Treating Brain and Spinal Cord Tumors in Adults

How are brain and spinal cord tumors treated?

Several types of treatment can be used to treat brain and spinal cord tumors, including:

- Surgery for Adult Brain and Spinal Cord Tumors
- Radiation Therapy for Adult Brain and Spinal Cord Tumors
- Chemotherapy for Adult Brain and Spinal Cord Tumors
- Targeted Therapy for Adult Brain and Spinal Cord Tumors
- Other Drug Treatments for Adult Brain and Spinal Cord Tumors
- Alternating Electric Field Therapy for Adult Brain and Spinal Cord Tumors

Common treatment approaches

Treatment is based on the type of tumor and other factors, and often more than one type of treatment is used. Typically a team of doctors plan each person’s treatment individually to give them the best chance of treating the tumor while limiting the side effects as much as possible.

- Treating Specific Types of Adult Brain and Spinal Cord Tumors

Who treats brain and spinal cord tumors?

Brain and spinal cord tumors can often be hard to treat and require care from a team of different types of doctors. This team is often led by a neurosurgeon, a doctor who operates on brain and nervous system tumors. Other doctors on the team might include:
• **Neurologist:** a doctor who diagnoses brain and nervous system diseases and treats them with medicines

• **Radiation oncologist:** a doctor who uses radiation to treat cancer

• **Medical oncologist:** a doctor who uses chemotherapy and other medicines to treat cancers

• **Endocrinologist:** a doctor who treats diseases in glands that secrete hormones

You might have many other specialists on your treatment team as well, including physician assistants (PAs), nurse practitioners (NPs), nurses, psychologists, social workers, rehabilitation specialists, and other health professionals.

• [Health Professionals Associated With Cancer Care](#)

### Making treatment decisions

It’s important to discuss all of your treatment options, including their goals and their possible side effects, with your treatment team to help make the decision that best fits your needs. Some important things to consider include:

- Your age and overall health
- The type and location of your tumor
- The likelihood that treatment will cure your tumor (or help in some other way)
- Your feelings about the possible side effects from treatment

You may feel that you need to decide quickly, but it’s important to give yourself time to think about the information you have learned. It’s also very important to ask questions if there is anything you’re not sure about.

• [Questions to Ask About Adult Brain and Spinal Cord 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 harmful.

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.

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**Surgery for Adult Brain and Spinal Cord Tumors**

Surgery on brain and spinal cord tumors may be done to:

- Get a biopsy sample to determine the type of tumor
- Remove the tumor (or as much of it as possible)
- Help prevent or treat symptoms or possible complications from the tumor

Before surgery, be sure you understand the goal of the surgery, as well as its possible benefits and risks.

**Surgery to remove the tumor**
Most often, the first step in brain tumor treatment is for the neurosurgeon to remove as much of the tumor as is safe without affecting normal brain function.

Surgery alone or combined with radiation therapy\(^4\) may control or cure many tumors, including some low-grade astrocytomas, ependymomas, craniopharyngiomas, gangliogliomas, and meningiomas.

Tumors that tend to spread widely into nearby brain tissue such as anaplastic astrocytomas or glioblastomas cannot be cured by surgery. But surgery can reduce the amount of tumor that needs to be treated by radiation or chemotherapy\(^5\), which might help these treatments work better. This could help prolong the person’s life even if all of the tumor can’t be removed.

Surgery can also help relieve some of the symptoms\(^6\) caused by brain tumors, particularly those caused by a buildup of pressure within the skull. These can include headaches, nausea, vomiting, and blurred vision. Surgery may also make seizures easier to control with medicines.

Surgery may not be a good option in some situations, such as if the tumor is deep within the brain, if it’s in a part of the brain that can’t be removed, such as the brain stem, or if a person can’t have a major operation for other health reasons.

Surgery is not very effective against some types of brain tumors, such as lymphomas, although it may be used to get a biopsy for diagnosis.

