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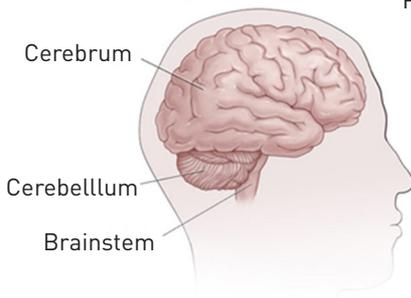
# Adult Brain and Spinal Cord Tumors

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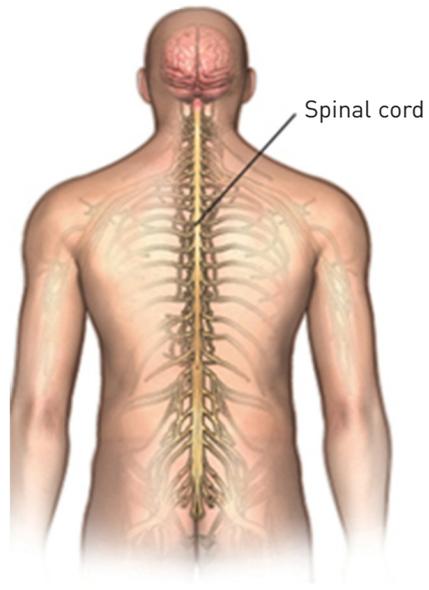
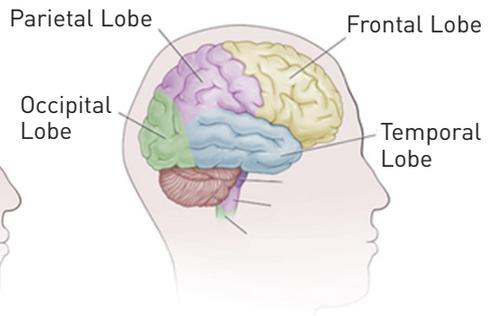
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CANCER CENTER

# An adult central nervous system (CNS) tumor is a disease in which abnormal cells form in the tissues of the brain and or the spinal cord.

## Major Parts of the Brain



## Anatomy of the Brain



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# **There are many types of brain and spinal cord tumors.**

Tumors are a growth of cells that are not normal and may begin in different parts of the brain or spinal cord. Together, the brain and spinal cord make up the central nervous system (CNS).

The tumors may be either benign (not cancer) or malignant (cancer):

- Benign brain and spinal cord tumors grow and press on nearby areas of the brain. They rarely spread into other tissues and may recur (come back).
- Malignant brain and spinal cord tumors are likely to grow quickly and spread into other brain tissue.

When a tumor grows into or presses on an area of the brain, it may stop that part of the brain from working the way it should. Both benign and malignant brain tumors cause signs and symptoms and need treatment.

Brain and spinal cord tumors can occur in both adults and children. However, treatment for children may be different than treatment for adults.

Tumors that start in the brain are called primary brain tumors. Primary brain tumors may spread to other parts of the brain or to the spine. They rarely spread to other parts of the body.

Often, tumors found in the brain have started somewhere else in the body and spread to one or more parts of the brain. These are called metastatic brain tumors (or brain metastases). Metastatic brain tumors are more common than primary brain tumors.

Up to half of metastatic brain tumors are from lung cancer. Other types of cancer that commonly spread to the brain include:

- Melanoma
- Breast cancer
- Colon cancer
- Kidney cancer
- Nasopharyngeal cancer
- Cancer of unknown primary site

Cancer may spread to the leptomeninges (the two innermost membranes covering the brain and spinal cord). This is called leptomeningeal carcinomatosis. The most common cancers that spread to the leptomeninges include:

- Breast cancer
- Lung cancer
- Leukemia
- Lymphoma

Cancers that commonly spread to the brain or spinal cord include:

- Adult Hodgkin lymphoma
- Adult non-Hodgkin lymphoma
- Breast cancer
- Carcinoma of unknown primary
- Colon cancer
- Leukemia
- Melanoma
- Nasopharyngeal cancer

- Non-small cell lung cancer
- Renal cell cancer
- Small cell lung cancer

## **The brain controls many important body functions.**

The brain has 3 major parts:

- The **cerebrum** is the largest part of the brain. It is at the top of the head. The cerebrum controls thinking, learning, problem solving, emotions, speech, reading, writing, and voluntary movement.
- The **cerebellum** is in the lower back of the brain (near the middle of the back of the head). It controls movement, balance, and posture.
- The **brain stem** connects the brain to the spinal cord. It is in the lowest part of the brain (just above the back of the neck). The brain stem controls breathing, heart rate, and the nerves and muscles used to see, hear, walk, talk, and eat.

