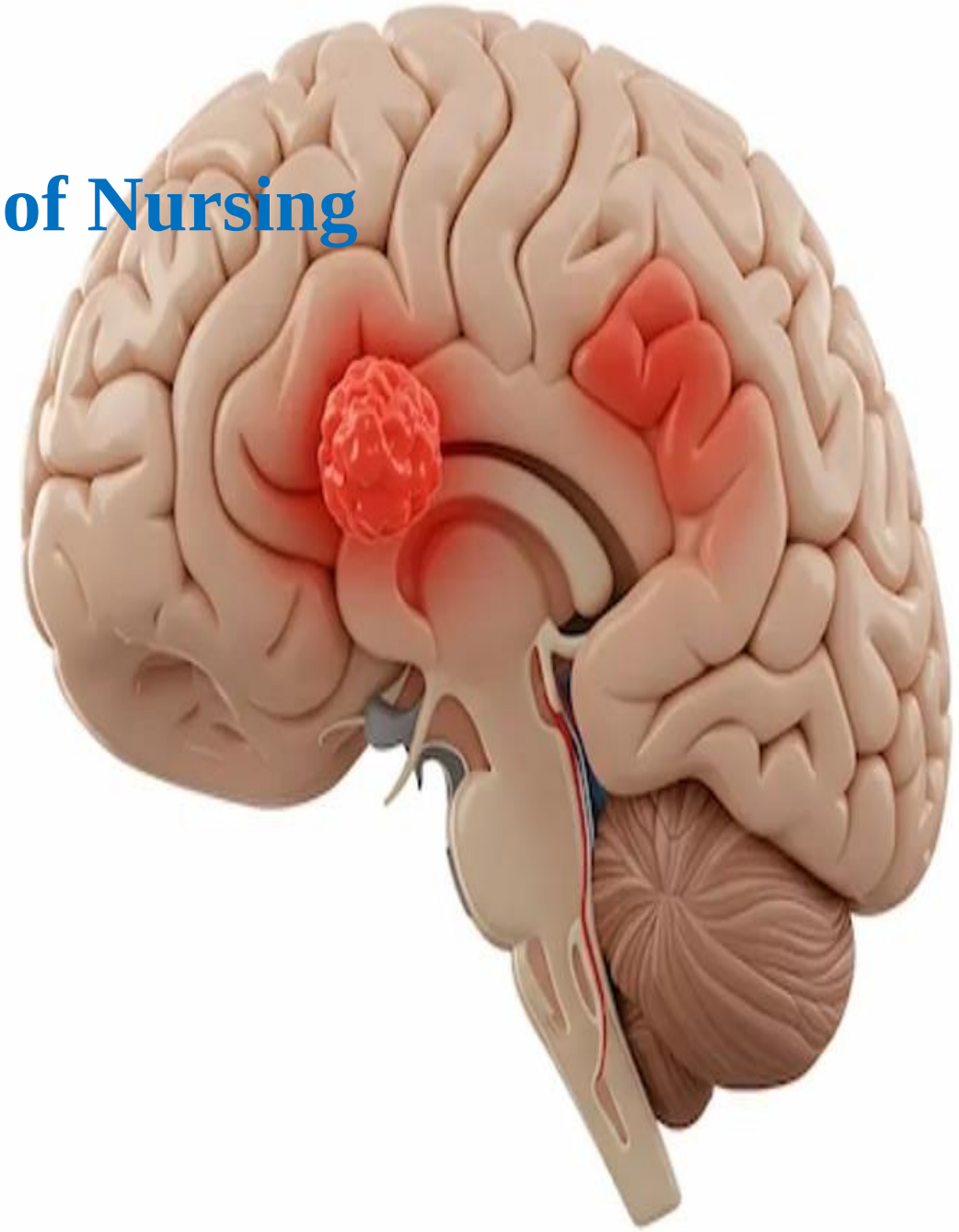
University of Al-Ameed / College of Nursing