**Craniotomy**

A craniotomy is a surgical opening made in the skull. This is the most common approach for surgery to treat brain tumors. The person may either be under general anesthesia (in a deep sleep) or may be awake for at least part of the procedure (with the surgical area numbed) if brain function needs to be assessed during the operation.

Part of the head might need to be shaved before surgery. The neurosurgeon first makes a cut in the scalp over the skull near the tumor, and folds back the skin. A special type of drill is used to remove the piece of the skull over the tumor.

The opening is typically large enough for the surgeon to insert several instruments and see the parts of the brain needed to operate safely. The surgeon may need to cut into the brain itself to reach the tumor. The surgeon might use MRI or CT scans\(^7\) taken before the surgery (or may use ultrasound once the skull has been opened) to help locate the tumor and its edges.
The surgeon can remove the tumor in different ways depending on how hard or soft it is, and whether it has many or just a few blood vessels:

- One way is to cut it out with a scalpel or special scissors.
- Some tumors are soft and can be removed with suction devices.
- In other cases, a probe attached to an ultrasonic generator can be placed into the tumor to break it up and liquefy it. A small vacuum device is then used to suck it out.

Many devices can help the surgeon see the tumor and surrounding brain tissue. The surgeon often operates while looking at the brain through a special microscope. MRI or CT scans\(^8\) can be done before surgery (or ultrasound can be used once the skull has been opened) to map the area of tumors deep in the brain. In some cases, the surgeon uses intraoperative imaging, in which MRI (or other) images are taken at different times during the operation to show the location of any remaining tumor. This may allow some brain tumors to be resected more safely and extensively.

As much of the tumor is removed as possible without affecting important brain tissue or leaving the patient disabled in any way. The surgeon can use different techniques to lower the risk of removing vital parts of the brain, such as:

- **Intraoperative cortical stimulation (cortical mapping):** In this approach, the surgeon electrically stimulates parts of the brain in and around the tumor during the operation and monitors the response. This can show if these areas control an important function (and therefore should be avoided).
- **Functional MRI:** This type of imaging test (described in Tests for Brain and Spinal Cord Tumors in Adults\(^9\)) can be done before surgery to locate a particular function of the brain. This information can be used to identify and preserve that region during the operation.
- **Newer techniques:** Newer types of MRI, as well as other techniques such as fluorescence-guided surgery, might be helpful in some situations. Some of these are described in What’s New in Adult Brain and Spinal Cord Tumor Research and Treatment?\(^10\)

Once the tumor is removed, the piece of the skull bone is put back in place and fastened with metal screws and plates, wires, or special stitches. (Usually any metal pieces are made from titanium, which allows a person to get follow-up MRIs [and will not set off metal detectors].)
You might have small tube (called a drain) coming out of the incision that allows excess cerebrospinal fluid (CSF) to leave the skull. Other drains may be in place to allow blood that builds up after surgery to drain from under the scalp. The drains are usually removed after a few days. An imaging test such as an MRI or CT scan is typically done 1 to 3 days after the operation to confirm how much of the tumor has been removed. Recovery time in the hospital is usually 4 to 6 days, although this depends on the size and location of the tumor, the patient’s general health, and whether other treatments are given. Healing around the surgery site usually takes several weeks.

**Surgery to put in a shunt or ventricular access catheter**

If a tumor blocks the flow of the CSF, it can increase pressure inside the skull. This can cause symptoms like headaches, nausea, and drowsiness, and may even be life-threatening.

To drain excess CSF and lower the pressure, the neurosurgeon may put in a silicone tube called a shunt (sometimes referred to as a ventriculoperitoneal or VP shunt). One end of the shunt is placed in a ventricle of the brain (an area filled with CSF) and the other end is placed in the abdomen or, less often, the heart or other areas. The tube runs under the skin of the neck and chest. The flow of CSF is controlled by a valve placed along the tubing.

