



[cancer.org](https://www.cancer.org) | 1.800.227.2345

About Brain and Spinal Cord Tumors in Adults

Overview and Types

If you have been diagnosed with a brain or spinal cord tumor or are worried about it, you likely have a lot of questions. Learning some basics is a good place to start.

- [What Are Adult Brain and Spinal Cord Tumors?](#)
- [Types of Brain and Spinal Cord Tumors in Adults](#)

Research and Statistics

See the latest estimates for new cases of brain and spinal cord tumors and deaths in the US and what research is currently being done.

- [Key Statistics for Brain and Spinal Cord Tumors](#)
 - [What's New in Adult Brain and Spinal Cord Tumor Research?](#)
-

What Are Adult Brain and Spinal Cord Tumors?

Brain and spinal cord tumors are masses of abnormal cells in the brain or spinal cord that have grown out of control.

In most other parts of the body, it is very important to distinguish between benign (non-cancerous) tumors and malignant tumors ([cancers](#)¹). Benign tumors do not grow into nearby tissues or spread to distant areas, so benign tumors in other parts of the body are almost never life-threatening. One of the main reasons malignant tumors are so dangerous is because they can spread throughout the body.

Brain tumors rarely spread to other parts of the body, but most of them can spread through the brain tissue. Even so-called benign brain tumors can, as they grow, press on and destroy normal brain tissue, which can lead to serious or sometimes even life-threatening damage. For this reason, doctors usually speak of **brain tumors** rather than **brain cancers**. The main concerns with brain and spinal cord tumors are:

- How fast they grow
- How readily they spread through the rest of the brain or spinal cord
- Where they are located
- If they can be removed (or destroyed) and not come back

But both benign and malignant brain and spinal cord tumors can be life threatening.

Brain and spinal cord tumors tend to be different in adults and children. They often form in different areas, develop from different cell types, and may have a different outlooks and treatments.

Information on these types of tumors in children is covered in [Brain and Spinal Cord Tumors in Children](#)².

The central nervous system

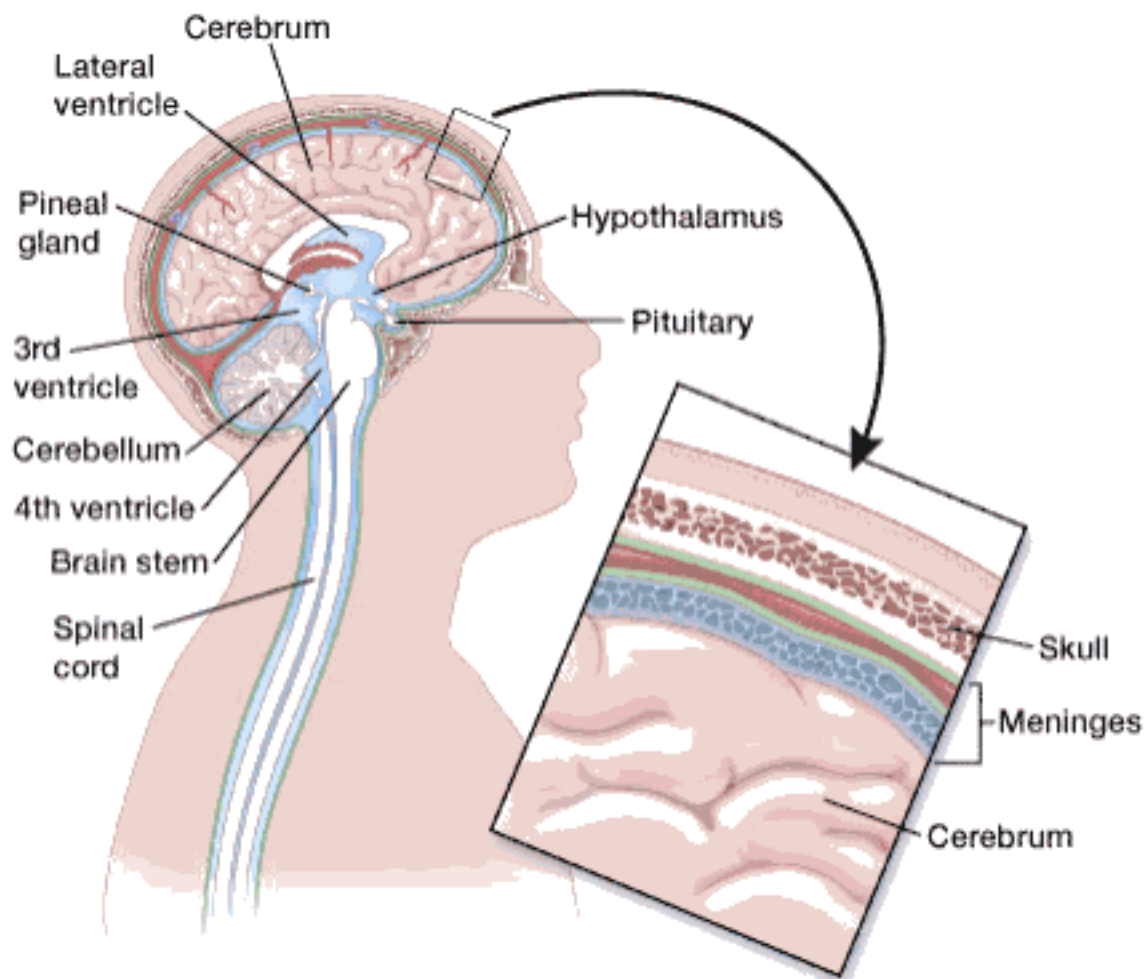
To understand brain and spinal cord tumors, it helps to know about the normal structure and function of the central nervous system (CNS), which is the medical name for the brain and spinal cord.

