

Brain Tumor Basics

The adult body normally forms new cells only when they are needed to replace old or damaged ones. Infants and children form new cells to complete their development in addition to those needed for repair. A tumor develops if normal or abnormal cells multiply when they are not needed.

A brain tumor is a mass of unnecessary cells growing in the brain. There are two basic kinds of brain tumors — primary brain tumors and metastatic brain tumors. Primary brain tumors start, and tend to stay, in the brain. Metastatic brain tumors begin as cancer elsewhere in the body and spreads to the brain.

When doctors describe brain tumors, they often use the words “benign” or “malignant.” Those descriptions refer to the degree of malignancy or aggressiveness of a brain tumor. It is not always easy to classify a brain tumor as “benign” or “malignant” as many factors other than the pathological features contribute to the outcome.

Primary Brain Tumors

A tumor that starts in the brain is a primary brain tumor. Glioblastoma multiforme, astrocytoma, medulloblastoma, and ependymoma are examples of primary brain tumors. Primary brain tumors can be grouped into benign tumors and malignant tumors.

BENIGN BRAIN TUMORS

A benign brain tumor consists of very slow growing cells, usually has distinct borders, and rarely spreads. When viewed under a microscope, the cells have an almost normal appearance. Surgery alone might be an effective treatment for this type of tumor. A brain tumor composed of benign cells, but located in a vital area, can be considered to be life-threatening — although the tumor and its cells would not be classified as malignant.

MALIGNANT BRAIN TUMORS

A malignant brain tumor is usually rapid growing, invasive, and life-threatening. Malignant brain tumors are often called brain cancer. However, since primary brain tumors rarely spread outside the brain and spinal cord, they do not exactly fit the general definition of cancer.

Cancer is a disease defined by:

- unregulated growth of abnormal cells
- abnormal cells that grow into/around parts of the body and interfere with their normal functioning
- spread to distant organs in the body

Brain tumors can be called malignant if they:

- have the characteristics of cancer cells or
- are located in a critical part of the brain or
- are causing life-threatening damage

Malignant brain tumors that are cancerous can spread within the brain and spine. They rarely spread to other parts of the body. They lack distinct borders due to their tendency to send “roots” into nearby normal tissue. They can also shed cells that travel to distant parts

of the brain and spine by way of the cerebrospinal fluid. Some malignant tumors, however, do remain localized to a region of the brain or spinal cord.

BENIGN TUMORS

- slow growing
- distinct borders
- rarely spread

MALIGNANT TUMORS

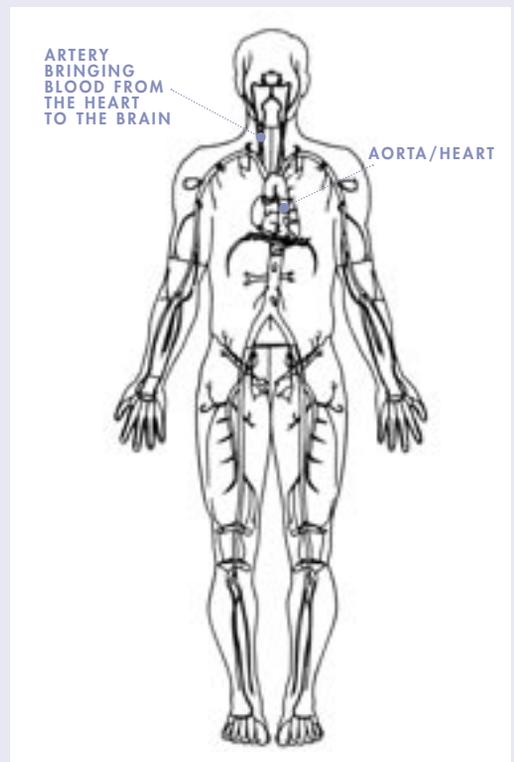
- usually rapidly growing
- invasive
- life-threatening

Metastatic Brain Tumors

Cancer cells that begin growing elsewhere in the body and then travel to the brain form metastatic brain tumors. For example, cancers of the lung, breast, colon and skin (melanoma) frequently spread to the brain via the bloodstream or a magnetic-like attraction to other organs of the body.

All metastatic brain tumors are, by definition, malignant.

ARTERIAL BLOOD FLOW



Tumor Names

Tumors are diagnosed and then named based on a classification system. Most medical centers now use the World Health Organization (WHO) classification system for this purpose.

Tumor Grading

Tumors are graded to facilitate communication, to plan treatment, and to predict outcome. The grade of a tumor indicates its degree of malignancy.

Grade is assigned based on the tumor's microscopic appearance using some or all of the following criteria:

- similarity to normal cells (atypia)
- rate of growth (mitotic index)
- indications of uncontrolled growth
- dead tumor cells in the center of the tumor (necrosis)
- potential for invasion and/or spread (infiltration) based on whether or not it has a definitive margin (diffuse or focal)
- blood supply (vascularity)

Using the WHO grading system, grade I tumors are the least malignant and are usually associated with long-term survival. The tumors grow slowly, and have an almost normal appearance when viewed through a microscope. Surgery alone might be an effective treatment for this grade of tumor. Pilocytic astrocytoma, craniopharyngioma, and many tumors of neurons — for example, gangliocytoma and ganglioglioma — are examples of grade I tumors.