Shunts may be temporary or permanent. They can be placed before or after the surgery to remove the tumor. Placing a shunt normally takes about an hour. As with any operation, complications might develop, such as bleeding or infection. Strokes are possible as well. Sometimes shunts get clogged and need to be replaced. The hospital stay after shunt procedures is typically 1 to 3 days, depending on the reason it is placed and the patient’s general health.

Surgery may also be used to insert a ventricular access catheter, such as an Ommaya reservoir, to help deliver chemotherapy directly into the CSF. A small incision is made in the scalp, and a small hole is drilled in the skull. A flexible tube is then threaded through the hole until the open end of the tube is in a ventricle, where it reaches the CSF. The other end, which has a dome-shaped reservoir, stays just under the scalp. After the operation, doctors and nurses can use a thin needle to give chemotherapy drugs through the reservoir or to remove CSF from the ventricle for testing.

**Possible risks and side effects of surgery**

Surgery on the brain or spinal cord 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 are rare, but they can happen.

A major concern after surgery is swelling in the brain. Drugs called corticosteroids are typically given before and for several days after surgery to help lessen this risk.

One of the biggest concerns when removing brain tumors is the possible loss of brain function afterward, which is why doctors are very careful to remove only as much tissue as is safely possible. If problems do arise, it could be right after surgery, or it could be days or even weeks later, so close monitoring for any changes is very important (see Living as a Brain or Spinal Cord Tumor Survivor\(^\text{13}\)).

For more information on surgery as a treatment for cancer, see Cancer Surgery\(^\text{14}\).

**Hyperlinks**

Radiation Therapy for Adult Brain and Spinal Cord Tumors

Radiation therapy uses high-energy rays or small particles to kill cancer cells. This type of treatment is given by a doctor called a radiation oncologist. Radiation therapy may be used in different situations:

- After surgery to try to kill any remaining tumor cells
- As the main treatment if surgery\(^1\) is not a good option and medicines are not effective


References


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• To help prevent or relieve symptoms from the tumor

**Types of radiation therapy**

Most often, the radiation is focused on the tumor from a source outside the body. This is called **external beam radiation therapy (EBRT)**. This type of radiation therapy is much like getting an x-ray, but the dose of radiation is much higher.

Before your treatments start, the radiation team will determine the correct angles for aiming the radiation beams and the proper dose of radiation. This planning session, called **simulation**, usually includes getting **imaging tests** such as CT or MRI scans.

In most cases, the total dose of radiation is divided into daily fractions (usually given Monday through Friday) over several weeks. At each treatment session, you lie on a special table while a machine delivers the radiation from precise angles. The treatment is not painful. Each session lasts about 15 to 30 minutes. Much of that time is spent making sure the radiation is aimed correctly. The actual treatment time each day is much shorter.

High doses of radiation therapy can damage normal brain tissue, so doctors try to deliver the radiation to the tumor with the lowest possible dose to normal surrounding brain areas. Several techniques can help doctors focus the radiation more precisely:

- **Three-dimensional conformal radiation therapy (3D-CRT):** 3D-CRT uses the results of imaging tests such as MRI and special computers to map the location of the tumor precisely. Several radiation beams are then shaped and aimed at the tumor from different directions. Each beam alone is fairly weak, which makes it less likely to damage normal tissues, but the beams converge at the tumor to give a higher dose of radiation there.

- **Intensity modulated radiation therapy (IMRT):** IMRT is an advanced form of 3D therapy. It uses a computer-driven machine that moves around the patient as it delivers radiation. Along with shaping the beams and aiming them at the tumor from several angles, the intensity (strength) of the beams can be adjusted to limit the dose reaching the most sensitive normal tissues. This may let the doctor deliver a higher dose to the tumor. Many major hospitals and cancer centers now use IMRT.

- **Conformal proton beam radiation therapy:** Proton beam therapy uses an approach similar to 3D-CRT. But instead of using x-rays, it focuses proton beams on the tumor. Protons are positive parts of atoms. Unlike x-rays, which release energy both before
and after they hit their target, protons cause little damage to tissues they pass through and then release their energy after traveling a certain distance. Doctors can use this property to deliver more radiation to the tumor and do less damage to nearby normal tissues.