Adult Nursing II

Brain Tumors

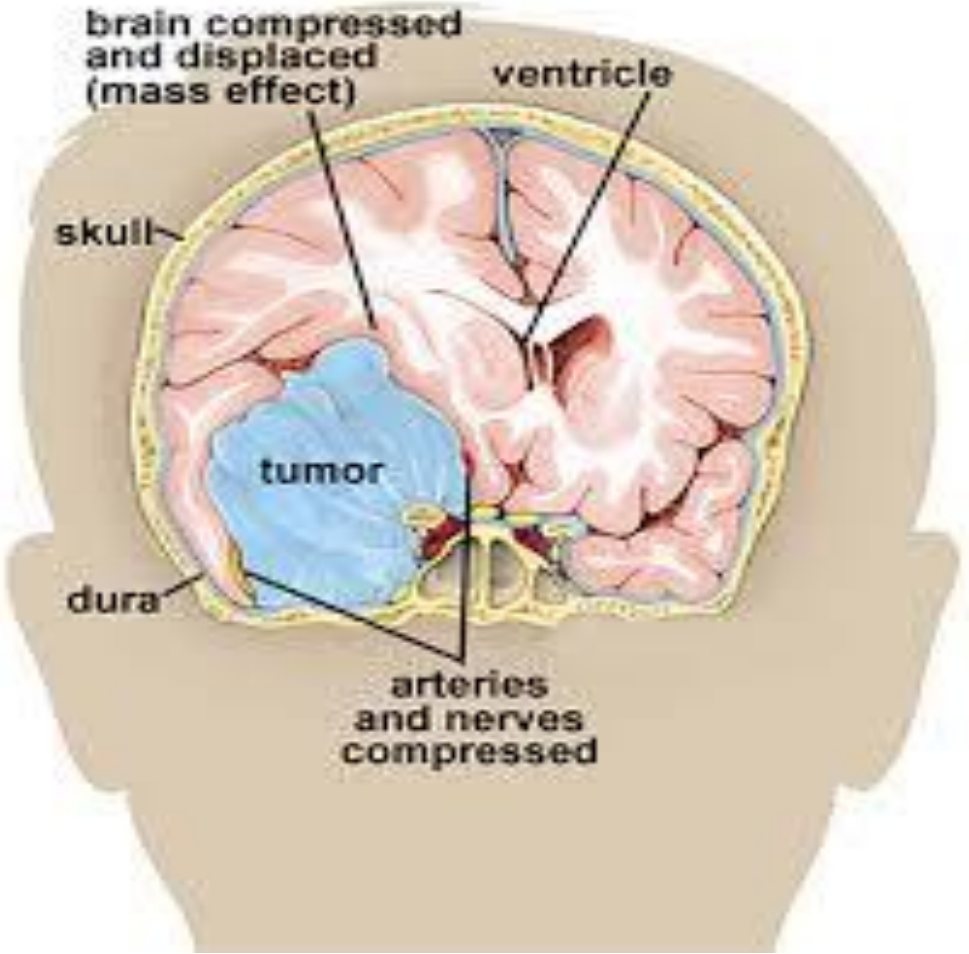
Dr. Hawraa Razzaq



Definition of brain tumors

A brain tumor occupies space within the skull, growing as:

spherical mass or diffusely infiltrating tissue.



The effects of brain tumors are caused by:

1. **Inflammation**
2. **Compression**
3. **Infiltration of tissue.**

A variety of physiologic changes result, causing any or all of the following pathophysiologic events:

- **Increased intracranial pressure (ICP) and cerebral edema**
- **Seizure activity and focal neurologic signs**
- **Hydrocephalus**
- **Altered pituitary function**

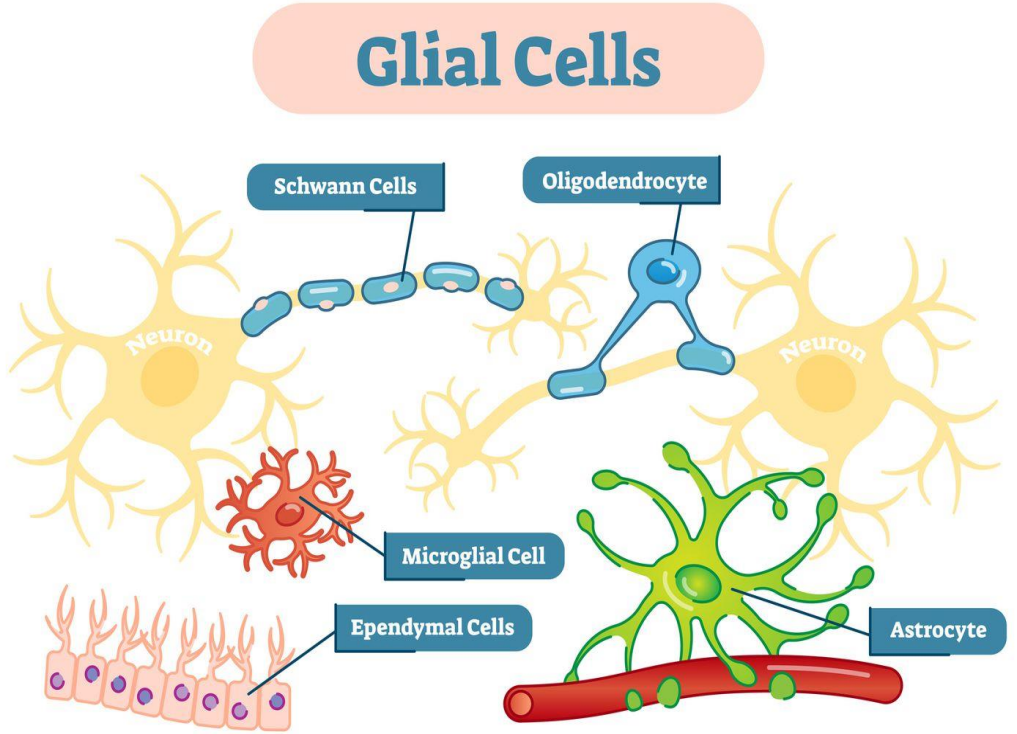
Neoplastic lesions in the brain ultimately **cause death by**:

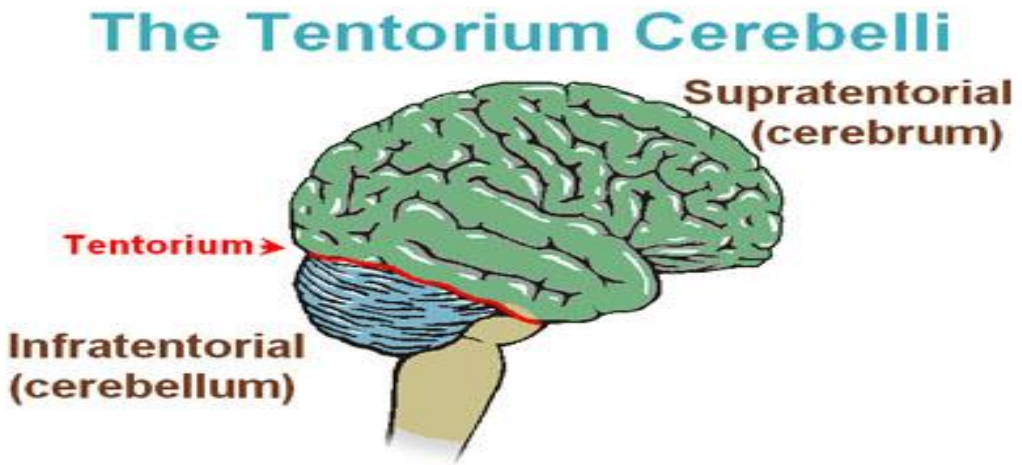
1. **Increasing ICP**
2. **Impairing vital functions, such as respiration**.

