Treating Pituitary Tumors

Nearly all pituitary tumors are adenomas and not cancer (benign). Treatment of a pituitary adenoma depends on whether or not it makes excess hormones and, if it does, which hormone it makes. Treatment also depends on whether it's a microadenoma (smaller than 1 centimeter across) or a macroadenoma (1 centimeter across or larger).

How are pituitary tumors treated?

Treatment for pituitary tumors may include:

- Surgery for Pituitary Tumors
- Radiation Therapy for Pituitary Tumors
- Medicines to Treat Pituitary Tumors

Common treatment approaches

Sometimes a combination of treatments is used. For example, surgery may be done to remove some of the tumor, while drugs can be used to relieve symptoms and sometimes shrink the remaining tumor. Common treatment plans differ by tumor type.

- Treatment of Functional (Hormone-Making) Pituitary Tumors
- Treatment of Non-Functional Pituitary Tumors (Tumors That Don’t Make Excess Hormones)
- Treatment of Pituitary Carcinomas

Who treats pituitary tumors?

Pituitary tumors often require care from a team of doctors. Doctors on your team may include:

- **Neurosurgeon:** a doctor who uses surgery to treat brain and pituitary tumors

- **Endocrinologist:** a doctor who treats diseases in glands that make hormones
- **Neurologist:** a doctor who diagnoses and treats brain and nervous system diseases
- **Radiation oncologist:** a doctor who uses radiation to treat cancers and other tumors
- **Medical oncologist:** a doctor who uses chemotherapy and other medicines to treat cancers and other tumors

Many other specialists might be part of your treatment team as well, including physician assistants, nurse practitioners, nurses, psychologists, social workers, rehabilitation specialists, and other health professionals.

- Health Professionals Associated With Cancer Care

Making treatment decisions

Your doctor will discuss treatment options with you. It's important to take time and think about your choices, weighing the benefits of each option against the possible risks and side effects. It's also important to ask questions if there's anything you're not sure about.

Because pituitary tumors are rare, not many doctors have much experience with them. You may want to get a second opinion. This can give you more information and help you feel more certain about the treatment plan you choose. Many people find it helpful to get a second opinion about the best treatment options based on their situation, especially if they have several choices.

- What Should You Ask Your Doctor About Pituitary Tumors?
- Seeking a Second Opinion

Thinking about taking part in a clinical trial

Clinical trials are carefully controlled research studies that are done to get a closer look at promising new treatments or procedures. Clinical trials are one way to get state-of-the art cancer treatment. In some cases they may be the only way to get access to newer treatments. They are also the best way for doctors to learn better methods to treat cancer. Still, they're not right for everyone.

If you would like to learn more about clinical trials that might be right for you, start by asking your doctor if your clinic or hospital conducts clinical trials.

- Clinical Trials

Considering complementary and alternative methods

You may hear about alternative or complementary methods that your doctor hasn't mentioned to treat your cancer or relieve symptoms. These methods can include vitamins, herbs, and special diets, or other methods such as acupuncture or massage, to name a few.

Complementary methods refer to treatments that are used along with your regular medical care. Alternative treatments are used instead of a doctor's medical treatment. Although some of these methods might be helpful in relieving symptoms or helping you feel better, many have not been proven to work. Some might even be dangerous.

Be sure to talk to your cancer care team about any method you are thinking about using. They can help you learn what is known (or not known) about the method, which can help you make an informed decision.

- Complementary and Alternative Medicine

Help getting through cancer treatment

Your cancer care team will be your first source of information and support, but there are other resources for help when you need it. Hospital- or clinic-based support services are an important part of your care. These might include nursing or social work services, financial aid, nutritional advice, rehab, or spiritual help.

The American Cancer Society also has programs and services – including rides to treatment, lodging, and more – to help you get through treatment. Call our National Cancer Information Center at 1-800-227-2345 and speak with one of our trained specialists.

- Find Support Programs and Services in Your Area

Choosing to stop treatment or choosing no treatment at all

For some people, when treatments have been tried and are no longer controlling the cancer, it could be time to weigh the benefits and risks of continuing to try new treatments. Whether or not you continue treatment, there are still things you can do to help maintain or improve your quality of life.

