Thyroid Cancer

What is cancer?

The body is made up of hundreds of millions of living cells. Normal body cells grow, divide to make new cells, and die in an orderly fashion. During the early years of a person's life, normal cells divide faster to allow the person to grow. After the person becomes an adult, most cells divide only to replace worn-out or dying cells or to repair injuries.

Cancer begins when cells in a part of the body start to grow out of control. There are many kinds of cancer, but they all start because of out-of-control growth of abnormal cells.

Cancer cell growth is different from normal cell growth. Instead of dying, cancer cells continue to grow and form new, abnormal cells. Cancer cells can also invade (grow into) other tissues, something that normal cells cannot do. Growing out of control and invading other tissues are what makes a cell a cancer cell.

Cells become cancer cells because of damage to DNA. DNA is in every cell and directs all its actions. In a normal cell, when DNA gets damaged the cell either repairs the damage or the cell dies. In cancer cells, the damaged DNA is not repaired, but the cell doesn't die like it should. Instead, this cell goes on making new cells that the body does not need. These new cells will all have the same damaged DNA as the first cell does.

People can inherit damaged DNA, but most DNA damage is caused by mistakes that happen while the normal cell is reproducing or by something in our environment. Sometimes the cause of the DNA damage is something obvious, like cigarette smoking. But often no clear cause is found.

In most cases the cancer cells form a tumor. Some cancers, like leukemia, rarely form tumors. Instead, these cancer cells involve the blood and blood-forming organs and circulate through other tissues where they grow.

Cancer cells often travel to other parts of the body, where they begin to grow and form new tumors that replace normal tissue. This process is called *metastasis*. It happens when the cancer cells get into the bloodstream or lymph vessels of our body.

No matter where a cancer may spread, it is always named for the place where it started. For example, breast cancer that has spread to the liver is still called breast cancer, not liver cancer. Likewise, prostate cancer that has spread to the bone is metastatic prostate cancer, not bone cancer.

Different types of cancer can behave very differently. For example, lung cancer and breast cancer are very different diseases. They grow at different rates and respond to different treatments. That is why people with cancer need treatment that is aimed at their particular kind of cancer.

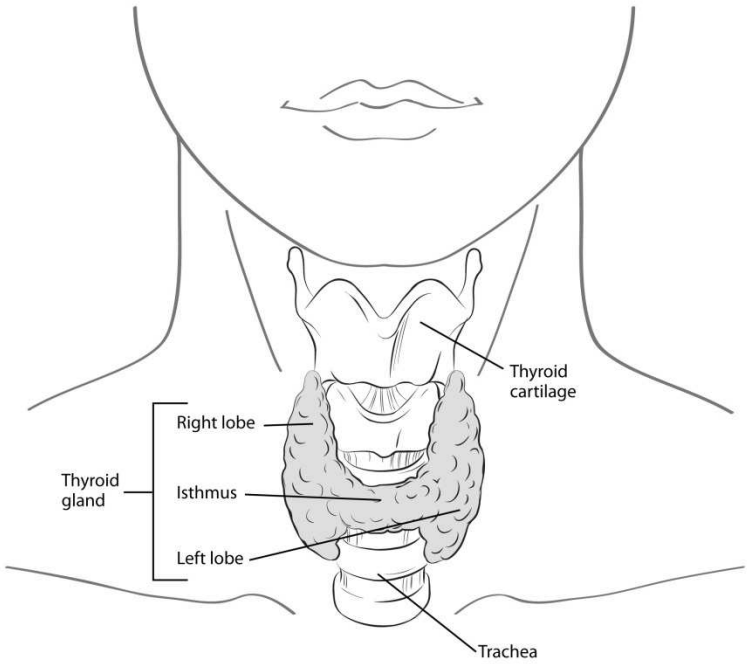
Not all tumors are cancerous. Tumors that aren't cancer are called *benign*. Benign tumors can cause problems – they can grow very large and press on healthy organs and tissues. But they cannot grow into (invade) other tissues. Because they can't invade, they also can't spread to other parts of the body (metastasize). These tumors are almost never life threatening.

What is thyroid cancer?

Thyroid cancer is a cancer that starts in the thyroid gland. To understand thyroid cancer, it helps to know about the normal structure and function of the thyroid gland.

The thyroid gland

The thyroid gland is below the thyroid cartilage (Adam's apple) in the front part of the neck. In most people, the thyroid cannot be seen or felt. It is butterfly shaped, with 2 lobes — the right lobe and the left lobe — joined by a narrow isthmus (see picture below).



The thyroid gland has 2 main types of cells:

- **Follicular cells** use iodine from the blood to make thyroid hormones, which help regulate a person's metabolism. Having too much thyroid hormone (a condition called *hyperthyroidism*) can cause a rapid or irregular heartbeat, trouble sleeping, nervousness, hunger, weight loss, and a feeling of being too warm. Having too little hormone (called *hypothyroidism*) causes a person to slow down, feel tired, and gain weight. The amount of thyroid hormone released by the thyroid is regulated by the pituitary gland at the base of the brain, which makes a substance called *thyroid-stimulating hormone* (TSH).

- **C cells** (also called *parafollicular cells*) make calcitonin, a hormone that helps control how the body uses calcium.

Other, less common cells in the thyroid gland include immune system cells (lymphocytes) and supportive (stromal) cells.

Different cancers develop from each kind of cell. The differences are important because they affect how serious the cancer is and what type of treatment is needed.

Many types of growths and tumors can develop in the thyroid gland. Most of these are benign (non-cancerous) but others are malignant (cancerous), which means they can spread into nearby tissues and to other parts of the body.

Benign thyroid enlargement and nodules

Changes in the thyroid gland's size and shape can often be felt or even seen by patients or by their doctor.

The medical term for an abnormally large thyroid gland is *goiter*. Some goiters are diffuse, meaning that the whole gland is large. Other goiters are nodular, meaning that the gland is large and has one or more nodules (bumps) in it. There are many reasons the thyroid gland might be larger than usual, and most of the time it is not cancer. Both diffuse and nodular goiters are usually caused by an imbalance in certain hormones. For example, not getting enough iodine in the diet can cause changes in hormone levels and lead to a goiter.

Lumps or bumps in the thyroid gland are called *thyroid nodules*. Most thyroid nodules are benign, but about 1 in 20 is cancerous (see the next section). Sometimes these nodules make too much thyroid hormone and cause hyperthyroidism.

People can develop thyroid nodules at any age, but they occur most commonly in older adults. Fewer than 1 in 10 adults have thyroid nodules that can be felt by a doctor. But when the thyroid is looked at using ultrasound, many more people are found to have nodules that are too small to feel.

Most nodules are cysts filled with fluid or with a stored form of thyroid hormone called *colloid*.

Solid nodules have little fluid or colloid. These nodules are more likely to be cancerous than are fluid-filled nodules. Still, most solid nodules are not cancer. Some types of solid nodules, such as hyperplastic nodules and adenomas, have too many cells, but the cells are not cancer cells.

Benign thyroid nodules sometimes can be left alone (not treated) as long as they're not growing or causing symptoms. Others may require some form of treatment.

Malignant (cancerous) thyroid tumors

There are several types of thyroid cancer.

Differentiated thyroid cancers

Most thyroid cancers are differentiated cancers. In these cancers, the cells look a lot like normal thyroid tissue when seen under a microscope. These cancers develop from thyroid follicular cells.

Papillary carcinoma: About 8 out of 10 thyroid cancers are papillary carcinomas (also called *papillary cancers* or *papillary adenocarcinomas*). Papillary carcinomas tend to grow very slowly and usually develop in only one lobe of the thyroid gland. Even though they

grow slowly, papillary carcinomas often spread to the lymph nodes in the neck. Still, these cancers can often be treated successfully and are rarely fatal.

There are several subtypes of papillary carcinoma. Of these, the follicular subtype (also called *mixed papillary-follicular variant*) occurs most often. The usual form of papillary carcinoma and the follicular subtype have the same good outlook (prognosis) when found early, and they are treated the same way. Other subtypes of papillary carcinoma (columnar, tall cell, insular, and diffuse sclerosing) are not as common and tend to grow and spread more quickly.

Follicular carcinoma: Follicular carcinoma, also called *follicular cancer* or *follicular adenocarcinoma*, is the next most common type, making up about 1 out of 10 thyroid cancers. It is more common in countries where people don't get enough iodine in their diet. These cancers usually do not spread to lymph nodes, but they can spread to other parts of the body, such as the lungs or bones. The outlook (prognosis) for follicular carcinoma is not quite as good as that of papillary carcinoma, although it is still very good in most cases.

Hürthle (Hurthle) cell carcinoma, also known as *oxyphil cell carcinoma*, is actually a variant of follicular carcinoma. It accounts for about 3% of thyroid cancers. The prognosis may not be as good as that of typical follicular carcinoma because this type is harder to find and treat. This is because it is less likely to absorb radioactive iodine, which is used both for treatment and to look for the spread of differentiated thyroid cancer.

Other types of thyroid cancers

These thyroid cancers occur less often than differentiated thyroid cancers.

Medullary thyroid carcinoma: Medullary thyroid carcinoma (MTC) accounts for about 4% of thyroid cancers. It develops from the C cells of the thyroid gland, which normally make calcitonin, a hormone that helps control the amount of calcium in blood. Sometimes this cancer can spread to lymph nodes, the lungs, or liver even before a thyroid nodule is discovered.

Medullary thyroid cancers often release too much calcitonin and a protein called *carcinoembryonic antigen (CEA)* into the blood. These substances can be detected with blood tests.

Because MTC does not absorb or take up radioactive iodine (used for treatment and to find metastases of differentiated thyroid cancer), the prognosis (outlook) is not quite as good as that for differentiated thyroid cancers. There are 2 types of MTC:

- **Sporadic MTC**, which accounts for about 8 out of 10 cases of MTC, is not inherited (meaning it does not run in families). It occurs mostly in older adults and affects only one thyroid lobe.

- **Familial MTC** is inherited and can occur in each generation of a family. These cancers often develop during childhood or early adulthood and can spread early. Patients usually have cancer in several areas of both lobes. Familial MTC is often linked with an increased risk of other types of tumors. This is described in more detail in the section "What are the risk factors for thyroid cancer?"

Anaplastic carcinoma: Anaplastic carcinoma (also called *undifferentiated carcinoma*) is a rare form of thyroid cancer, making up about 2% of all thyroid cancers. It is thought to sometimes develop from an existing papillary or follicular cancer. This cancer is called *undifferentiated* because the cancer cells do not look very much like normal thyroid cells under the microscope. This cancer often spreads quickly into the neck and to other parts of the body, and is very hard to treat.

Thyroid lymphoma: Lymphoma is very uncommon in the thyroid gland. Lymphomas are cancers that develop from lymphocytes, the main cell type of the immune system. Most lymphocytes are found in lymph nodes, which are pea-sized collections of immune cells scattered throughout the body (including the thyroid gland). Lymphomas are discussed in our separate document, *Non-Hodgkin Lymphoma*.

Thyroid sarcoma: These rare cancers start in the supporting cells of the thyroid. They are often aggressive and hard to treat. Sarcomas are discussed in our separate document, *Sarcoma: Adult Soft Tissue Cancer*.

Parathyroid cancer

Behind, but attached to, the thyroid gland are 4 tiny glands called the *parathyroids*. The parathyroid glands help regulate the body's calcium levels. Cancers of the parathyroid glands are very rare — there are probably fewer than 100 cases each year in the United States.

Parathyroid cancers are often found because they cause high blood calcium levels. This makes a person tired, weak, and drowsy. It can also makes you urinate (pee) a lot, causing dehydration, which can make the weakness and drowsiness worse. Other symptoms include bone pain and fractures, pain from kidney stones, depression, and constipation.

Larger parathyroid cancers may also be found as a nodule near the thyroid. No matter how large the nodule is, the only treatment is to remove it surgically. Unfortunately, parathyroid cancer is much harder to cure than thyroid cancer.

The remainder of this document only discusses thyroid cancer.

What are the key statistics about thyroid cancer?

The American Cancer Society's estimates for thyroid cancer in the United States for 2015 are:

- About 62,450 new cases of thyroid cancer (47,230 in women, and 15,220 in men)
- About 1,950 deaths from thyroid cancer (1,080 women and 870 men)

Thyroid cancer is commonly diagnosed at a younger age than most other adult cancers. Nearly 2 out of 3 cases are found in people younger than 55 years of age. About 2% of thyroid cancers occur in children and teens.

The chance of being diagnosed with thyroid cancer has risen in recent years and it the most rapidly increasing cancer in the US. Most of this is the result of the increased use of thyroid ultrasound, which can detect small thyroid nodules that might not otherwise have been found in the past. Still, at least part of the increase is from finding more large tumors as well.

The death rate from thyroid cancer has been fairly stable for many years, and remains very low compared with most other cancers. Statistics on survival rates for thyroid cancer are discussed in the section "Thyroid cancer survival by type and stage."

What are the risk factors for thyroid cancer?

A risk factor is anything that affects a person's chance of getting a disease such as cancer. Different cancers have different risk factors. Some risk factors, like smoking, can be changed. Others, like a person's age or family history, can't be changed.

But risk factors don't tell us everything. Having a risk factor, or even several risk factors, does not mean that you will get the disease. And many people who get the disease may have few or no known risk factors. Even if a person with thyroid cancer has a risk factor, it is very hard to know how much that risk factor may have contributed to the cancer.

Scientists have found a few risk factors that make a person more likely to develop thyroid cancer.

Gender and age

For unclear reasons thyroid cancers (like almost all diseases of the thyroid) occur about 3 times more often in women than in men.

Thyroid cancer can occur at any age, but the risk peaks earlier for women (who are most often in their 40s or 50s when diagnosed) than for men (who are usually in their 60s or 70s).

A diet low in iodine

Follicular thyroid cancers are more common in areas of the world where people's diets are low in iodine. In the United States, most people get enough iodine in their diet because it is added to table salt and other foods. A diet low in iodine may also increase the risk of papillary cancer if the person also is exposed to radioactivity.

Radiation

Exposure to radiation is a proven risk factor for thyroid cancer. Sources of such radiation include certain medical treatments and radiation fallout from power plant accidents or nuclear weapons.