Brain tumors are classified as: **primary** or **secondary.**

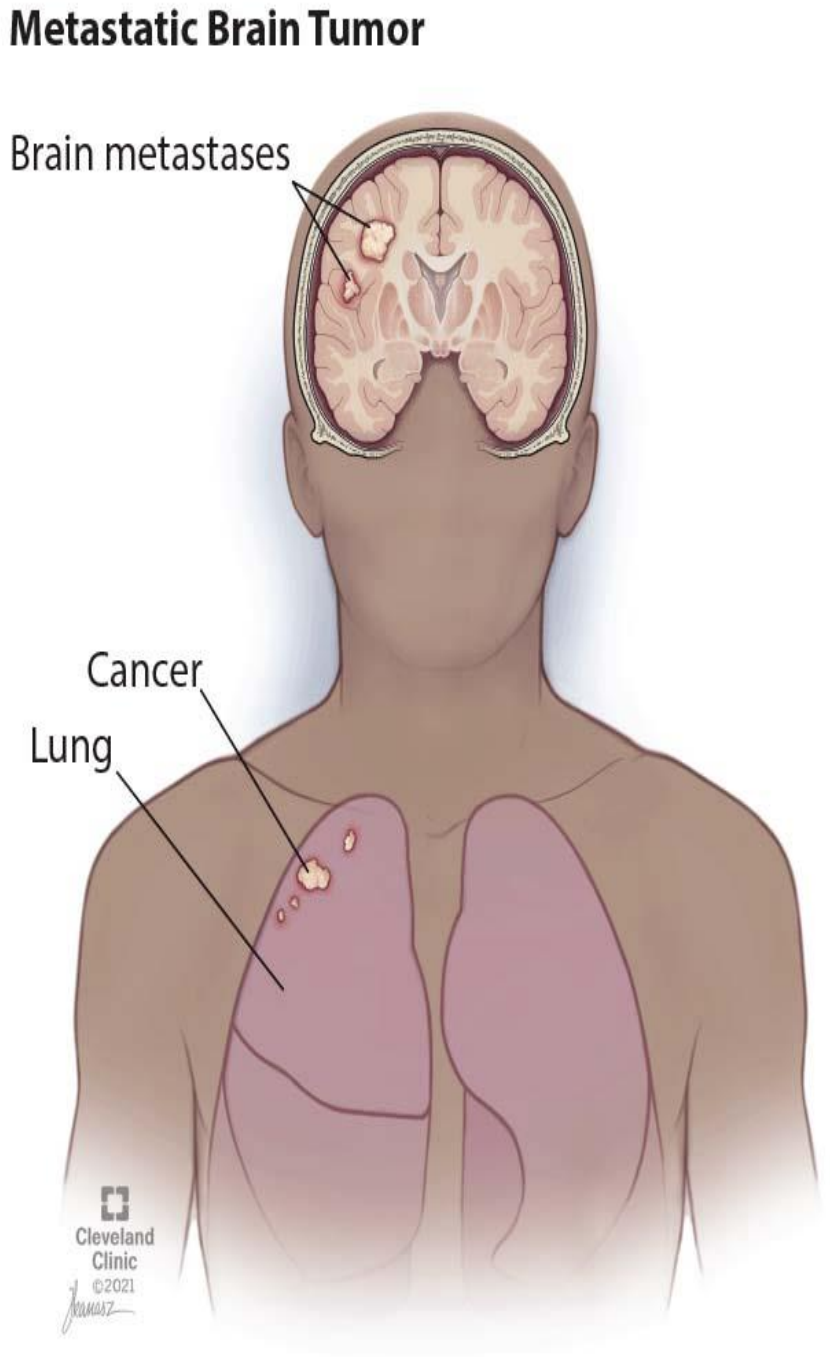
- **Primary brain tumors** **originate from cells within the brain**. In adults, most primary brain tumors originate from **glial cells** (cells that make up the structure and support system of the brain and spinal cord) and are **supratentorial** (located above the covering of the cerebellum).

Primary tumors progress **locally** and **rarely metastasize outside the CNS.**





- **<u>Secondary, or metastatic, brain tumors develop from structures outside the brain</u>** and are twice as common as primary brain tumors.
- Metastatic lesions to the brain can occur from the lung, breast, lower gastrointestinal tract, pancreas, kidney, and skin (melanomas) neoplasms.
- Single or multiple metastases may occur, and brain metastases may be found at any time during the disease course, even at initial diagnosis of the primary disease.

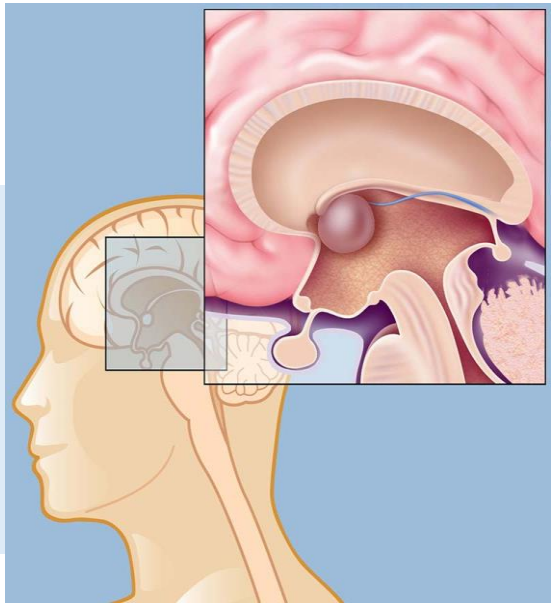


Types of Primary Brain Tumors

Brain tumors may be classified into **several groups**:

those arising from the **coverings of the brain** (e.g., dural meningioma), those **developing in or on the cranial nerves** (e.g., acoustic neuroma), those **originating within brain tissue** (e.g., glioma), and **metastatic lesions originating elsewhere in the body**. Tumors of the **pituitary and pineal glands and of cerebral blood vessels** are also types of brain tumors.

