

Astrocytoma

Glioma

Gliomas are a family of *primary* tumors that are born in and grow from brain tissue rather than spreading to the brain from other parts of the body.

The two most common types of glioma are:

1. **Astrocytoma**
2. **Oligodendroglioma.**

These tumors are distinguished by their features when examined under a microscope by a *pathologist* (a physician who examines tissue removed from the body by a surgeon). **Astrocytomas are not common.** Less than 15,000 new cases are diagnosed in the United States every year. With the exception of previous high-dose radiation exposure, there are no definite causes for these tumors. A variety of factors have been investigated, including cell phone usage, but no definite associations have been established. Similarly, gliomas do not usually run in families.

Glioma Growth and Spread

Gliomas are characterized by *invasive* growth – they form roots that invade the normal, surrounding brain. The roots cannot be seen on MRI or any other type of imaging. Consequently, even when the entire *visible* tumor is surgically removed, tumor cells are always left behind. As such, gliomas cannot be surgically cured. This is why additional treatments after surgery are usually recommended. Furthermore, it is sometimes necessary to leave visible tumor behind, to avoid causing permanent brain damage. Outcomes are better for patients when damage is avoided, even when visible tumor is left. Although gliomas can invade the brain, they only rarely spread to other parts of the body (they do not *metastasize*).

Tumor Grade and Stage

Tumors are identified by 2 features:

- **Histology** - The appearance of the tumor cells when viewed under a microscope by a pathologist. A pathologist is a physician who looks at the tissue collected by the neurosurgeon with a microscope. Once they receive the tissue, they do a series of tests that can take several days to complete.
- **Molecular-Genetic expression** – The tissue removed by the neurosurgeon is also tested for different genes and proteins that, compared to normal cells, are often altered in the tumor. This type of testing takes longer and may require the tissue be sent to specialized labs outside of the Baptist MD Anderson system.

Based on the results of these tests, the tumor is named and *graded*. **Gliomas are not staged.** The tumor grade cannot be established on imaging (MRI or CT scan). Only a pathologist examining the tissue with a microscope can grade a glioma. Higher grade tumors tend to be more aggressive than lower grade tumors.

Molecular Genetics of Astrocytoma

In addition to naming tumors by their appearance under the microscope, astrocytomas can be tested for certain proteins and genes that are abnormal in tumor cells compared to normal cells. There are several abnormal proteins and genes that have been identified.

Two such abnormalities include:

- **IDH** (isocitrate dehydrogenase) is a gene that is mutated (abnormal) in the cells of some astrocytomas. Although most often found in grade 2 and 3 tumors, IDH mutations can also be found in a small percentage of grade 4 tumors. Tumors that have this mutation often behave less aggressively and may be more responsive to treatment. The presence or absence of this mutation however, does not influence how we treat astrocytomas. We routinely test astrocytomas for this mutation but it may take 1 - 2 weeks to receive the results.
- **MGMT** (Methylguanine Methyltransferase) is another protein present in all cells of our body. It is a protein that repairs damaged DNA and therefore protects our normal tissue from damage. There is a switch (called methylation) that controls whether a cell produces MGMT. In some tumors the switch is on, while in others it is off. As a result, some tumors have higher levels of the protein, while others have lower levels. Whether the gene is on or off may predict how aggressive the tumor is or how it responds to certain medicines (chemotherapy). In some circumstances it may influence whether we use chemotherapy to treat astrocytomas. We routinely test astrocytomas for MGMT but it may take 2 weeks to receive the results.

Astrocytoma

The most common type of astrocytomas are divided into 2 groups defined by the presence of a *normal (wild-type)* or *abnormal (mutant)* IDH gene. Tumors with abnormal IDH genes are further graded based on how the cells look under a microscope. Astrocytomas with a normal IDH gene are always grade 4. These tumors are also referred to as glioblastoma.

Glioblastoma are the most common type of astrocytoma with approximately 12,000 diagnosed per year in the United States. Astrocytomas with an abnormal or mutant IDH gene are much less common. They are less aggressive and tend to be more responsive to treatment. Higher grade may reflect more aggressive behavior

Astrocytoma, IDH-wildtype	Astrocytoma, IDH-mutant
	Grade 2
	Grade 3
Grade 4 (Glioblastoma)	Grade 4

In adults, there are other less common types of astrocytoma that have a wide range of behavior. Some examples include:

- **Pilocytic Astrocytoma**, a less aggressive, grade 1 tumor typically diagnosed in children and young adults. They tend to be less aggressive and often managed with surgery alone
- **Pleomorphic xanthoastrocytoma**, commonly referred to as a PXA, is a tumor with a wide range of behavior. Often it is managed by surgery alone. Sometimes, however, they require more aggressive treatment with medicines and radiation. PXA is either grade 2 or 3 and often contain a mutation in the *BRAF* gene which may impact treatment options.
- **Diffuse midline glioma**, H3 K27-altered is a grade 4 tumor usually found in young adults. It is located deep in the brain and consequently, cannot be surgically removed. It is treated with radiation and medicines.