Having had head or neck radiation treatments in childhood is a risk factor for thyroid cancer. Risk depends on how much radiation is given and the age of the child. In general, the risk increases with larger doses and with younger age at treatment. Before the 1960s, children were sometimes treated with low doses of radiation for things we wouldn't use radiation for now, like acne, fungus infections of the scalp (ringworm), or enlarged tonsils or adenoids. Years later, the people who had these treatments were found to have a higher risk of thyroid cancer. Radiation therapy in childhood for some cancers such as lymphoma, Wilms tumor, and neuroblastoma also increases risk. Thyroid cancers that develop after radiation therapy are not more serious than other thyroid cancers.

Imaging tests such as x-rays and CT scans also expose children to radiation, but at much lower doses, so it's not clear how much they might raise the risk of thyroid cancer (or other cancers). If there is an increased risk it is likely to be small, but to be safe, children should not have these tests unless they are absolutely needed. When they are needed, they should be done using the lowest dose of radiation that still provides a clear picture.

Several studies have pointed to an increased risk of thyroid cancer in children because of radioactive fallout from nuclear weapons or power plant accidents. For instance, thyroid cancer was many times more common than normal in children who lived near Chernobyl, the site of a 1986 nuclear plant accident that exposed millions of people to radioactivity. Adults involved with the cleanup after the accident and those who lived near the plant have also had higher rates of thyroid cancer. Children who had more iodine in their diet appeared to have a lower risk.

Some radioactive fallout occurred over certain regions of the United States after nuclear weapons were tested in western states during the 1950s. This exposure was much, much lower than that around Chernobyl. A higher risk of thyroid cancer has not been proven at these low exposure levels. If you are concerned about possible exposure to radioactive fallout, discuss this with your doctor.

Being exposed to radiation when you are an adult carries much less risk of thyroid cancer.

Hereditary conditions and family history

Several inherited conditions have been linked to different types of thyroid cancer, as has family history. Still, most people who develop thyroid cancer do not have an inherited condition or a family history of the disease.

Medullary thyroid cancer

About 1 out of 3 medullary thyroid carcinomas (MTCs) result from inheriting an abnormal gene. These cases are known as *familial medullary thyroid carcinoma* (FMTC). FMTC can occur alone, or it can be seen along with other tumors.

The combination of FMTC and tumors of other endocrine glands is called *multiple endocrine neoplasia type 2* (MEN 2). There are 2 subtypes, MEN 2a and MEN 2b, both of which are caused by mutations (defects) in a gene called *RET*.

- In MEN 2a, MTC occurs along with pheochromocytomas (tumors that make adrenaline) and with parathyroid gland tumors.
- In MEN 2b, MTC is associated with pheochromocytomas and with benign growths of nerve tissue on the tongue and elsewhere called *neuromas*. This subtype is much less common than MEN 2a.

In these inherited forms of MTC, the cancers often develop during childhood or early adulthood and can spread early. MTC is most aggressive in the MEN 2b syndrome. If MEN 2a, MEN 2b, or isolated FMTC runs in your family, you may be at very high risk of developing MTC. Ask your doctor about having regular blood tests or ultrasound exams to look for problems and the possibility of genetic testing.

Other thyroid cancers

People with certain inherited medical conditions have a higher risk of more common forms of thyroid cancer. Higher rates of thyroid cancer occur among people with uncommon genetic conditions such as:

Familial adenomatous polyposis (FAP): People with this syndrome develop many colon polyps and have a very high risk of colon cancer. They also have an increased risk of some other cancers, including papillary thyroid cancer. *Gardner syndrome* is a subtype of FAP in which patients also get certain benign tumors. Both Gardner syndrome and FAP are caused by defects in the gene *APC*.

Cowden disease: People with this syndrome have an increased risk of thyroid problems and certain benign growths (including some called hamartomas). They also have an increased risk of cancers of the thyroid, uterus, breast, as well as some others. The thyroid cancers tend to be either the papillary or follicular type. This syndrome is most often caused by defects in

the gene *PTEN*. It is also known as Multiple Hamartoma Syndrome and PTEN Hamartoma Tumor Syndrome

Carney complex, type I: People with this syndrome may develop a number of benign tumors and hormone problems. They also have an increased risk of papillary and follicular thyroid cancers. This syndrome is caused by defects in the gene *PRKAR1A*.

Familial nonmedullary thyroid carcinoma: Thyroid cancer occurs more often in some families, and is often seen at an earlier age. The papillary type of thyroid cancer most often runs in families. Genes on chromosome 19 and chromosome 1 are suspected of causing these familial cancers.

If you suspect you might have a familial condition, talk with your doctor, who might recommend genetic counseling if your medical history warrants it.

Family history: Having a first-degree relative (parent, brother, sister, or child) with thyroid cancer, even without a known inherited syndrome in the family, increases your risk of thyroid cancer. The genetic basis for these cancers is not totally clear.

Do we know what causes thyroid cancer?

Thyroid cancer is linked with a number of inherited conditions (described in the section "What are the risk factors for thyroid cancer?"), but the exact cause of most thyroid cancers is not yet known.

Certain changes in a person's DNA can cause thyroid cells to become cancerous. DNA is the chemical in each of our cells that makes up our *genes* – the instructions for how our cells function. We usually look like our parents because they are the source of our DNA. But DNA affects more than just how we look. It also can influence our risk for developing certain diseases, including some kinds of cancer.

Some genes contain instructions for controlling when our cells grow and divide into new cells. Certain genes that help cells grow and divide or make them live longer than they should are called *oncogenes*. Other genes that slow down cell division or make cells die at the right time are called *tumor suppressor genes*. Cancers can be caused by DNA changes that turn on oncogenes or turn off tumor suppressor genes.

People inherit 2 copies of each gene – one from each parent. We can inherit damaged DNA from one or both parents. Most cancers, though, are not caused by inherited gene changes. In these cases, the genes change during a person's life. They may occur when a cell's DNA is damaged by something in the environment, like radiation, or they may just be random events that sometimes happen inside a cell, without an outside cause.

Papillary thyroid cancer

Several DNA mutations (changes) have been found in papillary thyroid cancer. Many of these cancers have changes in specific parts of the *RET* gene. The altered form of this gene, known as the *PTC* oncogene, is found in about 10% to 30% of papillary thyroid cancers overall, and in a larger percentage of these cancers in children and/or linked with radiation exposure. These *RET* mutations usually are acquired during a person's lifetime rather than being inherited. They are found only in cancer cells and are not passed on to the patient's children.

Many papillary thyroid cancers have a mutated *BRAF* gene. The *BRAF* mutation is less common in thyroid cancers in children and in those thought to develop from exposure to radiation. Cancers with *BRAF* changes tend to grow and spread to other parts of the body more quickly.

Both *BRAF* and *RET/PTC* changes are thought to make cells grow and divide. It is extremely rare for papillary cancers to have changes in both the *BRAF* and *RET/PTC* genes. Some doctors now advise testing thyroid biopsy samples for these gene mutations, as they can help diagnose cancer and may also affect the patient's outlook (see "How is thyroid cancer diagnosed?").

Changes in other genes have also been tied to papillary thyroid cancer, including those in the *NTRK1* gene and the *MET* gene.

Follicular thyroid cancer

Acquired changes in the *RAS* oncogene have a role in causing some follicular thyroid cancers.

Anaplastic thyroid cancer

These cancers tend to have some of the mutations described above and often have changes in the *TP53* tumor suppressor gene and the *CTNNB1* oncogene as well.

Medullary thyroid cancer

People who have medullary thyroid carcinoma (MTC) have mutations in different parts of the *RET* gene compared with papillary carcinoma patients. Nearly all patients with the inherited form of MTC and about 1 of every 10 with the sporadic (non-inherited) form of MTC have a mutation in the *RET* gene. Most patients with sporadic MTC have gene mutations only in their cancer cells. Those with familial MTC and MEN 2 inherit the *RET* mutation from a parent. These mutations are in every cell of the patient's body and can be detected by testing the DNA of blood cells.

In people with inherited mutations of *RET*, one *RET* gene is usually normal and one is mutated. Because every person has 2 *RET* genes but passes only one of them to a child (the child's other *RET* gene comes from the other parent), the odds that a person with familial MTC will pass a mutated gene on to a child are 1 in 2 (or 50%).

Can thyroid cancer be prevented?

Most people with thyroid cancer have no known risk factors, so it is not possible to prevent most cases of this disease.

Radiation exposure, especially in childhood, is a known risk factor for thyroid cancer. Because of this, doctors no longer use radiation to treat less serious diseases. Imaging tests such as x-rays and CT scans also expose children to radiation, but at much lower doses, so it's not clear how much they might raise the risk of thyroid cancer (or other cancers). If there is an increased risk it is likely to be small, but to be safe, children should not have these tests unless they are absolutely needed. When they are needed, they should be done using the lowest dose of radiation that still provides a clear picture.

Blood tests can be done to look for the gene mutations found in familial medullary thyroid cancer (MTC). Because of this, most of the familial cases of MTC can be prevented or treated early by removing the thyroid gland. Once the disease is discovered in a family, the rest of the family members can be tested for the mutated gene.

If you have a family history of MTC, it is important that you see a doctor who is familiar with the latest advances in genetic counseling and genetic testing for this disease. Removing the thyroid gland in children who carry the abnormal gene will probably prevent a cancer that might otherwise be fatal.

Can thyroid cancer be found early?

Many cases of thyroid cancer can be found early. In fact, most thyroid cancers are now found much earlier than in the past and can be treated successfully.

Most early thyroid cancers are found when patients see their doctors because of neck lumps or nodules they noticed. If you have unusual symptoms such as a lump or swelling in your neck, you should see your doctor right away.

Other cancers are found by health care professionals during a routine checkup. The American Cancer Society recommends that doctors do a cancer-related checkup that includes an examination of the thyroid during routine physical exams. Some doctors also recommend that people examine their own necks twice a year to look and feel for any growths or lumps.

Early thyroid cancers are also sometimes found when people have ultrasound tests for other health problems, such as narrowing of carotid arteries (which pass through the neck to supply blood to the brain) or for enlarged or overactive parathyroid glands.

Blood tests or thyroid ultrasound can often find changes in the thyroid, but these tests are not recommended as screening tests for thyroid cancer unless a person is at increased risk, such as because of a family history of thyroid cancer.

People with a family history of medullary thyroid cancer (MTC), with or without type 2 multiple endocrine neoplasia (MEN 2), might have a very high risk for developing this cancer. Most doctors recommend genetic testing for these people when they are young to see if they carry the gene changes linked to MTC. For those who may be at risk but don't get genetic testing, blood tests can help find MTC at an early stage, when it may still be curable. Thyroid ultrasounds may also be done in high-risk people.

Signs and symptoms of thyroid cancer

Prompt attention to signs and symptoms is the best way to diagnose most thyroid cancers early. Thyroid cancer can cause any of the following signs or symptoms:

- A lump in the neck, sometimes growing quickly
- Swelling in the neck
- Pain in the front of the neck, sometimes going up to the ears
- Hoarseness or other voice changes that do not go away
- Trouble swallowing
- Trouble breathing
- A constant cough that is not due to a cold

If you have any of these signs or symptoms, talk to your doctor right away. Many of these symptoms can also be caused by non-cancerous conditions or even other cancers of the neck area. Lumps in the thyroid are common and are usually benign. Still, if you have any of these symptoms, it's important to see your doctor right away so the cause can be found and treated, if needed.

How is thyroid cancer diagnosed?

Thyroid cancer may be diagnosed after a person goes to a doctor because of symptoms, or it might be found during a routine physical exam or other tests. If there is a reason to suspect you might have thyroid cancer, your doctor will use one or more tests to find out. Signs and symptoms might suggest you have thyroid cancer, but you will need tests to confirm the diagnosis.

Medical history and physical exam

If you have any signs or symptoms that suggest you might have thyroid cancer, your health care professional will want to know your complete medical history. You will be asked questions about your possible risk factors, symptoms, and any other health problems or concerns. If someone in your family has had thyroid cancer (especially medullary thyroid cancer) or tumors called *pheochromocytomas*, it is important to tell your doctor, as you might be at high risk for this disease.

Your doctor will examine you to get more information about possible signs of thyroid cancer and other health problems. During the exam, the doctor will pay special attention to the size and firmness of your thyroid and any enlarged lymph nodes in your neck.

Biopsy

The actual diagnosis of thyroid cancer is made with a biopsy, in which cells from the suspicious area are removed and looked at under a microscope. However, this might not be the first test done if you have a suspicious lump in your neck. The doctor might order other tests first, such as blood tests, an ultrasound exam, or a radioiodine scan to get a better sense of whether you might have thyroid cancer. These tests are described below.

If your doctor thinks a biopsy is needed, the simplest way to find out if a thyroid lump or nodule is cancerous is with a *fine needle aspiration* (FNA) of the thyroid nodule. This type of biopsy can usually be done in your doctor's office or clinic.

Before the biopsy, local anesthesia (numbing medicine) may be injected into the skin over the nodule, but in most cases an anesthetic is not needed. Your doctor will place a thin, hollow needle directly into the nodule to aspirate (take out) some cells and a few drops of fluid into a syringe. The doctor usually repeats this 2 or 3 more times, taking samples from several areas of the nodule. The biopsy samples are then sent to a lab, where they are looked at under a microscope to see if the cells look cancerous or benign.

Bleeding at the biopsy site is very rare except in people with bleeding disorders. Be sure to tell your doctor if you have problems with bleeding or are taking medicines that could affect bleeding, such as aspirin or blood thinners.

This test is generally done on all thyroid nodules that are big enough to be felt. This means that they are larger than about 1 centimeter (about 1/2 inch) across. Doctors often use ultrasound to see the thyroid during the biopsy, which helps make sure they are getting samples from the right areas. This is especially helpful for smaller nodules. FNA biopsies can also be used to get samples of swollen lymph nodes in the neck to see if they contain cancer.

Sometimes an FNA biopsy will need to be repeated because the samples didn't contain enough cells. Most FNA biopsies will show that the thyroid nodule is benign. Rarely, the biopsy may come back as benign even though cancer is present. Cancer is clearly diagnosed in only about 1 of every 20 FNA biopsies.

Sometimes the test results first come back as “suspicious” or “of undetermined significance” if FNA findings don’t show for sure if the nodule is either benign or malignant. If this happens, the doctor may order tests on the sample to see if the *BRAF* or *RET/PTC* genes are mutated (changed). Finding these changes makes thyroid cancer much more likely, and may also play a role in determining the best treatment for the cancer.

