

ACTH

Also known as: Corticotrophin

Formal name: Adrenocorticotrophic Hormone

Related tests: Cortisol, Cortrosyn (ACTH) stimulation test, Dexamethasone suppression test.

ACTH is made in the pituitary gland in response to the release of another hormone, called corticotropin-releasing hormone (CRH), by the hypothalamus. In turn, the adrenal glands then make a hormone called cortisol, which helps your body manage stress. Cortisol is needed for life, so its levels in the blood are closely controlled. When cortisol levels rise, ACTH levels normally fall. When cortisol levels fall, ACTH levels normally rise.

Both ACTH and cortisol levels change throughout the day. ACTH is normally highest in the early morning (between 6 a.m. and 8 a.m.) and lowest in the evening (between 6 p.m. and 11 p.m.). ACTH levels may be tested in the morning or evening if your doctor thinks that they are abnormal. Cortisol levels are often measured at the same time as ACTH.

Because ACTH is released in bursts, its levels in the blood can vary from minute to minute. Interpretation of the test results is difficult and often requires the skill of an endocrinologist.

A test to measure ACTH is done to check for:

- A problem with the adrenal glands or pituitary gland. A high level of ACTH and a low level of cortisol (or low ACTH and high cortisol levels) could be caused by a problem with the adrenal glands. Low levels of ACTH and cortisol could be caused by a problem with the pituitary gland.

- Overproduction of ACTH. This may be caused by an overactive pituitary gland. In response, the adrenal glands release too much cortisol (one form of Cushing's syndrome).

ACTH levels in the blood are measured to help detect, diagnose, and monitor conditions associated with excessive or deficient cortisol in the body. These conditions include:

- Cushing's disease: excess cortisol that is due to an ACTH-producing tumor in the pituitary gland (usually a benign tumor)
- Cushing's syndrome: refers to the symptoms and signs associated with excess exposure to cortisol. In addition to Cushing's disease, Cushing's syndrome may be due to an adrenal tumor, adrenal hyperplasia, the use of steroid medications, or due to an ACTH-producing tumor that is ectopic, located outside the pituitary (such as in the lungs).
- Addison's disease, primary adrenal insufficiency: decreased cortisol production due to adrenal gland damage
- Secondary adrenal insufficiency: decreased cortisol production because of pituitary dysfunction
- Hypopituitarism: pituitary dysfunction or damage that leads to decreased (or no) hormone production by the pituitary, including ACTH production

Measuring both ACTH and cortisol can help to differentiate among some of these conditions because the level of ACTH normally changes in the opposite direction to the level of cortisol.

This test is ordered when a patient has signs or symptoms associated with excess or deficient cortisol.

Too much cortisol can cause symptoms that include:

- obesity, with majority of the weight on the trunk of the body and not the arms and legs
- rounded face
- fragile and thin skin

- purple lines on the abdomen
- muscle weakness
- acne
- increased body hair

These are often accompanied by findings such as high blood pressure, low potassium, high bicarbonate, high glucose levels, and sometimes diabetes.

People with insufficient cortisol production may exhibit symptoms such as:

- muscle weakness
- fatigue
- weight loss
- increased skin pigmentation, even in areas not exposed to the sun
- Loss of appetite.

These are often accompanied by findings such as low blood pressure, low blood glucose, low sodium, high potassium, and high calcium.

Symptoms suggestive of hypopituitarism include loss of appetite, fatigue, irregular menstrual cycle, hypogonadism, decreased sex drive, frequent nighttime urination, and weight loss. When the condition is due to a pituitary tumor (usually benign), the affected person may also have symptoms associated with the compression of nearby cells and nerves. The tumor can affect the nerves controlling vision, causing symptoms such as ‘tunnel vision’ (inability to see things off to the side), loss of vision to some localized areas, and double vision, and can cause a change in a pattern of headaches.