Some people, especially if the cancer is advanced, might not want to be treated at all. There are many reasons you might decide not to get cancer treatment, but it's important to talk to your doctors and you make that decision. Remember that even if you choose

not to treat the cancer, you can still get supportive care to help with pain or other symptoms.

- If Cancer Treatments Stop Working
- Palliative or Supportive Care

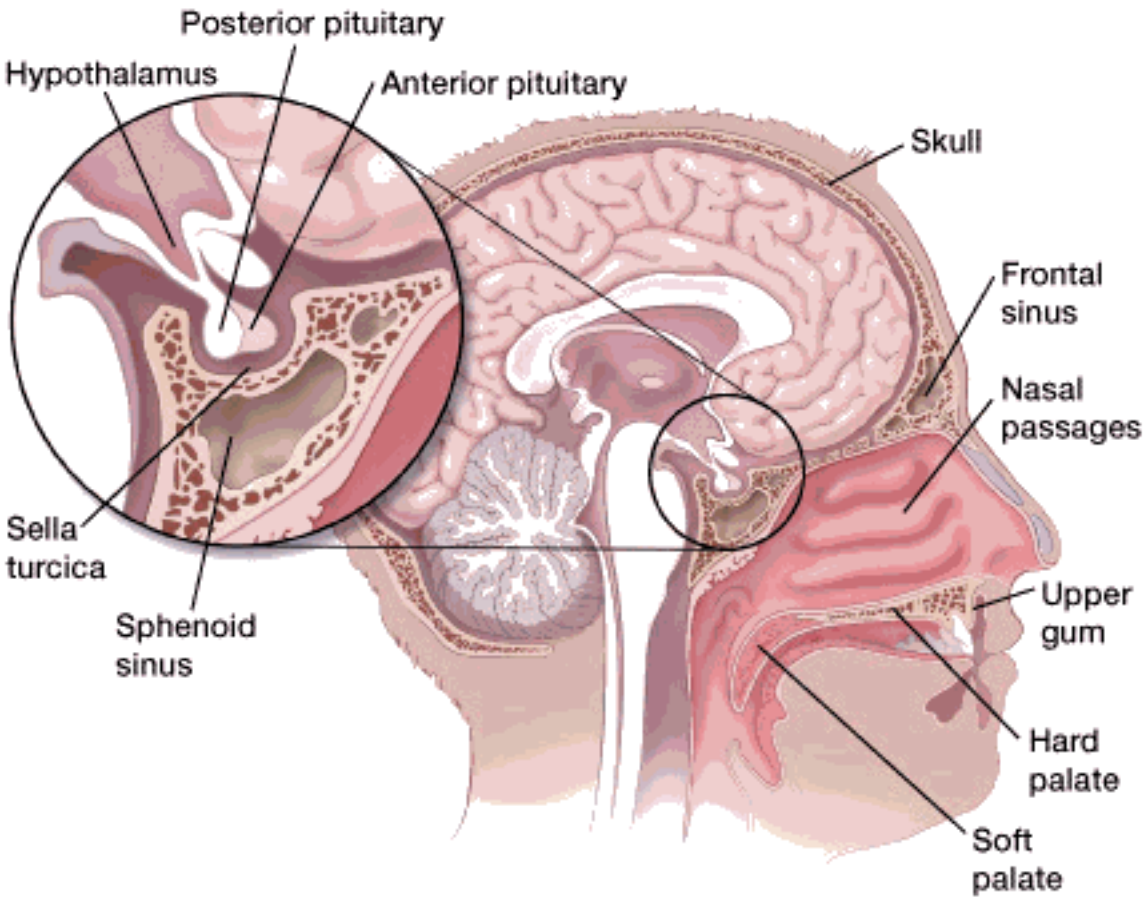
The treatment information given here is not official policy of the American Cancer Society and is not intended as medical advice to replace the expertise and judgment of your cancer care team. It is intended to help you and your family make informed decisions, together with your doctor. Your doctor may 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.

Surgery for Pituitary Tumors

The main treatment for many pituitary tumors is surgery. How well the surgery works depends on the type of tumor, its exact location, its size, and whether it has spread into nearby structures.

