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## Brain tumors: symptoms and diagnosis

### What is a brain tumor?

A brain tumor takes up space within the skull and can interfere with normal brain activity. It can increase pressure in the brain, shift the brain or push it against the skull, and/or invade and damage nerves and healthy brain tissue. The location of a brain tumor influences the type of symptoms that occur. Identifying the presence of a brain tumor is the first step in determining a course of treatment.

### What are the symptoms of a brain tumor?

Brain tumors may have a variety of symptoms ranging from headache to stroke. Different parts of the brain control different functions, so symptoms will vary depending on the tumor's location. Brain tumors are great mimics of other neurological disorders, and many of the common symptoms could indicate other medical conditions. The best way to determine if you or someone you know has a brain tumor is to have a doctor perform a type of brain scan called an MRI or a scan called a CT scan. It is sometimes hard to know whether a CT scan or MRI should be done if someone you know has some of the symptoms and signs noted below, but it is important to know that these studies will usually establish whether a brain tumor is behind them. If you are truly concerned, be sure to discuss your concerns with a physician.

### Possible symptoms of a brain tumor include:

- A new seizure in an adult
- Gradual loss of movement or sensation in an arm or leg
- Unsteadiness or imbalance, especially if it is associated with headache
- Loss of vision in one or both eyes, especially if the vision loss is more peripheral
- Double vision, especially if it is associated with headache
- Hearing loss with or without dizziness
- Speech difficulty of gradual onset

Other symptoms may also include nausea or vomiting that is most severe in the morning, confusion and disorientation, and memory loss.

The following symptoms are usually not caused by a brain tumor, but may sometimes be:

- **Headache:** Although headaches are probably the most common symptom of a brain tumor, most people with headaches – even persistent or severe headaches – do not have a tumor. However, some kinds of headaches are particularly worrisome. A steady headache that is worse in the morning than the afternoon, a persistent headache that is associated with nausea or vomiting, or a headache accompanied by double vision, weakness, or numbness all suggest a possible tumor.

- **A change in behavior:** The development of an "I don't care" attitude, memory loss, loss of concentration, and general confusion may all be subtle signs. In this case, an evaluation by a neurologist may be an important step, but a CT or MRI will also help.

- **Infertility or abnormal cessation of menstruation** (also known as amenorrhea)

- **Troubles that seem to be caused by other diseases or concerns:** A seizure that results from a fall or the discovery of what appears to be a subarachnoid hemorrhage (a type of stroke) may actually be caused by tumors.

If you are concerned that you or someone you know might have a brain tumor, call your doctor. If symptoms persist, an MRI or CT scan can facilitate the diagnosis. Early detection and treatment may increase survival.

*With grateful acknowledgment of the content provided by Peter McL. Black, M.D., Ph.D., Neurosurgeon-in-Chief at Brigham and Women's Hospital and Children's Hospital in Boston, Massachusetts.*

### **How is a brain tumor diagnosed?**

Identifying a brain tumor usually involves a neurological examination, brain scans, and/or an analysis of the brain tissue. Doctors use the diagnostic information to classify the tumor from the least aggressive (benign) to the most aggressive (malignant). In most cases, a brain tumor is named for the cell type of origin or its location in the brain. Identifying the type of tumor helps doctors determine the most appropriate course of treatment.

A **neurological examination** is a series of tests to measure the function of the patient's nervous system and physical and mental alertness. If responses to the exam are not normal, the doctor may order a brain scan or refer the patient to a neurologist or neurosurgeon, who will then order a brain scan.

A **brain scan** is a picture of the internal structures in the brain. A specialized machine takes a scan in much the same way a digital camera takes a photograph. Using computer technology, a scan compiles an image of the brain by photographing it from various angles.

Some types of scans use a contrast agent (or contrast dye), which helps the doctor see the difference between normal and abnormal brain tissue. The contrast agent is injected into a vein and flows into brain tissue. Abnormal or diseased brain tissue absorbs more dye than normal healthy tissue. The most common scans used for diagnosis are as follows:

- **MRI (Magnetic Resonance Imaging)** is a scanning device that uses magnetic fields and computers to capture images of the brain on film. It does not use x-rays. It provides pictures from various planes, which permit doctors to create a three-dimensional image of the tumor. The MRI detects signals emitted from normal and abnormal tissue, providing clear images of most tumors.
- **CT or CAT Scan (Computed Tomography)** combines sophisticated x-ray and computer technology. CT can show a combination of soft tissue, bone, and blood vessels. CT images can determine some types of tumors, as well as help detect swelling, bleeding, and bone and tissue calcification. Usually, iodine is the contrast agent used during a CT scan.
- **PET Scan (Positron Emission Tomography)** provides a picture of the brain's activity, rather than its structure, by measuring the rate at which a tumor absorbs glucose (a sugar). The patient is injected with deoxyglucose that has been labeled with radioactive markers. The PET scan measures the brain's activity and sends this information to a computer, which creates a live image. Doctors use PET scans to see the difference between scar tissue, recurring tumor cells, and necrosis (cells destroyed by radiation treatment).