Grade II tumors are relatively slow growing and have a slightly abnormal microscopic appearance. Some can spread into nearby normal tissue and recur. Sometimes these tumors recur as a higher grade.

Grade III tumors are, by definition, malignant although there is not always a sharp distinction between a grade II and a grade III tumor. The cells of a grade III tumor are actively reproducing abnormal cells which grow into nearby normal brain tissue. These tumors tend to recur, often as a higher grade.

The most malignant tumors are given a grade of IV. They reproduce rapidly, can have a bizarre appearance when viewed under the microscope, and easily grow into surrounding normal brain tissue. These tumors form new blood vessels so they can maintain their rapid growth. They also have areas of dead cells in their center. The glioblastoma multiforme is the most common example of a grade IV tumor.

WHO (WORLD HEALTH ORGANIZATION) GRADING SYSTEM

GRADE I TUMOR

- slow growing cells
- almost normal appearance under a microscope
- least malignant
- usually associated with long-term survival

GRADE II TUMOR

- relatively slow growing cells
- slightly abnormal appearance under a microscope
- can invade adjacent normal tissue
- can recur as a higher grade tumor

GRADE III TUMOR

- actively reproducing abnormal cells
- abnormal appearance under a microscope
- infiltrate adjacent normal brain tissue
- tumor tends to recur, often at higher grade

GRADE IV TUMOR

- abnormal cells which reproduce rapidly
- very abnormal appearance under a microscope
- form new blood vessels to maintain rapid growth
- areas of dead cells in center

Tumors often contain several grades of cells. The highest or most malignant grade of cell determines the grade, even if most of the tumor is a lower grade.

Some tumors undergo change. A benign growth might become malignant. In some tumors, a lower-grade tumor might recur as a higher-grade tumor. Your doctor can tell you if your tumor might have this potential.

Change of Diagnosis

Although it may initially seem alarming, your diagnosis and the name of your tumor might be changed. There are several factors that might cause the change in diagnosis:

- Be aware that classification of brain tumors by the pathologist is a subjective procedure that is not always straightforward. Different pathologists might disagree about the classification, and grade, of the same tumor.
- Tumors do not always remain static. They can undergo transformation, usually to a higher grade. If that occurs, the name and grade of the tumor might change. A grade III anaplastic/malignant astrocytoma could become a glioblastoma (also called a grade IV astrocytoma).
- Inspecting only a small sample of the tumor, such as that obtained by a needle biopsy, might not be representative of the whole tumor.
- As scientists learn more about the biology of brain tumors, they are becoming aware of new differences and new similarities in tumors. Sometimes this means re-naming or re-grouping tumors.

All grading systems have inherent difficulties — they are not precise.

- Criteria used to assign grades are subject to interpretation by each pathologist.
- Tumors are not uniform, and the sample examined might not be representative of the entire tumor.

Tumor Staging

Staging determines if a tumor has spread beyond the site of its origin. In cancers such as breast, colon, or prostate this is primarily accomplished by a pathologist's examination of nearby tissue such as lymph nodes. In those cancers, staging is a basic part of the diagnostic work-up.

Staging for central nervous system (CNS) tumors is usually inferred from CT scan or MRI images, or by examining the cerebrospinal fluid. Scans taken after surgery are used to

determine if there is remaining tumor. CNS tumors that are especially prone to spread are studied with both scan images and laboratory tests. For example, patients with medulloblastoma will often have their cerebrospinal fluid examined for the presence of tumor cells. Those patients will also have scans of their spinal cord because of that tumor's tendency to spread there. Staging information often influences treatment recommendations and prognosis.

Prognosis

Prognosis means prediction. It is an educated guess about the future course of a disease in a specific individual.

Prognosis is based on the type of tumor, its grade, location, and spread (if any), the age of the patient, how long the patient had symptoms before the tumor was diagnosed, how much the tumor has affected the patient's ability to function, and the extent of surgery if surgery was performed.

The type of therapy is also instrumental. Certain tumors, although malignant, can be cured by radiation therapy or chemotherapy. Others, by virtue of their location, may ultimately be lethal in spite of their "benign" appearance under the microscope.

Additional information about tumor prognosis is also available in our Focusing on Tumors series of publications.

About "Lesions"

"Lesion" is a general term which refers to any change in tissue. Tumor, inflammation, blood, infection, scar tissue, or necrosis (dead cells) are all examples of lesions that may be found in the brain. Determining the nature of the lesion is the work of the pathologist.

If your doctor tells you a "lesion" was seen on your scan, the next step is to ask your doctor what *type* of lesion s/he believes this to be. Treatment will be determined based on the type of lesion.