This approach may be more helpful for brain tumors that have distinct edges (such as chordomas), but it is not clear if it will be useful for tumors that are infiltrative or mixed with normal brain tissue (such as astrocytomas or glioblastomas). There are a limited number of proton beam centers in the United States at this time.

**Stereotactic radiosurgery (SRS)/stereotactic radiotherapy (SRT):** This type of treatment delivers a large, precise radiation dose to the tumor area in a single session (SRS) or in a few sessions (SRT). (There is no actual surgery in this treatment.) It may be used for some tumors in parts of the brain or spinal cord that can’t be treated with surgery or when a patient isn’t healthy enough for surgery.

First, a head frame is usually attached to the skull to help aim the radiation beams. (Sometimes a face mask is used to hold the head in place instead.) Once the exact location of the tumor is found on CT or MRI scans, radiation is focused at the tumor from many different angles. This can be done in 2 ways:

- In one approach, radiation beams 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.
- Another approach uses a movable linear accelerator (a machine that creates radiation) that is controlled by a computer. Instead of delivering many beams at once, this machine moves around the head to deliver radiation to the tumor from many different angles. Several machines with names such as X-Knife, CyberKnife, and Clinac deliver stereotactic radiosurgery in this way.

SRS typically delivers the whole radiation dose in a single session, though it may be repeated if needed. For SRT (sometimes called fractionated radiosurgery), doctors give the radiation in several treatments to deliver the same or a slightly higher dose. Frameless techniques are now available to make this more comfortable.

**Brachytherapy (internal radiation therapy):** Unlike the external radiation approaches above, brachytherapy involves inserting radioactive material directly into or near the tumor. The radiation it gives off travels a very short distance, so it affects only the tumor. This technique is most often used along with external radiation. It provides a high dose of radiation at the tumor site, while the external radiation treats nearby areas with a
lower dose.

**Whole brain and spinal cord radiation therapy (craniospinal radiation):** If tests like an MRI scan or lumbar puncture find the tumor has spread along the covering of the spinal cord (meninges) or into the surrounding cerebrospinal fluid, then radiation may be given to the whole brain and spinal cord. Some tumors such as ependymomas and medulloblastomas are more likely to spread this way and often require craniospinal radiation.

**Possible side effects of radiation therapy**

Radiation is more harmful to tumor cells than it is to normal cells. Still, radiation can also damage normal brain tissue, which can lead to side effects.

**Side effects during or soon after treatment:** Some people become irritable and tired during the course of radiation therapy. Nausea, vomiting, and headaches are also possible side effects but are uncommon. Sometimes dexamethasone (a corticosteroid) or other drugs can help relieve these symptoms. Some people might have hair loss in areas of the scalp that get radiation. Other side effects are also possible, depending on where the radiation is aimed.

**Problems with thinking and memory:** A person may lose some brain function if large areas of the brain get radiation. Problems can include memory loss, personality changes, and trouble concentrating. There may also be other symptoms depending on the area of brain treated and how much radiation was given. These risks must be balanced against the risks of not using radiation and having less control of the tumor.

**Radiation necrosis:** Rarely after radiation therapy, a mass of dead (necrotic) tissue forms at the site of the tumor in the months or years after radiation treatment. It can often be controlled with corticosteroid drugs, but surgery may be needed to remove the necrotic tissue in some instances.

**Increased risk of another tumor:** Radiation can damage genes in normal cells. As a result, there is a small risk of developing a second cancer in an area that got radiation — for example, a meningioma of the coverings of the brain, another brain tumor, or less likely a bone cancer in the skull. If this occurs, it's usually many years after the radiation is given. This small risk should not prevent those who need radiation from getting treatment.

