actions of thyroid hormone are due to T3 and most of the T3 in the body comes from the conversion of T4 to T3. The conversion of T4 to T3 is normal in patients with hypothyroidism and so treatment with T4 alone is entirely appropriate. A synthetic form of T3 (brand name of Cytomel) is available. The main concern with giving T3 is that it has a very short lifespan in the body and so it needs to be given several times a day, and even if this is done, the levels do not remain steady. Shortly after taking a dose of T3, the levels are high, then they drop quickly until the next dose is given. High T3 levels can cause unpleasant symptoms of hyperthyroidism (fast heart rate, tremor, anxiety, excessive sweating). Hypothyroidism should not be treated with T3 alone.

WHAT ABOUT COMBINED T4 AND T3 TREATMENT?

A hormone preparation containing a combination of synthetic T4 and synthetic T3 is available in the United States (Thyrolar). This combination contains much more T3 relative to T4 than is produced naturally in the body and so results in higher than normal T3 levels shortly after the dose is given. This can cause the same side effects as if T3 is given alone. The combination medicine is also given once a day, ignoring the short lifespan of T3 in the body. In the very rare situation that the physician feels combination therapy is needed, T4 (levothyroxine) and T3 (Cytomel) should both be prescribed.

WHAT ABOUT "NATURAL" THYROID HORMONES?

Dessicated (dried and powdered) animal thyroid (mainly obtained from pigs) was the most common form of thyroid therapy before the individual active thyroid hormones were discovered and could be manufactured. It still can be prescribed. Pills made from animal thyroid glands are not purified and contain hormones and proteins which are not usually present in the body outside the thyroid gland. The pills contain both T4 and T3 but the balance of T4 and T3 is different in animals than in humans, so the hormones are not necessarily "natural" for the human body. The proportions of T4 and T3 can vary in every batch of dessicated thyroid which makes it difficult to control blood levels. Even though the thyroid hormone levels come from an animal (not a manufacturing facility), there are other chemicals in these pills (binders) to hold the pill together so they are not completely "natural". There is no evidence that dessicated thyroid hormone has any advantage over synthetic T4. Desiccated animal thyroid is not FDA-approved for use in children or adults and is rarely prescribed. People can also buy this product over the internet as a food supplement or as a medicine (this is illegal).

WHAT IF SYMPTOMS OF HYPOTHYROIDISM CONTINUE DESPITE THYROID HORMONE REPLACEMENT?

The symptoms of *hypothyroidism* can occur for reasons aside from hypothyroidism. If symptoms of hypothyroidism are present, thyroid blood tests (TSH with or without T4 or free T4) should be performed to check if the hypothyroidism is undertreated and responsible for the symptoms.

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