[CN]Chapter 1

[CT]All About Your Thyroid

[IP]Most of us don't give much thought to our thyroid glands. But in the scheme of the human body, this tiny gland is a vital part of our health and well-being. Sadly, it usually isn't until it malfunctions and causes disease that the thyroid gets any attention. In this chapter we introduce you to this wonder gland and all it does.

[H1]A Busy Gland

[NF]Ever wonder why your best friend can down desserts with reckless abandon and never gain weight? And why you pack on pounds by nibbling on just one or two desserts a week? At least some of the blame – or credit, depending on whom you ask -- goes to your thyroid, which produces the hormone that determines your metabolism, or basal metabolic rate (BMR). That's the rate at which your body cells use oxygen and energy to do their jobs. Too much thyroid hormone, and your metabolism speeds up. Too little, and it slows down.

But metabolic rate is only one of its tasks. The thyroid gland is also responsible for how your body uses the energy sources – carbohydrates, proteins, and fats -- that you derive from food.  It is responsible for bone

growth and muscle function. In addition, the thyroid affects respiration, heart rate, mood, skin, hair, and nails.

For all it does, the thyroid is a modest organ that weighs about half to three-quarters of an ounce in mature adults. On the body, the small butterfly-shaped gland resembles a bowtie, nestled in the front of your neck, just below the larynx – also called your Adam's apple or voice box -- and in front of the trachea, the windpipe that carries air to your lungs. The wings of the butterfly are called its left and right lobes, and are wrapped around the trachea. Each lobe measures about an inch and a half. In between is the isthmus, a narrow strip that connects the two wings.

Development of the thyroid begins around the seventeenth day after conception. When the fetus reaches three months gestation, it begins to make its first thyroid hormone. During pregnancy, it also receives thyroid hormone from the mother. Even at these early stages, thyroid hormone is needed for the fetus's development of the brain and nervous system.

The thyroid gland is part of the body's endocrine system, a collection of glands that produce the hormones that regulate your growth, metabolism, and sexual development and function. Hormones, which comes from a Greek word meaning "to excite" or "to spur on," are chemical messengers that act on cells to cause chemical reactions. Once released by specific

glands, they travel in the bloodstream to the targeted organ, where they spur the organ to action. Other parts of the endocrine system include the:

[BL]Adrenal glands, which are located above the kidney, and affect metabolism, the body's stress response, and salt regulation.

[BL]Hypothalamus, a part of the brain that regulates the pituitary gland as well as involuntary body functions, sleep, appetite, and hormones.

[BL]Ovaries and testicles, which are located in the sex organs, and produce sex hormones involved in influencing female and male sexual characteristics. They regulate the menstrual cycle in women and sperm production in men.

[BL]Pancreas, which is located below your stomach, and secretes insulin, a hormone that regulates the body's use of glucose.

[BL]Parathyroid glands, which are located near the thyroid, and regulate calcium levels in the blood.

[BL]Pineal gland, which is in the back of the brain, and produces melatonin, a hormone that involved in sleep-wake cycles.

[BL]Pituitary gland, which is located near the base of the brain, and produces numerous hormones that affect the other endocrine glands, including the thyroid.

[BL]Thymus gland, which is located at the top of the chest, and is involved in the body's immune function.

Each one of these glands plays a vital role in keeping you healthy, and the thyroid is no exception. But the thyroid doesn't work alone. It requires help from other body parts and elements in your diet to perform the critical task of regulating metabolism and promoting healthy growth.

[E-ssential]

[SB]The thyroid has a profound impact on your mood. A drop in thyroid hormone can cause depression, malaise, and forgetfulness. An increase in thyroid hormone can cause excitability, wide fluctuations in mood, and crying spells for no reason. Be on the lookout for radical mood changes – they might be thyroid-related.

[ESB]

[H2]How the Thyroid Works

Thyroid function involves a complex interplay of several organs, various hormones, and the right nutrients. In fact, thyroid function is directly affected by two other major organs -- the hypothalamus and the pituitary gland.  Together the three organs form what is sometimes called the hypothalamic-pituitary-thyroid axis, or HPT axis. The way they operate

provides a glimpse of your body's highly regulated system of checks and balances.

The hypothalamus is a region of the brain that acts as an internal regulation system. It controls certain metabolic processes and autonomic activities, such as breathing, swallowing, and blinking.