To learn more, see [Radiation Therapy](#).
Chemotherapy for Adult Brain and Spinal Cord Tumors

Chemotherapy (chemo) uses anti-cancer drugs that are usually given into a vein (IV) or taken by mouth. These drugs enter the bloodstream and reach almost all areas of the body. However, many chemo drugs aren't able to enter the brain and reach tumor cells.
For some brain tumors, the drugs can be given directly into the cerebrospinal fluid (CSF, the fluid that bathes the brain and spinal cord), either in the brain or into the spinal canal below the spinal cord. To help with this, a thin tube known as a ventricular access catheter may be inserted through a small hole in the skull and into a ventricle of the brain during a minor operation (see Surgery for Adult Brain and Spinal Cord Tumors).

**When might chemotherapy be used?**

In general, chemo is used for faster growing brain tumors. Some types of brain tumors, such as medulloblastoma and lymphoma, tend to respond better to chemo than others. Chemo is not as helpful for treating spinal cord tumors, so it is used less often for these tumors.

Chemo is most often used along with other treatments such as surgery and/or radiation therapy. Chemo can also be used by itself, especially for more advanced tumors or for tumors that have come back after other types of treatment.

**Which chemo drugs are used to treat brain and spinal cord tumors?**

Some of the chemo drugs used to treat brain and spinal cord tumors include:

- Carboplatin
- Carmustine (BCNU)
- Cisplatin
- Cyclophosphamide
- Etoposide
- Irinotecan
- Lomustine (CCNU)
- Methotrexate
- Procarbazine
- Temozolomide
- Vincristine

These drugs can be used alone or in combinations, depending on the type of brain tumor. Doctors give chemo in cycles, with each period of treatment followed by a rest period to give the body time to recover. Each cycle typically lasts for a few weeks.

**Carmustine (Gliadel) wafers:** These dissolvable wafers contain the chemo drug
carmustine (BCNU). After the surgeon removes as much of the brain tumor as is safe during a craniotomy, the wafers can be placed directly on or next to the parts of the tumor that can’t be removed. Unlike IV or oral chemo that reaches all areas of the body, this type of therapy concentrates the drug at the tumor site, producing few side effects in other parts of the body.

**Possible side effects of chemotherapy**

Chemo drugs can cause side effects. These depend on the type and dose of drugs, and how long treatment lasts. Common side effects can include:

- Hair loss
- Mouth sores
- Loss of appetite
- Nausea and vomiting
- Diarrhea
- Increased chance of infections (from having too few white blood cells)
- Easy bruising or bleeding (from having too few blood platelets)
- Fatigue (from having too few red blood cells, changes in metabolism, or other factors)

Some of the most effective drugs against brain tumors tend to have fewer of these side effects than other common chemo drugs. Most side effects usually go away after treatment is finished. There are often ways to lessen these side effects. For example, drugs can often help prevent or reduce nausea and vomiting.

Some chemo drugs can also cause other, less common side effects. For example, cisplatin and carboplatin can also cause kidney damage and hearing loss. Your doctor will check your kidney function and hearing if you are getting these drugs. Some of these side effects might last after treatment is stopped.

Be sure to report any side effects while getting chemo to your medical team so that you can be treated promptly. In some cases, the doses of the drugs may need to be reduced or treatment may need to be delayed or stopped to prevent the effects from getting worse.

To learn more, see the Chemotherapy section on our website.

**Hyperlinks**

References


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Targeted Therapy for Adult Brain and Spinal Cord Tumors
As researchers have learned more about the inner workings of cells that cause cancer or help cancer cells grow, they have developed newer drugs that specifically target these changes. These targeted drugs work differently from standard chemotherapy\(^1\) drugs. They sometimes work when chemo drugs don’t, and they often have different side effects. Targeted drugs don’t yet play a large role in treating brain or spinal cord tumors, but some of them might be helpful for certain types of tumors.

**Bevacizumab (Avastin, Mvasi)**

Bevacizumab is a man-made version of an immune system protein called a **monoclonal antibody**. This antibody targets vascular endothelial growth factor (VEGF), a protein that helps tumors form new blood vessels to get nutrients (a process known as **angiogenesis**). Tumors need new blood vessels to grow.