The brain is the center of thought, feeling, memory, speech, vision, hearing, movement, breathing, and much more. The spinal cord and special nerves in the head called **cranial nerves** help carry messages between the brain and the rest of the body. These messages tell our muscles how to move, transmit information gathered by our senses, and help coordinate the functions of our internal organs.

The brain is protected by the skull. Likewise, the spinal cord is protected by the bones (vertebrae) of the spinal column.

The brain and spinal cord are surrounded and cushioned by a special liquid, called **cerebrospinal fluid** (CSF). Cerebrospinal fluid is made by the choroid plexus, which is found in spaces within the brain called **ventricles**. The ventricles and the spaces around the brain and spinal cord are filled with CSF.

Parts of the brain and spinal cord



The main areas of the brain include the cerebrum, cerebellum, and brain stem. Each part has a special function.

Cerebrum: The cerebrum is the large, outer part of the brain. It is divided into left and right hemispheres (halves) and controls reasoning, thought, emotion, and language. It is also responsible for planned (voluntary) muscle movements (throwing a ball, walking, chewing, etc.) and for taking in and interpreting sensory information such as vision, hearing, smell, touch, and pain.

Cerebellum: The cerebellum lies under the cerebrum at the back part of the brain. It helps coordinate movement.

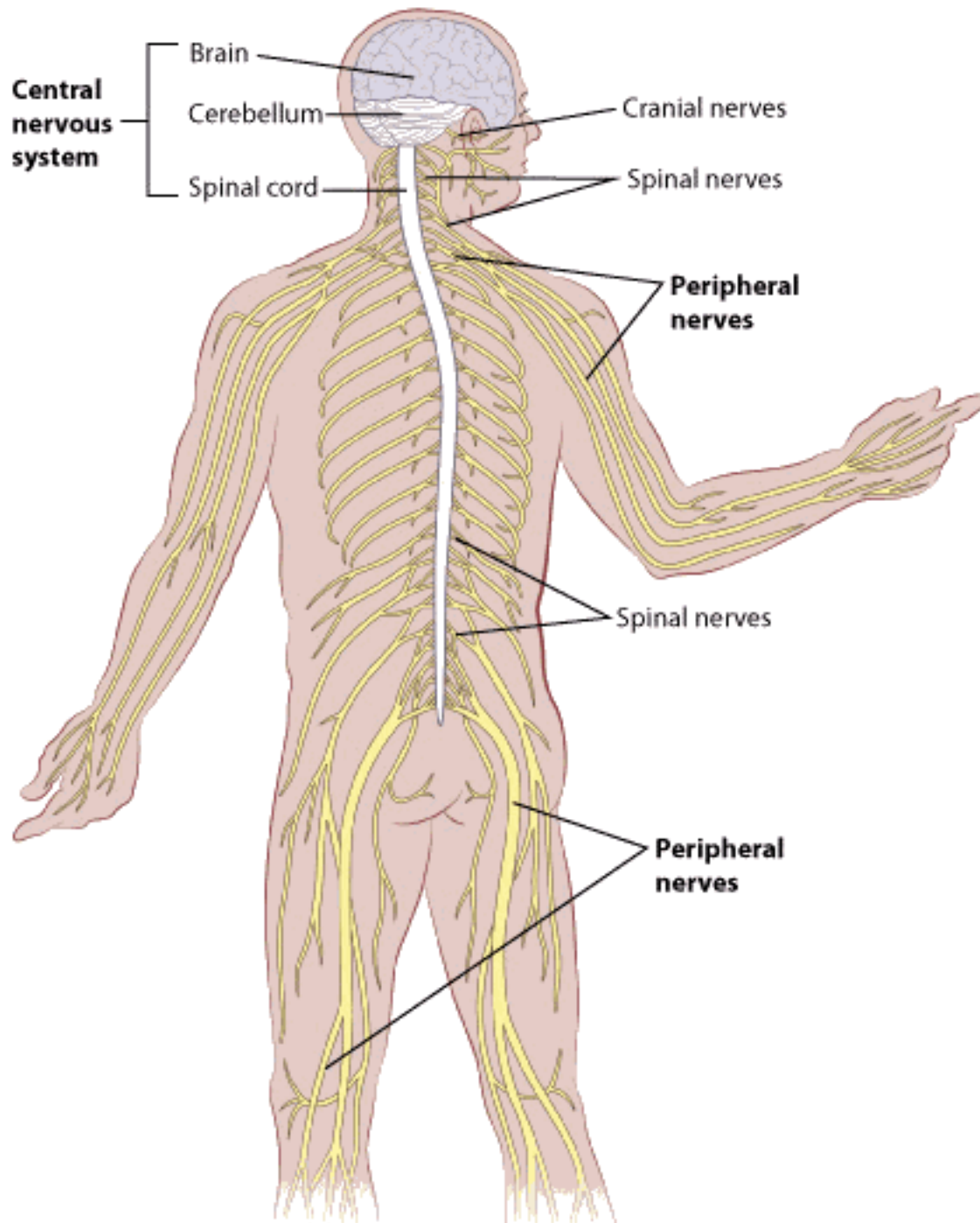
Brain stem: The brain stem is the lower part of the brain that connects to the spinal cord. It contains bundles of very long nerve fibers that carry signals controlling muscles and sensation or feeling between the cerebrum and the rest the body. Special centers in the brain stem also help control breathing and the beating of the heart. Also, most cranial nerves (described below) start in the brain stem.