The hypothalamus also links the nervous system to the endocrine system through its production of neurohormones. Of particular importance to the thyroid gland is a neurohormone called thyrotropin--releasing hormone (TRH), also called TSH-releasing hormone. TRH levels are too low to be measured in the blood and so are never used to diagnose thyroid disease. But when thyroid hormone levels are low, TRH stimulates the pituitary gland to produce thyroid-stimulating hormone (TSH). TSH in turn, acts on the thyroid gland to produce thyroid hormone.

But the pituitary gland doesn't sit back after the thyroid hormone is released. It continues to monitor and assess the amount of hormone in the blood. If thyroid hormone drops too low, it releases more TSH to spur on greater production of thyroid hormone. If the amount of thyroid hormone goes too high, then the pituitary gland stops releasing TSH.

TSH levels can sometimes change even when your thyroid hormones are in the normal range. But usually, when the levels of thyroid hormone are just

right, the pituitary maintains its production of TSH. That's why the measure of TSH is considered the most telling of your thyroid hormone levels. Together, the hypothalamus and the pituitary and thyroid glands work together with help from other parts of the brain to ensure that your body cells work at the proper speed. In a healthy person, this well-orchestrated feedback loop keeps your body cells functioning the way it should, much in the same way that a thermostat ensures that your house stays at a stable temperature. Even the slightest increase or decrease however, can alter the activity in your cells. That's when disease sets in.

[E-Fact]

[SB]People in the United States consume approximately 200 to 700 micrograms of iodine in their diets every day, according to the Thyroid Foundation of America. In the Japanese island of Hokkaido, where people consume large amounts of a seaweed called kombu, the daily iodine intake is about 200,000 micrograms. Oddly enough, the people on Hokkaido don't have many thyroid problems, suggesting that normal, healthy people may naturally regulate how much iodine enters the thyroid.

[ESB]

[H2]The Role of Iodine

Cut back on salt. Eat less sodium. These days, we hear a lot about the benefits of eating a low-sodium diet as a way to reduce hypertension. Although too much salt is undoubtedly bad for people with high blood pressure, adequate amounts of iodized salt are critical to the healthy functioning of your thyroid gland.

Iodine is a trace mineral that occurs naturally in the sea. Seafood and plants grown near saltwater, such as kelp, are natural sources of iodine. You can also find iodine in eggs and dairy products that come from chicken and cattle that have been given iodine-fortified feed. According to the American Dietetic Association, you need 150 micrograms (mcgs) of iodine a day – which is found in a half teaspoon of iodized salt. Pregnant women require 220 mcgs, and breastfeeding moms need 290 mcgs.

These days, the primary source of iodine in North America is iodized salt. Without enough iodine in the diet, you are at risk of developing goiter, an enlarged thyroid gland. Thanks to the introduction of iodized salt in North America, goiter caused by iodine deficiency has practically been eliminated. But in countries where iodized salt is not the norm, many people continue to suffer from iodine deficiency. In fact, iodine deficiency is the most common cause of thyroid disease worldwide. Iodine deficiency leads to goiter, and in severe cases, cretinism, severe mental retardation in infants due to iodine

deficiency. Some of the areas that suffer from iodine deficiency include mountainous regions of Mexico and Central America, parts of Africa including Ethiopia and Nigeria, parts of Asia including India, Nepal and China, and parts of Europe including Italy and Switzerland.

Why is iodine so important to the thyroid? Simply put, the thyroid gland requires iodine for the production of thyroid hormones. In fact, the cells in your thyroid gland are the only ones in your body that are capable of absorbing iodine. Without it, your thyroid is totally incapable of producing the thyroid hormone that your body needs. In addition, iodine plays a significant role in the diagnosis and treatment of thyroid disease.

[SIDEBAR]

[E-Fact]

[SB]Iodized salt was first introduced to the U.S. in 1917 by David Marine as a way to combat large cases of goiter in schoolgirls living in Akron, Ohio. When the results of his experiment were successful, the idea of using iodized salt spread to other areas. In 1924, Morton became the first company to distribute iodized table salt for the prevention of goiters, which was a major health problem in the U.S. at that time.