If the diagnosis is not clear after an FNA biopsy, you might need a more involved biopsy to get a better sample, particularly if the doctor has reason to think the nodule may be cancerous. This might include a core biopsy using a larger needle, a surgical “open” biopsy to remove the nodule, or a lobectomy (removal of half of the thyroid gland). Surgical biopsies and lobectomies are done in an operating room while you are under general anesthesia (in a deep sleep). A lobectomy can also be the main treatment for some early cancers, although for many cancers the rest of the thyroid will need to be removed as well (during an operation called a *completion thyroidectomy*).

Imaging tests

Imaging tests may be done for a number of reasons, including to help find suspicious areas that might be cancer, to learn how far cancer may have spread, and to help determine if treatment is working.

People who have or may have thyroid cancer will get one or more of these tests.

Ultrasound

Ultrasound uses sound waves to create images of parts of your body. For this test, a small, wand-like instrument called a *transducer* is placed on the skin in front of your thyroid gland. It gives off sound waves and picks up the echoes as they bounce off the thyroid. The echoes are converted by a computer into a black and white image on a computer screen. You are not exposed to radiation during this test.

This test can help determine if a thyroid nodule is solid or filled with fluid. (Solid nodules are more likely to be cancerous.) It can also be used to check the number and size of thyroid nodules. How a nodule looks on ultrasound can sometimes suggest if it is likely to be a cancer, but ultrasound can’t tell for sure.

For thyroid nodules that are too small to feel, this test can be used to guide a biopsy needle into the nodule to obtain a sample. Even when a nodule is large enough to feel, most doctors prefer to use ultrasound to guide the needle.

Ultrasound can also help determine if any nearby lymph nodes are enlarged because the thyroid cancer has spread. Many thyroid specialists recommend ultrasound for all patients with thyroid nodules large enough to be felt.

Radioiodine scan

Radioiodine scans can be used to help determine if someone with a lump in the neck might have thyroid cancer. They are also often used in people who have already been diagnosed with differentiated (papillary, follicular, or Hürthle cell) thyroid cancer to help show if it has spread. Because medullary thyroid cancer cells do not absorb iodine, radioiodine scans are not used for this cancer.

For this test, a small amount of radioactive iodine (called *I-131*) is swallowed (usually as a pill) or injected into a vein. Over time, the iodine is absorbed by the thyroid gland (or thyroid cells anywhere in the body). A special camera is used several hours later to see where the radioactivity is.

For a *thyroid scan*, the camera is placed in front of your neck to measure the amount of radiation in the gland. Abnormal areas of the thyroid that have less radioactivity than the surrounding tissue are called *cold nodules*, and areas that take up more radiation are called *hot nodules*. Hot nodules are usually not cancerous, but cold nodules can be benign or cancerous. Because both benign and cancerous nodules can appear cold, this test by itself can't diagnose thyroid cancer.

After surgery for thyroid cancer, whole-body radioiodine scans are useful to look for possible spread throughout the body. These scans become even more sensitive if the entire thyroid gland has been removed by surgery because more of the radioactive iodine is picked up by any remaining thyroid cancer cells.

Radioiodine scans work best if patients have high blood levels of thyroid-stimulating hormone (TSH, or thyrotropin). For people whose thyroid has been removed, TSH levels can be increased by stopping thyroid hormone pills for a few weeks before the test. This leads to low thyroid hormone levels (hypothyroidism) and causes the pituitary gland to release more TSH, which in turn stimulates any thyroid cancer cells to take up the radioactive iodine. A downside of this is that it can cause the symptoms of hypothyroidism, including tiredness, depression, weight gain, sleepiness, constipation, muscle aches, and reduced concentration. Another way to raise TSH levels for a scan is to give an injectable form of thyrotropin (Thyrogen®) before the scan, which does not require withholding thyroid hormone.

Because any iodine already in the body can affect this test, people are usually told not to ingest foods or medicines that contain iodine in the days before the scan.

Radioactive iodine can also be used to treat differentiated thyroid cancer, but it is given in much higher doses. This type of treatment is described in the section "Radioactive iodine (radioiodine) therapy."

Chest x-ray

If you have been diagnosed with thyroid cancer (especially follicular thyroid cancer), a plain x-ray of your chest may be done to see if cancer has spread to your lungs.

Computed tomography (CT) scan

The CT scan is an x-ray test that produces detailed cross-sectional images of your body. It can help determine the location and size of thyroid cancers and whether they have spread to nearby areas, although ultrasound is usually the test of choice. A CT scan can also be used to look for spread into distant organs such as the lungs.

A CT scanner has been described as a large donut, with a narrow table in the middle opening. You will need to lie still on the table while the scan is being done. CT scans take longer than regular x-rays, and you might feel a bit confined by the ring while the pictures are being taken.

Instead of taking one picture, like a regular x-ray, a CT scanner takes many pictures as it rotates around you while you lie on the table. A computer then combines these pictures into images of slices of the part of your body being studied. A CT scan creates more detailed images of the soft tissues in the body than a standard x-ray.

Before the test, you may be asked to drink a contrast solution or receive an IV (intravenous) line through which a different contrast dye is injected. This helps better outline structures in your body. The injection may cause some flushing (a feeling of warmth, especially in the face). Some people are allergic and get hives. Rarely, more serious reactions like trouble breathing or low blood pressure can occur. Be sure to tell the doctor if you have any allergies or have ever had a reaction to any contrast material used for x-rays.

In some cases, a CT scan can be used to guide a biopsy needle precisely into a suspected area of cancer spread. For a CT-guided needle biopsy, you remain on the CT scanning table, while the doctor advances a biopsy needle through the skin and toward the mass. CT scans are repeated until the doctor can see that the needle is within the mass. A biopsy sample is then removed and looked at under a microscope.

One problem with using CT scans for differentiated thyroid cancer is that the CT contrast dye contains iodine, which interferes with radioiodine scans. For this reason, many doctors prefer MRI scans instead of CT scans.

Magnetic resonance imaging (MRI) scan

Like CT scans, MRI scans can be used to look for cancer in the thyroid, or cancer that has spread to nearby or distant parts of the body. But ultrasound is usually the first choice for looking at the thyroid. MRI can provide very detailed images of soft tissues such as the thyroid gland. MRI scans are also very helpful in looking at the brain and spinal cord.

MRI scans use radio waves and strong magnets instead of x-rays. The energy from the radio waves is absorbed and then released in a pattern formed by the type of body tissue and by certain diseases. A computer translates the pattern into a very detailed image of parts of the body. A contrast material called *gadolinium* is often injected into a vein before the scan to better show details.

MRI scans take longer than CT scans – often up to an hour. You may have to lie inside a narrow tube, which can upset people with a fear of enclosed spaces. Newer, more open MRI machines can sometimes be used instead. The machine also makes buzzing and clicking noises, so some centers provide earplugs to block this noise out.

Positron emission tomography (PET) scan

For a PET scan, a radioactive substance (usually a type of sugar related to glucose, known as *FDG*) is injected into the blood. The amount of radioactivity used is very low. Because cancer cells in the body grow quickly, they absorb more of the sugar than normal cells. After waiting about an hour, you lie on a table in the PET scanner for about 30 minutes while a special camera creates a picture of areas of radioactivity in the body.

This test can be very useful if your thyroid cancer is one that doesn't take up radioactive iodine. In this situation, the PET scan may be able to tell whether the cancer has spread.

PET scan images are not finely detailed like CT or MRI images, but a PET scan can look for possible areas of cancer spread in all areas of the body at once. Some newer machines are able to do both a PET and CT scan at the same time (PET/CT scan). This lets the doctor compare an abnormal area on the PET scan with its detailed appearance on the CT.

Blood tests

Blood tests alone can't tell if a thyroid nodule is cancerous. But they can help show if the thyroid is working normally, which may help the doctor decide what other tests may be needed.

Thyroid-stimulating hormone (TSH)

Tests of blood levels of thyroid-stimulating hormone (TSH or thyrotropin) may be used to check the overall activity of your thyroid gland. Levels of TSH, which is made by the pituitary gland, may be high if the thyroid is not making enough hormones. This information can be used to help choose which imaging tests (such as ultrasound or radioiodine scans) to use to look at a thyroid nodule. The TSH level is usually normal in thyroid cancer.

T3 and T4 (thyroid hormones)

These are the main hormones made by the thyroid gland. Levels of these hormones may also be measured to get a sense of thyroid gland function. The T3 and T4 levels are usually normal in thyroid cancer.

Thyroglobulin

Thyroglobulin is a protein made by the thyroid gland. Measuring the thyroglobulin level in the blood can't be used to diagnose thyroid cancer, but it can be helpful after treatment. A common way to treat thyroid cancer is to remove most of the thyroid by surgery and then use radioactive iodine to destroy any remaining thyroid cells. These treatments should lead to a very low level of thyroglobulin in the blood within several weeks. If it is not low, this might mean that there are still thyroid cancer cells in the body. If the level rises again after being low, it is a sign that the cancer could be coming back.

Calcitonin

Calcitonin is a hormone that helps control how the body uses calcium. It is made by C cells in the thyroid, the cells that can develop into medullary thyroid cancer (MTC). If MTC is suspected or if you have a family history of the disease, blood tests of calcitonin levels can help look for MTC. This test is also used to look for the possible recurrence of MTC after treatment. Because calcitonin can affect blood calcium levels, these may be checked as well.

Carcinoembryonic antigen (CEA)

People with MTC often have high blood levels of a protein called carcinoembryonic antigen (CEA). Tests for CEA can sometimes help find this cancer.

Other blood tests

You might have other blood tests as well. For example, if you are scheduled for surgery, tests will be done to check your blood cell counts, to look for bleeding disorders, and to check your liver and kidney function.

Medullary thyroid carcinoma (MTC) can be due to a genetic syndrome that also causes a tumor called pheochromocytoma, which can cause problems during surgery under anesthesia. This is why patients with MTC who will have surgery are often tested to see if they have pheochromocytoma, as well. This can involve blood tests for epinephrine (adrenaline) and a related hormone called norepinephrine, and/or urine tests for their breakdown products (called metanephrines).

Other tests

Vocal cord exam (laryngoscopy)

Thyroid tumors can sometimes affect the vocal cords. If you are going to have surgery to treat thyroid cancer, a procedure called a *laryngoscopy* will probably be done first to see if the vocal cords are moving normally. For this exam, the doctor looks down the throat at the

larynx (voice box) with special mirrors or with a laryngoscope, a thin tube with a light and a lens on the end for viewing.

How is thyroid cancer staged?

Staging is the process of finding out if and how far a cancer has spread. The stage of a cancer is one of the most important factors in choosing treatment options and predicting your chance for cure.

Staging is based on the results of the physical exam, biopsy, and imaging tests (ultrasound, radioiodine scan, CT scan, MRI, chest x-ray, and/or PET scans), which are described in the section “How is thyroid cancer diagnosed?”

The TNM staging system

A staging system is a standard way to sum up how large a cancer is and how far it has spread.

The most common system used to describe the stages of thyroid cancer is the American Joint Committee on Cancer (AJCC) TNM system. The TNM system is based on 3 key pieces of information:

- **T** indicates the size of the main (primary) **tumor** and whether it has grown into nearby areas.
- **N** describes the extent of spread to nearby (regional) lymph **nodes**. Lymph nodes are bean-shaped collections of immune system cells to which cancers often spread first. Cells from thyroid cancers can travel to lymph nodes in the neck and chest areas.
- **M** indicates whether the cancer has spread (**metastasized**) to other organs of the body. (The most common sites of spread of thyroid cancer are the lungs, the liver, and bones.)

Numbers or letters appear after T, N, and M to provide more details about each of these factors. The numbers 0 through 4 indicate increasing severity. The letter X means a category can’t be assessed because the information is not available.

T categories for thyroid cancer (other than anaplastic thyroid cancer)

TX: Primary tumor cannot be assessed.

T0: No evidence of primary tumor.

T1: The tumor is 2 cm (slightly less than an inch) across or smaller and has not grown out of the thyroid.

- **T1a:** The tumor is 1 cm (less than half an inch) across or smaller and has not grown outside the thyroid.

- **T1b:** The tumor is larger than 1 cm but not larger than 2 cm across and has not grown outside of the thyroid.

T2: The tumor is more than 2 cm but not larger than 4 cm (slightly less than 2 inches) across and has not grown out of the thyroid.

T3: The tumor is larger than 4 cm across, or it has just begun to grow into nearby tissues outside the thyroid.

T4a: The tumor is any size and has grown extensively beyond the thyroid gland into nearby tissues of the neck, such as the larynx (voice box), trachea (windpipe), esophagus (tube connecting the throat to the stomach), or the nerve to the larynx. This is also called *moderately advanced disease*.

T4b: The tumor is any size and has grown either back toward the spine or into nearby large blood vessels. This is also called *very advanced disease*.

T categories for anaplastic thyroid cancer

All anaplastic thyroid cancers are considered T4 tumors at the time of diagnosis.

T4a: The tumor is still within the thyroid.

T4b: The tumor has grown outside the thyroid.

N categories for thyroid cancer

NX: Regional (nearby) lymph nodes cannot be assessed.

N0: The cancer has not spread to nearby lymph nodes.

N1: The cancer has spread to nearby lymph nodes.

- **N1a:** The cancer has spread to lymph nodes around the thyroid in the neck (called *pretracheal*, *paratracheal*, and *prelaryngeal* lymph nodes).
- **N1b:** The cancer has spread to other lymph nodes in the neck (called *cervical*) or to lymph nodes behind the throat (*retropharyngeal*) or in the upper chest (*superior mediastinal*).

M categories for thyroid cancer

MX: Distant metastasis cannot be assessed.

M0: There is no distant metastasis.

M1: The cancer has spread to other parts of the body, such as distant lymph nodes, internal organs, bones, etc.

Stage grouping

Once the values for T, N, and M are determined, they are combined into stages, expressed as a Roman numeral from I through IV. Sometimes letters are used to further divide a stage. Unlike most other cancers, thyroid cancers are grouped into stages in a way that also considers the subtype of cancer and the patient's age.

Papillary or follicular (differentiated) thyroid cancer in patients younger than 45

Younger people have a low likelihood of dying from differentiated (papillary or follicular) thyroid cancer. The TNM stage groupings for these cancers take this fact into account. So, all people younger than 45 years with these cancers are *stage I* if they have no distant spread and *stage II* if they have distant spread.

Stage I (any T, any N, M0): The tumor can be any size (any T) and may or may not have spread to nearby lymph nodes (any N). It has not spread to distant sites (M0).

