Overview
Tumors that grow from the pituitary gland can affect the whole body by interfering with normal hormone levels. They can also cause headaches and vision problems. There are various kinds of pituitary tumors: adenomas, craniopharyngiomas, and Rathke’s cleft cysts. Most are benign (not cancer) and are often curable. Treatment options aim to remove the tumor or control its growth and restore normal hormone function. You may need medications to correct hormone levels.

Anatomy of the pituitary and sella
The pituitary gland is a small, bean-shaped organ that sits at the base of the brain, behind the bridge of the nose (Fig. 1 and 2). The gland has a larger anterior lobe (adenohypophysis) and a smaller posterior lobe (neurohypophysis). It sits in a small pocket of bone in the base of the skull called the sella turcica. The gland is connected to the hypothalamus of the brain by the pituitary stalk. The pituitary gland is bordered on either side by the cavernous sinuses and below by the sphenoid sinus. The sphenoid sinus is an air-filled sinus that drains into the nose. The internal carotid arteries and the nerves that control eye movement lie on the sides of the pituitary. Directly above the pituitary gland is the optic chiasm, which is responsible for vision. When pituitary tumors grow they can compress the above-mentioned structures and cause symptoms.

Known as the master gland, the pituitary controls the other endocrine glands in the body. It secretes hormones that control sexual development, promote bone and muscle growth, respond to stress, and fight disease. A healthy pituitary gland releases secretions into the bloodstream and provides feedback to the hypothalamus. The hypothalamus then regulates pituitary hormone levels, depending on the needs of the body.

Hormones made by the pituitary gland include:
- Prolactin hormone: causes a woman’s breasts to make milk after pregnancy.
- Growth hormone: helps control body growth and the metabolism of sugar and fat.
- Adrenocorticotropic hormone: causes the adrenal glands to make cortisol. Cortisol helps control the use of sugar, protein, and fats in the body and helps the body deal with stress.
- Thyroid-stimulating hormone: causes the thyroid gland to make other hormones that

Figure 1A. Front view. A cross-section of the pituitary gland (green) shows its relationship to the optic chiasm above, the sphenoid sinus below, and the cavernous sinuses on each side.

Figure 1B. Side view. A cross-section of the pituitary gland inside the bony sella.
control growth, temperature, and heart rate.

- Antidiuretic hormone (ADH or vasopressin): regulates water balance. Too little of this hormone can cause diabetes insipidus. Too much of this hormone can cause syndrome of inappropriate ADH secretion. Both of these conditions affect the kidneys’ ability to regulate the balance of water and electrolytes.
- Luteinizing hormone and follicle-stimulating hormone: control the menstrual cycle in women and sperm production in men.

What is a pituitary tumor?
A tumor that grows from the pituitary gland is called an adenoma. Tumors of the pituitary gland occur in 15% of adults and are classified as functional or nonfunctional. The majority of these tumors are asymptomatic.

Functional tumors secrete abnormal levels of hormones and interfere with the normal hormone regulation process. These tumors behave according to their cell of origin and are named for the specific hormone they produce. For example, a prolactin-secreting pituitary tumor (prolactinoma) arises from prolactin-producing cells.

Nonfunctional tumors do not secrete hormones. Instead, they grow until their size and mass effect cause headache, vision loss, nausea, vomiting, or fatigue. Based on size, pituitary tumors can be either microadenomas (less than 10mm) or macroadenomas (larger than 10mm). Large tumors can press on the optic nerves and invade the cavernous sinuses, which house the carotid arteries and the nerves involved in eye movement. Tumor growth may compress the normal pituitary gland, compromising its function and manifesting symptoms of decreased pituitary function.

Closely related to pituitary adenomas are craniopharyngiomas and Rathke’s cleft cysts. These grow from embryonic remnant cells in the pituitary gland. Craniopharyngiomas typically grow from the pituitary stalk upward into the third ventricle and cause symptoms similar to pituitary adenomas.

What are the symptoms?
Symptoms of a pituitary tumor vary depending on its size and hormone secretion function; many are asymptomatic. About 25% of pituitary tumors are nonfunctional; 75% are functional. Of hormonally active adenomas, about 50% secrete prolactin, 20% secrete growth hormone, 20% secrete adrenocorticotropic hormone, and 10% secrete multiple hormones.

Prolactin-producing tumors. The most common pituitary tumor, a prolactinoma, causes an overproduction of the hormone that helps control sexual function. In women, the tumor can cause menstruation to stop (amenorrhea) or inappropriate production of milk by the breasts (galactorrhea). In men, prolactinomas may cause enlarged breasts (gynecomastia), erectile dysfunction or impotence, infertility, decrease in body hair, and low sex drive.