How to Prepare for taking ACTH tests

You may not be able to eat or drink for 10 to 12 hours before an ACTH test. Your doctor may ask you to eat low-carbohydrate foods

for 48 hours before the test. Be sure to ask your doctor if there are any foods that you should not eat.

Many medicines can change the results of this test. Be sure to tell your doctor about all the nonprescription and prescription medicines you take. If you take a medicine, such as a corticosteroid, that could change the test results, you will need to stop taking it for up to 48 hours before the test. Your doctor will tell you exactly how long depending on what medicine you take.

Do not exercise for 12 hours before this test.

Try to avoid emotional stress for 12 hours before the test.

Collecting the blood sample at the right time is often important. Your blood will be drawn in the morning if your doctor wants a peak ACTH level. Your blood will be drawn in the evening if your doctor wants a low (trough) ACTH level.

Normal

Normal values vary widely from lab to lab.

| Normal ACTH levels | |
|---------------------------|---|
| 6 a.m. to 8 a.m. | Less than 80 pg/mL or less than 18 pmol/L |
| 6 p.m. to 11 p.m. | Less than 50 pg/mL or less than 11 pmol/L |

High values

High levels of ACTH may be caused by:

- Emotional or physical stress (such as recent surgery or severe pain).

- Diseases such as Addison's disease, Cushing's disease, or a tumor in the adrenal glands or the pituitary gland.

Low values

Low levels of ACTH may be caused by:

- Damage to the pituitary gland from surgery, radiation, stroke, head injury, or a tumor.
- An increased amount of cortisol from a tumor in the adrenal glands (Cushing's syndrome).

| ACTH and cortisol levels in specific conditions | | |
|--|-------------|-----------------|
| Condition | ACTH | Cortisol |
| Cushing's disease | High | High |
| Cushing's syndrome | Low | High |
| ACTH made outside the pituitary gland | High | High |
| Addison's disease | High | Low |
| Hypopituitarism | Low | Low |

What Affects the Test

Reasons you may not be able to have the test or why the results may not be helpful include:

- Taking medicine, such as corticosteroids and medicines that act like cortisol or cause the release of cortisol, including amphetamines, lithium carbonate, and insulin.
- Being drunk (intoxicated).
- Being pregnant or having your period.
- Having a severe injury.
- Physical or emotional stress.

- Having a medical test that uses a radioactive tracer within 1 week before an ACTH test.

There are other medicines that may affect the test results, so talk with your doctor about any medicines you are taking.

Inferior petrosal sinus sampling is a test that measures the amount of ACTH from a channel (inferior petrosal sinus) near the pituitary gland. This test may be done along with an ACTH blood test when the levels of both ACTH and cortisol are high. It is used to tell the difference between ACTH made by the pituitary gland and ACTH made somewhere else in the body.

Changes in ACTH and cortisol are usually evaluated together. The table below indicates the common patterns of ACTH and cortisol seen with different diseases involving the adrenal and pituitary glands.

An increased ACTH result can mean that a patient has Cushing's disease, Addison's disease, or ectopic ACTH-producing tumors. A decreased ACTH result can be due to an adrenal tumor, steroid medication, or hypopituitarism.

The interpretation of the ACTH test is complicated because many things can change the results. Blood must be collected in special tubes, placed on ice, and processed quickly. The time of day when the blood is drawn can also change the results. ACTH test results should be compared to medical information gathered from other tests, especially the blood cortisol level.

In some cases, the interpretation of the results can be complex. Concentrations of both ACTH and cortisol vary throughout the day. Normally, ACTH will be at its highest level in the morning and lowest at night. It will stimulate cortisol production, which will follow the same daily pattern but will rise after ACTH does and fall to its lowest level very late in the evening. Conditions that affect the production of ACTH and cortisol often disrupt this diurnal variation.

Testing the change in cortisol when certain drugs are given to stimulate or suppress hormone production often helps the doctor make the right diagnosis. The most commonly used drugs are cortrosyn (cosyntropin, a drug form of ACTH) for an ACTH stimulation test and dexamethasone for dexamethasone suppression test.

