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Brain Tumor - Diagnosis [1]

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ON THIS PAGE: You will find a list of the common tests, procedures, and scans that doctors can use to find out what's wrong and identify the cause of the problem. To see other pages, use the menu on the side of your screen.

Doctors use many tests to diagnose a brain tumor, find out the type of brain tumor, and rarely, find out if it has spread to another part of the body, called metastasis. Some tests may also determine which treatments may be the most effective. For most types of tumors, taking a sample of the tumor tissue, either by biopsy (see below) or by removing part or all of the tumor, is the only way to make a definitive diagnosis of a brain tumor. If this is not possible, the doctor may suggest other tests that will help make a diagnosis.

Imaging tests may be used to help determine whether the tumor is a primary brain tumor or if it is another type of cancer that has spread to the brain from elsewhere in the body. Your doctor may consider these factors when choosing a diagnostic test:

- Age and medical condition
- Type of tumor suspected
- Signs and symptoms
- Previous test results

Most brain tumors are not diagnosed until after symptoms appear. Often a brain tumor is initially diagnosed by an internist or a neurologist. An internist is a doctor who specializes in treating adults. A neurologist is a doctor who specializes in problems with the brain and central nervous system.

In addition to asking the patient for a detailed medical history and doing a physical examination, the doctor may recommend the tests described below to determine the presence, and perhaps the type or grade, of a brain tumor.

This list describes options for diagnosing a brain tumor, and not all tests listed will be used for every person. Based on the combined results of the different tests, the doctor will recommend treatment options.

Imaging tests

The most effective and common tool for diagnosing a brain tumor is the use of a magnetic resonance imaging (MRI) scan, although computed tomography (CT or CAT) scans are also used. A positron emission tomography (PET) scan is used at first to find out more about a tumor while a patient is receiving treatment or if the tumor comes back after treatment.

Once an imaging scan shows that there is a tumor in the brain, the most common way to determine the type of brain tumor is to look at the results from a sample of tissue after a biopsy or surgery (see further below).

Each imaging test can provide specific information, but they must be combined with the results of the patient's medical history, physical examination, and neurologic and other tests. The most common imaging tests used for diagnosing a brain tumor include:

- **MRI.** An MRI [3] uses magnetic fields, not x-rays, to produce detailed images of the body. MRI can also be used to measure the tumor's size. A special dye called a contrast medium is given before the scan to create a clearer picture. This dye can be injected into a patient's vein or given as a pill to swallow. MRIs create more detailed pictures than CT scans (see below) and are the preferred way to diagnose a brain tumor. The MRI may be of the brain, spinal cord, or both, depending on the type of tumor suspected and the likelihood that it will spread in the CNS. There are different types of MRI. The results of a neuro-examination, done by the internist or neurologist, helps determine which type of MRI to use.
    - Intravenous (IV) gadolinium-enhanced MRI is typically used to help create a clearer picture of a brain tumor. This is when a patient first has a regular MRI, and afterwards is given a special type of contrast medium called gadolinium through an IV; a second MRI is then done to get another series of pictures using the dye.

    - A spinal MRI may be used to diagnose a tumor on or near the spine.

    - A functional MRI (fMRI) provides information about the location of specific areas of the brain that are responsible for muscle movement and speech. During the fMRI examination, the patient is asked to do certain tasks that cause changes in the brain and can be seen on the fMRI image. This test is used to help plan surgery, so the surgeon can avoid damaging the functional parts of the brain while removing the tumor.

    - Magnetic resonance spectroscopy (MRS) is a test using MRI that provides information on the chemical composition of the brain. It can help tell the difference between dead tissue caused by previous radiation treatments and new tumor cells in the brain.

- **CT scan.** A CT scan [4] creates a three-dimensional picture of the inside of the body with an x-ray machine. A computer then combines these images into a detailed, cross-sectional view that shows any abnormalities or tumors. A CT scan can help find bleeding and enlargement of the fluid-filled spaces in the brain, called ventricles. Changes to bone in the skull can also be seen on a CT scan, and it can be used to measure a tumor's size. A CT scan may also be used if the patient cannot have an MRI, such as if the person has a pacemaker for his or her heart. Sometimes, a contrast medium is given before the scan to provide better detail on the image. This dye can be injected into a patient's vein or given as a pill to swallow.