Growth hormone-producing tumors. Most commonly found in men, these pituitary tumors are larger and may grow toward the third ventricle of the brain. These tumors may cause gigantism in children or adolescents. Adults may develop acromegaly—an enlargement of bones in the hands, feet, or face. Other symptoms include excess sweating, high blood pressure, heart disease, diabetes, and arthritis.

Adrenocorticotropic hormone (ACTH)-producing tumors. ACTH-producing adenomas occur more often in women. The ACTH hormone stimulates the adrenal gland to secrete cortisol. Excess cortisol causes Cushing’s disease—a fatty hump between the shoulders; weight gain in the face, neck, and trunk of the body; and pink or purple stretch marks on the skin. Cushing’s can also cause diabetes, menstrual irregularities, excessive hair growth, bruising, hypertension, and bone fractures from calcium depletion.

Thyroid-stimulating hormone-producing tumors. TSH-secreting tumors can cause hyperthyroidism. Hyperthyroidism can accelerate the body’s metabolism, causing sudden weight loss, irregular heartbeat, and nervousness or irritability.

Non-secreting tumors have few symptoms and are difficult to recognize until they grow quite large. These tumors can press against nearby optic nerves, causing headaches or vision loss. They can also impair hormone secretion from the pituitary gland, which can cause fatigue, weakness, loss of body hair, and pale skin.

Pituitary apoplexy. In rare instances, a pituitary tumor can suddenly bleed (hemorrhage). Symptoms include sudden onset of a severe headache and vision changes, including vision loss, double vision, or drooping of an eyelid. Pituitary apoplexy requires emergency treatment, usually with corticosteroids and often surgery.

What are the causes?
The cause of pituitary tumors is unknown. Some researchers believe they occur when a cell in the pituitary gland becomes abnormal or mutates.

Multiple endocrine neoplasia type 1 (MEN 1) is a rare condition with simultaneous tumors of the pituitary, pancreas and parathyroid glands. Pituitary adenomas develop in 25% of patients with MEN 1.

Who is affected?
Pituitary tumors affect 15% of adults; some tumors do not cause symptoms. They can occur at any age, but are more common after puberty.
How is a diagnosis made?

If you have symptoms that suggest a pituitary tumor, your physician will work with a team of specialists to confirm the diagnosis. This team may include a neurosurgeon, otolaryngologist (ear, nose, and throat surgeon), endocrinologist, ophthalmologist, radiologist, and pathologist.

First, the doctor will obtain your personal and family medical history and perform a physical examination. In addition to checking your general health, the doctor performs a neurological exam to check mental status and memory, cranial nerve function (sight, hearing, smell, tongue, and facial movement), muscle strength, coordination, reflexes, and response to pain. Additional tests may include:

- **Magnetic Resonance Imaging (MRI) scan** uses a magnetic field and radiofrequency waves to give a detailed view of the soft tissues of the brain. A dye (contrast agent) may be injected into your bloodstream. MRI is very useful to evaluate brain lesions and their effects on surrounding brain (Fig. 3).
- **Endocrine evaluation** measures hormone levels in the blood or urine to detect abnormal levels caused by pituitary tumors.
- **Visual field acuity test** is performed by a neuro-ophthalmologist to detect vision loss and missing areas in the field of view. This test measures both central vision (how much is seen when looking straight ahead) and peripheral vision (how much is seen in all other directions while staring straight ahead).

What treatments are available?

Treatment options vary, depending on the type, grade, size, and location of the tumor, and your age and general health. Medication, surgery, and radiation either alone or in combination, are used to treat pituitary tumors and return hormone levels to normal. It is important to seek treatment at a center that offers the full range of options including surgery, radiation, and endocrine therapy. A neurosurgeon, ENT surgeon, endocrinologist and radiation oncologist work as a team to treat pituitary tumors.

**Medication**

The goal of medication is to block the tumor from making abnormal quantities of hormones. Specific drugs are used to control specific types of hormone secretion. Prolactinomas can be controlled with the drugs cabergoline (Dostinex) or bromocriptine (Parlodel), which reduce the size of the tumor while maintaining normal prolactin levels. About 80% of patients will have prolactin levels restored to normal with cabergoline. Many will have marked tumor shrinkage on their MRI, making surgery unnecessary.

The production of growth hormone can be controlled with the drugs octreotide (Sandostatin) or pegvisomant (Somavert), which are used in conjunction with surgical removal. These drugs are also used to treat recurrent tumors.

To control the production of ACTH, drugs such as mitotane (Lysodren), ketoconazole (Nizoral), and aminoglutethimide (Cytadren) may be prescribed.
Surgery
Surgical removal of a pituitary tumor may be performed as a minimally invasive endoscopic transsphenoidal, traditional transsphenoidal, or a craniotomy approach. The best option varies for each patient, depending on the tumor size, type, and location. For growth hormone-producing and ACTH-producing tumors, surgery is the treatment of choice to reverse the endocrine problems. If a tumor is located near critical areas, surgeons may remove only part of it. A partial removal can still relieve symptoms. Radiation may be used to treat the remaining tumor.