Transsphenoidal surgery

This is the most common way to remove pituitary tumors. Transsphenoidal means that the surgery is done through the sphenoid sinus, a hollow space in the skull behind the nasal passages and below the brain. The back wall of the sinus covers the pituitary gland.



To do this surgery, the neurosurgeon makes a small incision (cut) along the nasal septum (the cartilage between the 2 sides of the nose) or under the upper lip (above the teeth). To reach the pituitary, the surgeon opens the boney walls of the sphenoid sinus with small surgical chisels, drills, or other instruments depending on the thickness of the bone and sinus. Small tools and a microscope are used to remove the tumor.

Another approach is to use an endoscope, a thin fiber-optic tube with a tiny camera at the tip. This way, the incision under the upper lip or along the nasal septum isn't needed, because the endoscope allows the surgeon to see through a small incision that's made in the back of the nasal septum. The surgeon passes instruments through the nose and opens the sphenoid sinus to reach the pituitary gland and take out the tumor. Whether this technique can be used depends on the tumor’s position and the shape of the sphenoid sinus.

The transsphenoidal approach has many advantages. First, no part of the brain is touched during the surgery, so the chance of damaging the brain is very low. There may be fewer side effects, and there's also no visible scar. But this surgery may take longer, and it’s hard to take out large tumors this way.

When this surgery is done by an experienced neurosurgeon and the tumor is small (a microadenoma), the cure rates are high (greater than 80%). If the tumor is large or has grown into the nearby structures (such as nerves, brain tissue, or the tissues covering the brain) the chances for a cure are lower and the chance of damaging nearby brain tissue, nerves, and blood vessels is higher.

Craniotomy

For larger or more complicated pituitary tumors, a craniotomy may be needed. In this approach the surgeon operates through an opening in the front of the skull, off to one side. The surgeon has to work carefully beneath and between the lobes of the brain to reach the tumor. Craniotomy has a higher chance of brain injury and other side effects than transsphenoidal surgery for small lesions, but it’s actually safer for large and complex lesions because the surgeon is better able to see and reach the tumor as well as nearby nerves and blood vessels.

Planning surgery

For both transsphenoidal surgery and craniotomies, the doctor may use image-guidance with MRI or CT scans before surgery to learn as much as they can about the tumor. It's important to know how big the tumor is and whether it has spread beyond the pituitary gland to plan the best surgical approach and predict how likely it is that they will be able to take out all of the tumor.

In rare cases, both types of surgery are used at the same time to try to completely remove large tumors that have spread into nearby tissues.

As a general rule, smaller pituitary tumors are easier to treat with surgery. The larger and more invasive the tumor, the less likely the tumor can be cured by surgery. Side effects also tend to be more likely after surgery to remove large, invasive tumors.

Possible side effects of surgery

Surgery on the pituitary gland is a serious operation, and surgeons are very careful to try to limit any problems either during or after surgery. Complications during or after surgery such as bleeding, infections, or reactions to anesthesia (the drugs used to make you sleep during surgery) are rare, but they can happen.

Most people who have transsphenoidal surgery will have a sinus headache and

congestion for up to a week or 2 after surgery.

If surgery causes damage to large arteries, to nearby brain tissue, or to nerves near the pituitary, it can lead to brain damage, a stroke, or blindness, but this is quite rare.

When doctors use the transsphenoidal approach to operate on the pituitary gland, they create a temporary pathway between the nasal sinuses and airways and the brain. Until this heals, a person can get meningitis, infection and inflammation of the meninges (the thin protective layers covering the brain). Damage to the meninges can also lead to leakage of cerebrospinal fluid (CSF, the fluid that bathes and cushions the brain) out of the nose. Whether this happens seems to depend to the size and type of tumor.

Diabetes insipidus (see Signs and Symptoms of Pituitary Tumors) may occur right after surgery, but it usually improves on its own within a few weeks after surgery.

Damage to the rest of the pituitary can lead to other symptoms from a lack of pituitary hormones. This is rare after surgery for small tumors, but it may be unavoidable when treating some larger macroadenomas. If pituitary hormone levels are low after surgery, this can be treated with medicine to replace certain hormones normally made by the pituitary and other glands.

