CONDITION

Brain cancer

Learn about primary and metastatic brain cancer, including possible symptoms, diagnosis, treatment options, complications, and follow-up care.

WHAT IT IS
Malignant tumor affecting the brain

BODY SYSTEM
Nervous system

MAIN SYMPTOMS
Changing headaches, seizures, weakness, speech or vision changes

WHAT CAUSES IT
Usually unknown, sometimes inherited

HOW IT IS DIAGNOSED
MRI, biopsy and tissue testing

MAIN TREATMENT
Surgery, radiation and drug treatment

CAN IT BE CURED?
Sometimes - depending on tumor and response

IS IT AN EMERGENCY?
Sometimes - with prolonged or repeated seizures

LONG-TERM OUTLOOK
May recur and cause lasting neurological problems

Overview

Brain cancer is a general term for a malignant, or cancerous, tumor affecting the brain. A tumor is an abnormal growth of cells. Not every brain tumor is cancer, but even a noncancerous tumor can cause serious problems if it presses on important brain tissue or blocks the normal flow of fluid around the brain.

A primary brain cancer starts in the brain or nearby tissues. Gliomas are a major group of primary brain tumors. They begin in glial cells, which support and protect nerve cells. Gliomas include astrocytomas, oligodendrogliomas, and glioblastomas. Other tumors can begin in the brain's coverings, nerves, glands, or immune cells.

A metastatic brain tumor , also called a brain metastasis, begins as cancer elsewhere in the body and then spreads to the brain. Lung cancer, breast cancer, melanoma, kidney cancer, and

colorectal cancer are among the cancers that may spread there. A brain metastasis is named and treated according to the cancer where it began. For example, breast cancer that spreads to the brain remains metastatic breast cancer.

Primary brain tumors are usually described by their grade rather than by the staging systems used for many other cancers. Grade reflects how abnormal the tumor cells look and how the tumor is expected to behave. Modern classification also uses molecular features-changes in genes, chromosomes, or proteins-to define the tumor more precisely.

Brain cancer matters because the brain controls movement, speech, memory, behavior, vision, hormones, breathing, and many other functions. The effects depend on the tumor's type, size, location, growth rate, and response to treatment. Care is often provided by a team that may include neurosurgeons, medical oncologists, radiation oncologists, neurologists, rehabilitation specialists, and supportive-care clinicians.

Symptoms

Brain tumors do not all cause the same symptoms. Some symptoms develop slowly, while others appear over days or weeks. A small tumor in an important area may cause symptoms before a larger tumor in a less sensitive area.

Possible symptoms include:

Headaches are common and usually are not caused by a brain tumor. A clinician should assess headaches that are new, progressively worsening, different from a person's usual pattern, or associated with vomiting, seizures, weakness, confusion, or vision changes.

A first seizure needs prompt medical assessment. Call emergency services for a seizure lasting several minutes, repeated seizures without recovery, breathing difficulty, serious injury, or a seizure occurring in water.

Sudden weakness or numbness, new trouble speaking, sudden severe confusion, loss of consciousness, or an abrupt and extremely severe headache requires emergency care. These symptoms can also occur with a stroke, bleeding in the brain, or another urgent condition.

Symptoms that are mild but persistent or progressively worsening should be discussed with a healthcare professional through a routine or prompt appointment.

- New or changing headaches, especially when accompanied by other neurological symptoms
- Seizures
- Weakness, numbness, or reduced coordination on one side of the body

- Problems with balance or walking
- Changes in speech, hearing, or vision
- Memory, concentration, personality, or behavior changes
- Persistent nausea or vomiting
- Unusual sleepiness, confusion, or reduced alertness
- Hormone-related changes if the tumor affects the pituitary gland or nearby structures

Causes and risk factors

Brain cancer develops when cells acquire changes that allow them to grow and survive when they normally would not. In most people with a primary brain tumor, the exact reason these changes occurred is unknown. Everyday actions or minor head injuries have not been shown to explain most cases.

Exposure to ionizing radiation , especially previous radiation treatment directed at the head, is an established risk factor for some brain tumors. Ionizing radiation has enough energy to damage DNA. The potential risk depends on factors such as the radiation type, dose, age at exposure, and time since exposure.

A small proportion of brain tumors are related to inherited genetic syndromes. Examples include neurofibromatosis, tuberous sclerosis complex, Li-Fraumeni syndrome, and von Hippel-Lindau disease. Genetic counseling may be considered when the tumor type, age at diagnosis, personal history, or family history suggests an inherited condition.

Age is also relevant. Different brain tumor types occur more often in different age groups. Brain tumors in children can differ from those in adults and should be assessed by teams with pediatric brain tumor expertise.

For metastatic brain tumors, the main risk factor is having a cancer that can spread to the brain. This does not mean that everyone with such a cancer will develop brain metastases.

Diagnosis

Diagnosis begins with a medical history and neurological examination. The clinician may check strength, sensation, reflexes, balance, eye movements, vision, speech, memory, and alertness. These findings can help identify which part of the nervous system may be affected.

Magnetic resonance imaging, or MRI , is the main imaging test for many suspected brain

tumors. MRI uses a magnetic field and radio waves to create detailed images. A contrast agent may be given through a vein to make certain abnormalities easier to see.