• **Endoscopic transsphenoidal surgery.** An ENT surgeon inserts an endoscope through the nostril to reach the sphenoid sinus. An endoscope is a thin, tube-like instrument with a light and a camera. Video from the camera is viewed on a monitor. An opening is made in the sphenoid sinus to access the sella and pituitary gland (Fig. 4). Next, the neurosurgeon removes the tumor by passing long instruments through the nostril while watching the monitor. Surgery is usually carried out with the aid of computer image guidance (an anatomical navigation system akin to a GPS). The goal is to precisely expose the tumor and to avoid nearby carotid arteries or optic nerves.

• **Traditional microscopic transsphenoidal.** This technique is performed through an incision made under the upper lip (sublabial) along with removal of the nasal septum to access the tumor. The endoscopic technique is replacing the traditional microscopic approach as it reduces the trauma to the nasal tissues and the recovery time for the patient.

• **Expanded endoscopic transsphenoidal surgery** involves opening more bone into the anterior skull base. This enables the surgeon to safely expose very large tumors that extend beyond the boundaries of the transsphenoidal approach. It provides the surgeon with direct visualization of compressed structures, such as the optic nerves or anterior cerebral arteries.

• **Craniotomy.** A skin incision is made in the scalp. A small bone flap above the eye (supraorbital craniotomy) is cut and removed to access the brain (Fig. 5). The brain is gently retracted to locate and remove the tumor. The bone flap is replaced and secured with tiny plates and screws. A craniotomy is required for large tumors that have invaded nearby tissues and cannot be removed through a transsphenoidal approach.
Radiation therapy uses controlled high-energy rays to treat pituitary tumors. Radiation works by damaging the DNA inside cells making them unable to divide and reproduce. The goal of radiation therapy is to maximize the dose to abnormal tumor cells and minimize exposure to normal healthy cells. The benefits of radiation are not immediate but occur over time. Gradually, the lesion will stop growing, shrink, and in some cases, completely disappear.

External beam radiation is delivered from outside the body by a machine that aims high-energy rays (x-rays, gamma rays) at the tumor. There are two ways to deliver radiation:

- **Stereotactic radiosurgery** delivers a high dose of radiation during a single session. The two main technologies are the Leksell Gamma Knife and linear accelerator systems such as the BrainLab Novalis. Although it is called surgery, no incision is made. Because a single radiosurgery dose is more damaging than multiple fractionated doses, the target area must be precisely located and completely immobilized with a head frame or facemask.

- **Fractionated radiotherapy** delivers a low dose of radiation daily over 5 to 6 weeks. A facemask is used to precisely localize the tumor and accurately reposition the patient for each treatment session. Over time, the abnormal cells die and the tumor shrinks. Benign tumors, whose cells divide slowly, may take several months to a year to show an effect.

**Observation ("watch and wait")**

Sometimes the best treatment is observation. Small, slow-growing tumors that produce few symptoms may be observed with routine MRI scans until their growth or symptoms necessitate surgery. Observation may be the best option for older patients with other health conditions. You and your doctor can weigh the risk of symptoms developing versus the risk of treatment intervention.

**Sources & links**

If you have more questions, please contact Mayfield Brain & Spine at 800-325-7787 or 513-221-1100. For information about the University of Cincinnati Neuroscience Institute’s Brain Tumor Center, call 866-941-8264.

**Links**

Pituitary Network Association, [www.pituitary.org](http://www.pituitary.org)

Glossary

- **Acromegaly**: enlargement of the hands, feet or face in adults due to overproduction of growth hormone; often from a growth hormone-secreting pituitary tumor.
- **Adenoma**: a tumor that grows from a gland.
- **Apoplexy**: sudden bleeding inside an organ.
- **Cushing’s syndrome**: an endocrine disease caused by increased levels of cortisol in the body; often from an adrenocorticotropic hormone (ACTH)-secreting pituitary tumor. Hallmark signs include a fatty hump between the shoulders, a rounded face, and pink or purple stretch marks on the skin. Also caused by excessive use of corticosteroid medication.
- **Diabetes insipidus**: a disorder in which there is an abnormal increase in urine output, fluid intake, and often thirst. Caused by a decrease in vasopressin hormone due to damage of the posterior pituitary lobe.
- **Gigantism**: excessive growth and height in children caused by overproduction of growth hormone; often from a growth hormone-secreting pituitary tumor.
- **Hyperthyroidism**: increased heart rate, weight loss, nervousness, and sleeplessness caused by excess thyroid hormone; can be caused by thyroid-stimulating hormone (TSH)-producing pituitary tumor.
- **Prolactinoma**: a benign pituitary tumor that overproduces the hormone prolactin. Too much prolactin causes abnormal milk production in the breasts, lack of menstruation, infertility, and decreased sex drive.