You will be closely watched and your blood will be checked often as your body adjusts to normal hormone levels. If diabetes insipidus doesn't get better, it may need to be treated with a desmopressin nasal spray. If vitamin and/or mineral levels change, you may need supplements for a while. For instance, potassium levels often drop, so you may need to get it intravenously (IV, or in a vein) right after surgery.

Complications are rare after pituitary surgery, but they can be serious. Talk to your doctor about what you should watch for and what you should do if you have any problems.

For more general information about surgery as a treatment for tumors, see Cancer Surgery.

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See all references for Pituitary Tumors

Last Medical Review: November 2, 2017 Last Revised: November 2, 2017

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Radiation Therapy for Pituitary Tumors

Radiation therapy uses high energy x-rays or particle waves to kill tumor cells. This type of treatment is given by a doctor called a *radiation oncologist*. Radiation is directed at the tumor from a source outside the body.

Radiation therapy may be recommended if surgery isn't an option, if some of a pituitary tumor remains or comes back after surgery, or if the tumor causes symptoms that aren’t controlled with medicines.

Radiation therapy is much like getting an x-ray, but the doses of radiation used are much higher. Before your treatments start, the radiation team will get imaging tests such as MRI scans to define the exact location, size, and shape of the tumor. This is used to determine the correct angles for aiming the radiation beams, the shape of the beams, and the proper dose of radiation.

Standard radiation is usually given in a series of treatments 5 times a week over 4 to 6 weeks. At each session, you lie on a special table while a machine delivers the radiation from precise angles. The treatment doesn't hurt. Each session lasts about 15 to 30 minutes. Much of that time is spent making sure you are in the right position so the radiation is aimed correctly. The actual time you're getting the treatment is much shorter.

Radiation can work well, but it has some drawbacks:

- It works slowly, so it can take months or even years before the tumor growth and/or excess hormone production is fully controlled.
- It can damage the remaining normal pituitary. In many cases, normal pituitary function will be lost over time, so treatment with hormones will be needed.
- It may damage some normal brain tissue, particularly near the pituitary gland, which could affect mental function years later.
- The optic nerves may be damaged, causing vision changes.
- The radiation may increase the risk of developing a brain tumor later in life, but this risk is low in adults.

Newer radiation therapy techniques

Newer techniques help lower the risks of radiation therapy. These techniques focus the radiation more precisely on the pituitary. However, some of these techniques might not be possible for some tumors that are very close to the optic nerves.

Intensity modulated radiation therapy (IMRT)

IMRT is an advanced form of 3-D radiation therapy. It uses a computer-driven machine that moves around the patient as it sends out the radiation. IMRT lets the doctor shape the radiation beams and aim them at the tumor from many angles. The intensity (strength) of the beams can also be adjusted to limit the dose reaching nearby normal tissues. This may mean fewer side effects. Many major hospitals and cancer centers now use IMRT.

Stereotactic radiosurgery/stereotactic radiation therapy

This type of treatment delivers a large, precise radiation dose to the tumor area in one treatment. Though this is called radiosurgery, no cutting or surgery is involved. In some cases, the treatment might be done in a few sessions (called stereotactic radiotherapy). Radiosurgery targets the tumor more precisely than standard radiation, causing less harm to the normal pituitary gland and limiting radiation exposure to the rest of the brain.

For this treatment, a lightweight metal frame is often attached to the head with small pins or screws to help hold the head still and aim the radiation beams very precisely. (The areas on the scalp where the frame is attached are numbed first.) Sometimes a mesh face mask is used to hold the head in place instead of a frame. Once the exact location of the tumor is known from CT or MRI scans, radiation is focused at the tumor from many different angles. This can be done in 2 ways:

- Thin radiation beams from a machine are focused at the tumor from hundreds of different angles for a short period of time. Each beam alone is weak, but they all converge at the tumor to give a higher dose of radiation. An example of such a machine is the *Gamma Knife*.
- A movable linear accelerator (a machine that creates radiation) that's controlled by a computer is used. Instead of delivering many beams at once, this machine moves around the head to deliver radiation to the tumor from different angles. Several machines do stereotactic radiosurgery in this way, with names such as *X-Knife*, *CyberKnife*, and *Clinac*.