The brain stem is divided into 3 main parts: the midbrain, pons, and medulla oblongata.

Because the brain stem is a small area that is so essential for life, it might not be possible to surgically remove tumors in this area.

Cranial nerves: The cranial nerves extend directly out of the base of the brain (as opposed to coming out of the spinal cord). These nerves carry signals directly between the brain and the face, eyes, ears, tongue, mouth, and some other areas.

Spinal cord: The spinal cord is made up of bundles of very long nerve fibers that carry signals related to muscle control, sensation or feeling, and bladder and bowel control.



Pituitary gland and hypothalamus: The pituitary is a small gland at the base of the brain. It is connected to a part of the brain called the **hypothalamus**. They work together to make hormones that help regulate the activity of several other glands in the body. For example:

- They control the amount of thyroid hormone made by the thyroid gland.
- They affect breast milk production and release.
- They control the amount of male or female hormones made by the testicles or ovaries.
- They make growth hormone, which stimulates body growth.
- They make vasopressin, which regulates water balance by the kidneys.

The growth of tumors in or near the pituitary or hypothalamus, as well as surgery and/or radiation therapy in this area, can affect these functions. For example, [tumors starting in the pituitary gland](#)³ sometimes make too much of a certain hormone, which can cause problems. On the other hand, a person may have low levels of one or more hormones after treatment and may need to take hormones to make up for this.

Pineal gland: The pineal gland is not really part of the brain. It is a small endocrine gland that sits between the cerebral hemispheres. It makes melatonin, a hormone that regulates sleep, in response to changes in light. The most common tumors of the pineal gland are called **pineoblastomas**.

Blood-brain barrier: The inner lining of the small blood vessels (capillaries) in the brain and spinal cord creates a very selective barrier between the blood and the tissues of the central nervous system. This barrier normally helps maintain the brain's metabolic balance and keeps harmful toxins from getting into the brain. Unfortunately, it also keeps out most [chemotherapy](#)⁴ drugs that are used to kill cancer cells, which in some cases limits their usefulness.

Choroid plexus: The choroid plexus is the area of the brain within the ventricles that makes CSF, which nourishes and protects the brain.

Types of cells and body tissues in the brain and spinal cord

The brain and spinal cord have many kinds of tissues and cells, which can develop into different [types of tumors](#).

Neurons (nerve cells): These are the cells in the brain that help determine thought, memory, emotion, speech, muscle movement, sensation, and just about everything else that the brain and spinal cord do.

Unlike many other types of cells that can grow and divide to repair damage from injury or disease, neurons in the brain and spinal cord largely stop dividing about a year after birth (with a few exceptions). Neurons do not usually form tumors, but they are often

damaged by tumors that start nearby.

Glial cells: Glial cells are the supporting cells of the brain. Most brain and spinal cord tumors develop from glial cells. These tumors are sometimes referred to as **gliomas**.

There are 3 main types of glial cells:

- **Astrocytes** help support and nourish neurons. When the brain is injured, astrocytes form scar tissue that helps repair the damage. The main tumors starting in these cells are called **astrocytomas** or **glioblastomas**.
- **Oligodendrocytes** make myelin, a fatty substance that surrounds and insulates the nerve cell axons of the brain and spinal cord. This helps neurons send electric signals through the axons. Tumors starting in these cells are called **oligodendrogliomas**.
- **Ependymal cells** line the ventricles (fluid-filled areas) within the brain and form part of the pathway through which CSF flows. Tumors starting in these cells are called **ependymomas**.