- **PET scan.** A PET scan [5] is a way to create pictures of organs and tissues inside the body. A small amount of a radioactive sugar substance is injected into the patient's body. This sugar substance is taken up by cells that use the most energy. Because cancer tends to use energy actively, it absorbs more of the radioactive substance. A scanner then detects this substance to produce images of the inside of the body.

- **Cerebral arteriogram, also called a cerebral angiogram.** A cerebral arteriogram is an x-ray, or series of x-rays, of the head that shows the arteries in the brain. X-rays are taken after a contrast medium is injected into the main arteries of the patient's head.

- **Lumbar puncture or spinal tap.** A lumbar puncture is a procedure in which a doctor uses a needle to take a sample of cerebrospinal fluid (CSF) to look for tumor cells, blood, or tumor markers. Tumor markers or biomarkers are substances found in higher than normal amounts in the blood, urine, spinal fluid, plasma or other bodily fluids of people with certain types of cancer. Typically a local anesthetic is given to numb the patient's lower back before the procedure.

- **Myelogram.** Because some specific types of brain tumors can spread to the spinal fluid, other parts of the brain, or the spinal cord, the doctor may recommend a myelogram to look for areas where the tumor may have spread. A myelogram uses a dye injected into the CSF that surrounds the spinal cord. The dye shows up on an x-ray and can outline the spinal cord to help the doctor look for a tumor. This is rarely done; a lumbar puncture (see above) is more common.

Tissue sampling/biopsy/surgical removal of a tumor

As explained above, imaging tests are useful, but a sample of the tumor's tissue is usually needed for the final diagnosis. A biopsy is the removal of a small amount of tissue for examination under a microscope and is the only definitive way a brain tumor can be diagnosed. A pathologist then analyzes the sample(s). A pathologist is a doctor who specializes in interpreting laboratory tests and evaluating cells, tissues, and organs to diagnose disease. A biopsy can be done as part of surgery to remove the entire tumor or as a separate procedure if surgical removal of the tumor is not possible because of its location or a patient's health.

Molecular testing of the tumor

Your doctor may recommend running laboratory tests on a tumor sample to identify specific genes, proteins, and other factors, such as tumor markers, unique to the tumor. Some biomarkers may help doctors determine a patient's prognosis (see Grades and Prognostic Factors [6]). Researchers are examining biomarkers to find ways to diagnose a brain tumor before symptoms begin. Ultimately, results of these tests may help decide whether your treatment options include a type of treatment called targeted therapy (see Treatment Options [7]).

Neurological, vision, and hearing tests

These tests help determine if a tumor is affecting how the brain functions. An eye examination can detect changes to the optic nerve, as well as changes to a person's field of vision.

Neurocognitive assessment

This consists of a detailed assessment of all major functions of the brain, such as storage and retrieval of memory, expressive and receptive language abilities, calculation, dexterity, and the overall well-being of the patient. These tests are done by a licensed clinical neuropsychologist, who will write a formal report to be used for comparison with future assessments or to identify specific problems that can be helped through treatment.

Electroencephalography (EEG)

An EEG is a noninvasive test in which electrodes are attached to the outside of a person's head to measure electrical activity of the brain. It is used to monitor for possible seizures (see

Symptoms and Signs [8]).

Evoked potentials

Evoked potentials involve the use of electrodes to measure the electrical activity of nerves and can often detect acoustic schwannoma, a noncancerous brain tumor. This test can be used as a guide when removing a tumor that is growing around important nerves.

Test results

After diagnostic tests are done, your doctor will review all of the results with you. If the diagnosis is a tumor, additional tests will be done to learn more about the tumor. The results help the doctor describe the tumor and plan treatment.

The next section in this guide is Grades and Prognostic Factors [6], and it explains the system doctors use to describe a brain tumor. Or, use the menu on the side of your screen to choose another section to continue reading this guide.

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