Stereotactic radiosurgery typically delivers the whole radiation dose in one session, though it may be repeated if needed. Sometimes doctors give the radiation in several

treatments to deliver the same or a slightly higher dose. This is called *fractionated radiosurgery* or *stereotactic radiotherapy*.

The benefits of stereotactic radiation are usually seen a bit sooner than with other forms of radiation therapy, but it can still take months to be fully effective.

Unfortunately, this therapy can't be used for tumors that are very close to the optic nerves. It also might not be helpful for tumors that have an unusual shape.

Proton beam radiation therapy

This form of treatment uses a beam of protons rather than x-rays to kill cancer cells. Protons are positive parts of atoms.

X-rays release their energy both before and after they hit their target, which can damage nearby healthy tissues and the tissues they pass through to reach the tumor. Protons, on the other hand, cause little damage to tissues they pass through and only release their energy after traveling a certain distance. Doctors can use this property to deliver more radiation to the tumor with less damage to normal tissues. Like stereotactic radiation, it has the advantage of focusing the radiation more precisely on the pituitary tumor.

But proton beam radiation therapy requires highly specialized equipment and isn't widely available – there are only a handful of proton beam centers in the United States at this time. It's not a standard treatment for pituitary tumors. Studies are still needed to see if it's safer or more effective than stereotactic radiosurgery or stereotactic radiotherapy.

More information about radiation therapy

To learn more about how radiation is used to treat tumors, see Radiation Therapy.

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See all references for Pituitary Tumors

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Medicines to Treat Pituitary Tumors

Many medicines can be used to treat pituitary tumors.

Drugs for lactotroph adenomas or prolactin-secreting

tumors (prolactinomas)

Drugs called *dopamine agonists* can stop prolactinomas from making too much prolactin and shrink these tumors. Drugs are often the only treatment needed. Cabergoline (Dostinex®) and bromocriptine (Parlodel®) are most commonly used. Both drugs work well, but cabergoline seems to work better and this drug stays in the body longer than bromocriptine, so it can be taken once or twice a week instead of every day.

Most people with prolactinomas can control their prolactin levels with these medicines. The drugs also shrink almost all prolactin-secreting macroadenomas. In fact, these drugs work so well that surgery usually isn't needed for prolactinomas. Even if the tumor doesn't shrink, these drugs often can keep prolactinomas from growing larger. If successful, the drug treatment may be continued for life. It's rare that prolactinomas become resistant to these drugs.

Possible side effects of these drugs include drowsiness, dizziness, nausea, vomiting, diarrhea or constipation, headaches, confusion, and depression. For women whose high prolactin levels had been causing infertility, these drugs may restore fertility. Cabergoline may cause fewer side effects than bromocriptine.

Drugs for somatotroph adenomas or growth hormone-secreting tumors

These tumors can cause acromegaly in adults and gigantism in children. (See Signs and Symptoms of Pituitary Tumors.) Medicines do not work well for these tumors, so they're not usually the first treatment used (surgeryis).

Somatostatin analogs: Drugs like octreotide (Sandostatin®), lanreotide (Somatuline® Depot), and pasireotide (Signifor® LAR) are man-made forms of the natural hormone somatostatin. Somatostatin, which is made in the pituitary and other glands, blocks growth hormone (somatotropin) production by adenomas. These somatostatin-like drugs can return insulin-like growth factor-1 (IGF-1) to normal levels in about 2 out of 3 patients.

Octreotide is first given as an injection under the skin 3 times per day. A longer acting form is available, which can be given as a monthly injection. Lanreotide and pasireotide are given as an injection about once a month. They may be tried if the octreotide isn't working well. Doctors measure how well these drugs are working by testing blood growth hormone and IGF-1 levels. Tumors tend to shrink very slowly with these drugs.

These drugs can have side effects, such as a slowed heart rate, nausea, vomiting, diarrhea, gas, stomach pain, dizziness, headache, and pain at the site of injection. Many of these side effects improve or even go away with time. They can also cause gallstones, and pasireotide may cause diabetes or worsen it if a person already has it.