## **The spinal cord connects the brain to nerves in most parts of the body.**

The spinal cord is a column of nerve tissue that runs from the brain stem down the center of the back. It is covered by three thin layers of tissue called membranes. These membranes are surrounded by the vertebrae (back bones). Spinal cord nerves carry messages between the brain and the rest of the body, such as a message from the brain to cause muscles to move or a message from the skin to the brain to feel touch.

**The cause of most adult brain and spinal cord tumors is not known. The signs and symptoms of adult brain and spinal cord tumors are not the same in every person.**

Signs and symptoms depend on the following:

- Where the tumor forms in the brain or spinal cord
- What the affected part of the brain controls
- The size of the tumor

Signs and symptoms may be caused by CNS tumors or by other conditions, including cancer that has spread to the brain.

## **Brain tumor symptoms**

- Morning headache or headache that goes away after vomiting
- Seizures
- Vision, hearing, and speech problems
- Loss of appetite
- Frequent nausea and vomiting
- Changes in personality, mood, ability to focus, or behavior
- Loss of balance and trouble walking
- Weakness
- Unusual sleepiness or change in activity level

## Spinal cord tumor symptoms

- Back pain or pain that spreads from the back towards the arms or legs
- A change in bowel habits or trouble urinating
- Weakness or numbness in the arms or legs
- Trouble walking

## There are different types of brain and spinal cord tumors.

Brain and spinal cord tumors are named based on the type of cell they formed in and where the tumor first grew in the CNS. The grade of a tumor may be used to tell the difference between slow-growing and fast-growing types of the tumor. Tissue grading and finding the molecular structure helps determine treatment decisions. Molecular testing can take a few weeks to complete.

The following types of primary tumors can form in the brain or spinal cord:

### Astrocytic tumors

An astrocytic tumor begins in star-shaped brain cells called astrocytes, which help keep nerve cells healthy. An astrocyte is a type of glial cell. Glial cells sometimes form tumors called gliomas. Astrocytic tumors include the following:

- **Brain stem glioma (usually high grade):** A brain stem glioma forms in the brain stem, which is the part of the brain connected to the spinal cord. It is often a high-grade tumor, which spreads widely through the brain stem and is hard to cure. Brain stem gliomas are rare in adults.

- **Pineal astrocytic tumor (any grade):** A pineal astrocytic tumor forms in tissue around the pineal gland and may be any grade. The pineal gland is a tiny organ in the brain that makes melatonin, a hormone that helps control the sleeping and waking cycle.
- **Pilocytic astrocytoma (grade I):** A pilocytic astrocytoma grows slowly in the brain or spinal cord. It may be in the form of a cyst and rarely spreads into nearby tissues. Pilocytic astrocytomas can often be cured.
- **Diffuse astrocytoma (grade II):** A diffuse astrocytoma grows slowly, but often spreads into nearby tissues. The tumor cells look something like normal cells. In some cases, a diffuse astrocytoma can be cured. It is also called a low-grade diffuse astrocytoma.
- **Anaplastic astrocytoma (grade III):** An anaplastic astrocytoma grows quickly and spreads into nearby tissues. The tumor cells look different from normal cells. This type of tumor usually cannot be cured. An anaplastic astrocytoma is also called a malignant astrocytoma or high-grade astrocytoma.
- **Glioblastoma (grade IV):** A glioblastoma grows and spreads very quickly. The tumor cells look very different from normal cells. This type of tumor usually cannot be cured. It is also called glioblastoma multiforme.