There are some drawbacks to these diagnostic tests, however. Please refer to the section below for more information.

A **biopsy** is a surgical procedure in which a sample of tissue is taken from the tumor site and examined under a microscope. The biopsy will provide information on types of abnormal cells present in the tumor. The purpose of a biopsy is to discover the type and grade of a tumor. A biopsy is the most accurate method of obtaining a diagnosis.

An open biopsy is done during a craniotomy. A craniotomy involves removing a piece of the skull in order to get access to the brain. After the tumor is resected (completely removed) or debulked (partially removed), the bone is usually put back into place. A closed biopsy (also called a stereotactic or needle biopsy) may be performed when the tumor is in an area of the brain that is difficult to reach. In a closed biopsy, the neurosurgeon drills a small hole into the skull and passes a narrow hollow needle into the tumor to remove a sample of tissue.

Once a sample is obtained, a pathologist examines the tissue under a microscope and writes a **pathology report** containing an analysis of the brain tissue. Sometimes the pathologist may not be able to make an exact diagnosis. This may be because more than one grade of tumor cells exists within the same tumor. In some cases, the tissue may be sent to another institution for additional analysis.

### **What else should I know about diagnostic tests?**

Because an MRI uses magnetic fields, people who have metal implanted in their body in any form should let the doctor know about it before scheduling the procedure. An MRI may not be an option for these patients because the intense magnetic fields can damage some types of implanted medical devices. Patients should advise the doctor if they have a pacemaker, cardiac monitor, surgical clip, or facial tattoos.

In a **standard MRI** scan, the patient lies on a narrow table, which slides through a long, cylindrical tube with a narrow

opening. Although there is enough room for the patient's body inside the cylinder, the patient will not be able to move around. The scan takes approximately 15-45 minutes. During the scan, the patient will hear loud banging sounds, caused by the electronics within the machine. Patients may request earplugs to reduce noise. Some people find the MRI claustrophobic and ask for a sedative beforehand to relax. Other people request an open MRI.

An **open MRI** machine does not have a cylinder, so the patient is not enclosed. The procedure lasts approximately 45 minutes. There is some discussion among doctors concerning the quality of the images of an open MRI compared to the standard or closed MRI.

**Contrast agents** may cause allergic reactions in some patients. Gadolinium, the contrast agent used with an MRI, may cause temporary headaches but has no other known side effects. Iodine is the contrast agent most commonly used for CT scanning. If you know you are allergic to iodine, tell your doctor. Allergic reactions can include rashes, a warm sensation, or, in rare cases, difficulty breathing.

**CT scans** involve exposure to ionizing radiation, which is known to cause cancer. This is a concern for people who may need multiple CT scans and for children, because they are more sensitive to radiation than adults. It is wise for people who have had frequent x-ray exams and parents of children who have brain tumors to keep a record of their x-ray history. This information can help doctors make informed decisions and minimize radiation over-exposure.

### **How is a pathology report used to diagnose brain tumors?**

A pathology report contains the analysis of brain tissue taken at the time of a craniotomy or needle biopsy. A pathologist examines the tissue under a microscope. Further tests or analysis may be performed on the tumor tissue. Then the pathologist will write a pathology report, which provides the information needed to make a diagnosis of the tumor type.

Sometimes the pathologist may not be able to make an exact diagnosis. This may be because more than one grade of tumor cells exists within the same tumor. [If cells of only one grade are removed and classified during a biopsy, it is possible that the tumor grade will be misdiagnosed. This is called a sampling error.] In some cases, the tissue may be sent to another institution for additional input.

### **How can I find out more about the location and type of tumor in my brain?**

The NBTS Interactive Tour of the Brain illustrates parts of the brain and their functions.

### **Find support**

The NTBS Online Community provides a space where brain tumor patients and their loved ones can connect with each other through discussion forums, groups, blogs, and more.

Find a support group: <https://braintumor.org/brain-tumor-information/finding-support-coping/>.

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National Brain Tumor Society. Signs and Symptoms. Available at: <https://braintumor.org/brain-tumor-information/signs-and-symptoms/>. Accessed September 4, 2018.

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