Growth hormone antagonists: Pegvisomant (Somavert®) is a newer drug that works by blocking the action of growth hormone on other cells. It's very effective in lowering blood IGF-1 levels, but it doesn't block growth hormone secretion by the pituitary gland or shrink pituitary tumors. It has few side effects, but it can lower blood sugar levels and cause mild liver damage in some people. It's given by daily injection under the skin to start, but over time may be given less often, such as once a week. It can be used alone or given along with cabergoline or a somatostatin analog.

Dopamine agonists: Drugs like cabergoline or bromocriptine can reduce growth hormone levels in about 1 out of 3 patients. But higher doses are needed for these tumors than for prolactinomas, and some patients have trouble with the side effects they can cause (discussed above). An advantage of these drugs is that they can be taken as a pill.

Drugs for corticotroph adenomas or corticotropin (ACTH)-secreting tumors

These tumors cause the adrenal glands to make excess steroid hormones such as cortisol, which leads to Cushing's disease (discussed in Signs and Symptoms of Pituitary Tumors). Surgeryis the preferred treatment. Medicines are not usually part of treatment for these tumors unless surgery and radiationtherapy don't work. (Or if the effects of radiation haven't happened yet. It can take 2 to 5 years to know if radiation worked.)

Many different kinds of drugs can be used, but medicines don't always work as well in ACTH-secreting tumors as they do in some other types of pituitary tumors.

- Pasireotide (Signifor®) is a somatostatin analog. It can help some people who have Cushing's disease from ACTH-secreting tumors when surgery is not an option or has not worked. Along with side effects such as nausea, vomiting, and diarrhea, this drug can cause high blood sugar levels and gallstones.
- Cyproheptadine (Periactin®) is an antihistamine drug that can suppress ACTH production in some of these tumors.
- Drugs called *steroidogenesis inhibitors* can be used to keep the adrenal gland from making cortisol, but they don't affect the pituitary tumor itself. These include

ketoconazole, aminoglutethimide, etomidate, metyrapone, and mitotane. These drugs can sometimes be helpful after surgery or radiation (or if surgery is not an option), but they can be hard to take because of side effects.

- Mifepristone (Korlym®) is a type of drug called a *cortisol receptor blocker*. It limits the effects of cortisol on other tissues in the body. This drug can help treat high blood sugar levels in people with Cushing's disease, but it doesn't affect the pituitary tumor itself. It can have serious side effects and requires close monitoring.
- Dopamine agonists such as cabergoline or bromocriptine can also be tried if other drugs don't work.

Drugs for thyrotroph adenomas or thyrotropin (TSH)-secreting tumors

The first treatment for these rare tumors is surgery. If this doesn't cure the patient, somatostatin analogs such as octreotide and lanreotide can usually reduce the amount of TSH that's produced and may help shrink the tumor. In fact, in some cases, these drugs may be used to normalize thyroid hormone levels and shrink the tumor before surgery is done.

Dopamine agonists such as cabergoline or bromocriptine can also be used. These drugs are discussed in more detail above.

Drugs for null cell adenomas or tumors that do not make hormones

Even though these tumors don't make hormones, drugs may be used to treat them. Surgeryand radiation are usually done first.

Dopamine agonists and somatostatin analogs have been found to help slow or decrease growth in some of these tumors. These are discussed above in the lactotroph and somatotroph drug sections.

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See all references for Pituitary Tumors

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Treatment of Functional (Hormone-Making) Pituitary Tumors

The treatment of functional pituitary tumors depends on which type of hormone they

make.

Treatment of lactotroph adenomas or prolactin-secreting adenomas (prolactinomas)

Unlike most other pituitary tumors, surgery is usually not the first treatment for these tumors. Sometimes these tumors can just be watched and nothing needs to be done right away. Blood prolactin levels are checked regularly. If they start to go up, an MRI can be done to look for an increase in tumor size. Treatment can then be started as needed.

Medicines that block the production of prolactin (like cabergoline or bromocriptine) are used first. (See Medicines to Treat Pituitary Tumors.) They usually work so well that surgery isn't needed.

These drugs also shrink most prolactin-secreting macroadenomas. Even when the tumors don’t shrink, these drugs often keep them from getting bigger.