Stage II (any T, any N, M1): The tumor can be any size (any T) and may or may not have spread to nearby lymph nodes (any N). It has spread to distant sites (M1).

Papillary or follicular (differentiated) thyroid cancer in patients 45 years and older

Stage I (T1, N0, M0): The tumor is 2 cm or less across and has not grown outside the thyroid (T1). It has not spread to nearby lymph nodes (N0) or distant sites (M0).

Stage II (T2, N0, M0): The tumor is more than 2 cm but not larger than 4 cm across and has not grown outside the thyroid (T2). It has not spread to nearby lymph nodes (N0) or distant sites (M0).

Stage III: One of the following applies:

T3, N0, M0: The tumor is larger than 4 cm across or has grown slightly outside the thyroid (T3), but it has not spread to nearby lymph nodes (N0) or distant sites (M0).

T1 to T3, N1a, M0: The tumor is any size and may have grown slightly outside the thyroid (T1 to T3). It has spread to lymph nodes around the thyroid in the neck (N1a) but not to other lymph nodes or to distant sites (M0).

Stage IVA: One of the following applies:

T4a, any N, M0: The tumor is any size and has grown beyond the thyroid gland and into nearby tissues of the neck (T4a). It might or might not have spread to nearby lymph nodes (any N). It has not spread to distant sites (M0).

T1 to T3, N1b, M0: The tumor is any size and might have grown slightly outside the thyroid gland (T1 to T3). It has spread to certain lymph nodes in the neck (cervical nodes) or to lymph nodes in the upper chest (superior mediastinal nodes) or behind the throat (retropharyngeal nodes) (N1b), but it has not spread to distant sites (M0).

Stage IVB (T4b, any N, M0): The tumor is any size and has grown either back toward the spine or into nearby large blood vessels (T4b). It might or might not have spread to nearby lymph nodes (any N), but it has not spread to distant sites (M0).

Stage IVC (any T, any N, M1): The tumor is any size and might or might not have grown outside the thyroid (any T). It might or might not have spread to nearby lymph nodes (any N). It has spread to distant sites (M1).

Medullary thyroid cancer

Age is not a factor in the stage of medullary thyroid cancer.

Stage I (T1, N0, M0): The tumor is 2 cm or less across and has not grown outside the thyroid (T1). It has not spread to nearby lymph nodes (N0) or distant sites (M0).

Stage II: One of the following applies:

T2, N0, M0: The tumor is more than 2 cm but is not larger than 4 cm across and has not grown outside the thyroid (T2). It has not spread to nearby lymph nodes (N0) or distant sites (M0).

T3, N0, M0: The tumor is larger than 4 cm or has grown slightly outside the thyroid (T3), but it has not spread to nearby lymph nodes (N0) or distant sites (M0).

Stage III (T1 to T3, N1a, M0): The tumor is any size and might have grown slightly outside the thyroid (T1 to T3). It has spread to lymph nodes around the thyroid in the neck (N1a) but not to other lymph nodes or to distant sites (M0).

Stage IVA: One of the following applies:

T4a, any N, M0: The tumor is any size and has grown beyond the thyroid gland and into nearby tissues of the neck (T4a). It might or might not have spread to nearby lymph nodes (any N). It has not spread to distant sites (M0).

T1 to T3, N1b, M0: The tumor is any size and might have grown slightly outside the thyroid gland (T1 to T3). It has spread to certain lymph nodes in the neck (cervical nodes) or to lymph nodes in the upper chest (superior mediastinal nodes) or behind the throat (retropharyngeal nodes) (N1b), but it has not spread to distant sites (M0).

Stage IVB (T4b, any N, M0): The tumor is any size and has grown either back toward the spine or into nearby large blood vessels (T4b). It might or might not have spread to nearby lymph nodes (any N), but it has not spread to distant sites (M0).

Stage IVC (any T, any N, M1): The tumor is any size and might or might not have grown outside the thyroid (any T). It might or might not have spread to nearby lymph nodes (any N). It has spread to distant sites (M1).

Anaplastic (undifferentiated) thyroid cancer

All anaplastic thyroid cancers are considered stage IV, reflecting the poor prognosis of this type of cancer.

Stage IVA (T4a, any N, M0): The tumor is still within the thyroid (T4a). It might or might not have spread to nearby lymph nodes (any N), but it has not spread to distant sites (M0).

Stage IVB (T4b, any N, M0): The tumor has grown outside the thyroid (T4b). It might or might not have spread to nearby lymph nodes (any N), but it has not spread to distant sites (M0).

Stage IVC (any T, any N, M1): The tumor might or might not have grown outside of the thyroid (any T). It might or might not have spread to nearby lymph nodes (any N). It has spread to distant sites (M1).

Recurrent cancer

This is not an actual stage in the TNM system. Cancer that comes back after treatment is called *recurrent* (or *relapsed*). If thyroid cancer returns it is usually in the neck, but it may come back in another part of the body (for example, lymph nodes, lungs, or bones). Doctors may assign a new stage based on how far the cancer has spread, but this is not usually as formal a process as the original staging. The presence of recurrent disease does not change the original, formal staging.

If you have any questions about the stage of your cancer or how it affects your treatment options, be sure to ask your doctor.

Thyroid cancer survival by type and stage

Survival rates are often used by doctors as a standard way of discussing a person’s prognosis (outlook). Some patients with cancer may want to know the survival statistics for people in similar situations, while others may not find the numbers helpful, or may even not want to know them. If you do not want to read about the survival statistics for thyroid cancer, skip to the next section.

The 5-year survival rate refers to the percentage of patients who live at least 5 years after their cancer is diagnosed. Of course, many people live much longer than 5 years (and many are cured).

Five-year *relative* survival rates take the 5-year survival rate and divide it by the survival expected for people without cancer. This helps adjust for deaths caused by things other than cancer. This is a more accurate way to describe the prognosis for patients with a particular type and stage of cancer.

In order to get 5-year survival rates, doctors have to look at people who were treated at least 5 years ago. Improvements in treatment since then may result in a more favorable outlook for people now being diagnosed with thyroid cancer.

Survival rates are often based on previous outcomes of large numbers of people who had the disease, but they cannot predict what will happen in any particular person's case. The type and the stage of a person's cancer are important in estimating their outlook. But many other factors may also affect their prognosis, such as their age and general health and how well the cancer responds to treatment. Even when taking these other factors into account, survival rates are at best rough estimates. Your doctor can tell you how the numbers below might apply to you, as he or she is familiar with your situation.

The following survival statistics were published in 2010 in the 7th edition of the AJCC Cancer Staging Manual. They are based on the stage of the cancer when the person is first diagnosed.

Papillary thyroid cancer*

Stage	**5-Year Relative Survival Rate**
I	near 100%
II	near 100%
III	93%
IV	51%

*Based on patients diagnosed 1998 to 1999

Follicular thyroid cancer*

Stage	**5-Year Relative Survival Rate**
I	near 100%
II	near 100%

III	71%
IV	50%

*Based on patients diagnosed 1998 to 1999

Medullary thyroid cancer**

Stage	5-Year Relative Survival Rate
I	near 100%
II	98%
III	81%
IV	28%

**Based on patients diagnosed between 1985 and 1991

Anaplastic thyroid cancer

The 5-year relative survival rate for anaplastic (undifferentiated) carcinomas, all of which are considered stage IV, is around 7% (based on patients diagnosed between 1985 and 1991).

How is thyroid cancer treated?

This information represents the views of the doctors and nurses serving on the American Cancer Society's Cancer Information Database Editorial Board. These views are based on their interpretation of studies published in medical journals, as well as their own professional experience.

The treatment information in this document is not official policy of the Society and is not intended as medical advice to replace the expertise and judgment of your cancer care team. It is intended to help you and your family make informed decisions, together with your doctor.

Your doctor may have reasons for suggesting a treatment plan different from these general treatment options. Don't hesitate to ask him or her questions about your treatment options.

Making treatment decisions

Depending on the type and stage of your thyroid cancer, you may need more than one type of treatment. Doctors on your cancer treatment team may include:

- A surgeon: a doctor who uses surgery to treat cancers or other problems

- An endocrinologist: a doctor who treats diseases in glands that secrete hormones
- A radiation oncologist: a doctor who uses radiation to treat cancer
- A medical oncologist: a doctor who uses chemotherapy and other medicines to treat cancer

Many other specialists may be involved in your care as well, including nurse practitioners, nurses, psychologists, social workers, rehabilitation specialists, and other health professionals.

After thyroid cancer is found and staged, your cancer care team will discuss your treatment options with you. It is important to take the time to consider each of your options. In choosing a treatment plan, factors to consider include the type and stage of the cancer and your general health. The treatment options for thyroid cancer might include:

- Surgery
- Radioactive iodine treatment
- Thyroid hormone therapy
- External beam radiation therapy
- Chemotherapy
- Targeted therapy

Often 2 or more of these are combined.

Most thyroid cancers can be cured, especially if they have not spread to distant parts of the body. If the cancer can't be cured, the goal of treatment may be to remove or destroy as much of the cancer as possible and to keep it from growing, spreading, or returning for as long as possible. Sometimes treatment is aimed at palliating (relieving) symptoms such as pain or problems with breathing and swallowing.

If you have any concerns about your treatment plan, if time permits it is often a good idea to get a second opinion. In fact, many doctors encourage this. A second opinion can provide more information and help you feel confident about the treatment plan you choose.

Some treatments for thyroid cancer might affect your ability to have children later in life. If this might be a concern for you, talk to your doctor about it before you decide on treatment. For more information, see *Fertility and Women With Cancer* or *Fertility and Men With Cancer*.

The next few sections describe the types of treatment used for thyroid cancers. This is followed by a description of the most common approaches based on the type and stage of the cancer.

Surgery for thyroid cancer

Surgery is the main treatment in nearly every case of thyroid cancer, except for some anaplastic thyroid cancers. If thyroid cancer is diagnosed by a fine needle aspiration (FNA) biopsy, surgery to remove the tumor and all or part of the remaining thyroid gland is usually recommended.

Lobectomy

This operation is sometimes used to treat differentiated (papillary or follicular) thyroid cancers that are small and show no signs of spread beyond the thyroid gland. It is also sometimes used to diagnose thyroid cancer if an FNA biopsy result doesn't provide a clear diagnosis (see "How is thyroid cancer diagnosed?").

First, the surgeon makes an incision (cut) a few inches long across the front of the neck and exposes the thyroid. The lobe containing the cancer is then removed, usually along with the isthmus (the small piece of the gland that acts as a bridge between the left and right lobes).

An advantage of this surgery, if it can be done, is that some patients might not need to take thyroid hormone pills afterward because it leaves part of the gland behind. But having some thyroid left can interfere with some tests that look for cancer recurrence after treatment, such as radioiodine scans and thyroglobulin blood tests.

Thyroidectomy

Thyroidectomy is surgery to remove the thyroid gland. As with lobectomy, this is typically done through an incision a few inches long across the front of the neck.

This is the most common surgery for thyroid cancer. If the entire thyroid gland is removed, it is called a *total thyroidectomy*. Sometimes the surgeon may not be able to remove the entire thyroid. If nearly all of the gland is removed, it is called a *near-total thyroidectomy*. If most of the gland is removed, it is called a *subtotal thyroidectomy*.

After a thyroidectomy (and possibly radioactive iodine [radioiodine] therapy), you will need to take daily thyroid hormone (levothyroxine) pills. But one advantage of this surgery over lobectomy is that your doctor can most often watch you for disease recurrence afterward using radioiodine scans and thyroglobulin blood tests.

Lymph node removal

If cancer has spread to nearby lymph nodes in the neck, these will be removed at the same time surgery is done on the thyroid. This is especially important for treatment of medullary thyroid cancer and for anaplastic cancer (when surgery is an option).

For papillary or follicular cancer where only 1 or 2 enlarged lymph nodes are thought to contain cancer, the enlarged nodes may be removed and any small deposits of cancer cells that may be left are then treated with radioactive iodine (see the section about radioactive iodine [radioiodine] therapy). More often, several lymph nodes near the thyroid are removed in an operation called a *central compartment neck dissection*. Removal of even more lymph nodes, including those on the side of the neck, is called a *modified radical neck dissection*.

Risks and side effects of surgery

Complications are less likely to happen when your operation is done by an experienced thyroid surgeon. Patients who have thyroid surgery are often ready to leave the hospital within a day after the operation. Potential complications of thyroid surgery include:

- Temporary or permanent hoarseness or loss of voice. This can happen if the larynx (voice box) or windpipe is irritated by the breathing tube that was used during surgery. It may also occur if the nerves to the larynx (or vocal cords) are damaged during surgery. The doctor should examine your vocal cords before surgery to see if they move normally (see "How is thyroid cancer diagnosed?").
- Damage to the parathyroid glands (small glands near the thyroid that help regulate blood calcium levels). This can lead to low blood calcium levels, causing muscle spasms and numbness and tingling sensations.
- Excessive bleeding or formation of a major blood clot in the neck (called a *hematoma*)
- Wound infection

You will have a small scar across the front of your neck after surgery. This should become less noticeable over time as it heals.

If most or all of your thyroid gland is removed, you will need to take daily thyroid hormone replacement pills. All patients who have had near-total or total thyroidectomy will need to do this.

For more information about cancer surgery in general, see *A Guide to Cancer Surgery*.

Radioactive iodine (radioiodine) therapy for thyroid cancer

Your thyroid gland absorbs nearly all of the iodine in your body. When radioactive iodine (RAI), also known as I-131, is taken into the body in liquid or capsule form, it concentrates in thyroid cells. The radiation can destroy the thyroid gland and any other thyroid cells (including cancer cells) that take up iodine, with little effect on the rest of your body. (The radiation dose used here is much stronger than the one used in radioiodine scans, which were described in "How is thyroid cancer diagnosed?")

This treatment can be used to ablate (destroy) any thyroid tissue not removed by surgery or to treat some types of thyroid cancer that have spread to lymph nodes and other parts of the body.

Radioactive iodine therapy improves the survival rate of patients with papillary or follicular thyroid cancer (differentiated thyroid cancer) that has spread to the neck or other body parts, and this treatment is now standard practice in such cases. But the benefits of RAI therapy are less clear for patients with small cancers of the thyroid gland that do not seem to have spread, which can often be removed completely with surgery. Discuss your risks and benefits of RAI therapy with your doctor. Radioactive iodine therapy cannot be used to treat anaplastic (undifferentiated) and medullary thyroid carcinomas because these types of cancer do not take up iodine.