(A fourth type of cell, called **microglia**, are the infection-fighting cells of the central nervous system. They are part of the immune system and are not truly glial cells.)

Neuroectodermal cells: These are very early forms of nervous system cells that are probably involved in brain cell development. They are found throughout the brain, although they are not often seen in the adult central nervous system. The most common tumors that come from these cells develop in the cerebellum and are called **medulloblastomas**.

Meninges: These are layers of tissue that line and protect the brain and spinal cord. CSF travels through spaces formed by the meninges. The most common tumors that start in these tissues are called **meningiomas**.

Hyperlinks

1. www.cancer.org/cancer/cancer-basics/what-is-cancer.html
2. www.cancer.org/cancer/brain-spinal-cord-tumors-children.html
3. www.cancer.org/cancer/pituitary-tumors.html
4. www.cancer.org/treatment/treatments-and-side-effects/treatment-types/chemotherapy.html

References

Dorsey JF, Salinas RD, Dang M, et al. Chapter 63: Cancer of the central nervous system. In: Niederhuber JE, Armitage JO, Doroshow JH, Kastan MB, Tepper JE, eds. *Abeloff's Clinical Oncology*. 6th ed. Philadelphia, Pa: Elsevier; 2020.

National Cancer Institute Physician Data Query (PDQ). Adult Central Nervous System Tumors Treatment. 2020. Accessed at www.cancer.gov/types/brain/hp/adult-brain-treatment-pdq on February 4, 2020.

Last Medical Review: May 5, 2020 Last Revised: May 5, 2020

Types of Brain and Spinal Cord Tumors in Adults

There are two main types of brain and spinal cord tumors:

- Tumors that start in the brain or spinal cord are called **primary brain (or spinal cord) tumors**.
- Tumors that start in another part of the body and then spread to the brain or spinal cord are called **metastatic or secondary brain (or spinal cord) tumors**.

In adults, metastatic tumors to the brain are actually more common than primary brain tumors, and they are treated differently. **This information is about primary brain tumors.**

Unlike cancers that start in other parts of the body, tumors that start in the brain or spinal cord rarely spread to distant organs. Even so, brain or spinal cord tumors are rarely considered benign (non-cancerous). They can still cause damage by growing and spreading into nearby areas, where they can destroy normal brain tissue. And unless they are completely removed or destroyed, most brain or spinal cord tumors will continue to grow and eventually be life-threatening.

How brain and spinal cord tumors are classified

Several factors are important when doctors are trying to figure out how best to treat a brain or spinal cord tumor and what the prognosis (outlook) is likely to be:

The type of tumor (based on the type of cell it starts in): Tumors can form in almost any [type of tissue or cell in the brain or spinal cord](#). Some tumors have a mix of cell types. Different types of tumors tend to start in certain parts of the brain or spinal cord, and tend to grow in certain ways. (The most common types of brain and spinal cord tumors in adults are described below.)

The grade of the tumor: Some types of brain and spinal cord tumors are more likely to grow into nearby brain or spinal cord tissue (and to grow quickly) than are others. Brain and spinal cord tumors are typically divided into 4 grades (using Roman numerals I to IV), based largely on how the tumor cells look under a microscope:

- **Lower grade (grade I or II) tumors** tend to grow more slowly and are less likely to grow into (invade or infiltrate) nearby tissues.
- **Higher grade (grade III or IV) tumors** tend to grow quickly and are more likely to grow into nearby tissues. These tumors often require more intense treatment.

Gene changes in the tumor cells: Even for a specific type of brain tumor, the changes in the genes (DNA) of the tumor cells can be different. For example, many types of tumors are now divided based on whether the cells have mutations in one of the *IDH* genes (*IDH1* or *IDH2*). For a specific type of tumor, those with *IDH* mutations tend to have a better outlook than those without a mutation. Other gene mutations can also be important for certain types of tumors.

The location of the tumor: Where the tumor is in the brain or spinal cord can affect what symptoms it causes, as well as which treatments might be best.

Gliomas

Gliomas are not a specific type of brain tumor. Glioma is a general term for tumors that start in glial cells. A number of tumors can be considered gliomas, including:

- **Astrocytomas** (which include **glioblastomas**)
- **Oligodendrogliomas**
- **Ependymomas**

About 3 out of 10 of all brain tumors are gliomas. Most fast-growing brain tumors are gliomas.

Astrocytomas

Astrocytomas are tumors that start in glial cells called **astrocytes**. About 2 out of 10 brain tumors are astrocytomas.