Within 3 months of starting drug treatment, the blood prolactin level is measured again and an MRI scan of the pituitary is done to see if the medicine is working. If so, treatment may be continued for the rest of the patient’s life. For some people, if treatment with these medicines has worked and over time, MRI scans show no tumor, the treatment may be stopped. These people will need to have regular MRIs to see if the tumor comes back. On the other hand, if after 6 months the tumor hasn’t responded well enough, or if serious side effects occur, then surgery is considered.

Some doctors recommend surgery in special cases, such as for people who cannot tolerate the drugs, or for women who want to become pregnant. (The drugs must be stopped during pregnancy, and pregnancy might cause the tumor to grow quickly.) Surgery can also be used when drug treatment doesn't work.

Radiation may be used if drug treatment and surgery do not work.

Treatment of somatotroph or growth hormone-secreting adenomas

Adults with these tumors often have acromegaly, while children have gigantism.

Surgery is usually the first treatment for these adenomas, but it often can’t remove all of

the tumor. Sometimes, a somatostatin analog (see below) is given for a few months before surgery. This may cause the tumor to shrink, which could improve the chance that the surgery will remove all of the tumor, but doctors can't be certain before trying that this will help.

If growth hormone and insulin-like growth factor-1 (IGF-1) levels remain high after surgery, many experts recommend treating with medicine first. Radiation therapy is another option, but it's used most often when surgery and drug treatments don't work. (This is because radiation is very slow to act and over time it can lead to lowered levels of other pituitary hormones.)

Octreotide (Sandostatin), lanreotide (Somatuline Depot), and pasireotide (Signifor LAR) are man-made forms of the natural hormone somatostatin (they're called *somatostatin analogs*). These drugs return IGF-1 to normal levels in about 2 out of 3 patients. They are taken as injections, usually about once a month. The dose of these drugs may need to be adjusted based on blood IGF-1 levels.

Because these drugs work well and can be given monthly, doctors have started to question whether surgery should always be the first treatment for people with somatotroph adenomas. In those who might have problems with surgery, such as people with other major health problems, these drugs might be a good choice as the first treatment.

Another drug, pegvisomant, works by blocking the action of growth hormone. It can be used if somatostatin analogs (octreotide, lanreotide, or pasireotide) aren't doing enough to block growth hormone production.

Drugs such as cabergoline or bromocriptine can be used along with a somatostatin analog. This helps reduce growth hormone levels in about 1 out of 2 patients. But some patients have trouble tolerating the high doses often needed for these drugs to work. The good thing about these drugs is that they're taken as pills.

If surgery and drug treatments don't work, radiation therapy may be used.

Treatment of corticotroph or corticotropin (ACTH)-secreting adenomas

These tumors cause the adrenal glands to make too much of the steroid hormone cortisol, which leads to Cushing's disease. (See Signs and Symptoms of Pituitary Tumors.)

Surgery is usually the main treatment. If the surgery doesn't remove the tumor completely or if it grows back, the main options are a second surgery or radiation therapy. Radiation can often take months or years to work, so medicines may be given to help control cortisol levels in the meantime.

If surgery and radiation don't control cortisol levels, treatment options may include using medicines or removing both of the adrenal glands (see below).

Several different types of medicines can be used to help control cortisol levels or limit the effects of this hormone in the body. (See Medicines to Treat Pituitary Tumors.) But medicines don't work as well for ACTH-secreting tumors as they do in some other types of pituitary tumors. And some of these drugs can have serious side effects that make them hard to take for a long time.

If medicines aren't helpful, or if the patient can't take them because of side effects, both adrenal glands can be removed with an operation called a *bilateral adrenalectomy*. This can usually be done with laparoscopic surgery, using small incisions in the belly instead of one large one. The surgeon works through these small incisions with special long, thin instruments, including one with a tiny video camera lens on the end (called a laparoscope) for looking into the belly. Adrenalectomy stops all cortisol production, so high cortisol levels will no longer be a problem. But after surgery patients will need to take pills to replace the adrenal steroid hormones for the rest of their life.