For RAI therapy to be most effective, patients must have high levels of thyroid-stimulating hormone (TSH or thyrotropin) in the blood. This substance stimulates thyroid tissue (and cancer cells) to take up radioactive iodine. If the thyroid has been removed, one way to raise TSH levels is to not take thyroid hormone pills for several weeks. This causes very low thyroid hormone levels (a condition known as *hypothyroidism*), which in turn causes the pituitary gland to release more TSH. This intentional hypothyroidism is temporary, but it often causes symptoms like tiredness, depression, weight gain, constipation, muscle aches, and reduced concentration. Another way to raise TSH levels before RAI therapy is to give an injectable form of thyrotropin (Thyrogen), which can make withholding thyroid hormone for a long period of time unnecessary. This drug is given daily for 2 days, with the RAI on the 3rd day.

Most doctors also recommend that the patient follow a low iodine diet for 1 or 2 weeks before treatment. This means avoiding foods that contain iodized salt and red dye #3, as well as dairy products, eggs, seafood, and soy.

Risks and side effects

Your body will give off radiation for some time after you get RAI therapy. Depending on the dose of radioiodine used and where you are being treated, you might need to be in the hospital for a few days after treatment, staying in a special isolation room to prevent others from being exposed to radiation. Some people may not need to be hospitalized. Once you are allowed to go home after treatment, you will be given instructions on how to protect others from radiation exposure and how long you need to take these precautions. These instructions may vary slightly by treatment center. Be sure you understand the instructions before you leave the hospital.

Short-term side effects of RAI treatment may include:

- Neck tenderness and swelling
- Nausea and vomiting

- Swelling and tenderness of the salivary glands
- Dry mouth
- Taste changes

Chewing gum or sucking on hard candy may help with salivary gland problems.

Radioiodine treatment also reduces tear formation in some people, leading to dry eyes. If you wear contact lenses, ask your doctor how long you should keep them out.

Men who receive large total doses because of many treatments with RAI may have lower sperm counts or, rarely, become infertile. Radioactive iodine may also affect a woman's ovaries, and some women may have irregular periods for up to a year after treatment. Many doctors recommend that women avoid becoming pregnant for 6 months to a year after treatment. No ill effects have been noted in the children born to parents who received radioactive iodine in the past.

Both men and women who have had RAI therapy may have a slightly increased risk of developing leukemia in the future. Doctors disagree on exactly how much this risk is increased, but most of the largest studies have found that this is an extremely rare complication. Some research even suggests the risk of leukemia may not be significantly increased.

Talk to your health care team if you have any questions about the possible risks and benefits of your treatment.

Thyroid hormone therapy

Taking daily pills of thyroid hormone (thyroid hormone therapy) can serve 2 purposes:

- It can help maintain the body's normal metabolism (by replacing missing thyroid hormone after surgery).
- It can help stop any remaining cancer cells from growing (by lowering TSH levels).

After a thyroidectomy, the body can no longer make the thyroid hormone it needs, so patients must take thyroid hormone (levothyroxine) pills to replace the loss of the natural hormone.

Taking thyroid hormone may also help prevent some thyroid cancers from returning. Normal thyroid function is regulated by the pituitary gland. The pituitary makes a hormone called TSH that causes the thyroid gland to make thyroid hormone for the body. TSH also promotes growth of the thyroid gland and probably of thyroid cancer cells. The level of TSH, in turn, is regulated by how much thyroid hormone is in the blood. If the level of thyroid hormone is low, the pituitary makes more TSH. If the level of thyroid hormone is high, not as much TSH is needed, so the pituitary makes less of it.

Doctors have learned that by giving higher than normal doses of thyroid hormone, TSH levels can be kept very low. This may slow the growth of any remaining cancer cells and lower the chance of some thyroid cancers (especially high-risk cancers) coming back.

Possible side effects

Taking higher than normal levels of thyroid hormone seems to have few short-term side effects, but some doctors have expressed concerns about taking them for long periods of time. High levels of thyroid hormone can lead to problems with a rapid or irregular heartbeat. Over the long run, high doses of thyroid hormone can lead to weak bones (osteoporosis). Because of this, high doses of thyroid hormone may be reserved for people with differentiated thyroid cancers who are at high risk of recurrence.

External beam radiation therapy for thyroid cancer

External beam radiation therapy uses high-energy rays (or particles) to destroy cancer cells or slow their growth. A carefully focused beam of radiation is delivered from a machine outside the body. Generally, this type of radiation treatment is not used for cancers that take up iodine (that is, most differentiated thyroid cancers), which are better treated with radioiodine therapy. It is more often used as part of the treatment for medullary thyroid cancer and anaplastic thyroid cancer.

When a cancer that does not take up iodine has spread beyond the thyroid, external radiation treatment may help treat the cancer or reduce the chance of the disease coming back in the neck after surgery. If a cancer does not respond to radioiodine therapy, external radiation therapy may be used to treat local neck recurrence or distant metastases that are causing pain or other symptoms.

External beam radiation therapy is usually given 5 days a week for several weeks. Before your treatments start, the medical team will take careful measurements to find the correct angles for aiming the radiation beams and the proper dose of radiation. The treatment itself is painless and much like getting a regular x-ray. Each treatment lasts only a few minutes, although the setup time — getting you into place for treatment — usually takes longer.

Possible side effects

The main drawback of this treatment is that the radiation can destroy nearby healthy tissue along with the cancer cells. Some patients get skin changes similar to a sunburn, but this slowly fades away. Trouble swallowing, dry mouth, hoarseness, and fatigue are also potential side effects of external beam radiation therapy aimed at or near the thyroid.

To reduce the risk of side effects, doctors carefully figure out the exact dose needed and aim the beam as accurately as they can to hit the target.

For more information about radiation therapy, see the “Radiation Therapy” section of our website, or *Understanding Radiation Therapy: A Guide for Patients and Families*.

Chemotherapy for thyroid cancer

Chemotherapy (chemo) uses anti-cancer drugs that are injected into a vein or muscle, or are taken by mouth. Chemotherapy is systemic therapy, which means that the drug enters the bloodstream and travels throughout the body to reach and destroy cancer cells.

Chemotherapy is seldom helpful for most types of thyroid cancer, but fortunately it is not needed in most cases. It is combined with external beam radiation therapy for anaplastic thyroid cancer and is sometimes used for other advanced cancers that no longer respond to other treatments.

Possible side effects

Chemo drugs attack cells that are dividing quickly, which is why they work against cancer cells. But other cells in the body, such as those in the bone marrow, the lining of the mouth and intestines, and the hair follicles, also divide quickly. These cells are also likely to be affected by chemotherapy, which can lead to side effects.

The side effects of chemotherapy depend on the type and dose of drugs given and the length of time they are taken. Common side effects of chemo include:

- Hair loss
- Mouth sores
- Loss of appetite
- Nausea and vomiting
- Diarrhea
- Increased chance of infections (from too few white blood cells)
- Easy bruising or bleeding (from too few low blood platelets)
- Fatigue (from too few low red blood cells)

These side effects are usually short-term and go away after treatment is finished. There are often ways to lessen these side effects. For example, drugs can be given to help prevent or reduce nausea and vomiting.

Some chemotherapy drugs may have other specific side effects that require monitoring. For example, doxorubicin (one of the most common chemo drugs used in thyroid cancer) can

affect heart function. Therefore a patient taking doxorubicin will get regular heart function tests like echocardiograms.

For more information about chemotherapy, see the “Chemotherapy” section on our website, or *A Guide to Chemotherapy*.

Targeted therapy for thyroid cancer

Researchers have begun to develop newer drugs that specifically target the changes inside cells that cause them to become cancerous. Unlike standard chemotherapy drugs, which work by attacking rapidly growing cells in general (including cancer cells), these drugs attack one or more specific targets on cancer cells.

Targeted drugs for medullary thyroid cancer

Doctors have been especially interested in finding targeted drugs to treat medullary thyroid cancer (MTC) because thyroid hormone-based treatments (including radioactive iodine therapy) are not effective against these cancers.

Vandetanib (Caprelsa®) is a targeted drug taken as a pill once a day. In patients with advanced MTC, vandetanib stops cancers from growing for an average of about 6 months, although it is not yet clear if it can help people live longer.

Some common side effects of vandetanib include diarrhea, rash, nausea, high blood pressure, headache, fatigue, decreased appetite, and belly (abdominal) pain. Rarely, it can also cause serious problems with heart rhythm and infection that can lead to death. Because of its potential side effects, doctors must get special training before they are allowed to prescribe this drug.

Cabozantinib (Cometriq®) is another targeted drug used to treat MTC. It is taken in pill form once a day. In MTC patients, cabozantinib has been shown to help stop cancers from growing for about 7 months longer than a sugar pill. So far, though, it has not been shown to help patients live longer.

Common side effects include diarrhea, constipation, belly pain, mouth sores, decreased appetite, nausea, weight loss, fatigue, high blood pressure, loss of hair color, and hand-foot syndrome (redness, pain, and swelling of the hands and feet). Rarely, this drug can also cause serious side effects, such as severe bleeding and holes in the intestine.

Several other targeted drugs have shown promising early results against MTC as well. Some of these, such as sorafenib (Nexavar®) and sunitinib (Sutent®) are already used to treat other types of cancer. Doctors may try giving these drugs if other treatments, including vandetanib and cabozantinib, aren’t helpful.

Targeted drugs for papillary or follicular thyroid cancer

Fortunately, most of these cancers can be treated effectively with surgery and radioactive iodine therapy, so there is less need for other drugs to treat them. But for cancers in which these treatments aren't effective, targeted drugs can be helpful.

Sorafenib (Nexavar®) and **lenvatinib** (Lenvima®) are both the type of targeted drug known as kinase inhibitors. They work in 2 ways. They helps block tumors from forming new blood vessels, which the tumors need to grow. These drugs also target some of the proteins made by cancer cells that normally help them grow.

These drugs can help stop cancer growth for a time when given to patients with differentiated thyroid cancer (papillary, follicular, and poorly differentiated thyroid cancers) whose cancers no longer respond to treatment with radioactive iodine. It isn't yet clear if these drugs help patients live longer.

Both of these drugs are taken by mouth.

Common side effects include fatigue, rash, loss of appetite, diarrhea, nausea, high blood pressure, and hand foot syndrome (redness, pain, swelling, or blisters on the palms of the hands or soles of the feet). Other side effects can also occur, some of which can be serious. Ask your doctor what you can expect.

Other targeted drugs, such as such as, sunitinib (Sutent®), pazopanib (Votrient®), and vandetanib are not approved to treat papillary and follicular thyroid cancer, but have shown some early promise and may be helpful for some patients.

For general information about targeted therapy, see *Targeted Therapy*.

Clinical trials for thyroid cancer

You may have had to make a lot of decisions since you've been told you have cancer. One of the most important decisions you will make is choosing which treatment is best for you. You may have heard about clinical trials being done for your type of cancer. Or maybe someone on your health care team has mentioned a clinical trial to you.

Clinical trials are carefully controlled research studies that are done with patients who volunteer for them. They are done to get a closer look at promising new treatments or procedures.

If you would like to take part in a clinical trial, you should start by asking your doctor if your clinic or hospital conducts clinical trials. You can also call our clinical trials matching service for a list of clinical trials that meet your medical needs. You can reach this service at 1-800-303-5691 or on our website at www.cancer.org/clinicaltrials. You can also get a list of current clinical trials by calling the National Cancer Institute's Cancer Information Service

toll-free at 1-800-4-CANCER (1-800-422-6237) or by visiting the NCI clinical trials Web site at www.cancer.gov/clinicaltrials.

There are requirements you must meet to take part in any clinical trial. If you do qualify for a clinical trial, it is up to you whether or not to enter (enroll in) it.

Clinical trials are one way to get state-of-the art cancer treatment. Sometimes they may be the only way to get some newer treatments. They are also the only way for doctors to learn better methods to treat cancer. Still, they are not right for everyone.

You can get a lot more information on clinical trials in the "clinical trials" section of our website, or in *Clinical Trials: What You Need to Know*.

Complementary and alternative therapies for thyroid cancer

When you have cancer you are likely to hear about ways to treat your cancer or relieve symptoms that your doctor hasn't mentioned. Everyone from friends and family to Internet groups and websites may offer ideas for what might help you. These methods can include vitamins, herbs, and special diets, or other methods such as acupuncture or massage, to name a few.

What exactly are complementary and alternative therapies?

Not everyone uses these terms the same way, and they are used to refer to many different methods, so it can be confusing. We use *complementary* to refer to treatments that are used *along with* your regular medical care. *Alternative* treatments are used *instead of* a doctor's medical treatment.

Complementary methods: Most complementary treatment methods are not offered as cures for cancer. Mainly, they are used to help you feel better. Some methods that are used along with regular treatment are meditation to reduce stress, acupuncture to help relieve pain, or peppermint tea to relieve nausea. Some complementary methods are known to help, while others have not been tested. Some have been proven not to be helpful, and a few have even been found harmful.

Alternative treatments: Alternative treatments may be offered as cancer cures. These treatments have not been proven safe and effective in clinical trials. Some of these methods may pose danger, or have life-threatening side effects. But the biggest danger in most cases is that you may lose the chance to be helped by standard medical treatment. Delays or interruptions in your medical treatments may give the cancer more time to grow and make it less likely that treatment will help.

Finding out more

It is easy to see why people with cancer think about alternative methods. You want to do all you can to fight the cancer, and the idea of a treatment with few or no side effects sounds great. Sometimes medical treatments like chemotherapy can be hard to take, or they may no longer be working. But the truth is that most of these alternative methods have not been tested and proven to work in treating cancer.

As you consider your options, here are 3 important steps you can take:

- Look for “red flags” that suggest fraud. Does the method promise to cure all or most cancers? Are you told not to have regular medical treatments? Is the treatment a “secret” that requires you to visit certain providers or travel to another country?
- Talk to your doctor or nurse about any method you are thinking about using.
- Contact us at 1-800-227-2345 or see the “Complementary and Alternative Medicine” section of our website to learn more about complementary and alternative methods.

The choice is yours

Decisions about how to treat or manage your cancer are always yours to make. If you want to use a non-standard treatment, learn all you can about the method and talk to your doctor about it. With good information and the support of your health care team, you may be able to safely use the methods that can help you while avoiding those that could be harmful.