Most astrocytomas can spread widely throughout the brain and blend with the normal brain tissue, which can make them very hard to remove with [surgery](#)¹. Sometimes they spread along the cerebrospinal fluid (CSF) pathways. It is very rare for them to spread outside of the brain or spinal cord.

As with other types of brain tumors, astrocytomas are often grouped by grade.

Low-grade (grade I or II) astrocytomas tend to grow slowly. These include:

- **Non-infiltrating (grade I) astrocytomas**, which do not usually grow into nearby tissues and tend to have a good prognosis. Examples include pilocytic astrocytomas and subependymal giant cell astrocytomas (SEGAs). These are more common in children than in adults.
- **Grade II astrocytomas**, such as diffuse astrocytomas and pleomorphic xanthoastrocytomas (PXAs). These tumors tend to be slow growing, but they can grow into nearby areas, which can make them harder to remove with surgery. These tumors can become more aggressive and faster growing over time.

High-grade (grade III or IV) astrocytomas tend to grow quickly and spread into the surrounding normal brain tissue. These include:

- **Anaplastic (grade III) astrocytomas**
- **Glioblastomas (grade IV)**, which are the fastest growing. These tumors make up more than half of all gliomas and are the most common malignant brain tumors in adults.

Oligodendrogliomas

These tumors start in brain glial cells called **oligodendrocytes**. These are grade II tumors that tend to grow slowly, but most of them can grow into (infiltrate) nearby brain tissue and can't be removed completely by surgery. Oligodendrogliomas sometimes spread along the CSF pathways but rarely spread outside the brain or spinal cord. As with astrocytomas, they can become more aggressive over time. Very aggressive (grade III) forms of these tumors are known as **anaplastic oligodendrogliomas**. Only

about 1% to 2% of brain tumors are oligodendrogliomas.

Ependymomas

These tumors start in ependymal cells, and typically grow in the ventricles or spinal cord in adults. They can range from fairly low-grade (grade II) tumors to higher grade (grade III) tumors, which are called **anaplastic ependymomas**. Only about 2% of brain tumors are ependymomas.

Ependymomas are more likely to spread along the cerebrospinal fluid (CSF) pathways than other gliomas but do not spread outside the brain or spinal cord. These tumors may block the flow of CSF from the ventricles, causing the ventricles to become very large – a condition called **hydrocephalus**.

Some (but not all) ependymomas can be removed completely and cured by surgery. But because they can spread along ependymal surfaces and CSF pathways, treating them can sometimes be difficult. Spinal cord ependymomas have the greatest chance of being cured with surgery, but treatment can cause side effects related to nerve damage.

Meningiomas

Meningiomas begin in the meninges, the layers of tissue that surround the outer part of the brain and spinal cord. Meningiomas account for about 1 out of 3 primary brain and spinal cord tumors. They are the most common primary brain tumors in adults (although strictly speaking, they are not actually brain tumors).

The risk of these tumors increases with age. They occur about twice as often in women. Sometimes these tumors run in families, especially in those with [neurofibromatosis²](#), a syndrome in which people develop many benign tumors of nerve tissue.

Meningiomas are often assigned a grade, based on how the cells look under the microscope.

- **Grade I (benign) meningiomas** have cells that look the most like normal cells. These are the most common type of meningioma. Most of these tumors can be cured by [surgery³](#), but some grow very close to vital structures in the brain or cranial nerves and cannot be cured by surgery alone.
- **Grade II (atypical or invasive) meningiomas** usually have cells that look slightly more abnormal. They can grow directly into nearby brain tissue and bone and are more likely to come back (recur) after surgery.

- **Grade III (anaplastic or malignant) meningiomas** have cells that look the most abnormal. These are the least common type of meningiomas. They tend to grow quickly, can grow into nearby brain tissue and bone, and are the most likely to come back after treatment. Some may even spread to other parts of the body.

Medulloblastomas

Medulloblastomas develop from neuroectodermal cells (early forms of nerve cells) in the cerebellum. They are fast-growing (grade IV) tumors and often spread throughout the CSF pathways, but they can be treated by [surgery](#)⁴, [radiation therapy](#)⁵, and [chemotherapy](#)⁶.

Medulloblastomas occur much more often in children than in adults. They are part of a class of tumors called **embryonal tumors** that can also start in other parts of the central nervous system. For more information on these tumors, see [Brain and Spinal Cord Tumors in Children](#)⁷.

Gangliogliomas

Gangliogliomas contain both neurons and glial cells. These tumors are very uncommon in adults. They are typically slow growing (grade I) tumors and can usually be cured by [surgery](#)⁸ alone or surgery combined with [radiation therapy](#)⁹.

Schwannomas (neurilemmomas)

Schwannomas develop from Schwann cells, which surround and insulate cranial nerves and other nerves. They make up about 8% of all CNS tumors.