Tumors may be **benign or malignant**. A benign tumor, such as a colloid cyst, can occur in a vital area and can grow large enough to have serious effects.



Classification of Brain Tumors in Adults

I. Intracerebral Tumors
- **A.** Gliomas—infiltrate any portion of the brain; most common type of brain tumor
  1. Astrocytomas (grades I and II)
  2. Glioblastoma (astrocytoma grades III and IV)
  3. Oligodendroglioma (low and high grades)
  4. Ependymoma (grades I to IV)
  5. Medulloblastoma

II. Tumors Arising From Supporting Structures
- **A.** Meningiomas
- **B.** Neuromas (acoustic neuroma, schwannoma)
- **C.** Pituitary adenomas

III. Developmental Tumors
- **A.** Angiomas
- **B.** Dermoid, epidermoid, teratoma, craniopharyngioma

IV. Metastatic Lesions

I. Intracerebral Tumors

A. Gliomas—infiltrate any portion of the brain; **most common type of brain tumor**. In adults, gliomas (principally astrocytoma) account for approximately 25% of symptomatic primary brain tumors. Glial tumors, the most common type of intracerebral brain neoplasm, are divided into many categories.

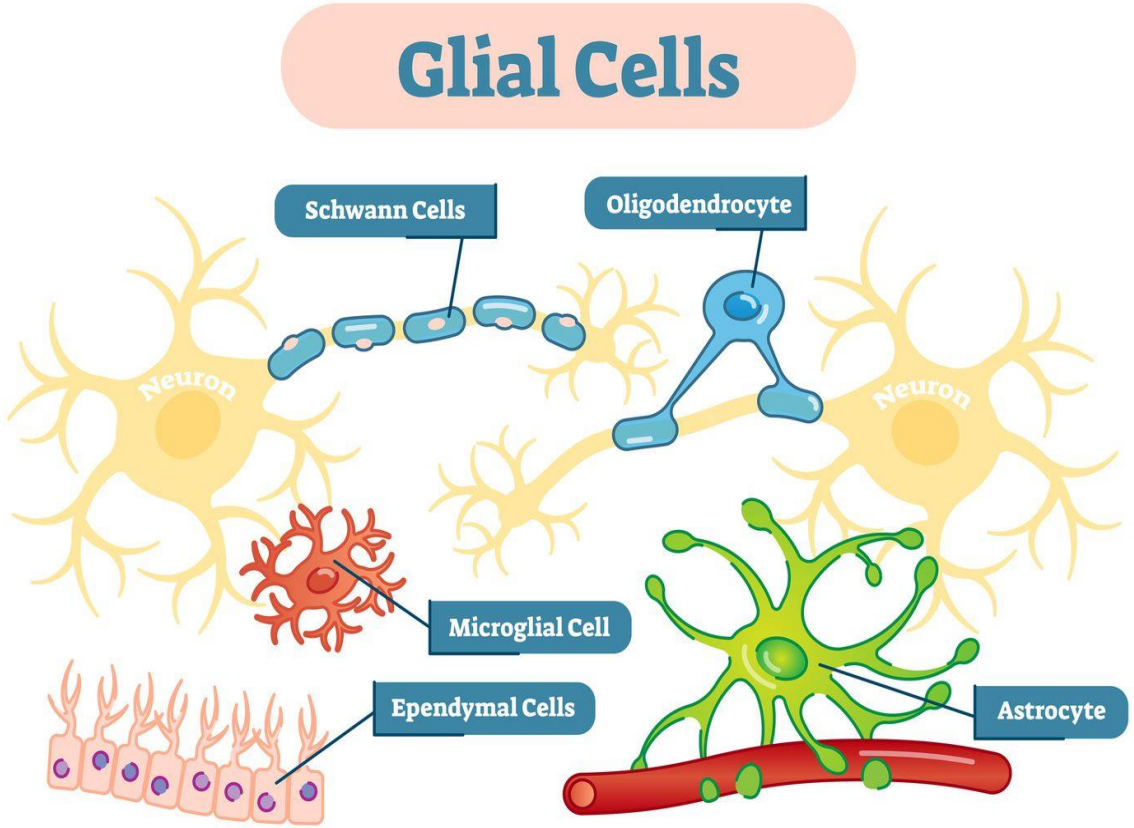
The grade is based on cellular density, cell mitosis, and degree of differentiation from the original cell type.

Astrocytomas, arising from astrocytic cells, are the **most common type of glioma** and are graded from I to IV, indicating the degree of malignancy. Astrocytomas **infiltrate** into the surrounding neural connective tissue and therefore cannot be totally removed without causing considerable damage to vital structures.

Oligodendroglial tumors, arising from oligodendroglial cells, represent about 1.4% of gliomas. Most oligodendrogliomas occur in adults aged 50 to 60, are found in men more often than in women, and are categorized as low or high grade (anaplastic). The histologic distinction between astrocytomas and oligodendrogliomas is difficult to make but is important, because oligodendrogliomas are more sensitive than astrocytomas to chemotherapy.

Ependymomas are more common in children than adults.

Glial tumors may be treated with a **combination of surgery, radiation therapy, and chemotherapy**, depending on specific cell and patient characteristics as well as the location of the tumor.