Treatment of thyroid cancer by type and stage

The type of treatment your doctor will recommend depends on the type and stage of the cancer and on your overall health. This section discusses the typical treatment options for each type and stage of thyroid cancer, but your doctor may have reasons for suggesting a different treatment plan. Don’t hesitate to ask him or her questions about your treatment options.

Papillary carcinoma and its variants

Most cancers are treated with removal of the thyroid gland (thyroidectomy), although small tumors that have not spread outside the thyroid gland may be treated by just removing the side of the thyroid containing the tumor (lobectomy). If lymph nodes are enlarged or show signs of cancer spread, they will be removed as well.

Even if the lymph nodes aren’t enlarged, some doctors recommend central compartment neck dissection (surgical removal of lymph nodes next to the thyroid) along with removal of the thyroid. Although this operation has not been shown to improve cancer survival, it might lower the risk of cancer coming back in the neck area. Because removing the lymph nodes

allows them to be checked for cancer under the microscope, this surgery also makes it easier to accurately stage the cancer. If cancer has spread to other neck lymph nodes, a modified radical neck dissection (a more extensive removal of lymph nodes from the neck) is often done.

Treatment after surgery depends on the stage of the cancer.

Radioactive iodine (RAI) treatment is sometimes used after thyroidectomy for early stage cancers (T1 or T2, N0, M0), but the cure rate with surgery alone is excellent. If the cancer does come back, radioiodine treatment can still be given.

For more advanced cancers, such as T3 or T4 tumors, or cancers that have spread to lymph nodes or distant sites, RAI therapy is often given. The goal is to destroy any remaining thyroid tissue and to try to treat any cancer remaining in the body. Areas of distant spread that do not respond to RAI may need to be treated with external beam radiation therapy, targeted therapy, or chemotherapy.

People who have a thyroidectomy will need to take daily thyroid hormone (levothyroxine) pills. If RAI treatment is planned, the start of thyroid hormone therapy may be delayed until the treatment is finished (usually about 6 weeks after surgery).

Recurrent cancer: Treatment of cancer that comes back after initial therapy depends mainly on where the cancer is, although other factors may be important as well. The recurrence may be found by either blood tests or imaging tests such as ultrasound or radioiodine scans.

If cancer comes back in the neck, an ultrasound-guided biopsy is first done to confirm that it is really cancer. Then, if the tumor appears to be resectable (removable), surgery is often used. If the cancer shows up on a radioiodine scan (meaning the cells are taking up iodine), radioactive iodine (RAI) therapy may be used, either alone or with surgery. If the cancer does not show up on the radioiodine scan but is found by other imaging tests such as an MRI or PET scan, external radiation may be used.

Targeted therapy or chemotherapy may be tried if the cancer has spread to several places and RAI and other treatments are not helpful, but doctors are still trying to find effective drugs for this disease. Because these cancers can be hard to treat, another option is taking part in a clinical trial of newer treatments.

Follicular and Hürthle cell carcinoma

Often, it isn’t clear that a tumor is a follicular cancer based on a FNA biopsy. If the biopsy results are unclear, they might list “follicular neoplasm” as a diagnosis. Only about 2 of every 10 tumors that are called follicular neoplasm will actually turn out to be cancer, so the next step is usually surgery to remove the half of the thyroid gland that contains the tumor (a lobectomy). Then if the tumor turns out to be a follicular cancer, a second operation to remove the rest of the thyroid is usually needed (this is called a *completion thyroidectomy*). If

the patient is only willing to have one operation, the doctor may just remove the whole thyroid gland in the first place. Still, for most patients, this isn't really needed.

If there are signs of cancer spread before surgery, the tumor must be a cancer and so a thyroidectomy will be done.

Hürthle (Hurthle) cell carcinoma can also be hard to diagnose with certainty based on a FNA biopsy. Tumors suspected of being Hürthle cell carcinomas are often treated like follicular neoplasms. A lobectomy is usually done first. If the diagnosis is confirmed, a completion thyroidectomy is done. A thyroidectomy may be done as the first surgery if there are signs of cancer spread or if the patient requests it to keep from having more surgery later.

As with papillary cancer, some lymph nodes usually are removed and examined. If cancer has spread to lymph nodes, a central compartment or modified neck dissection (surgical removal of lymph nodes from the neck) may be done. Because the thyroid is removed, patients will need thyroid hormone therapy as well, although it is often not started right away.

Radioiodine scanning is usually done after surgery to look for areas still taking up iodine. Spread to nearby lymph nodes and to distant sites that shows up on the scan can be treated by radioactive iodine (RAI). For cancers that don't take up iodine, external beam radiation therapy may help treat the tumor or prevent it from growing back in the neck.

Distant metastases may need to be treated with external beam radiation therapy, targeted therapy, or chemotherapy if they do not respond to RAI. Another option is taking part in a clinical trial of newer treatments.

Recurrent cancer: Treatment of cancer that comes back after initial therapy depends mainly on where the cancer is, although other factors may be important as well. The recurrence may be found by either blood tests or imaging tests such as ultrasound or radioiodine scans.

If cancer comes back in the neck, an ultrasound-guided biopsy is first done to confirm that it is really cancer. Then, if the tumor appears to be resectable (removable), surgery is often used. If the cancer shows up on a radioiodine scan (meaning the cells are taking up iodine), radioactive iodine (RAI) therapy may be used, either alone or with surgery. If the cancer does not show up on the radioiodine scan but is found by other imaging tests such as an MRI or PET scan, external radiation may be used.

Targeted therapy or chemotherapy may be tried if the cancer has spread to several places and RAI and other treatments are not helpful, but doctors are still trying to find effective drugs for this disease. Because these cancers can be hard to treat, another option is taking part in a clinical trial of newer treatments.

Medullary thyroid carcinoma

Most doctors advise that patients diagnosed with medullary thyroid carcinoma (MTC) be tested for other tumors that are typically seen in patients with the MEN 2 syndromes (see

“What are the risk factors for thyroid cancer?”), such as pheochromocytoma and parathyroid tumors. Screening for pheochromocytoma is particularly important, since the unknown presence of this tumor can make anesthesia and surgery extremely dangerous. If surgeons and anesthesiologists know about such tumors ahead of time, they can treat the patient before and during surgery with medicines to make surgery safe.

Stages I and II: Total thyroidectomy is the main treatment for MTC and often cures patients with stage I or stage II MTC. Nearby lymph nodes are usually removed as well (central compartment or modified radical neck dissection). Because the thyroid gland is removed, thyroid hormone therapy is needed after surgery. For MTC, thyroid hormone therapy is meant to provide enough hormone to keep the patient healthy, but it does not reduce the risk that the cancer will come back.

Because MTC cells do not take up radioactive iodine, there is no role for radioactive iodine therapy in treating MTC. Still, some doctors give a dose of radioactive iodine to destroy any remaining normal thyroid tissue. If MTC cells are in or near the thyroid, this may affect them as well.

Stages III and IV: Surgery is the same as for stages I and II (usually after screening for MEN 2 syndrome and pheochromocytoma). Thyroid hormone therapy is given afterward. When the tumor is extensive and invades many nearby tissues or cannot be completely removed, external beam radiation therapy may be given after surgery to try to reduce the chance of recurrence in the neck.

For cancers that have spread to distant parts of the body, surgery, radiation therapy, or similar treatments may be used if possible. If these treatments can’t be used, vandetanib (Caprelsa), cabozantinib (Cometriq), or other targeted drugs may be tried. Chemotherapy may be another option. Because these cancers can be hard to treat, another option is taking part in a clinical trial of newer treatments.

Recurrent cancer: If the cancer recurs in the neck or elsewhere, surgery, external radiation therapy, targeted therapy (such as vandetanib or cabozantinib), or chemotherapy may be needed. Clinical trials of new treatments may be another option if standard treatments aren’t effective.

Genetic testing in medullary thyroid cancer: If you are told that you have MTC, even if you are the first one in the family to be diagnosed with this disease, ask your doctor about genetic counseling and testing. Genetic testing can find mutations in the *RET* gene, which is seen in cases of familial MTC and the MEN 2 syndromes.

If you have one of these mutations, it’s important that close family members (children, brothers, sisters, and parents) be tested as well. Because almost all children and adults with mutations in this gene will develop MTC at some time, most doctors agree anyone who has a *RET* gene mutation should have their thyroid removed to prevent MTC soon after getting the test results. This includes children, since some hereditary forms of MTC affect children and pre-teens. Total thyroidectomy can prevent this cancer in people with *RET* mutations who

have not yet developed it. Of course, this means that lifelong thyroid hormone replacement will be needed.

Anaplastic carcinoma

Because this cancer is often already widespread when it is diagnosed, surgery is often not helpful in treating this cancer. If the cancer is confined to the area around the thyroid, which is rare, the entire thyroid and nearby lymph nodes may be removed. The goal of surgery is to remove as much cancer in the neck area as possible, ideally leaving no cancer tissue behind. Because of the way anaplastic carcinoma spreads, this is often difficult or impossible.

Radioactive iodine treatment does not work in this cancer and so is not used.

External beam radiation therapy may be used alone or combined with chemotherapy:

- To try to shrink the cancer before surgery to increase the chance of complete tumor removal
- After surgery to try to control any disease that remains in the neck
- When the tumor is too large or widespread to be treated by surgery

If the cancer is causing (or may eventually cause) trouble breathing, a hole may be placed surgically in the front of the neck and into the windpipe to bypass the tumor and allow the patient to breathe more comfortably. This hole is called a *tracheostomy*.

For cancers that have spread to distant sites, chemotherapy may be used, sometimes along with radiation therapy if the cancer is not too widespread. Because these cancers can be hard to treat, clinical trials of newer treatments are an option as well.

More treatment information for thyroid cancer

For more details on treatment options – including some that may not be addressed in this document – the National Comprehensive Cancer Network (NCCN) and the National Cancer Institute (NCI) are good sources of information.

The NCCN, made up of experts from many of the nation’s leading cancer centers, develops cancer treatment guidelines for doctors to use when treating patients. These are available on the NCCN website (www.nccn.org).

The NCI provides treatment information via telephone (1-800-4-CANCER) and its website (www.cancer.gov). Information for patients as well as more detailed information intended for use by cancer care professionals is also available on www.cancer.gov.

What should you ask your doctor about thyroid cancer?

As you deal with thyroid cancer and the process of treatment, you need to have honest, open discussions with your cancer care team. You should feel free to ask any question on your mind, no matter how minor it might seem. Some of the questions you might want to ask are:

- What kind of thyroid cancer do I have?
- Has my cancer spread beyond the thyroid gland?
- What is the stage of my thyroid cancer? What does this mean in my case?
- Are there other tests that need to be done before we decide on treatment?
- Is this form of thyroid cancer hereditary? Should my family be tested?
- Are there other doctors I need to see?
- How much experience do you have treating this type of cancer?
- How much surgery do I need? Should I get other treatments as well?
- What other treatment choices do I have?
- What should I do to be ready for treatment?
- What are the risks and possible side effects of treatment?
- Will I need to take thyroid hormone for the rest of my life?
- How long will treatment last? What will it involve? Where will it be done?
- When can I go back to my normal activities after treatment?
- Will this treatment affect my ability to have children? Do I need to avoid pregnancy for a while?
- What are the chances that my cancer will come back after treatment?
- What would we do if the treatment doesn’t work or if the cancer recurs?
- What type of follow-up will I need after treatment?

No doubt you will have other questions about your situation. Be sure to write your questions down so that you remember to ask them during each visit with your cancer care team. For example, you might want to ask about getting a second opinion or about clinical trials you may be eligible for. Keep in mind, too, that doctors are not the only ones who can give you

information. Other health care professionals, such as nurses and social workers, may have the answers to your questions. You can find more information about communicating with your health care team in our document *Talking With Your Doctor*.

What happens after treatment for thyroid cancer?

For many people with thyroid cancer, treatment may remove or destroy the cancer. Completing treatment can be both stressful and exciting. You may be relieved to finish treatment, but find it hard not to worry about cancer growing or coming back. (When cancer comes back after treatment, it is called *recurrence*.) This is a very common concern in people who have had cancer.

It may take a while before your fears lessen. But it may help to know that many cancer survivors have learned to live with this uncertainty and are leading full lives. Our document *Living With Uncertainty: The Fear of Cancer Recurrence* gives more detailed information on this.

For some people, thyroid cancer may never go away completely. These people may get regular treatments with chemotherapy, radiation therapy, or other therapies to help keep the cancer in check. Learning to live with cancer as a more of a chronic disease can be difficult and very stressful. It has its own type of uncertainty. Our document *When Cancer Doesn't Go Away* talks more about this.

Follow-up care

If you have completed treatment, your doctors will still want to watch you closely. It is very important to go to all follow-up appointments. During these visits, your doctors will ask about symptoms, examine you, and might order blood tests or imaging tests such as radioiodine scans or ultrasounds. Follow-up is needed to check for cancer recurrence or spread, as well as possible side effects of certain treatments. This is the time for you to ask your health care team any questions you need answered and to discuss any concerns you might have.

Most people do very well after treatment, but follow-up care can continue for a lifetime. This is very important since most thyroid cancers grow slowly and can recur even 10 to 20 years after initial treatment. Your health care team will explain what tests you need and how often they should be done.

Papillary or follicular cancer: If you have had papillary or follicular cancer, and your thyroid gland has been completely removed or ablated, your doctors might do at least one radioactive iodine scan after treatment, especially if you are at higher risk for recurrence. This is usually done about 6 to 12 months later. If the result is negative, you will generally not need further scans unless you have symptoms or other abnormal test results.

Your blood will also be tested for TSH and thyroglobulin levels. Thyroglobulin is made by thyroid tissue, so after total thyroid removal and ablation it should be at very low levels or not be found at all in your blood. If the thyroglobulin level begins to rise, it might be a sign the cancer is coming back, and further testing will be done. This usually includes a radioactive iodine scan, and may include PET scans and other imaging tests.

For those with a low-risk, small papillary cancer that was treated by removing only one lobe of the thyroid, a physical exam by your doctor, as well as a thyroid ultrasound and periodic chest x-ray is typical.

If the cancer does come back, treatment would be as described for recurrent cancer in the section “Treatment of thyroid cancer by type and stage.”

Medullary thyroid cancer: If you had medullary thyroid cancer (MTC), your doctors will check the levels of calcitonin and carcinoembryonic antigen (CEA) in your blood. If these begin to rise, imaging tests such as an ultrasound of the neck or a CT or MRI scan will be done to look for any cancer coming back. If the tests show recurrent cancer, treatment is as described in the section “Treatment of thyroid cancer by type and stage.”