Schwannomas are almost always benign (grade I) tumors. They can arise from any cranial nerve. When they form on the cranial nerve responsible for hearing and balance near the cerebellum, they are called **vestibular schwannomas** or **acoustic neuromas**. They can also start on spinal nerves after the point where they have left the spinal cord. When this happens, they can press on the spinal cord, causing weakness, sensory loss, and bowel and bladder problems.

Craniopharyngiomas

These slow-growing (grade I) tumors start above the pituitary gland but below the brain

itself. They may press on the pituitary gland and the hypothalamus, causing hormone problems. Because they start very close to the optic nerves, they can also cause vision problems. Their tendency to stick to these important structures can make them hard to remove completely without damaging vision or hormone balance. Craniopharyngiomas are more common in children, but they are sometimes seen in adults.

Other tumors that can start in or near the brain

Chordomas

These rare tumors start in the bone at the base of the skull or at the lower end of the spine. Chordomas don't start in the central nervous system, but they can injure the nearby brain or spinal cord by pressing on it.

These tumors are treated with [surgery](#)¹⁰ if possible, often followed by [radiation therapy](#)¹¹, but they tend to come back in the same area after treatment, causing more damage. They usually do not spread to other organs. For more information on chordomas, see [Bone Cancer](#)¹².

Non-Hodgkin lymphomas

Lymphomas are cancers that start in white blood cells called **lymphocytes** (one of the main cell types of the immune system). Most lymphomas start in other parts of the body, but some start in the CNS, and are called **primary CNS lymphomas**.

These lymphomas are more common in people with immune system problems, such as those infected with [HIV](#)¹³, the virus that causes AIDS. Because of new treatments for AIDS, primary CNS lymphomas have become less common in recent years. They account for about 2% of primary brain tumors.

These lymphomas often grow quickly and can be hard to treat. Recent advances in chemotherapy, however, have improved the outlook for people with these cancers. For more information on primary CNS lymphomas (including treatment), see [Non-Hodgkin Lymphoma](#)¹⁴.

Pituitary tumors

Tumors that start in the pituitary gland are almost always benign (non-cancerous). But they can still cause problems if they grow large enough to press on nearby structures or if they make too much of any kind of hormone. For more information, see [Pituitary](#)

[Tumors](#)¹⁵.

Hyperlinks

1. www.cancer.org/cancer/brain-spinal-cord-tumors-adults/treating/surgery.html
2. www.cancer.org/cancer/brain-spinal-cord-tumors-adults/causes-risks-prevention/risk-factors.html
3. www.cancer.org/cancer/brain-spinal-cord-tumors-adults/treating/surgery.html
4. www.cancer.org/cancer/brain-spinal-cord-tumors-adults/treating/surgery.html
5. www.cancer.org/cancer/brain-spinal-cord-tumors-adults/treating/radiation-therapy.html
6. www.cancer.org/cancer/brain-spinal-cord-tumors-adults/treating/chemotherapy.html
7. www.cancer.org/cancer/brain-spinal-cord-tumors-children.html
8. www.cancer.org/cancer/brain-spinal-cord-tumors-adults/treating/surgery.html
9. www.cancer.org/cancer/brain-spinal-cord-tumors-adults/treating/radiation-therapy.html
10. www.cancer.org/cancer/brain-spinal-cord-tumors-adults/treating/surgery.html
11. www.cancer.org/cancer/brain-spinal-cord-tumors-adults/treating/radiation-therapy.html
12. www.cancer.org/cancer/bone-cancer.html
13. www.cancer.org/cancer/cancer-causes/infectious-agents/hiv-infection-aids.html
14. www.cancer.org/cancer/non-hodgkin-lymphoma.html
15. www.cancer.org/cancer/pituitary-tumors.html

References

Dorsey JF, Salinas RD, Dang M, et al. Chapter 63: Cancer of the central nervous system. In: Niederhuber JE, Armitage JO, Doroshow JH, Kastan MB, Tepper JE, eds. *Abeloff's Clinical Oncology*. 6th ed. Philadelphia, Pa: Elsevier; 2020.

Louis DN, Perry A, Reifenberger G, et al. The 2016 World Health Organization classification of tumors of the central nervous system: A summary. *Acta Neuropathol*. 2016;131(6):803-820.

National Cancer Institute Physician Data Query (PDQ). Adult Central Nervous System Tumors Treatment. 2020. Accessed at www.cancer.gov/types/brain/hp/adult-brain-treatment-pdq on February 4, 2020.

Ostrom QT, Cioffi G, Gittleman H, et al. CBTRUS statistical report: Primary brain and other central nervous system tumors diagnosed in the United States in 2012–2016. *Neuro-Oncol.* 2019;21 Suppl 5:v1–v100.