# Oligodendroglial tumors

An oligodendroglial tumor begins in brain cells called oligodendrocytes, which help keep nerve cells healthy. An oligodendrocyte is a type of glial cell. Oligodendrocytes sometimes form tumors called oligodendrogliomas. Grades of oligodendroglial tumors include the following:

- **Oligodendroglioma (grade II):**  
An oligodendroglioma grows slowly, but often spreads into nearby tissues. The tumor cells look something like normal cells. In some cases, an oligodendroglioma can be cured.
- **Anaplastic oligodendroglioma (grade III):**  
An anaplastic oligodendroglioma grows quickly and spreads into nearby tissues. The tumor cells look different from normal cells. This type of tumor usually cannot be cured.

# Ependymal tumors

An ependymal tumor usually begins in cells that line the fluid-filled spaces in the brain and around the spinal cord. An ependymal tumor may also be called an ependymoma. Grades of ependymomas include the following:

- **Ependymoma (grade I or II):** A grade I or II ependymoma grows slowly and has cells that look something like normal cells. There are two types of grade I ependymoma — myxopapillary ependymoma and subependymoma. A grade II ependymoma grows in a ventricle (fluid-filled space in the brain) and its connecting paths or in the spinal cord. In some cases, a grade I or II ependymoma can be cured.

- **Anaplastic ependymoma (grade III):**

An anaplastic ependymoma grows quickly and spreads into nearby tissues. The tumor cells look different from normal cells. This type of tumor usually has a worse prognosis than a grade I or II ependymoma.

## **Medulloblastomas**

A medulloblastoma is a type of embryonal tumor. Medulloblastomas are most common in children or young adults.

## **Pineal parenchymal tumors**

A pineal parenchymal tumor forms in parenchymal cells or pineocytes, which are the cells that make up most of the pineal gland. These tumors are different from pineal astrocytic tumors. Grades of pineal parenchymal tumors include the following:

- Pineocytoma (grade II): A pineocytoma is a slow-growing pineal tumor
- Pineoblastoma (grade IV): A pineoblastoma is a rare tumor that is very likely to spread

## **Meningeal tumors**

A meningeal tumor, also called a meningioma, forms in the meninges (thin layers of tissue that cover the brain and spinal cord). It can form from different types of brain or spinal cord cells. Meningiomas are most common in adults. Types of meningeal tumors include the following:

- **Meningioma (grade I):** A grade I meningioma is the most common type of meningeal tumor. A grade I meningioma is a slow-growing tumor. It forms most often in the dura mater. A grade I meningioma can be cured if it is completely removed by surgery.
- **Meningioma (grade II and III):** This is a rare meningeal tumor. It grows quickly and is likely to spread within the brain and spinal cord. The prognosis is worse than a grade I meningioma because the tumor usually cannot be completely removed by surgery.

A hemangiopericytoma is not a meningeal tumor but is treated like a grade II or III meningioma. A hemangiopericytoma usually forms in the dura mater. The prognosis is worse than a grade I meningioma because the tumor usually cannot be completely removed by surgery.

## **Germ cell tumors**

A germ cell tumor forms in germ cells, which are the cells that develop into sperm in men or ova (eggs) in women. There are different types of germ cell tumors. These include germinomas, teratomas, embryonal yolk sac carcinomas, and choriocarcinomas. Germ cell tumors can be either benign or malignant.

## **Craniopharyngioma (grade I)**

A craniopharyngioma is a rare tumor that usually forms in the center of the brain just above the pituitary gland (a pea-sized organ at the bottom of the brain that controls other glands). Craniopharyngiomas can form from different types of brain or spinal cord cells.

# Having certain genetic syndromes may increase the risk of a central nervous system tumor.

Anything that increases your chance of getting a disease is called a risk factor. Having a risk factor does not mean that you will get cancer; not having risk factors does not mean that you will not get cancer. There are few known risk factors for brain tumors. The following conditions may increase the risk of certain types of brain tumors:

- Being exposed to vinyl chloride may increase the risk of glioma
- Infection with the Epstein-Barr virus, having AIDS (acquired immunodeficiency syndrome), or receiving an organ transplant may increase the risk of primary CNS lymphoma
- Having certain genetic syndromes may increase the risk of brain tumors:
  - Neurofibromatosis type 1 (NF1) or 2 (NF2).
  - von Hippel-Lindau disease
  - Tuberous sclerosis
  - Li-Fraumeni syndrome
  - Turcot syndrome type 1 or 2
  - Nevoid basal cell carcinoma syndrome

# What types of tests are done to diagnose a brain or spinal cord tumor?

The following tests and procedures may be used:

## Physical exam and history

**Neurological exam:** A series of questions and tests to check the brain, spinal cord, and nerve function. The exam checks a person's mental status, coordination, and ability to walk normally, and how well the muscles, senses, and reflexes work. This may also be called a neuro exam or a neurologic exam.