Each type of treatment for thyroid cancer has side effects that may last for a few months. Some, like the need for thyroid hormone pills, may be lifelong. You may be able to speed your recovery by being aware of the side effects before you start treatment. You might be able to take steps to reduce them and shorten the length of time they last. Don’t hesitate to tell your cancer care team about any symptoms or side effects that bother you so they can help you manage them.

Seeing a new doctor

At some point after your cancer diagnosis and treatment, you may find yourself seeing a new doctor who does not know anything about your medical history. It is important that you be able to give your new doctor the details of your diagnosis and treatment. Gathering these details soon after treatment may be easier than trying to get them at some point in the future. Make sure you have this information handy:

- A copy of your pathology report(s) from any biopsies or surgeries
- Copies of imaging tests (CT or MRI scans, etc.), which can usually be stored on a CD, DVD, etc.
- If you had surgery, a copy of your operative report(s)
- If you stayed in the hospital, a copy of the discharge summary that doctors prepare when patients are sent home
- If you had radiation therapy (including radioactive iodine therapy), a copy of the treatment summary

- If you had drug treatment (such as chemotherapy or targeted therapy), a list of the drugs, drug doses, and when you took them

It is also important to keep health insurance. Tests and doctor visits cost a lot, and even though no one wants to think of their cancer coming back, this could happen.

Can I get another cancer after having thyroid cancer?

Cancer survivors can be affected by a number of health problems, but often their greatest concern is facing cancer again. If a cancer comes back after treatment it is called a "recurrence." But some cancer survivors may develop a new, unrelated cancer later. This is called a "second cancer." No matter what type of cancer you have had, it is still possible to get another (new) cancer, even after surviving the first.

Unfortunately, being treated for cancer doesn't mean you can't get another cancer. People who have had cancer can still get the same types of cancers that other people get. In fact, certain types of cancer and cancer treatments can be linked to a higher risk of certain second cancers.

Survivors of thyroid cancer can get any type of second cancer, but they have an increased risk of:

- Breast cancer (in women)
- Prostate cancer
- Kidney cancer
- Adrenal cancer

Adrenal cancer risk is especially high in people who had the medullary type of thyroid cancer.

Patients treated with radioactive iodine also have an increased risk of acute lymphocytic leukemia (ALL), stomach cancer, and salivary gland cancer.

Follow-up after treatment

After completing treatment for thyroid cancer, you should see your doctor regularly. You may also have tests to look for signs that the cancer has come back or spread. Experts do not recommend any additional testing to look for second cancers in patients without symptoms. Let your doctor know about any new symptoms or problems, because they could be caused by the cancer coming back or by a new disease or second cancer.

Patients who have completed treatment should follow the American Cancer Society guidelines for the early detection of cancer.

All patients should be encouraged to avoid tobacco smoke, as smoking increases the risk of many cancers.

To help maintain good health, survivors should also:

- Achieve and maintain a healthy weight
- Adopt a physically active lifestyle
- Consume a healthy diet, with an emphasis on plant foods
- Limit consumption of alcohol to no more than 1 drink per day for women or 2 per day for men

These steps may also lower the risk of some cancers.

See *Second Cancers in Adults* for more information about causes of second cancers.

Lifestyle changes after having thyroid cancer

You can't change the fact that you have had cancer. What you can change is how you live the rest of your life — making choices to help you stay healthy and feel as well as you can. This can be a time to look at your life in new ways. Maybe you are thinking about how to improve your health over the long term. Some people even start during cancer treatment.

Make healthier choices

For many people, a diagnosis of cancer helps them focus on their health in ways they may not have thought much about in the past. Are there things you could do that might make you healthier? Maybe you could try to eat better or get more exercise. Maybe you could cut down on alcohol, or give up tobacco. Even things like keeping your stress level under control might help. Now is a good time to think about making changes that can have positive effects for the rest of your life. You will feel better and you will also be healthier.

You can start by working on those things that worry you most. Get help with those that are harder for you. For instance, if you are thinking about quitting smoking and need help, call the American Cancer Society at 1-800-227-2345. A tobacco cessation and coaching service can help increase your chances of quitting for good.

Eating better

Eating right can be hard for anyone, but it can get even tougher during and after cancer treatment. Treatment may change your sense of taste. Nausea can be a problem. You may not feel like eating and lose weight when you don't want to. Or you may have gained weight that you can't seem to lose. All of these things can be very frustrating.

If treatment caused weight changes or eating or taste problems, do the best you can and keep in mind that these problems usually get better over time. You may find it helps to eat small portions every few hours until you feel better. You might also want to ask your cancer team about seeing a dietitian, an expert in nutrition who can give you ideas on how to deal with these treatment side effects.

One of the best things you can do after cancer treatment is put healthy eating habits into place. You may be surprised at the long-term benefits of some simple changes, like increasing the variety of healthy foods you eat. Getting to and staying at a healthy weight, eating a healthy diet, and limiting your alcohol intake may lower your risk for a number of types of cancer, as well as having many other health benefits.

You can get more information in our document *Nutrition and Physical Activity During and After Cancer Treatment: Answers to Common Questions*.

Rest, fatigue, and exercise

Extreme tiredness, called *fatigue*, is very common in people treated for cancer. This is not a normal tiredness, but a bone-weary exhaustion that doesn't get better with rest. For some people, fatigue lasts a long time after treatment, and can make it hard for them to be active and do other things they want to do. But exercise can help reduce fatigue. Studies have shown that patients who follow an exercise program tailored to their personal needs feel better physically and emotionally and can cope better, too.

If you were sick and not very active during treatment, it is normal for your fitness, endurance, and muscle strength to decline. Any plan for physical activity should fit your own situation. An older person who has never exercised will not be able to take on the same amount of exercise as a 20-year-old who plays tennis twice a week. If you haven't exercised in a few years, you will have to start slowly – maybe just by taking short walks.

Talk with your health care team before starting anything. Get their opinion about your exercise plans. Then, try to find an exercise buddy so you're not doing it alone. Having family or friends involved when starting a new exercise program can give you that extra boost of support to keep you going when the push just isn't there.

If you are very tired, you will need to balance activity with rest. It is OK to rest when you need to. Sometimes it's really hard for people to allow themselves to rest when they are used to working all day or taking care of a household, but this is not the time to push yourself too hard. Listen to your body and rest when you need to. For more information on dealing with fatigue and other treatment side effects, please see the "Physical Side Effects" section of our website or "Additional resources for thyroid cancer" to get a list of available information.

Keep in mind exercise can improve your physical and emotional health.

- It improves your cardiovascular (heart and circulation) fitness.

- Along with a good diet, it will help you get to and stay at a healthy weight.
- It makes your muscles stronger.
- It reduces fatigue and helps you have more energy.
- It can help lower anxiety and depression.
- It can make you feel happier.
- It helps you feel better about yourself.

And long term, we know that getting regular physical activity plays a role in helping to lower the risk of some cancers, as well as having other health benefits.

Can I lower my risk of the cancer progressing or coming back?

Most people want to know if there are specific lifestyle changes they can make to reduce their risk of cancer progressing or coming back. Unfortunately, for most cancers there is little solid evidence to guide people. This doesn’t mean that nothing will help — it’s just that for the most part this is an area that hasn’t been well studied. Most studies have looked at lifestyle changes as ways of preventing cancer in the first place, not slowing it down or preventing it from coming back.

At this time, not enough is known about thyroid cancer to say for sure if there are things you can do that will be helpful. Adopting healthy behaviors such as not smoking, eating well, and maintaining a healthy weight may help, but no one knows for sure. However, we do know that these types of changes can have positive effects on your health that can extend beyond your risk of cancer.

How might having thyroid cancer affect your emotional health?

During and after treatment, you may find yourself overcome with many different emotions. This happens to a lot of people.

You may find yourself thinking about death and dying. Or maybe you're more aware of the effect the cancer has on your family, friends, and career. You may take a new look at your relationships with those around you. Unexpected issues may also cause concern. For instance, you might be stressed by financial concerns resulting from your treatment. You might also see your health care team less often after treatment and have more time on your hands. These changes can make some people anxious.

Almost everyone who is going through or has been through cancer can benefit from getting some type of support. You need people you can turn to for strength and comfort. Support can come in many forms: family, friends, cancer support groups, church or spiritual groups, online support communities, or one-on-one counselors. What's best for you depends on your

situation and personality. Some people feel safe in peer-support groups or education groups. Others would rather talk in an informal setting, such as church. Others may feel more at ease talking one-on-one with a trusted friend or counselor. Whatever your source of strength or comfort, make sure you have a place to go with your concerns.

The cancer journey can feel very lonely. It is not necessary or good for you to try to deal with everything on your own. And your friends and family may feel shut out if you do not include them. Let them in, and let in anyone else who you feel may help. If you aren't sure who can help, call your American Cancer Society at 1-800-227-2345 and we can put you in touch with a group or resource that may work for you. You can also read our document *Distress in People with Cancer* or see the “Emotional Side Effects” section of our website for more information.

If treatment for thyroid cancer is no longer working

If cancer keeps growing or comes back after one kind of treatment, it may be possible to try another treatment plan that might still cure the cancer, or at least shrink the tumors enough to help you live longer and feel better. But when a person has tried many different treatments and the cancer has not gotten any better, the cancer tends to become resistant to all treatment. If this happens, it’s important to weigh the possible limited benefits of a new treatment against the possible downsides, including treatment side effects. Everyone has their own way of looking at this.

This is likely to be the hardest part of your battle with cancer – when you have been through many medical treatments and nothing’s working anymore. Your doctor may offer you new options, but at some point you may need to consider that treatment is not likely to improve your health or change your outcome or survival.

If you want to continue to get treatment for as long as you can, you need to think about the odds of treatment having any benefit and how this compares to the possible risks and side effects. In many cases, your doctor can estimate how likely it is the cancer will respond to treatment you are considering. For instance, the doctor may say that more treatment might have about a 1 in 100 chance of working. Some people are still tempted to try this. But it is important to think about and understand your reasons for choosing this plan.

No matter what you decide to do, it is important that you feel as good as you can. Make sure you are asking for and getting treatment for any symptoms you might have, such as nausea or pain. This type of treatment is called palliative care.

Palliative care helps relieve symptoms, but is not expected to cure the disease. It can be given along with cancer treatment, or can even be cancer treatment. The difference is its purpose – the main goal is to improve the quality of your life, or help you feel as good as you can for as long as you can. Sometimes this means using drugs to help with symptoms like pain or nausea. Sometimes, though, the treatments used to control your symptoms are the same as those used to treat cancer. For instance, radiation might be used to help relieve bone pain

caused by cancer that has spread to the bones. But this is not the same as treatment to try to cure the cancer.

You can learn more about the changes that occur when curative treatment stops working, and about planning ahead for yourself and your family, in our documents *Nearing the End of Life* and *Advance Directives*.

At some point, you may benefit from hospice care. This is special care that treats the person rather than the disease; it focuses on quality rather than length of life. Most of the time, it is given at home. Your cancer may be causing problems that need to be managed, and hospice focuses on your comfort. You should know that while getting hospice care often means the end of treatments such as chemo and radiation, it doesn't mean you can't have treatment for the problems caused by your cancer or other health conditions. In hospice, the focus of your care is on living life as fully as possible and feeling as well as you can at this difficult time. You can learn more about hospice in our document called *Hospice Care*.

Staying hopeful is important, too. Your hope for a cure may not be as bright, but there is still hope for good times with family and friends – times that are filled with happiness and meaning. Pausing at this time in your cancer treatment gives you a chance to refocus on the most important things in your life. Now is the time to do some things you've always wanted to do and to stop doing the things you no longer want to do. Though the cancer may be beyond your control, there are still choices you can make.

What's new in thyroid cancer research and treatment?

Important research into thyroid cancer is being done right now in many university hospitals, medical centers, and other institutions around the country. Each year, scientists find out more about what causes the disease, how to prevent it, and how to improve treatment. In past years, for example, evidence has grown showing the benefits of combining surgery with radioactive iodine therapy and thyroid hormone therapy. The results include higher cure rates, lower recurrence rates, and longer survival.

Genetics

The discovery of the genetic causes of familial (inherited) medullary thyroid cancer now makes it possible to identify family members carrying the abnormal *RET* gene and to remove the thyroid to prevent cancer from developing there.

Understanding the abnormal genes that cause sporadic (not inherited) thyroid cancer has led to better treatments as well. In fact, treatments that target some of these gene changes are already being used, and more are being developed (see below).

Treatment

Most thyroid cancers can be treated successfully. But advanced cancers can be hard to treat, especially if they do not respond to radioactive iodine (RAI) therapy. Doctors and researchers are looking for new ways to treat thyroid cancer that are more effective and lead to fewer side effects.

Surgery

Surgery is an effective treatment for most thyroid cancers, and it can usually be done without causing major side effects, especially when done by experienced surgeons.

Some people who have thyroid surgery are bothered by the scar it leaves on the neck. Newer approaches to surgery may help with this. For example, in endoscopic surgery, the surgeon operates on the thyroid by inserting, long, thin instruments through small incisions in the neck instead of making one larger incision.

In an even newer approach, the surgeon sits at a control panel and maneuvers robotic arms to do the surgery through an incision under the arm, so there is no scar in the neck. These approaches are much more likely to be used for thyroid conditions other than cancer at this time, but some doctors are now looking to see if they can be used for thyroid cancers as well.

Radioactive iodine (RAI) therapy

Doctors are looking for better ways to see which cancers are likely to come back after surgery. Patients with these cancers may be helped by getting RAI therapy after surgery. Recent studies have shown that patients with very low thyroglobulin levels 3 months after surgery have a very low risk of recurrence even without RAI. More research in this area is still needed.

Researchers are also looking for ways to make RAI effective against more thyroid cancers. For example, in some thyroid cancers, the cells have changes in the *BRAF* gene, which may make them less likely to respond to RAI therapy. Researchers are studying whether new drugs that target the *BRAF* pathway can be used to make thyroid cancer cells more likely to take up radioactive iodine. These types of drugs might be useful for people who have advanced cancer that is no longer responding to RAI therapy.

Chemotherapy

Some studies are testing the value of chemotherapy drugs such as paclitaxel (Taxol®) and other drugs, as well as combined chemotherapy and radiation in treating anaplastic thyroid cancer.