Park JK. Epidemiology, pathology, clinical features, and diagnosis of meningioma. UpToDate. 2020. Accessed at <https://www.uptodate.com/contents/epidemiology-pathology-clinical-features-and-diagnosis-of-meningioma> on February 6, 2020.

Last Medical Review: May 5, 2020 Last Revised: May 5, 2020

Key Statistics for Brain and Spinal Cord Tumors

The American Cancer Society's estimates for brain and spinal cord tumors in the United States for 2020 include both [adults](#)¹ and [children](#)².

- About 23,890 malignant tumors of the brain or spinal cord (13,590 in males and 10,300 in females) will be diagnosed. These numbers would be much higher if benign (non-cancer) tumors were also included.
- About 18,020 people (10,190 males and 7,830 females) will die from brain and spinal cord tumors.

Overall, the chance that a person will develop a malignant tumor of the brain or spinal cord in his or her lifetime is less than 1%. The risk of developing any type of brain or spinal cord tumor is slightly higher among women than among men, although the risk of developing a malignant tumor is slightly higher for men than for women. This is largely because certain types of tumors are more common in one gender or the other (for example, meningiomas are more common in women).

Survival rates for brain and spinal cord tumors vary widely, depending on the [type of tumor](#) (and [other factors](#)³). Rates for some of the more common types of brain and spinal cord tumors are discussed in [Survival Rates for Selected Adult Brain and Spinal Cord Tumors](#)⁴.

Visit the [American Cancer Society's Cancer Statistics Center](#)⁵ for more key statistics.

Hyperlinks

1. www.cancer.org/cancer/brain-spinal-cord-tumors-adults.html
2. www.cancer.org/cancer/brain-spinal-cord-tumors-children.html
3. www.cancer.org/cancer/brain-spinal-cord-tumors-adults/detection-diagnosis-staging/staging.html
4. www.cancer.org/cancer/brain-spinal-cord-tumors-adults/detection-diagnosis-staging/survival-rates.html
5. cancerstatisticscenter.cancer.org/

References

American Cancer Society. *Cancer Facts & Figures 2020*. Atlanta, Ga: American Cancer Society; 2020.

Howlader N, Noone AM, Krapcho M, et al (eds). SEER Cancer Statistics Review, 1975-2014, National Cancer Institute. Bethesda, MD, https://seer.cancer.gov/csr/1975_2014/, based on November 2016 SEER data submission, posted to the SEER web site, April 2017.

Ostrom QT, Gittleman H, Xu J, et al. CBTRUS statistical report: Primary brain and other central nervous system tumors diagnosed in the United States in 2009-2013. *Neuro Oncol*. 2016;18 Suppl 5:v1v75.

Last Medical Review: May 5, 2020 Last Revised: May 5, 2020

What's New in Adult Brain and Spinal Cord Tumor Research?

Research is always being done in the area of brain and spinal cord tumors. Scientists and doctors are looking for causes and ways to prevent these tumors, better tests to help characterize these tumors, and better ways to treat them.

Lab tests of brain tumors

In recent years, researchers have found some changes in genes, chromosomes, and proteins inside brain tumor cells that can be used to help predict a person's outlook (prognosis) or help guide treatment. Some examples of changes that can now be tested for include:

- *IDH1* or *IDH2* gene mutations
- Chromosomal 1p19q co-deletions
- MGMT promoter methylation

For more on how these tests are used, see [Tests for Brain and Spinal Cord Tumors in Adults¹](#).

Testing might also be done in certain situations to look for changes in other genes, such as *ATRX*, *TERT*, *H3F3A*, *BRAF*, and *HELA*.

Researchers are also looking for other changes in tumor cells that might help guide treatment.

Imaging and surgery techniques

Recent advances have made surgery for brain tumors much safer and more successful. Some of these newer techniques include:

Magnetic resonance spectroscopic imaging (MRSI)

In this approach, specially processed information from magnetic resonance spectroscopy (MRS, described in [Tests for Brain and Spinal Cord Tumors in Adults²](#)) is used to make a map of important chemicals involved in tumor metabolism. MRSI can help surgeons direct their biopsies to the most abnormal areas in the tumor. It can also help doctors direct radiation to the right areas and evaluate the effects of chemotherapy or targeted therapy.

Diffusion tensor imaging (DTI) or tractography

This is a type of MRI test that can show where the major pathways (tracts) of white matter are in the brain. Surgeons can look at this information before operating to help avoid these important parts of the brain when removing tumors.

Fluorescence-guided surgery

For this approach, the patient is given a special fluorescent dye a few hours before surgery. The dye is taken up by some tumors, which then glow when the surgeon looks at them under special lighting from the operating microscope. This lets the surgeon better separate the tumor from normal brain tissue. Researchers are now looking to improve on the dyes currently in use.