**Visual field exam:** An exam to check a person's field of vision (the total area in which objects can be seen). This test measures both central vision (how much a person can see when looking straight ahead) and peripheral vision (how much a person can see in all other directions while staring straight ahead). Any loss of vision may be a sign of a tumor that has damaged or pressed on the parts of the brain that affect eyesight.

**Tumor marker test:** A procedure in which a sample of blood, urine, or tissue is checked to measure the amounts of certain substances made by organs, tissues, or tumor cells in the body. Certain substances are linked to specific types of cancer when found in increased levels in the body. These are called tumor markers. This test may be done to diagnose a germ cell tumor.

**Gene testing:** A laboratory test in which a sample of blood or tissue is tested for changes in a chromosome that has been linked with a certain type of brain tumor. This test may be done to diagnose an inherited syndrome.

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

**MRI (magnetic resonance imaging)**

**with gadolinium:** A procedure that uses a magnet, radio waves, and a computer to make a series of detailed pictures of the brain and spinal cord. A substance called gadolinium is injected into a vein. The gadolinium collects around the cancer cells so they show up brighter in the picture. This procedure is also called nuclear magnetic resonance imaging (NMRI). MRI is often used to diagnose tumors in the spinal cord. Sometimes a procedure called magnetic resonance spectroscopy (MRS) is done during the MRI scan. An MRS is used to diagnose tumors, based on their chemical make-up.

**SPECT scan (single photon emission computed tomography scan):** A procedure to find malignant tumor cells in the brain. A small amount of a radioactive substance is injected into a vein or inhaled through the nose. As the substance travels through the blood, a camera rotates around the head and takes pictures of the brain. A computer uses the pictures to make a 3-dimensional (3-D) image of the brain. There will be increased blood flow and more activity in areas where cancer cells are growing. These areas will show up brighter in the picture.

**PET scan (positron emission tomography scan):**

A procedure to find malignant tumor cells in the body. A small amount of radioactive glucose (sugar) is injected into a vein. The PET scanner rotates around the body and makes a picture of where glucose is being used in the brain. Malignant tumor cells show up brighter in the picture because they are more active and take up more glucose than normal cells do. PET is used to tell the difference between a primary tumor and a tumor that has spread to the brain from somewhere else in the body.

**Biopsy:** If imaging tests show there may be a brain tumor, a biopsy is usually done. One of the following types of biopsies may be used:

- **Stereotactic biopsy:** When imaging tests show there may be a tumor deep in the brain in a hard to reach place, a stereotactic brain biopsy may be done. This kind of biopsy uses a computer and a 3-dimensional (3-D) scanning device to find the tumor and guide the needle used to remove the tissue. A small incision is made in the scalp and a small hole is drilled through the skull. A biopsy needle is inserted through the hole to remove cells or tissues so they can be viewed under a microscope by a pathologist to check for signs of cancer.
- **Open biopsy:** When imaging tests show that there may be a tumor that can be removed by surgery, an open biopsy may be done. A part of the skull is removed in an operation called a craniotomy. A sample of brain tissue is removed and viewed under a microscope by a pathologist. If cancer cells are found, some or all of the tumor may be removed during the

same surgery. Tests are done before surgery to find the areas around the tumor that are important for normal brain function. There are also ways to test brain function during surgery. The doctor will use the results of these tests to remove as much of the tumor as possible with the least damage to normal tissue in the brain.

The pathologist checks the biopsy sample to find out the type and grade of brain tumor. The grade of the tumor is based on how the tumor cells look under a microscope and how quickly the tumor is likely to grow and spread.

The following tests may be done on the tumor tissue that is removed:

- **Immunohistochemistry:** A test that uses antibodies to check for certain antigens in a sample of tissue. The antibody is usually linked to a radioactive substance or a dye that causes the tissue to light up under a microscope. This type of test may be used to tell the difference between different types of cancer.
- **Light and electron microscopy:** A laboratory test in which cells in a sample of tissue are viewed under regular and high-powered microscopes to look for certain changes in the cells.
- **Cytogenetic analysis:** A laboratory test in which cells in a sample of tissue are viewed under a microscope to look for certain changes in the chromosomes.