This drug is used mainly to treat some types of gliomas (especially glioblastomas) that come back after initial treatment. When used alone or added to chemotherapy, this drug can help shrink some tumors or extend the time until they start growing again, although it does not seem to help people live longer. It can also help lower the dose of the steroid drug dexamethasone needed to help reduce swelling in the brain, which is especially important for patients sensitive to steroid side effects.

Bevacizumab is given by intravenous (IV) infusion, usually once every 2 weeks.

Common side effects include high blood pressure, tiredness, bleeding, low white blood cell counts, headaches, mouth sores, loss of appetite, and diarrhea. Less common but possibly serious side effects include blood clots, internal bleeding, heart problems, and holes (perforations) in the intestines. This drug can also slow wound healing, so usually it can’t be given within a few weeks of surgery.

**Everolimus (Afinitor)**

Everolimus works by blocking a cell protein known as mTOR, which normally helps cells grow and divide into new cells. For subependymal giant cell astrocytomas (SEGAs) that can’t be removed completely by surgery\(^2\), this drug may shrink the tumor or slow its growth for some time, although it’s not clear if it can help people with these tumors live longer.

Everolimus is a pill taken once a day. Common side effects include mouth sores, increased risk of infections, nausea, loss of appetite, diarrhea, skin rash, feeling tired or weak, fluid buildup (usually in the legs), and increases in blood sugar and cholesterol levels. A less common but serious side effect is damage to the lungs, which can cause
shortness of breath or other problems.

Other targeted therapies are now being developed and studied in clinical trials\(^3\).
but they may help lessen symptoms from the tumor or its treatment.

**Corticosteroids**

Corticosteroid drugs such as dexamethasone (Decadron) are often given to reduce swelling around brain tumors. This may help relieve headaches and other symptoms.

**Anti-seizure drugs (anticonvulsants)**

Drugs may also be given to lower the chance of seizures in people with brain tumors. Different anti-seizure drugs can be used. Because many of these drugs can affect how other drugs such as chemotherapy¹ work in the body, they are not usually given unless the tumor has caused seizures.

**Hormones**

The pituitary gland helps control the levels of many different hormones in the body. If the pituitary gland is damaged by the tumor itself or by tumor treatments (such as surgery² or radiation therapy³), you may need to take pituitary hormones or other hormones to replace those missing.

**Hyperlinks**


**References**


Researchers have found that exposing some types of tumor cells to alternating electric fields (also known as tumor treating fields) can interfere with the cells’ ability to grow and spread. A portable device that generates such electric fields, known as Optune, is now an option to help treat some people with glioblastomas:

- It can be used in people with newly diagnosed glioblastoma after treatment with surgery and radiation therapy. The device is used along with chemotherapy. It may help people live longer than if they just get chemotherapy alone.
- It can also be used (instead of chemotherapy) in people whose glioblastoma has come back after initial treatment. It hasn’t been shown to help people live longer than chemotherapy in this situation, but it tends to have much milder side effects.

How is it done?

The head is shaved, and 4 sets of electrodes are placed on the scalp. The electrodes are attached to a battery pack (kept in a backpack) and are worn for most of the day. They generate mild electric currents that are thought to affect tumor cells in the brain more than normal cells.

Possible side effects
Side effects of the device tend to be minor, and can include skin irritation at the electrode sites, trouble sleeping, mood changes, and a slightly increased risk of headaches and seizures.

**References**


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**Treating Specific Types of Adult Brain and Spinal Cord Tumors**

The treatment options for brain and spinal cord tumors depend on several factors, including the type¹ and location of the tumor, how far it has grown or spread², and a person's age and overall health.

**Non-infiltrating astrocytomas**
These tumors include **pilocytic astrocytomas**, which most often develop in the cerebellum in young people, and **subependymal giant cell astrocytomas (SEGAs)**, which are almost always seen in people with **tuberous sclerosis**. Many doctors consider these tumors benign because they tend to grow very slowly and rarely grow into (infiltrate) nearby tissues.