Newer surgical approaches for some types of tumors

To treat some tumors near the pituitary gland, a 3-D endoscope, a thin tube with a tiny video camera lens at the tip, is used to allow the surgeon to see the small area around the tumor in 3 dimensions. The surgeon passes the endoscope through a small hole made in the back of the nose to operate through the nasal passages, limiting the potential damage to the brain. A similar technique can be used for some tumors in the ventricles, where an endoscope is inserted through a small opening in the skull near the hairline. The tumor's size, shape, and position determine if this technique can be used.

Laser interstitial thermal therapy (LITT)

For some tumors that are hard to treat surgically, another option might be to insert a thin probe with a tiny laser on the end through a small hole in the skull and into the tumor. The laser is then used to heat and [destroy](#)³ (ablate) the tumor. This technique is still fairly new, so doctors are still learning about the best ways to use it.

Radiation therapy

Some newer types of external radiation therapy planning can help doctors deliver radiation more precisely to the tumor, which helps spare normal brain tissue.

Modern radiation techniques such as intensity modulated radiation therapy (IMRT), volumetric modulated arc therapy (VMAT), proton beam therapy, and image-guided radiation therapy (IGRT) are described in [Radiation Therapy for Adult Brain and Spinal Cord Tumors](#)⁴.

Other new methods of planning and delivering radiation therapy are also being studied.

Chemotherapy

Along with developing and testing new chemotherapy drugs, many researchers are

testing new ways to get chemotherapy to the brain tumor.

Many chemotherapy drugs are limited in their effectiveness because the tightly controlled openings in the brain capillaries, sometimes referred to as the **blood-brain barrier**, prevents the drugs from getting from the bloodstream to the brain. Researchers are now trying to modify some of these drugs by putting them in tiny droplets of fat (liposomes) or attaching them to molecules that normally cross the blood-brain barrier, to help them work better. This is an area of active research and [clinical trials](#)⁵.

Other new treatment strategies

Researchers are also testing some newer approaches to treatment that may help doctors target tumors more precisely. This could lead to treatments that work better and cause fewer side effects. Several of these treatments are still being studied.

Tumor vaccines and other types of immunotherapy

Several vaccines are being tested against brain tumors. Unlike vaccines against infections, these vaccines are meant to help treat the disease instead of prevent it. The goal of the vaccines is to stimulate the body's immune system to attack the brain tumor. Early study results of vaccines to help treat glioblastoma have shown promise, but more research is needed to determine how well they work.

Researchers are also looking at other types of treatments that could boost the immune response against brain tumors.

At this time, brain tumor vaccines and other types of immunotherapy are available only through [clinical trials](#)⁶.

Targeted drugs (such as growth factor inhibitors)

Tumor cells are often very sensitive to proteins called **growth factors**, which help them grow and divide. Newer drugs target some of these growth factors, which may slow the growth of tumor cells or even cause them to die. Many targeted drugs are already used for other types of cancer, and some are being studied to see if they will work for brain tumors as well.

Hyperlinks

1. www.cancer.org/cancer/brain-spinal-cord-tumors-adults/detection-diagnosis-staging/how-diagnosed.html
2. www.cancer.org/cancer/brain-spinal-cord-tumors-adults/detection-diagnosis-staging/how-diagnosed.html
3. www.cancer.org/treatment/treatments-and-side-effects/treatment-types/lasers-in-cancer-treatment.html
4. www.cancer.org/cancer/brain-spinal-cord-tumors-adults/treating/radiation-therapy.html
5. www.cancer.org/treatment/treatments-and-side-effects/clinical-trials.html
6. www.cancer.org/treatment/treatments-and-side-effects/clinical-trials.html

References

Dorsey JF, Salinas RD, Dang M, et al. Chapter 63: Cancer of the central nervous system. In: Niederhuber JE, Armitage JO, Doroshow JH, Kastan MB, Tepper JE, eds. *Abeloff's Clinical Oncology*. 6th ed. Philadelphia, Pa: Elsevier; 2020.

National Comprehensive Cancer Network. NCCN Clinical Practice Guidelines in Oncology: Central Nervous System Cancers. V.3.2019. Accessed at www.nccn.org/professionals/physician_gls/pdf/cns.pdf on February 7, 2020.

Scaringi C, Agolli L, Minniti G. Technical advances in radiation therapy for brain tumors. *Anticancer Res*. 2018;38(11):6041-6045.

Last Medical Review: May 5, 2020 Last Revised: May 5, 2020

Written by

The American Cancer Society medical and editorial content team
(www.cancer.org/cancer/acs-medical-content-and-news-staff.html)

Our team is made up of doctors and oncology certified nurses with deep knowledge of cancer care as well as journalists, editors, and translators with extensive experience in medical writing.

American Cancer Society medical information is copyrighted material. For reprint requests, please see our Content Usage Policy (www.cancer.org/about-

[us/policies/content-usage.html](#)).

cancer.org | 1.800.227.2345