[ESB]

[H2]Thyroid Hormone

Once the iodine is in your body, it travels to the stomach, where it is converted to iodide. It is then transported to the thyroid gland in the blood. The thyroid gland is comprised of follicles, round sacs that are clustered together like tiny bubbles. The follicle consists of a gelatinous material called colloid in the center and is lined with follicular cells on the outside. These follicular cells produce thyroid hormone by absorbing iodine from the diet and combining them with thyroglobulin, a thyroid protein produced in the thyroid and a precursor to thyroid hormone.

Inside each of these thyroid follicles, iodine hooks up with the thyroglobulin and mixes with an amino acid called tyrosine on the thyroglobulin to produce two forms of thyroid hormone, triiodothyronine (T3) and thyroxine (T4). The thyroid hormone is then stored in the colloid. When levels of thyroid hormone dip, the pituitary gland releases more TSH, which arrives at the thyroid follicles and attaches to TSH receptors on the cells. In the presence of TSH, T4 and T3 are cleaved off the thyroglobulin. The T4 and T3 go from the colloid back to the follicular cells and are then released into the bloodstream.

[E-Fact]

[SB]Follicular cells of the thyroid gland change shape depending on their activity. The cells are rectangular when the thyroid gland is active and square when it is inactive.

[ESB]

The numbers on these two forms of thyroid hormone reflect the number of iodine molecules in each molecule of thyroid hormone. In healthy people, eighty percent of the thyroid hormone you produce is T4, the less powerful form of thyroid hormone. The remaining 20 percent is T3, the more potent and active form of thyroid hormone.

The bulk of the T3 your body needs is produced by the conversion of T4 into T3. Your body cells do this conversion by removing one of the iodine molecules on T4, with help from enzymes known as deiodinases. There are three different types of these enzymes, each in different tissues. The deiodinase enzymes also convert T4 to reverse T3 (rT3), which is an inactive form of T3. The conversion of T4 into T3 takes place in organs such as the liver, kidneys, and muscles. The scientific name for the conversion process is called monodeiodination.

[H2]What Thyroid Hormones Do

Once inside the bloodstream, the bulk of T3 and T4 attach themselves to blood proteins produced by the liver, which are called thyroxine-binding

globulin (TBG), thyroxine-binding pre-albumin, also called transthyretin, and albumin. Only minute amounts of thyroid hormone – 0.04 percent of T4 and 0.4 percent of T3 – circulate in the blood as the free and active portions. The active form of thyroid hormone then travels throughout the body via the blood and binds to thyroid hormone receptors on different tissues. There are two types of thyroid receptors, TR alpha and TR beta, which have different activities.

Every single cell in your body relies on thyroid hormone to do its job. That's because thyroid hormone determines how quickly your body uses oxygen and calories from food to produce the energy cells need to do their jobs. Thyroid hormone begins doing its work at conception and continues until you die.

[E-Fact]

[SB]T3 has a shorter half-life than T4, which means T4 remains in the body a lot longer than T3. Animals such as pigs have a higher amount of T3 than humans and are used as a source for the production of natural hormone used in treatment.

[ESB]

Thyroid hormone has numerous and critical functions in the body, including the regulation of the speed at which individual cells function, or basal

metabolic rate. Here are some other ways that thyroid hormone works in your body.

[BL]It ensures the proper growth and development of children.

[BL]It aids in proper muscle functioning.

[BL]It ensures that the heart, a muscle, pumps effectively and efficiently.

[BL]It ensures that the gastrointestinal system is able to digest and excrete food properly.

[BL]It strengthens hair, skin, and nails.

[BL]It helps with the development of the brain.

[BL]It aids in the growth of strong bones.

[BL]It ensures proper development of the body's organs.

As you can see, thyroid hormone is a pivotal player in the proper functioning and well-being of your body. Even the slightest increase or decrease in hormone levels can affect your health.

But T4 and T3 aren't the only hormones produced by the thyroid gland. Tucked between the follicular cells are other cells known as parafollicular cells, also called chief cells or C cells. The parafollicular cells produce calcitonin, a hormone important to bone health.

Calcitonin inhibits the removal of bone by osteoclasts, a type of cell involved in the constant breakdown of bone. These cells also produce small

amounts of somatostatin, which inhibits the release of several hormones including TSH, growth hormone, and insulin.

[E-ssential]

[SB]You may know calcitonin as a drug, not just a hormone. In postmenopausal women who have osteoporosis, calcitonin may be prescribed as a medication, under such brand names Miacalcin and Calcimar. It works just like the natural hormone by slowing the breakdown of bone. Calcitonin is also found in salmon.