Meningiomas, which represent 37% of all primary brain tumors, are **common benign encapsulated tumors** of **arachnoid cells on the meninges**. They are **slow growing**, occur most often in middle aged adults, and are more common in women. Meningiomas often occur in areas proximal to the venous sinuses. Manifestations depend on the area involved and are often the result of **compression** rather than invasion of brain tissue. Preferred treatment for symptomatic lesions is **surgery** with complete removal or partial dissection, although **radiation** therapy may be useful for some patients. Metastasis is rare with meningiomas but benign meningiomas may be challenging to remove surgically without causing neurologic deficits if the tumor is located at the base of the skull or surrounds the optic nerve, or in the rare case if the tumor is invasive. Multiple meningiomas may occur with neurofibromatosis type 2

Acoustic neuromas account for 16% of brain tumors, with men and women equally affected, and occur most commonly in the fifth decade of life. **An acoustic neuroma is a tumor of the eighth cranial nerve**—the cranial nerve most responsible for **hearing and balance**. It usually arises just within the internal auditory meatus, where it frequently expands before filling the cerebellopontine recess. An acoustic neuroma may **grow slowly** and attain considerable size before it is diagnosed. The patient usually experiences **loss of hearing, tinnitus, and episodes of vertigo and staggering gait.** As the tumor becomes larger, **painful sensations of the face** may occur on the same side as a result of the tumor's **compression of the fifth cranial nerve**. Many acoustic neuromas are benign and can be managed conservatively. Many that continue to grow can be surgically removed and have a good prognosis.

Some acoustic neuromas may be suitable for stereotactic radiotherapy rather than open craniotomy

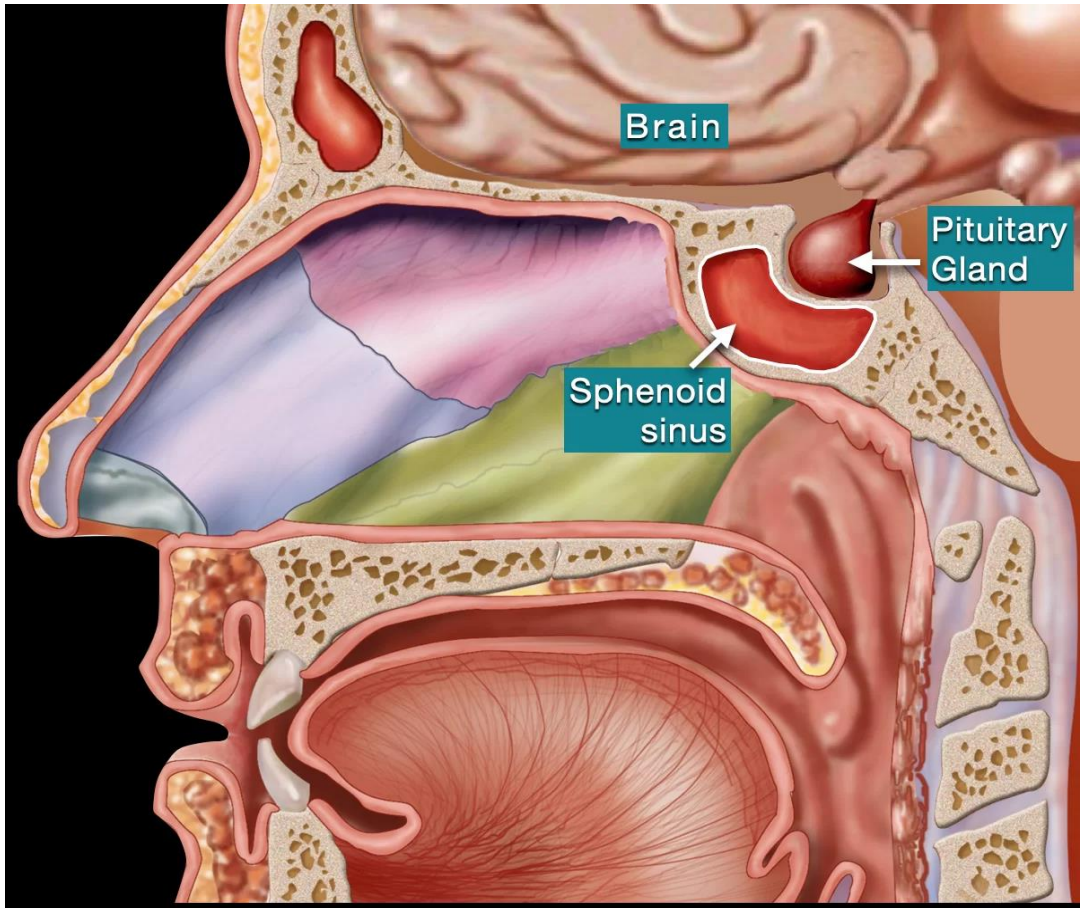
Pituitary Adenomas: Pituitary tumors account for about 16% of all primary brain tumors. They can occur at any age but are more common in older adults. Women are affected more often than men, particularly during the childbearing years. Pituitary tumors are rarely malignant but cause symptoms as a result of pressure on adjacent structures or hormonal changes.

Pressure Effects of Pituitary Adenomas:

Pressure may be exerted on:

the optic nerves, optic chiasm, or optic tracts or on the hypothalamus or the third ventricle if the tumor invades the cavernous sinuses or expands into the sphenoid bone.