These astrocytomas can often be cured if they can be removed completely by **surgery**, but older patients are less likely to be cured. **Radiation therapy** may be given after surgery, particularly if the tumor is not removed completely, although many doctors will wait until there are signs the tumor has grown back before considering it. Even then, repeating surgery may be the first option.

The outlook is not as good if the tumor occurs in a place where it can’t be removed by surgery, such as in the hypothalamus or brain stem. In these cases, radiation therapy is usually the best option.

For SEGAs that can’t be removed completely with surgery, treatment with the **targeted drug** everolimus (Afinitor) may shrink the tumor or slow its growth for some time, although it’s not clear if it can help people live longer.

**Low-grade infiltrating astrocytomas (diffuse astrocytomas)**

The initial treatment is **surgery** to remove the tumor if it can be done, or biopsy to confirm the diagnosis if surgery is not feasible. These tumors are hard to cure by surgery because they often grow into (infiltrate) nearby normal brain tissue. Usually the surgeon will try to remove as much of the tumor as safely possible. If the surgeon can remove it all, the patient may be cured.

**Radiation therapy** may be given after surgery, especially if a lot of tumor remains. Younger adults whose tumors were small and not causing many symptoms may not be given radiation unless the tumor shows signs of growing again. (In some cases, a second surgery may be tried before giving radiation) In people who are older or whose tumors are at higher risk of coming back for other reasons, radiation is more likely to be given after surgery. **Chemotherapy** (most often with temozolomide or the PCV regimen – procarbazine, CCNU, and vincristine) may also be given after surgery in some cases. Some doctors use **lab tests of the tumor** to help determine if radiation or chemotherapy should be given.

Radiation and/or chemotherapy may be used as the main treatment if surgery is not a good option.
Intermediate- and high-grade gliomas (Glioblastomas, anaplastic astrocytomas, anaplastic oligodendrogliomas, anaplastic oligoastrocytomas)

Surgery\textsuperscript{11} is often the first treatment when it can be done, but these tumors are almost never cured with surgery. As much of the tumor is removed as is safely possible. Radiation therapy\textsuperscript{12} is then given in most cases. This may be given with or followed by chemotherapy\textsuperscript{13} if a person is healthy enough. For some people who are in poor health or whose tumor cells have certain gene changes found on lab tests\textsuperscript{14}, chemo may be used instead of radiation therapy.

For tumors that can’t be treated with surgery, radiation therapy along with chemo is usually the best option.

Temozolomide is the chemotherapy drug used first by most doctors because it crosses the blood-brain barrier and it’s convenient because it can be taken as a pill. It is sometimes given along with radiation therapy and then continued after the radiation is completed.

Cisplatin, carmustine (BCNU), and lomustine (CCNU) are other commonly used drugs. Combinations of drugs, such as the PCV regimen (procarbazine, CCNU, and vincristine), may also be used. All of these treatments may shrink or slow tumor growth for some time, but they are very unlikely to cure the tumor.

If standard chemotherapy drugs are no longer effective, the targeted drug\textsuperscript{15} bevacizumab (Avastin, Mvasi) may be helpful for some people, either alone or with chemo.

For glioblastomas, another treatment option might be alternating electrical field therapy with the Optune device. This can be used along with chemo (after surgery and radiation) as part of the initial treatment, or it can be used by itself (instead of chemo) for tumors that come back after treatment.

In general, these gliomas are very hard to control for long periods of time. Because these tumors are so hard to cure with current treatments, clinical trials\textsuperscript{16} of promising new treatments may be a good option.

Oligodendrogliomas

If possible, surgery\textsuperscript{17} is the first option for oligodendrogliomas. Surgery usually doesn’t cure these tumors, but it can relieve symptoms and prolong survival. Many
Oligodendrogliomas grow slowly, especially in younger people, and may not need further treatment right away. Surgery may be repeated if the tumor grows back in the same spot. Radiation therapy\textsuperscript{18} and/or chemo\textsuperscript{19} (most often with temozolomide or the PCV regimen - procarbazine CCNU, and vincristine,) may also be options after surgery.