- Cortrosyn, like ACTH, stimulates the adrenal glands to make cortisol. If cortisol level does not rise after cortrosyn is given, this indicates adrenal failure as can occur in Addison's disease or hypopituitarism.
- Dexamethasone is a potent drug that acts like cortisol. Dexamethasone should stop ACTH production. By testing the ability of different doses of dexamethasone to stop ACTH production, a doctor can tell if the person has Cushing's syndrome and determine its cause.

A number of other drugs are sometimes used to stimulate or suppress cortisol production, including insulin, corticotrophin releasing hormone, and metyrapone (metapyrone).

Some drugs and conditions can cause ACTH levels to rise, including amphetamines, insulin, levodopa, metoclopramide, and RU 486.

Drugs that cause ACTH to fall include dexamethasone and other drugs that act like cortisol, including prednisone, hydrocortisone, prednisolone, and methylprednisolone, and megestrol acetate.

Secretion of ACTH may be increased by stress.

ACTH has also been used therapeutically as a drug to treat Multiple Sclerosis.

What is the difference between Cushing's disease and Cushing's syndrome?

Cushing's disease is the over-stimulation of the adrenal gland by ACTH because of a tumor (usually benign) of the pituitary gland.

Cushing's syndrome refers to the same symptoms regardless of the cause. It also can be caused by taking steroid hormones (often used to treat cancer or autoimmune diseases), by tumors of the adrenal glands, and by ACTH-producing tumors outside the pituitary gland.

Addison's disease is another name for primary adrenocortical insufficiency, which happens when the adrenal cortex is damaged or destroyed and there is a lack of cortisol and other adrenal steroids, especially aldosterone.

Another way your body can make ACTH is called ectopic production of ACTH. This means that ACTH is made from tumors elsewhere in the body, usually (but not always) in the lungs. This causes Cushing's syndrome and may alert your doctor to the presence of a tumor.

A pituitary tumor is a growth of abnormal cells in the tissues of the pituitary gland.

Pituitary tumors form in the pituitary gland, a pea-sized organ in the center of the brain, just above the back of the nose. The pituitary gland is sometimes called the 'master endocrine gland' because it makes hormones that affect the way many parts of the body work. It also controls hormones made by many other glands in the body. Pituitary tumors are divided into three groups:

- Benign pituitary adenomas: Tumors that are not cancer. These tumors grow very slowly and do not spread from the pituitary gland to other parts of the body.
- Invasive pituitary adenomas: Benign tumors that may spread to bones of the skull or the sinus cavity below the pituitary gland.
- Pituitary carcinomas: Tumors that are malignant (cancer). These pituitary tumors spread into other areas of the central nervous system (brain and spinal cord) or outside of the central nervous system. Very few pituitary tumors are malignant.

Pituitary tumors may be either non-functioning or functioning.

- Non-functioning pituitary tumors do not make hormones.
- Functioning pituitary tumors make more than the normal amount of one or more hormones. Most pituitary tumors are functioning tumors. The extra hormones made by pituitary tumors may cause certain signs or symptoms of disease.

The pituitary gland hormones control many other glands in the body.

Hormones made by the pituitary gland include:

- Prolactin: A hormone that causes a woman's breasts to make milk during and after pregnancy.
- Adrenocorticotrophic hormone (ACTH): A hormone that causes the adrenal glands to make a hormone called cortisol. Cortisol helps control the use of sugar, protein, and fats in the body and helps the body deal with stress.
- Growth hormone: A hormone that helps control body growth and the use of sugar and fat in the body. Growth hormone is also called somatotropin.
- Thyroid-stimulating hormone: A hormone that causes the thyroid gland to make other hormones that control growth, body temperature, and heart rate. Thyroid-stimulating hormone is also called thyrotrophin.
- Luteinizing hormone (LH) and follicle-stimulating hormone (FSH): Hormones that control the menstrual cycle in women and the making of sperm in men.