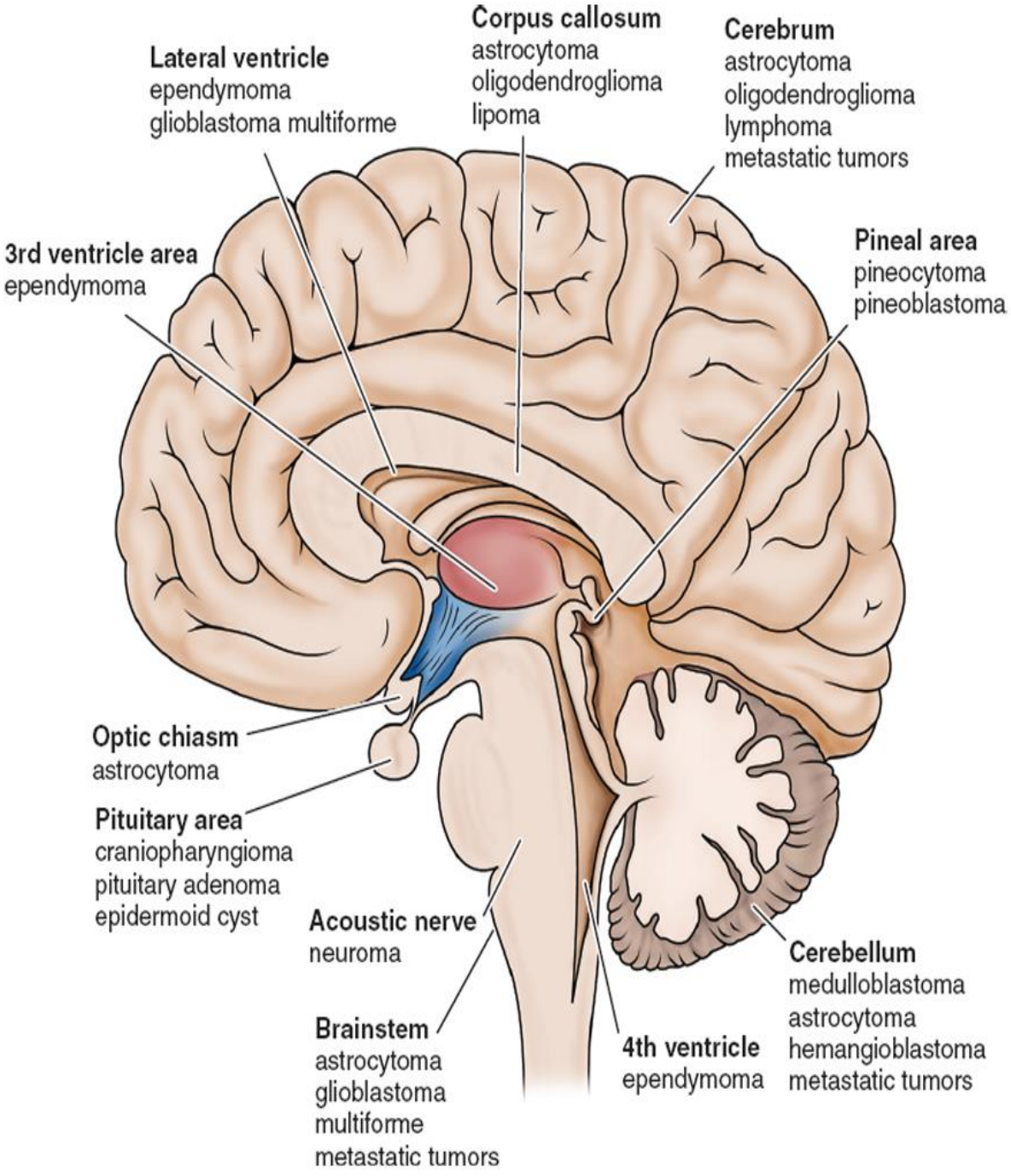
These pressure effects produce: headache, visual dysfunction, hypothalamic disorders (disorders of sleep, appetite, temperature, and emotions), increased ICP, and enlargement and erosion of the sella turcica.



Hormonal Effects of Pituitary Adenomas:

Hormonal hypersecretion is caused only by pituitary adenomas. Many adenomas (50%) secrete an excess amount of hormone including prolactin (prolactinomas), growth hormone (GH) producing acromegaly in adults, adrenocorticotropic hormone (ACTH) resulting in Cushing's disease, or thyroid-stimulating hormone (TSH). Adenomas that secrete TSH or follicle-stimulating hormone and luteinizing hormone occur infrequently, whereas adenomas that produce both GH and prolactin are relatively common.

Clinical Manifestations:
Brain tumors can produce both focal or generalized neurologic signs and symptoms. **Generalized symptoms reflect increased ICP**, and the most common focal or specific signs and symptoms result from tumors that interfere with functions in specific brain regions.



1- Increased Intracranial Pressure: the skull is a rigid compartment containing essential noncompressible contents: brain matter, intravascular blood, and cerebrospinal fluid (CSF). The **Monro-Kellie hypothesis** or doctrine explains the **dynamic equilibrium** of the cranial contents. According to this hypothesis, **if any one of these skull components increases in volume, ICP increases** unless one of the other components decreases in volume. Consequently, any change in volume occupied by the brain (as occurs with disorders such as brain tumor or cerebral edema) produces signs and symptoms of increased ICP.

The enlarging tumor and its associating edema **disrupts the equilibrium** between the brain, blood, and CSF. As the tumor grows, compensatory adjustments may occur through compression of intracranial veins, reduction of CSF volume (by increased absorption or decreased production), a modest decrease in cerebral blood flow, or reduction of intra- and extracellular brain tissue mass. When these **compensatory mechanisms fail**, the patient develops **signs and symptoms of increased ICP**, most often including **headache, nausea with or without vomiting, and papilledema (swelling of the optic nerve).** Personality changes and a variety of focal deficits, including motor, sensory, and cranial nerve dysfunction, are common.

2- Headache:

One third of patients with brain tumors report headache as an early symptom. Headache is most commonly reported in the early morning and is made worse by coughing, straining, or sudden movement. It is thought to be caused by the tumor invading, compressing, or distorting the pain-sensitive structures or by edema that accompanies the tumor. The headaches may be generalized or localized to the site of the tumor. As the edema increases, headache is generally bifrontal or bioccipital regardless of the tumor location.