For some tumors, a biopsy or surgery cannot be done safely because of where the tumor formed in the brain or spinal cord. These tumors are diagnosed and treated based on the results of imaging tests and other procedures.

Sometimes the results of imaging tests and other procedures show that the tumor is very likely to be benign and a biopsy is not done.

The prognosis (chance of recovery) and treatment options for primary brain and spinal cord tumors depend on the following:

- The type and grade of the tumor
- Where the tumor is in the brain or spinal cord
- Whether the tumor can be removed by surgery
- Whether cancer cells remain after surgery
- Whether there are certain changes in the chromosomes
- Whether the cancer has just been diagnosed or has recurred (come back)
- Your general health

The prognosis and treatment options for metastatic brain and spinal cord tumors depend on the following:

- Whether there are more than two tumors in the brain or spinal cord
- Where the tumor is in the brain or spinal cord
- How well the tumor responds to treatment
- Whether the primary tumor continues to grow or spread

## **How are brain and spinal cord tumors “staged?”**

The extent or spread of cancer is usually described as stages. There is no standard staging system for brain and spinal cord tumors. Brain tumors that begin in the

brain may spread to other parts of the brain and spinal cord, but they rarely spread to other parts of the body. Treatment of primary brain and spinal cord tumors is based on the following:

- The type of cell in which the tumor began
- Where the tumor formed in the brain or spinal cord
- The amount of cancer left after surgery
- The grade of the tumor

Treatment of tumors that have spread to the brain from other parts of the body is based on the number of tumors in the brain.

## **Recurrent adult central nervous system tumors**

A recurrent central nervous system (CNS) tumor is a tumor that has recurred (come back) after it has been treated. CNS tumors often recur, sometimes many years after the first tumor. The tumor may recur at the same place as the first tumor or in other parts of the central nervous system.

## **There are different types of treatment for people with adult brain and spinal cord tumors.**

Some treatments are standard (the currently used treatment), and some are being tested in clinical trials.

## **What is active surveillance?**

Active surveillance is closely watching your condition but not giving any treatment unless there are changes in test results that show the condition is getting worse. Active surveillance may be used to avoid or delay the need for treatments such as radiation therapy or surgery, which can cause side effects or other problems. During active surveillance, certain exams and tests are done on a regular schedule. Active surveillance may be used for very slow-growing tumors that do not cause symptoms.

## **Surgery**

Surgery may be used to diagnose and treat adult brain and spinal cord tumors. Removing tumor tissue helps decrease pressure of the tumor on nearby parts of the brain.

After the doctor removes all the cancer that can be seen at the time of the surgery, some people may be given chemotherapy or radiation therapy after surgery to kill any cancer cells that are left. Treatment given after the surgery, to lower the risk that the cancer will come back, is called adjuvant therapy.

## **Radiation therapy**

Radiation therapy is a cancer treatment that uses high-energy x-rays or other types of radiation to kill cancer cells or keep them from growing. The way the radiation therapy is given depends on the type and grade of tumor and where it is in the brain or spinal cord. Types of radiation therapy for CNS tumors include the following:

- **Conformal radiation therapy:** Conformal radiation therapy is a type of external radiation therapy that uses a computer to make a 3-dimensional (3-D) picture of the tumor and shapes the radiation beams to fit the tumor.
- **Intensity-modulated radiation therapy (IMRT):** IMRT is a type of 3-dimensional (3-D) external radiation therapy that uses a computer to make pictures of the size and shape of the tumor. Thin beams of radiation of different intensities (strengths) are aimed at the tumor from many angles.
- **Stereotactic radiosurgery:** Stereotactic radiosurgery is a type of external radiation therapy. A tightly fitted mask is used to hold the head as still as possible during the radiation treatment. A machine aims a single large dose of radiation directly at the tumor. This procedure does not involve surgery. It is also called stereotaxic radiosurgery, radiosurgery, and radiation surgery.

## **Alternating electric field therapy (Optune®)**

Alternating electric field therapy uses low-intensity, wave-like fields called Tumor Treating Fields (TTFields) to slow or stop glioblastoma multiforme cell growth. This is a portable device worn on the scalp. This type of treatment is often combined with chemotherapy.