Oligodendrogliomas tend to respond better to chemotherapy than some other brain tumors.

Radiation therapy and/or chemotherapy may be helpful for tumors that can’t be treated with surgery.

**Ependymomas and anaplastic ependymomas**

These tumors usually do not grow into nearby normal brain tissue. Sometimes, patients may be cured by surgery\textsuperscript{20} alone if the entire tumor can be removed, but often this is not possible. If only part of the tumor is removed with surgery (or if it is an anaplastic ependymoma), radiation therapy\textsuperscript{21} is given after surgery. If surgery cannot be done, radiation therapy is the main treatment.

Sometimes the tumor cells can spread into the cerebrospinal fluid (CSF). Patients typically get an MRI of the brain and spinal cord\textsuperscript{22} (and possibly a lumbar puncture\textsuperscript{23}) a few weeks after surgery if it is done. If either of these tests shows that the cancer has spread through the CSF, radiation therapy is given to the entire brain and spinal cord.

Chemotherapy\textsuperscript{24} is usually not helpful for these tumors, so it is usually not given unless the tumor can no longer be treated with surgery or radiation.

**Meningiomas**

Most meningiomas tend to grow slowly, so small tumors that aren’t causing symptoms can often be watched rather than treated, particularly in the elderly.

If treatment is needed, these tumors can usually be cured if they can be removed completely with surgery\textsuperscript{25}. Radiation therapy\textsuperscript{26} may be used along with, or instead of, surgery for tumors that can’t be removed completely.

For meningiomas that are atypical or invasive (grade II) or anaplastic (grade III), which tend to come back after treatment, radiation therapy is typically given after surgery even if all of the visible tumor has been removed.

For meningiomas that recur after initial treatment, further surgery (if possible) or
radiation therapy may be used. If surgery and radiation aren’t options, drug treatments (such as chemotherapy\textsuperscript{27}, immunotherapy, or hormone-like drugs) may be used, but it’s not clear how much benefit they offer.

**Schwannomas (including acoustic neuromas)**

These slow-growing tumors are usually benign and are cured by surgery\textsuperscript{28}. In some centers, small acoustic neuromas are treated by stereotactic radiosurgery (see Radiation Therapy for Adult Brain and Spinal Cord Tumors\textsuperscript{29}). For large schwannomas where complete removal is likely to cause problems, tumors may be operated on first to remove as much as is safe, and then the remainder is treated with radiosurgery.

**Spinal cord tumors**

If a spinal cord tumor is small and not causing symptoms, it might not need to be treated right away. Other spinal cord tumors are treated like those in the brain. Astrocytomas of the spinal cord usually cannot be removed completely. They may be treated with surgery\textsuperscript{30} to obtain a diagnosis and remove as much tumor as possible, and then by radiation therapy\textsuperscript{31}, or with radiation therapy alone. Meningiomas of the spinal canal are often cured by surgery, as are some ependymomas. If surgery doesn’t remove an ependymoma completely, radiation therapy is often given.

**Primary CNS lymphomas**

Treatment of central nervous system (CNS) lymphomas generally consists of chemotherapy and/or radiation therapy\textsuperscript{32}. Treatment is discussed in more detail in Non-Hodgkin Lymphoma\textsuperscript{33}.

**Brain tumors that occur more often in children**

Some types of brain tumors occur more often in children but do occur occasionally in adults. These include brain stem gliomas, germ cell tumors, craniopharyngiomas, choroid plexus tumors, medulloblastomas, primitive neuroectodermal tumors (PNETs), and some others. Treatment of these tumors is described in Brain and Spinal Cord Tumors in Children\textsuperscript{34}.

**Hyperlinks**

1. adults/about/types-of-brain-tumors.html

References


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