3-Vomiting:

Vomiting, seldom related to food intake, is usually the **result of irritation of the vagal centers in the medulla.** Forceful vomiting is described as projectile vomiting. Headache may be relieved by vomiting.

4- Visual Disturbances:

The tumor itself or the surrounding edema can compress the third cranial nerve, causing optic disc swelling or papilledema. This limits the visual acuity along the visual pathway, mildly or profoundly, as diplopia (double vision), hemianopsia (visual field deficits), or varying levels of blindness

5. Seizures are common in patients with brain tumors either initially or throughout their disease process .Seizures may be focal or generalized. **Tumors of the frontal, parietal, and temporal lobes carry the greatest risk of seizures**; seizures are unusual with brainstem or cerebellar tumors

Localized Symptoms:

A tumor in the **motor cortex** of the frontal lobe produces **hemiparesis** and **partial seizures** on the opposite side of the body or generalized seizures.

A frontal lobe tumor may also produce changes in **emotional state** and **behavior**, as well as an **apathetic mental attitude**. The patient often becomes **impulsive**, **inappropriate in speech, gestures, and behavior**.

A **parietal lobe** tumor may cause **decreased sensation** on the opposite side of the body or **generalized seizures**.

A **temporal lobe** tumor may cause **seizures** as well as **psychological disorders**.

An **occipital lobe** tumor produces **visual manifestations**: contralateral homonymous hemianopsia (visual loss in half of the visual field on the opposite side of the tumor) and **visual hallucinations**.

A **cerebellar tumor** causes **dizziness**; an **ataxic or staggering gait** with a tendency to fall toward the side of the lesion; **marked muscle incoordination**; and **nystagmus** (involuntary rhythmic eye movements), usually in the horizontal direction.

A **cerebellopontine angle tumor** usually originates in the sheath of the acoustic nerve and gives rise to a characteristic sequence of symptoms.

Tinnitus and vertigo appear first, soon followed by progressive **nerve deafness** (eighth cranial nerve dysfunction). **Numbness and tingling of the face and tongue occur** (due to involvement of the fifth cranial nerve). Later, **weakness or paralysis of the face develops** (seventh cranial nerve involvement). Finally, because the enlarging tumor presses on the cerebellum, abnormalities in **motor function may be present**.

Brainstem tumors may be associated with cranial nerve deficits along with complex motor and sensory function impairments

Assessment and Diagnostic Findings

Computed tomography (CT) scans, enhanced by a contrast agent, can give specific information concerning the number, size, and density of the lesions, and the extent of secondary cerebral edema. CT can provide information about the ventricular system.

A magnetic resonance imaging (MRI) scan is the most helpful diagnostic tool for detecting brain tumors, particularly smaller lesions, and tumors in the brainstem and pituitary regions, where bone is thick. MRI is also useful in monitoring response to treatment.

Computer-assisted stereotactic (three-dimensional) biopsy is used to diagnose deep-seated brain tumors and to provide a basis for treatment and prognosis. Stereotactic approaches involve the use of a three-dimensional frame that allows very precise localization of the tumor; a stereotactic frame and multiple imaging studies (x-rays, CT scans, or MRIs) are used to localize the tumor and verify its position

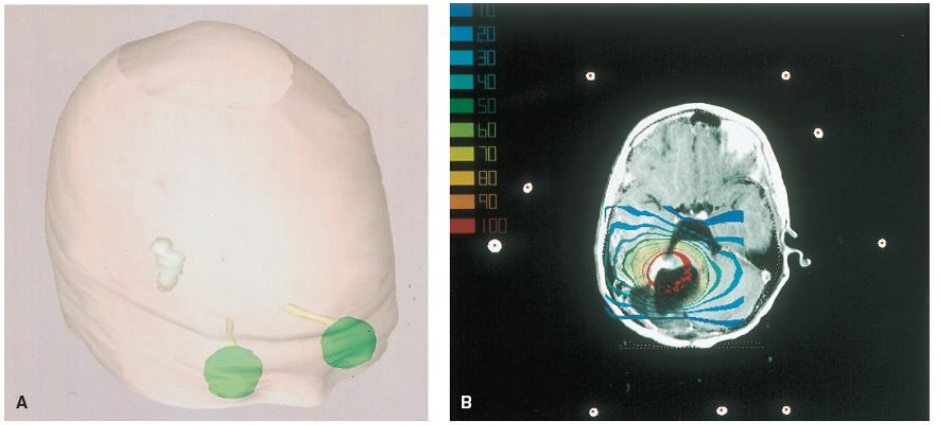


Figure 65-2 • **A.** Using stereotactic or "brain-mapping" guided approach, a three-dimensional computer image fuses the computed tomography image and magnetic resonance image to pinpoint the exact location of the brain tumor. This low-grade astrocytoma is localized adjacent to the brainstem, is inoperable, and is treated with radiation. Note the optic chasm and optic nerves. **B.** Computerized image of the prescribed radiation dose.

Positron emission tomography (PET) is used to supplement MRI scanning in many centers. On PET scans, low-grade tumors are associated with hypometabolism, and high-grade tumors show hypermetabolism. This information can be useful in making treatment decisions.

An electroencephalogram can detect abnormal brain waves in regions occupied by or adjacent to tumor; it is used to evaluate temporal lobe seizures and to assist in ruling out other disorders. Cytologic studies of the CSF may be performed to detect malignant cells as CNS tumors can shed cells into the CSF resulting in metastasis.

Medical Management

A variety of medical management **approaches**, including **surgery, chemotherapy, and external-beam radiation therapy**, are used alone or in combination.

A relatively new treatment option for glioblastomas is tumor-treating fields. This device provides alternating electric field therapy that disrupts the mitotic process and is worn on the head. The main side effect is skin irritation.

Secreting tumors may be treated with **medications** that suppress hormones.