## **Chemotherapy**

Chemotherapy is a cancer treatment that uses drugs to stop the growth of cancer cells, either by killing the cells or by stopping them from dividing. When chemotherapy is taken by mouth or injected into a vein or muscle, the drugs enter the bloodstream and can reach cancer cells throughout the body (systemic chemotherapy). When chemotherapy is placed directly into the cerebrospinal fluid, an organ, or a body cavity such as the abdomen, the drugs mainly affect cancer cells in those areas (regional chemotherapy). Combination chemotherapy is treatment using more than one anticancer drug. To treat brain tumors, a wafer that dissolves may be used to deliver an anticancer drug directly to the brain tumor site after the tumor has been removed by surgery. The way the chemotherapy is given depends on the type and grade of tumor and where it is in the brain.

Anticancer drugs given by mouth or vein to treat brain and spinal cord tumors cannot cross the blood-brain barrier and enter the fluid that surrounds the brain and spinal cord. Instead, an anticancer drug is injected into the fluid-filled space to kill cancer cells there. This is called intrathecal chemotherapy.

## **Targeted therapy**

Targeted therapy is a type of treatment that uses drugs or other substances to identify and attack specific cancer cells without harming normal cells.

Monoclonal antibody therapy is a type of targeted therapy that uses antibodies made in the laboratory from a single type of immune system cell. These antibodies can identify substances on cancer cells or normal substances that may help cancer cells grow. The antibodies attach to the substances and kill the cancer cells, block their growth, or keep them from spreading. Monoclonal antibodies are given by infusion. They may be used alone or to carry drugs, toxins, or radioactive material directly to cancer cells.

## **Supportive care is given to lessen the problems caused by the disease or its treatment.**

This therapy controls problems or side effects caused by the disease or its treatment and improves quality of life. For brain tumors, supportive care includes controlling seizures, fluid buildup, or swelling in the brain.

## **Follow-up tests may be needed.**

Some of the tests and procedures used to diagnose a brain or spinal cord tumor may be repeated after treatment to find out how much tumor is left.

Support is available for coping with changes that may have happened as a result of cancer treatment. Your healthcare team can offer ideas as well as a plan of care for long-term follow-up.

# What are Clinical trials?

Clinical trials are done to find out if new cancer treatments are safe and effective or better than the standard treatment.

People who take part in a clinical trial may receive:

- The standard treatment alone or
- The standard treatment plus the new treatment being studied

Taking part in a clinical trial helps improve the way cancer will be treated in the future. Even when clinical trials do not lead to effective new treatments, they often answer important questions and help move research forward.

Many of today's standard treatments for cancer are based on earlier clinical trials.

**Ask if there is a clinical trial right for you.**

Some clinical trials only include people who have not yet received treatment. Other trials test treatments for those whose cancer has not gotten better. There are also clinical trials that test new ways to stop cancer from coming back or reduce the side effects of cancer treatment.

# To learn more about central nervous system tumors

- **American Cancer Society**  
<https://www.cancer.org/>
- **National Cancer Institute**  
<https://www.cancer.gov/>
- **National Comprehensive Cancer Network Guidelines for Patients**  
<https://www.nccn.org/patients/guidelines/cancers.aspx>
- **MedlinePlus**  
<https://medlineplus.gov/>

## Common questions

What does the pathology report say?

What are my goals for treatment?

What are my treatment choices?

What are my treatment choices?

What kind of support services are available for me about finances, emotions, spiritual questions, etc.?

My Health Care Team	Contact Information
Surgeon:	
Radiation Oncologist:	
Medical Oncologist:	
Primary Care Doctor:	
Nurse:	
Navigator:	
Registered Dietitian Nutritionist:	
Other:	
Other:	
Other:	
Other:	

# Notes

# Notes

Adapted from:  
PDQ® Adult Treatment Editorial Board. PDQ Adult Central Nervous System Tumors Treatment.  
Bethesda, MD: National Cancer Institute. Updated < September 28, 2018>. Available at:  
<https://www.cancer.gov/types/brain/patient/adult-brain-treatment-pdq>. Accessed <10/10/2018>.  
[PMID: 26389458]

039051-00353 3/19