Having certain genetic conditions increases the risk of developing a pituitary tumor.

Anything that increases your risk of getting a disease is called a risk factor. Having a risk factor does not mean that you will get cancer; not having risk factors does not mean that you will not get cancer. People who think they may be at risk should discuss this with their

doctor. Risk factors for pituitary tumors include having the following hereditary diseases:

- Multiple endocrine neoplasia type 1 (MEN1) syndrome.
- Carney complex.
- Isolated familial acromegaly.

Possible signs of a pituitary tumor include problems with vision and certain physical changes.

Symptoms can be caused by the growth of the tumor and/or by hormones the tumor makes. Some tumors may not cause symptoms. Conditions other than pituitary tumors can cause the symptoms listed below. A doctor should be consulted if any of these problems occur.

Pituitary tumor

Signs and symptoms of a non-functioning pituitary tumor

Sometimes, a pituitary tumor may press on or damage parts of the pituitary gland, causing it to stop making one or more hormones. Too little of a certain hormone will affect the work of the gland or organ that the hormone controls. The following symptoms may occur:

- Headache.
- Some loss of vision.
- Loss of body hair.
- In women, less frequent or no menstrual periods or no milk from the breasts.
- In men, loss of facial hair, growth of breast tissue, and impotence.
- In women and men, lower sex drive.
- In children, slowed growth and sexual development.

Most of the tumors that make LH and FSH do not make enough extra hormones to cause symptoms. These tumors are considered to be non-functioning tumors.

Signs and symptoms of a functioning pituitary tumor

When a functioning pituitary tumor makes extra hormones, the symptoms will depend on the type of hormone being made.

Too much prolactin may cause:

- Headache.
- Some loss of vision.
- Less frequent or no menstrual periods or menstrual periods with a very light flow.
- Trouble becoming pregnant or an inability to become pregnant.
- Impotence in men.
- Lower sex drive.
- Flow of breast milk in a woman who is not pregnant or breast-feeding.

Too much ACTH may cause:

- Headache.
- Some loss of vision.
- Weight gain in the face, neck, and trunk of the body, and thin arms and legs.
- A lump of fat on the back of the neck.
- Thin skin that may have purple or pink stretch marks on the chest or abdomen.
- Easy bruising.
- Growth of fine hair on the face, upper back, or arms.
- Bones that break easily.
- Anxiety, irritability, and depression.

Too much growth hormone may cause:

- Headache.
- Some loss of vision.
- In adults, acromegaly (growth of the bones in the face, hands, and feet). In children, the whole body may grow much taller and larger than normal.
- Tingling or numbness in the hands and fingers.
- Snoring or pauses in breathing during sleep.
- Joint pain.
- Sweating more than usual.
- Dismorphophobia (extreme dislike of or concern about one or more parts of the body).

Too much thyroid-stimulating hormone may cause:

- Irregular heartbeat.
- Shakiness.
- Weight loss.
- Trouble sleeping.
- Frequent bowel movements.
- Sweating.

Other general signs and symptoms of pituitary tumors:

- Nausea and vomiting.
- Confusion.
- Dizziness.
- Seizures.
- Runny or ‘drippy’ nose (cerebrospinal fluid that surrounds the brain and spinal cord leaks into the nose).

Imaging studies and tests that examine the blood and urine are used to detect (find) and diagnose a pituitary tumor.

The following tests and procedures may be used:

- Physical exam and history: An exam of the body to check general signs of health, including checking for signs of disease,

such as lumps or anything else that seems unusual. A history of the patient's health habits and past illnesses and treatments will also be taken.