If the adrenal glands are to be removed, the pituitary gland will first be treated with radiation. If this isn't done, removing the adrenals can cause the pituitary tumor to get larger and even start growing into the structures near the pituitary. This is known as *Nelson syndrome*. When the adenoma gets large, it can damage the normal parts of the pituitary gland, causing problems from hormone deficiency. It can also lead to high levels of ACTH. Because ACTH is a lot like the hormone that causes tanning of the skin, the high ACTH levels make the skin darker.

Treatment of thyrotroph or thyrotropin (TSH)-secreting adenomas

The treatment of choice for these tumors is surgery, which usually works well. Sometimes medicines are used before surgery to correct thyroid hormone levels and help shrink the tumor.

Sometimes radiation therapymay be used along with surgery. But radiation is not always helpful, and medicines may be needed to control the tumor's hormone

production if surgery didn't work. Some of the drugs that can be helpful include octreotide, lanreotide, cabergoline, and bromocriptine. These are usually used only if other treatments have failed to control the tumor.

It’s important to treat the pituitary tumor to keep it from damaging nearby structures. Drugs that stop the thyroid gland from making thyroid hormone can actually make things worse because reducing thyroid hormone production may cause the TSH-secreting pituitary tumor to grow.

Treatment of gonadotroph or gonadotropin (FSH/LH)-secreting adenomas

The hormones made by these tumors rarely cause major symptoms, so these tumors are often not found until they are large (macroadenomas) and pressing on nearby structures.

Treatment of these tumors is similar to that used for non-functional adenomas. Surgery is often the best option because it works right away. Radiation may be given after surgery.

Follow up with frequent MRI scans will show if the tumor is growing back. If it is, options include radiation (if it hasn’t been given already) or medicines such as dopamine agonists (cabergoline or bromocriptine) or somatostatin analogs (octreotide or lanreotide).

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Treatment of Non-Functional Pituitary Tumors (Tumors That Don’t Make Excess Hormones)

Not all pituitary tumors need to be treated right away, especially if they’re not growing or causing problems. But large tumors and those that are clearly growing often do need treatment.

Large tumors

Large tumors (called macroadenomas) tend to cause symptoms and are most often treated with surgery. This helps get rid of the symptoms and reduces the risk of damaging tissues near the pitituitary gland (like blood vessels, nerves, and the brain). Radiation therapy or radiosurgery might be done after surgery to kill any tumor cells that were left behind.

If a patient is not able to have surgery, radiation may be used as the main treatment.

MRI scans are done for many years after treatment. Eye exams and blood tests may be done, too. If there's tumor re-growth, more surgery or radiation may be used. Drug treatment is usually not helpful in treating these tumors, but medicines used to treat functional tumors may be tried. Some doctors have reported success using the chemotherapy drug temozolomide for fast-growing tumors.

Incidentalomas

These are small pituitary tumors (called microadenomas) that are seen on scans done for other reasons. They usually don't cause symptoms because they're not big enough to press on nearby structures and they don't secrete high levels of any hormone.

Most of these tumors do not change, and many doctors recommend just watching them. Regular physical exams and yearly MRI scans will be done to see if they start growing. Hormone levels may be checked, too. If the does tumor start growing or causing symptoms, it can then be treated. But the important point is that people with incidentalomas shouldn't get tests or treatments that they don't really need.

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Treatment of Pituitary Carcinomas

Pituitary carcinomas are very rare tumors that have already spread to other parts of the body when they're found. Because so few people around the world have this cancer, it's been difficult to learn much about it, and it's hard to diagnose and treat. At this time, most treatment is focused on easing the problems caused by the cancer. This is called supportive or palliative care.

Surgery and radiation therapy are the main forms of treatment used. They may decrease tumor size, slow tumor growth, and help prevent or relieve symptoms. Surgery may be repeated, if needed.

Medicines are used to manage hormone levels in functional pituitary carcinomas. These are the same drugs used to treat pituitary adenomas, but higher doses and

combinations of drugs may be needed.

Chemotherapy and newer targeted therapy drugs may be tried, but it's not fully clear that these treatments improve survival. A chemo drug called temozolomide has been found to help and may be tried if surgery and radiation don't work. Because pituitary carcinoma affects so few patients, it's hard to study which treatments might be effective. Taking part in a clinical trial of a new treatment may be a good option.

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Last Medical Review: November 2, 2017 Last Revised: November 2, 2017