[ESB]

[H1]What are the Parathyroid Glands?

[NF]Although this book is dedicated to diseases of the thyroid gland, it's important to know a little bit about the parathyroid glands. Even though the names of these glands sound alike, they are completely different glands. Parathyroid glands are four tiny glands – some people may have more or less -- located behind the thyroid gland. Unlike the thyroid gland, which is made up of follicles, the parathyroid glands are comprised of distinct densely packed cells. These glands produce parathyroid hormone (PTH), which regulates the metabolism of calcium and phosphorous. They also play a role in maintaining healthy bones.

When blood calcium levels drop below a certain point, calcium-sensing receptors in the parathyroid gland respond by releasing PTH into the blood. Parathyroid hormone then stimulates osteoclasts to break down bone and release calcium into the blood. By keeping the calcium levels in our body within a narrow range, our nervous and muscular systems are able to function properly.

The parathyroid glands however, are separate and distinct from the thyroid gland. One can be healthy, while the other can become diseased. But the health of the parathyroid glands can be affected during thyroid surgery, which is why it's critical that the surgeon not harm the parathyroid glands during a thyroidectomy, removal of the thyroid gland.

[H1]Do a Self-Check

[NF]Most people know that they can feel their heartbeat in the left side of their chest. They know the lungs are nestled inside their ribs. But some people may have no idea that their thyroid resides in their neck. As a result, they may not notice when the thyroid is enlarged or developing abnormal growths.

To make matters more challenging, thyroid disease doesn't always have signs or symptoms.  When it does, the symptoms may be easily dismissed as symptoms of other conditions or lifestyle issues. Those who have symptoms

directly related to their thyroid may notice a lump in their throat, hoarseness in their voices, or a pain in the neck.

In any case, one of the best ways to assess your thyroid health is to do a thyroid neck check. Because thyroid disease is so prevalent, many experts recommend performing an annual neck check on yourself – the same way women are advised to do monthly breast exams and all people are told to examine their skin. Keep in mind however, that a self-check does not compensate for a visit to your doctor's. According to the American Association of Clinical Endocrinologists, here's how to do a neck check:

[NL] 1. Get a glass of water and a hand-held mirror.

[NL] 2. With the mirror in your hand, study the area of your neck just below the Adam's apple and immediately above the collarbone. That is the location of your thyroid gland.

[NL] 3. While focusing on this area, tip your head back.

[NL] 4. Take a drink of water and swallow.

[NL] 5. As you do, look at your neck. Be on the lookout for bulges or protrusions in this area when you swallow. Be careful not to confuse the Adam's apple with the thyroid gland, which is closer to the collarbone.

[NL] 6. Repeat this process a few times if you suspect anything.

[NL]  7. If you do see any bulges or protrusions, you should see your physician. Your thyroid gland may be enlarged, or you may have a nodule. In any case, it should be checked for cancer or thyroid disease.

[E-Alert]

[SB]According to the American Association of Clinical Endocrinologists (AACE), any woman with a parent, sibling or child who has thyroid disease should ask her doctor for a thyroid evaluation. Anyone who has a brother with thyroid disease – man or woman – should get his or her thyroid checked out as well.

[ESB]

[H1]The Goal of This Book

[NF]If you've picked up this book and gotten this far, you were probably just diagnosed with a form of thyroid disease, or you may suspect you have a thyroid problem. Or perhaps you have a relative or close friend who is dealing with a thyroid disease. Our goal is to help you figure out whether your thyroid is indeed the culprit and then find out what to do about it. Many things can go wrong with the thyroid, and there are myriad tests and treatments for many types of problems. Making sense of all of them can sometimes be overwhelming.

In this book, we'll strive to keep the information simple, straightforward, and easy to understand. If you're not feeling well, you may already be overwhelmed and fearful about your health. You may be worried that what you have is potentially fatal. But keep in mind that knowledge is power and that information about your health is critical. It just shouldn't compound your stress.

Our goal is for you to learn as much as possible about your thyroid and your particular thyroid condition. The more you know, the more quickly you'll get a diagnosis and treatment. It will also enable you to speak intelligently with your doctors and to become a partner in your ongoing care.

Most important perhaps, it will help you live as well as possible, even as you confront thyroid disease. But keep in mind that thyroid disease is highly complex. No amount of information in a book or elsewhere is a substitute for seeing your doctor for diagnosis and treatment.

###