- Eye exam: An exam to check vision and the general health of the eyes.
- Visual field exam: An exam to check a person's field of vision (the total area in which objects can be seen). This test measures both central vision (how much a person can see when looking straight ahead) and peripheral vision (how much a person can see in all other directions while staring straight ahead). The eyes are tested one at a time. The eye not being tested is covered.
- Neurological exam: A series of questions and tests to check the brain, spinal cord, and nerve function. The exam checks a person's mental status, coordination, and ability to walk normally, and how well the muscles, senses, and reflexes work. This may also be called a neuro exam or a neurologic exam.
- MRI (magnetic resonance imaging) with gadolinium: A procedure that uses a magnet, radio waves, and a computer to make a series of detailed pictures of areas inside the brain and spinal cord. A substance called gadolinium is injected into a vein. The gadolinium collects around the cancer cells so they show up brighter in the picture. This procedure is also called nuclear magnetic resonance imaging (NMRI).
- CT scan (CAT scan): A procedure that makes a series of detailed pictures of areas inside the brain, taken from different angles. The pictures are made by a computer linked to an x-ray machine. A dye may be injected into a vein or swallowed to help the organs or tissues show up more clearly. This procedure is also called computed tomography, computerized tomography, or computerized axial tomography.
- Blood chemistry study: A procedure in which a blood sample is checked to measure the amounts of certain substances, such as hormones, released into the blood by organs and tissues in the body. An unusual (higher or lower than normal) amount of a substance can be a sign of disease in the organ or tissue that makes it.

- Blood tests: Tests to measure the levels of testosterone or estrogen in the blood. A higher or lower than normal amount of these hormones may be a sign of pituitary tumor.
- Twenty-four-hour urine test: A test in which urine is collected for 24 hours to measure the amounts of certain substances. An unusual (higher or lower than normal) amount of a substance can be a sign of disease in the organ or tissue that makes it. A higher than normal amount of the hormone cortisol may be a sign of a pituitary tumor.
- High-dose dexamethasone suppression test: A test in which one or more high doses of dexamethasone are given. The level of cortisol is checked from a sample of blood or from urine that is collected for three days.
- Low-dose dexamethasone suppression test: A test in which one or more small doses of dexamethasone are given. The level of cortisol is checked from a sample of blood or from urine that is collected for three days.
- Venous sampling for pituitary tumors: A procedure in which a sample of blood is taken from veins coming from the pituitary gland. The sample is checked to measure the amount of ACTH released into the blood by the gland. Venous sampling may be done if blood tests show there is a tumor making ACTH, but the pituitary gland looks normal in the imaging tests.
- Biopsy: The removal of cells or tissues so they can be viewed under a microscope by a pathologist to check for signs of cancer.
- Immunohistochemistry study: A laboratory test in which a substance such as an antibody, dye, or radioisotope is added to a sample of cancer tissue to test for certain antigens. This type of study is used to tell the difference between different types of cancer.
- Immunocytochemistry study: A laboratory test in which a substance such as an antibody, dye, or radioisotope is added to a sample of cancer cells to test for certain antigens. This type of study is used to tell the difference between different types of cancer.

- Light and electron microscopy: A laboratory test in which cells in a sample of tissue are viewed under regular and high-powered microscopes to look for certain changes in the cells.

Certain factors affect prognosis (chance of recovery) and treatment options.

The prognosis (chance of recovery) depends on the type of tumor and whether the tumor has spread into other areas of the central nervous system (brain and spinal cord) or outside of the central nervous system to other parts of the body.

Treatment options depend on the following:

- The type and size of the tumor.
- Whether the tumor is making hormones.
- Whether the tumor is causing problems with vision or other symptoms.
- Whether the tumor has spread into the brain around the pituitary gland or to other parts of the body.
- Whether the tumor has just been diagnosed or has recurred (come back).

Stages of Pituitary Tumors

- Once a pituitary tumor has been diagnosed, tests are done to find out if it has spread within the central nervous system (brain and spinal cord) or to other parts of the body.
- Pituitary tumors are described in several ways.

Once a pituitary tumor has been diagnosed, tests are done to find out if it has spread within the central nervous system (brain and spinal cord) or to other parts of the body.