Nonfunctioning tumors may have no effect on pituitary function or may suppress hormone production and release. Hormone replacement may be necessary for these patients to restore normal endocrine function.

Surgical Management

The objective of surgical management is to remove as much tumor as possible without increasing the neurologic deficit (paralysis, blindness), or to relieve symptoms by partial removal (decompression).

Surgery also provides tissue to establish a definitive diagnosis. A variety of surgical approaches may be used; the specific approach depends on the type of tumor, its location, and its accessibility.

Conventional surgical approaches require a craniotomy (incision into the skull). This approach is used in patients with meningiomas, acoustic neuromas, cystic astrocytomas of the cerebellum, colloid cysts of the third ventricle, congenital tumors such as dermoid cyst, and some of the granulomas.

With improved imaging techniques and the availability of the operating microscope and microsurgical instrumentation, even large tumors can be removed through a relatively small craniotomy.

For patients with **malignant glioma**, complete removal of the tumor and cure are **not possible**, but the rationale for resection includes:

- relief of ICP
- removal of any necrotic tissue and reduction in the bulk of the tumor, which theoretically leaves behind fewer cells to become resistant to radiation or chemotherapy.

Most pituitary adenomas are treated by transsphenoidal microsurgical removal, and the remainder of tumors that cannot be removed completely are treated by radiation

Radiation Therapy

Radiation therapy—the cornerstone of treatment for many brain tumors— decreases the incidence of recurrence of incompletely resected tumors.

Gamma radiation is delivered via an external beam to the tumor in multiple fractions.

Brachytherapy (the surgical implantation of radiation sources to deliver high doses at a short distance) is an option for some types of tumors depending on their location.

Radioisotopes such as iodine 131 (131I) are used to minimize effects on surrounding brain tissue.

Stereotactic procedures may be performed using a linear accelerator or gamma knife to perform radiosurgery.

These procedures allow treatment of deep, inaccessible tumors, often in a single session. Precise localization of the tumor is accomplished by the stereotactic approach and by minute measurements and precise positioning of the patient. Multiple narrow beams then deliver a very high dose of radiation. An advantage of this method is that no surgical incision is needed. Disadvantages include the lag time between treatment and the desired result as well as the potential for developing radiation necrosis.

Chemotherapy

Chemotherapy may be used in conjunction with radiation therapy, or as the sole therapy, with the goal of increasing survival time.

The greatest challenge in chemotherapy of brain tumors is that the blood–brain barrier prevents drugs from getting to the tumor in effective doses without causing systemic toxicity.

Malignant glioma is usually treated with 6 weeks of oral temozolomide (Temodar) during radiation therapy, followed by 6 to 12 months of oral temozolomide.

Low-grade gliomas may be treated with 6 months of oral temozolomide alone.

Temozolomide is the first oral chemotherapy that crosses the blood–brain barrier. Several other chemotherapy agents are used alone or in combination depending on the type of tumor.

Autologous bone marrow transplantation is used in some patients who will receive chemotherapy or radiation therapy, because it can “rescue” the patient from the bone marrow toxicity associated with high doses of chemotherapy and radiation.

A fraction of the patient’s bone marrow is aspirated, usually from the iliac crest, and stored. The patient receives large doses of chemotherapy or radiation therapy to destroy large numbers of malignant cells. The marrow is then reinfused intravenously after treatment is completed.

Pharmacologic Therapy

Corticosteroids are useful in relieving headache and alterations in level of consciousness. Corticosteroids such as dexamethasone are thought to reduce inflammation and edema around tumors. Other medications used include osmotic diuretics (e.g., mannitol and hypertonic saline) to decrease the fluid content of the brain, which leads to a decrease in ICP. Anticonvulsant medications are used to treat and control seizures.

Nursing Management

Headache characteristics should be assessed. Upright positioning and pain medications may be useful in managing pain; nurses should evaluate effectiveness of pain management interventions.

Even if seizure history is absent, the patient and family should be educated about the possibility of seizure and the need to adhere to prophylactic anticonvulsant medications, if prescribed.

The patient with a brain tumor may be at increased risk for aspiration as a result of cranial nerve dysfunction.

Medications to alleviate nausea and prevent vomiting should be considered.

Preoperatively, the gag reflex and ability to swallow are evaluated. In patients with diminished gag response, care includes educating the patient to direct food and fluids toward the unaffected side, having the patient sit upright to eat, offering a semisoft diet, and having suction readily available.

The nurse performs neurologic checks; monitors vital signs; maintains a neurologic observation record; spaces nursing interventions to prevent rapid increase in ICP; and reorients the patient when necessary to person, time, and place.

The use of corticosteroids to control headache and neurologic symptoms requires astute nursing assessment and intervention because many adverse effects can occur, including hyperglycemia, electrolyte abnormalities, and muscle weakness.

Patients with changes in cognition caused by their lesion require frequent reorientation and the use of orienting devices (e.g., personal possessions, photographs, lists, a clock), supervision of and assistance with self-care, and ongoing monitoring and intervention for prevention of injury.

Patients with seizures are carefully monitored and protected from injury. Motor function is checked at intervals because specific motor deficits may occur, depending on the tumor’s location. When muscle weakness is present, a multidisciplinary approach, including the nurse and physical and occupational therapists, can be used to preserve muscle strength, promote range of motion, and facilitate independence in self-care.

Sensory disturbances are assessed and any area of numbness should be protected from injury.

Speech is evaluated, and patients with speech deficits can be educated to use alternative forms of communication.

Eye movement and pupillary size and reaction may be affected by cranial nerve involvement.

Fatigue is common during therapy; efforts should be made to conserve energy and promote rest.

The psychosocial effects on family caregivers of a family member who has a primary malignant brain tumor may be significant. Caregiving family members should be included in the plan of care.


Thank You