Computed tomography, or CT , uses X-rays to create images. It may be used when rapid imaging is needed, when MRI is not suitable, or when clinicians are looking for bleeding, pressure changes, or changes in the skull.

Imaging can strongly suggest a tumor, but it may not determine the exact type. When appropriate, a neurosurgeon may remove a sample through a biopsy or remove as much of the tumor as can be done safely. A pathologist examines the tissue under a microscope. Laboratory testing may also look for molecular markers that help classify the tumor, estimate its likely behavior, and guide treatment.

Not every person can safely undergo a biopsy. The decision depends on the tumor's location, the person's health, the usefulness of the expected information, and whether imaging suggests another diagnosis.

If brain metastasis is suspected, testing may look for the cancer's original site and evaluate disease elsewhere in the body. This can include body imaging and review of tissue from the brain or another location.

The diagnostic process may also include blood tests, hearing or vision tests, hormone testing, and assessments of memory or thinking. A second pathology opinion from a center experienced in brain tumors may be useful for rare or difficult-to-classify tumors.

Treatment and management

Treatment is individualized according to the tumor type, grade, molecular features, number and location of tumors, previous treatments, symptoms, age, general health, and personal goals. A multidisciplinary brain tumor team can help compare the expected benefits and burdens of each option.

Surgery may be used to obtain tissue, reduce pressure, relieve symptoms, or remove the tumor. The goal is often to remove as much tumor as possible without causing unacceptable injury to healthy brain tissue. Some tumors cannot be removed completely because their cells blend into the brain or because they are close to structures controlling speech, movement, or other vital functions.

Special techniques may help surgeons plan and perform an operation. These can include computer-guided imaging, mapping of movement or language areas, and surgery while a carefully selected patient is awake for part of the procedure.

Radiation therapy uses high-energy beams to damage tumor cells. It may be directed at the

tumor and a surrounding margin, a larger region of the brain, or-in selected cases-the whole brain. Stereotactic radiosurgery is a highly focused form of radiation, not an open surgical operation. The radiation plan depends on factors such as tumor type, size, location, and number.

Drug treatment varies by tumor. Temozolomide and other chemotherapy medicines are used for certain primary brain cancers. Targeted therapies act on specific tumor features or growth pathways and are appropriate only when the cancer has a relevant target. Immunotherapy has an important role in some cancers that spread to the brain, but its benefit depends on the original cancer and its biomarkers. Clinical trials may provide access to treatments being studied.

Tumor-treating fields, which deliver low-intensity alternating electrical fields through adhesive arrays placed on the scalp, may be considered for selected people with glioblastoma. They require specialized equipment and regular use.

Supportive treatment is part of cancer care. Corticosteroids like prednisone or hydrocortisone may temporarily reduce swelling around a tumor, but they can cause significant side effects and should be managed by the treating team. Anti-seizure medicine may be prescribed after a seizure or in other selected circumstances. Physical, occupational, speech, and cognitive rehabilitation can help maintain or recover function.

Palliative care focuses on symptom relief, communication, and quality of life. It can be provided alongside surgery, radiation, or drug treatment at any stage.

Complications

Brain cancer can injure nearby brain tissue or increase pressure inside the skull. Possible complications include seizures, weakness, speech or vision problems, swallowing difficulty, changes in thinking or behavior, and loss of independence. A tumor may also block cerebrospinal fluid, the liquid surrounding the brain, causing a buildup called hydrocephalus.

Cancer and reduced mobility can increase the risk of blood clots. New leg swelling or pain should be reported promptly. Sudden shortness of breath, chest pain, coughing blood, or collapse requires emergency care.

Treatment can also cause complications. Surgery may lead to bleeding, infection, fluid leakage, seizures, or new neurological problems. Radiation can cause fatigue, swelling, skin or hair changes, and later effects on brain tissue or thinking. Drug treatments may affect blood counts, digestion, energy, fertility, or infection risk.

After radiation and drug treatment, imaging changes do not always mean that the cancer is

growing. Treatment-related inflammation, sometimes called pseudoprogression, can resemble tumor growth. Radiation injury can also develop later. Specialists may use repeat scans or additional imaging methods to clarify the cause.

Follow up

Follow-up usually includes neurological examinations, review of symptoms and medicines, and repeat MRI scans. The timing is tailored to the tumor type, treatment, recent scan results, and clinical condition. Primary brain cancer may return near the original site or elsewhere in the nervous system, while metastatic cancer also requires monitoring of the original cancer and other organs.

Report new or steadily worsening headaches, seizures, weakness, balance problems, speech changes, confusion, vision changes, or repeated vomiting promptly. Emergency symptoms include sudden one-sided weakness, loss of consciousness, severe breathing difficulty, or a prolonged or repeated seizure.

Routine follow-up should also address rehabilitation, mood, sleep, memory, work or school needs, driving safety, and caregiver support. Steroids and anti-seizure medicines should not be stopped or changed without guidance because some need to be reduced gradually or adjusted carefully.

People living beyond treatment may need monitoring for later effects involving thinking, hearing, hormones, blood vessels, or physical function. The care plan may change if symptoms, imaging findings, or personal priorities change.

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