Targeted therapies

In general, thyroid cancers do not respond well to chemotherapy. But exciting data are emerging about some newer targeted drugs. Unlike standard chemotherapy drugs, which work by attacking rapidly growing cells (including cancer cells), these drugs attack specific targets on cancer cells. Targeted drugs may work in some cases when standard chemotherapy drugs do not, and they often have different (and less severe) side effects.

Kinase inhibitors: A class of targeted drugs known as *kinase inhibitors* may help treat thyroid cancer cells with mutations in certain genes, such as *BRAF* and *RET/PTC*. Many of these drugs also affect tumor blood vessel growth (see below).

In many papillary thyroid cancers, the cells have changes in the *BRAF* gene, which helps them grow. Drugs that target cells with *BRAF* gene changes, such as vemurafenib (Zelboraf®), dabrafenib (Tafinlar®), and selumetinib, are now being studied in thyroid cancers with this gene change.

In one study, giving selumetinib to patients with thyroid cancers that had stopped responding to radioactive iodine (RAI) treatment helped make some patients' tumors respond to treatment with RAI again. It helped patients not only with *BRAF* mutations, but also with mutations in a different gene called *NRAS*.

Other kinase inhibitors that have shown early promise against thyroid cancer in clinical trials include sorafenib (Nexavar®), sunitinib (Sutent®), pazopanib (Votrient®), cabozantinib (Cometriq®), motesanib (AMG 706), axitinib (Inlyta®), and vandetanib (Caprelsa®).

Vandetanib and cabozantinib are both targeted drugs shown to be helpful in the treatment of medullary thyroid cancer (MTC) in clinical trials, and are now approved for use against advanced forms of the disease. Some of these other drugs, such as sunitinib, sorafenib, and pazopanib, are already approved to treat other types of cancer, and might be useful against MTC and differentiated thyroid cancers if other treatments are no longer working.

Anti-angiogenesis drugs: As tumors grow, they need a larger blood supply to get enough nutrients. They get it by causing new blood vessels to form (a process called angiogenesis). Anti-angiogenesis drugs work by disrupting these new blood vessels. Some of the drugs listed above, such as axitinib, motesanib, sunitinib, sorafenib, pazopanib, and cabozantinib, have anti-angiogenic properties.

Other anti-angiogenesis drugs being studied for use against thyroid cancer include bevacizumab (Avastin®) and lenalidomide (Revlimid®).

Other targeted drugs: A recent early study found the combination of the chemotherapy drug paclitaxel (Taxol) with the targeted drug efatutazone could be helpful in patients with anaplastic thyroid cancer. Efatutazone targets a receptor called PPAR-gamma.

Additional resources for thyroid cancer

More information from your American Cancer Society

Here is more information you might find helpful. You can order free copies of our documents from our toll-free number, 1-800-227-2345, or read them on our website, www.cancer.org.

Dealing with diagnosis and treatment

Health Professionals Associated With Cancer Care

Talking With Your Doctor (also in Spanish)

After Diagnosis: A Guide for Patients and Families (also in Spanish)

Nutrition for the Person With Cancer During Treatment: A Guide for Patients and Families (also in Spanish)

Coping With Cancer in Everyday Life (also in Spanish)

Family and caregiver concerns

Talking With Friends and Relatives About Your Cancer (also in Spanish)

Helping Children When A Family Member Has Cancer: Dealing With Diagnosis (also in Spanish)

What It Takes to Be a Caregiver

Insurance and financial issues

In Treatment: Financial Guidance for Cancer Survivors and Their Families (also in Spanish)

Health Insurance and Financial Assistance for the Cancer Patient (also in Spanish)

More on cancer treatments

A Guide to Cancer Surgery (also in Spanish)

A Guide to Chemotherapy (also in Spanish)

Understanding Radiation Therapy: A Guide for Patients and Families (also in Spanish)

Cancer treatment side effects

Caring for the Patient With Cancer at Home: A Guide for Patients and Families (also in Spanish)

Distress in People With Cancer

Anxiety, Fear, and Depression

Nausea and Vomiting

Guide to Controlling Cancer Pain (also in Spanish)

Get Relief From Cancer Pain

Pain Diary

Anemia in People With Cancer

Fatigue in People With Cancer

Books

Your American Cancer Society also has books that you might find helpful. Call us at 1-800-227-2345 or visit our bookstore online at cancer.org/bookstore to find out about costs or to place an order.

National organizations and websites*

Along with the American Cancer Society, other sources of information and support include:

The American Thyroid Association
Toll-free number: 1-800-THYROID (1-800-849-7643)
Website: www.thyroid.org

> Provides patient information on diseases that affect the thyroid gland, including cancer, a list of patient support organizations, and a thyroid specialist locator

National Cancer Institute
Toll-free number: 1-800-4-CANCER (1-800-422-6237)
TTY: 1-800-332-8615
Website: www.cancer.gov

> Their “Cancer Information Service” offers a wide variety of free, accurate, up-to-date information about cancer to patients, their families, and the general public; also can help people find clinical trials in their area.

ThyCa: Thyroid Cancer Survivors' Association, Inc.
Toll-free number: 1-877-588-7904
Website: www.thyca.org

> For information and education on thyroid cancer types; a directory of local ThyCa thyroid cancer support group meetings coast-to-coast; the ThyCa Person-to-Person Network, which matches thyroid cancer patients with survivors of the same type of thyroid cancer for emotional and psychological support; 10 email support groups for different thyroid cancer types and situations; as well as free regional workshops

**Inclusion on this list does not imply endorsement by the American Cancer Society.*

No matter who you are, we can help. Contact us anytime, day or night, for information and support. Call us at 1-**800-227-2345** or visit www.cancer.org.

References: Thyroid cancer detailed guide

Ain K, Lee C, Holbrook K, et al. Lenalidomide in distantly metastatic, rapidly progressive and radioiodine unresponsive thyroid carcinomas: Preliminary results. *J Clin Oncol*. 2008:26 (May 20 suppl). Abstract 6027.

American Cancer Society. *Cancer Facts & Figures 2015*. Atlanta, Ga: American Cancer Society; 2015.

American Joint Committee on Cancer. Thyroid. In: *AJCC Cancer Staging Manual*. 7th ed. New York, NY: Springer; 2010:87-92.

American Thyroid Association Guidelines Task Force, Kloos RT, Eng C, Evans DB, et al. Medullary thyroid cancer: Management guidelines of the American Thyroid Association. *Thyroid*. 2009;19:565-612.

American Thyroid Association (ATA) Guidelines Taskforce on Thyroid Nodules and Differentiated Thyroid Cancer. Revised American Thyroid Association management guidelines for patients with thyroid nodules and differentiated thyroid cancer. *Thyroid*. 2009;19:1167-1214.

Bible KC, Suman VJ, Molina JR, et al. Efficacy of pazopanib in progressive, radioiodine-refractory, metastatic differentiated thyroid cancers: Results of a phase 2 consortium study. *Lancet Oncol*. 2010;11:962−972.

Brose MS, Nutting CM, Jarzab B, et al. Sorafenib in radioactive iodine-refractory, locally advanced or metastatic differentiated thyroid cancer: a randomised, double-blind, phase 3 trial. *Lancet*. 2014 Jul 26;384(9940):319-28. Epub 2014 Apr 24.

Carling T, Udelsman R. Thyroid tumors. In: DeVita VT, Hellman S, Rosenberg SA, eds. *DeVita, Hellman, and Rosenberg's Cancer: Principles and Practice of Oncology*. 9th ed. Philadelphia, Pa: Lippincott Williams & Wilkins; 2011.

Carr LL, Mankoff DA, Goulart BH, et al. Phase II study of daily sunitinib in FDG-PET-positive, iodine-refractory differentiated thyroid cancer and metastatic medullary carcinoma of the thyroid with functional imaging correlation. *Clin Cancer Res*. 2010;16:5260−5268.

Cohen E, Rosen L, Vokes E et al. Axitinib is an active treatment for all histologic subtypes of advanced thyroid cancer: Results from a phase II study. *J Clin Oncol*. 2008;26:4708−4713.

Elisei R, Schlumberger MJ, Müller SP, et al. Cabozantinib in progressive medullary thyroid cancer. *J Clin Oncol*. 2013 Oct 10;31(29):3639-46. Epub 2013 Sep 3.

Fagin JA. Challenging dogma in thyroid cancer molecular genetics — role of RET/PTC and BRAF in tumor initiation. *J Clin Endocrinol Metab*. 2004;89:4280−4284.

Gupta-AbramsonV, Troxel A, Nellore A, et al. Phase II trial of sorafenib in advanced thyroid cancer. *J Clin Oncol*. 2008:26:4714−4719.

Gharib H, Papini E, Paschke R, Duick DS, Valcavi R, Hegedüs L, Vitti P; AACE/AME/ETA Task Force on Thyroid Nodules. American Association of Clinical Endocrinologists, Associazione Medici Endocrinologi, and European Thyroid Association Medical Guidelines for Clinical Practice for the Diagnosis and Management of Thyroid Nodules. *Endocr Pract*. 2010 May-Jun;16 Suppl 1:1-43.

Ho AL, Grewal RK, Leboeuf R, et al. Selumetinib-enhanced radioiodine uptake in advanced thyroid cancer. *N Engl J Med*. 2013 Feb 14;368(7):623-32.

Howlader N, Noone AM, Krapcho M, Garshell J, Neyman N, Altekruse SF, Kosary CL, Yu M, Ruhl J, Tatalovich Z, Cho H, Mariotto A, Lewis DR, Chen HS, Feuer EJ, Cronin KA (eds). SEER Cancer Statistics Review, 1975-2010, National Cancer Institute. Bethesda, MD, http://seer.cancer.gov/csr/1975_2010/, based on November 2012 SEER data submission, posted to the SEER web site, April 2013.

Kloos RT, Ringel MD, Knopp MV, et al. Phase II trial of sorafenib in metastatic thyroid cancer. *J Clin Oncol*. 2009;27:1675−1684.

Kurzrock R, Sherman SI, Ball DW, et al. Activity of XL184 (cabozantinib), an oral tyrosine kinase inhibitor, in patients with medullary thyroid cancer. *J Clin Oncol*. 2011:29:2660-2666.

Kushi LH, Doyle C, McCullough M, Rock CL, Demark-Wahnefried W, Bandera EV, Gapstur S, Patel AV, Andrews K, Gansler T; American Cancer Society 2010 Nutrition and Physical Activity Guidelines Advisory Committee. American Cancer Society Guidelines on nutrition and physical activity for cancer prevention: reducing the risk of cancer with healthy food choices and physical activity. *CA Cancer J Clin*. 2012 Jan-Feb;62(1):30-67.

Leboulleux S, Bastholt L, Krause T, et al. Vandetanib in locally advanced or metastatic differentiated thyroid cancer: a randomised, double-blind, phase 2 trial. *Lancet Oncol*. 2012 Sep;13(9):897-905. Epub 2012 Aug 14.

National Cancer Institute. Physician Data Query (PDQ). Thyroid Cancer Treatment. 2/13/2013. Accessed at www.cancer.gov/cancertopics/pdq/treatment/thyroid/healthprofessional on January 9, 2014.

National Comprehensive Cancer Network. NCCN Clinical Practice Guidelines in Oncology: Thyroid Carcinoma. V.2.2013. Accessed at www.nccn.org/professionals/physician_gls/pdf/thyroid.pdf on January 8, 2014.

Online Mendelian Inheritance in Man, OMIM®. Johns Hopkins University, Baltimore, MD. MIM Number 188550. 8/8/2013. Accessed at http://omim.org/entry/188550 on January 10, 2014.

Ronckers CM, McCarron P, Engels EA, Ron E. New Malignancies Following Cancer of the Thyroid and Other Endocrine Glands. In: Curtis RE, Freedman DM, Ron E, Ries LAG, Hacker DG, Edwards BK, Tucker MA, Fraumeni JF Jr. (eds). New Malignancies Among Cancer Survivors: SEER Cancer Registries, 1973-2000. National Cancer Institute. NIH Publ. No. 05-5302. Bethesda, MD, 2006. Accessed on 4/18/2014 at http://seer.cancer.gov/archive/publications/mpmono/MPMonograph_complete.pdf.

Savvides P, Nagaiah G, Lavertu P, Fu P, Wright JJ, Chapman R, Wasman J, Dowlati A, Remick SC. Phase II trial of sorafenib in patients with advanced anaplastic carcinoma of the thyroid. *Thyroid*. 2013 May;23(5):600-4. Epub 2013 Apr 18.

Sherman SI, Wirth LJ, Droz J-P, et al. Motesanib diphosphate in progressive differentiated thyroid cancer. *N Engl J Med*. 2008;359:31−42

Schlumberger M, Tahara M, Wirth LJ, et al. Lenvatinib versus placebo in radioiodine-refractory thyroid cancer. N Engl J Med. 2015 Feb12;372(7):621-30.

Schlumberger MJ, Elisei R, Bastholt L, et al. Phase II study of safety and efficacy of motesanib in patients with progressive or symptomatic, advanced or metastatic medullary thyroid cancer. *J Clin Oncol*. 2009;27:3794−3801.

Schneider DF, Mazeh H, Lubner SJ, Jaume JC, Chen H. Cancer of the endocrine system. In: Niederhuber JE, Armitage JO, Doroshow JH, Kastan MB, Tepper JE, eds. *Abeloff's Clinical Oncology*. 5th ed. Philadelphia, Pa: Elsevier; 2014:1112−1142.

Schneider TC, Abdulrahman RM, Corssmit EP, Morreau H, Smit JW, Kapiteijn E. Long-term analysis of the efficacy and tolerability of sorafenib in advanced radio-iodine refractory differentiated thyroid carcinoma: final results of a phase II trial. *Eur J Endocrinol*. 2012 Nov;167(5):643-50. Epub 2012 Aug 23.

Smallridge RC, Copland JA, Brose MS, et al. Efatutazone, an oral PPAR-γ agonist, in combination with paclitaxel in anaplastic thyroid cancer: results of a multicenter phase 1 trial. *J Clin Endocrinol Metab*. 2013 Jun;98(6):2392-400. Epub 2013 Apr 15.

Vaisman A, Orlov S, Yip J, et al. Application of post-surgical stimulated thyroglobulin for radioiodine remnant ablation selection in low-risk papillary thyroid carcinoma. *Head Neck*. 2010;32:689−698.

Last Medical Review: 2/24/2014
Last Revised: 5/4/2015

2014 Copyright American Cancer Society

For additional assistance please contact your American Cancer Society
1-800-227-2345 or www.cancer.org