The extent or spread of cancer is usually described as stages. There is no standard staging system for pituitary tumors. Once a pituitary tumor is found, tests are done to find out if the tumor has spread

into the brain or to other parts of the body. The following tests and procedures may be used:

- MRI (magnetic resonance imaging): A procedure that uses a magnet, radio waves, and a computer to make a series of detailed pictures of areas inside the body. This procedure is also called nuclear magnetic resonance imaging (NMRI).
- CT scan (CAT scan): A procedure that makes a series of detailed pictures of areas inside the body, taken from different angles. The pictures are made by a computer linked to an x-ray machine. A dye may be injected into a vein or swallowed to help the organs or tissues show up more clearly. This procedure is also called computed tomography, computerized tomography, or computerized axial tomography.

Pituitary tumors are described in several ways.



Pea, peanut, walnut, and lime show tumor sizes.

Pituitary tumors are described by their size and grade, whether or not they make extra hormones, and whether the tumor has spread to other parts of the body.

The following sizes are used:

- Microadenoma: The tumor is smaller than 1 centimeter.
- Macroadenoma: The tumor is 1 centimeter or larger.

Most pituitary adenomas are microadenomas.

The grade of a pituitary tumor is based on how far it has grown into the surrounding area of the brain, including the sella (the bone at the base of the skull, where the pituitary gland sits).

Recurrent Pituitary Tumors

A recurrent pituitary tumor is cancer that has recurred (come back) after it has been treated. The cancer may come back in the pituitary gland or in other parts of the body.

Treatment Option Overview

Key Points for This Section

- There are different types of treatment for patients with pituitary tumors.
- Four types of standard treatment are used:
 - Surgery
 - Radiation therapy
 - Drug therapy
 - Chemotherapy
- New types of treatment are being tested in clinical trials.
- Patients may want to think about taking part in a clinical trial.
- Patients can enter clinical trials before, during, or after starting their cancer treatment.
- Follow-up tests may be needed.

There are different types of treatment for patients with pituitary tumors.

Different types of treatments are available for patients with pituitary tumors. Some treatments are standard (the currently used treatment), and some are being tested in clinical trials. A treatment clinical trial is a research study meant to help improve current treatments or obtain information on new treatments for patients with cancer. When clinical trials show that a new treatment is better than the standard treatment, the new treatment may become the standard treatment. Patients may want to think about taking part in a clinical trial. Some clinical trials are open only to patients who have not started treatment.

Four types of standard treatment are used:

Surgery

Many pituitary tumors can be removed by surgery using one of the following operations:

- Trans sphenoidal surgery: A type of surgery in which the instruments are inserted into part of the brain by going through an incision (cut) made under the upper lip or at the bottom of the nose between the nostrils and then through the sphenoid bone (a butterfly-shaped bone at the base of the skull) to reach the pituitary gland. The pituitary gland lies just above the sphenoid bone.
- Endoscopic trans sphenoidal surgery: A type of surgery in which an endoscope is inserted through an incision (cut) made at the back of the inside of the nose and then through the sphenoid bone to reach the pituitary gland. An endoscope is a thin, tube-like instrument with a light, a lens for viewing, and a tool for removing tumor tissue.
- Craniotomy: Surgery to remove the tumor through an opening made in the skull.

Even if the doctor removes all the cancer that can be seen at the time of the surgery, some patients may be given chemotherapy or radiation therapy after surgery to kill any cancer cells that are left.

Treatment given after the surgery, to lower the risk that the cancer will come back, is called adjuvant therapy.

Radiation therapy

Radiation therapy is a cancer treatment that uses high-energy x-rays or other types of radiation to kill cancer cells or keep them from growing. There are two types of radiation therapy. External radiation therapy uses a machine outside the body to send radiation toward the cancer. Internal radiation therapy uses a radioactive substance sealed in needles, seeds, wires, or catheters that are placed directly into or near the cancer.

Stereotactic radiation surgery uses a rigid head frame attached to the skull to aim a single large dose of radiation directly to a tumor, causing less damage to nearby healthy tissue. It is also called stereotaxic radiosurgery, radiosurgery, and radiation surgery. This procedure does not involve surgery.

The way the radiation therapy is given depends on the type of the cancer being treated.

Drug therapy

Drugs may be given to stop a functioning pituitary tumor from making too many hormones.

Chemotherapy

Chemotherapy may be used as palliative treatment for pituitary carcinomas, to relieve symptoms and improve the patient's quality of life. Chemotherapy uses drugs to stop the growth of cancer cells, either by killing the cells or by stopping them from dividing. When chemotherapy is taken by mouth or injected into a vein or muscle, the drugs enter the bloodstream and can reach cancer cells throughout the body (systemic chemotherapy). When chemotherapy is placed directly into the spinal column, an organ, or a body cavity

such as the abdomen, the drugs mainly affect cancer cells in those areas (regional chemotherapy). The way the chemotherapy is given depends on the type of the cancer being treated.

Follow-up tests may be needed.

Some of the tests that were done to diagnose the cancer or to find out the stage of the cancer may be repeated. Some tests will be repeated in order to see how well the treatment is working. Decisions about whether to continue, change, or stop treatment may be based on the results of these tests. This is sometimes called re-staging.

Some of the tests will continue to be done from time to time after treatment has ended. The results of these tests can show if your condition has changed or if the cancer has recurred (come back). These tests are sometimes called follow-up tests or check-ups.

Treatment Options for Pituitary Tumors

A link to a list of current clinical trials is included for each treatment section. For some types or stages of cancer, there may not be any trials listed. Check with your doctor for clinical trials that are not listed here but may be right for you.

Non-functioning Pituitary Tumors

Treatment may include the following:

- Surgery (trans sphenoidal surgery, if possible) to remove the tumor, followed by watchful waiting (closely monitoring a patient's condition without giving any treatment until symptoms appear or change). Radiation therapy is given if the tumor comes back.
- Radiation therapy alone.

Treatment for luteinizing hormone -producing and follicle-stimulating hormone-producing tumors is usually transsphenoidal surgery to remove the tumor.

Prolactin-Producing Pituitary Tumors

Treatment may include the following:

- Drug therapy to stop the tumor from making prolactin and to stop the tumor from growing.
- Surgery to remove the tumor (trans sphenoidal surgery or craniotomy) when the tumor does not respond to drug therapy or when the patient cannot take the drug.
- Radiation therapy.
- Surgery followed by radiation therapy.

ACTH-Producing Pituitary Tumors

Treatment may include the following:

- Surgery (usually trans-sphenoidal surgery) to remove the tumor, with or without radiation therapy.
- Radiation therapy alone.
- Drug therapy to stop the tumor from making ACTH.
- A clinical trial of stereo tactic radiation surgery.

Growth Hormone–Producing Pituitary Tumors

Treatment may include the following:

- Surgery (usually transsphenoidal or endoscopic transsphenoidal surgery) to remove the tumor, with or without radiation therapy.
- Drug therapy to stop the tumor from making growth hormone.

Thyroid-Stimulating Hormone–Producing Tumors

Treatment may include the following:

- Surgery (usually transsphenoidal surgery) to remove the tumor, with or without radiation therapy.
- Drug therapy to stop the tumor from making hormones.

Pituitary Carcinomas

Treatment of pituitary carcinomas is palliative, to relieve symptoms and improve the quality of life. Treatment may include the following:

- Surgery (trans sphenoidal surgery or craniotomy) to remove the cancer, with or without radiation therapy.
- Drug therapy to stop the tumor from making hormones.
- Chemotherapy.

Recurrent Pituitary Tumors

Treatment may include the following:

- Radiation therapy.
- A clinical trial of stereotactic radiation surgery.