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Risk Evaluation and Trends of Brain Tumor Development in Youth: A Comprehensive Analysis

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ABSTRACT

The increasing frequency of brain tumors is a major concern for world health. A large portion of this load falls on India because of the country's large population. Incidence rates of brain tumors vary among areas and demographic groups in India, creating a complicated epidemiological environment. Brain tumour incidence and distribution in India are affected by demographic variables including age, gender, socioeconomic position, and region. With continuous endeavors centered on customized medicine, targeted treatments, immunomodulation, and precision oncology, the future of brain tumor research and therapy in India is bright. To sum up, brain tumors are a major problem in Indian healthcare and need a thorough knowledge of their causes, symptoms, diagnosis, and treatment. In order to enhance patient outcomes and quality of life, it is necessary to tackle the complex issues related to brain tumor care via teamwork and new ideas.

Keywords: Brain tumors, Epidemiology socioeconomic, Socioeconomic, Geographic location.

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INTRODUCTION

India already has a high brain tumor burden, and a new data from the World Health Organization (WHO) indicates that the frequency of brain tumors is on the rise in the nation. Lifestyle changes, better diagnostic options, an aging population, and an expanding population are some of the reasons put up to explain this shift. The World Health Organization (WHO) reports that brain tumors are among the top 10 most common malignancies in India. This underscores the urgent need for targeted treatments and emotional support for patients undergoing treatment. Medical problems may be both complicated and diverse. There are regional differences in health outcomes, healthcare access, and treatment methods that affect the diagnosis, progression, and prognosis of brain cancer patients. In remote areas in particular, people may have a harder time gaining access to expert care and accurate diagnoses, which can prolong treatment times and worsen prognoses. 1 As well as their loved ones and neighbors. Medical bills, missed pay, and caregiving responsibilities may put a strain on family finances, which is especially true for households with a history of illness. In order to coordinate our approach to
It is of the utmost importance to tackle these socioeconomic issues in cancer treatment in India. Government organizations, non-profits, clinicians, and research centers are working together with the primary objectives of improving access to treatment and encouraging innovation in neurooncologist research. Potentially game-changing opportunities to improve mental health care outcomes exist in the realm of technological and therapeutic advancements. 2,3 There is hope for a more precise and effective treatment with less patient morbidity

because to developments in neuroimaging, surgery, radiation therapy, and targeted therapy. To succeed, you need a plan that covers all your bases. This can only be accomplished by allocating resources to healthcare institutions and medical research, while also tackling the broader factors that influence health and encouraging collaboration for mutual benefit. By working together, thinking outside the box, and speaking out for brain tumor patients, India can improve outcomes in 2024 and beyond, leading to a higher quality of life for those affected. A third of all diseases impact the brain and spinal cord. Of the total, 59.5% were high-grade variety of Grade III and IV, while 33.1% were low-grade variants of Grade I and II. 4 According to study, gliomas in India tend to manifest at a younger age compared to other nations. Men are more likely than women to have gliomas (66.6% vs. 36.6%). The majority of patients (41.4%) had glioblastoma as their primary histology finding. Among malignancies, diffuse astrocytoma is the second most common (22.8%). Maybe because of advancements in diagnostic tools or because there are more carcinogens in the air air, the glioma count is going up. 5 In addition to chronological age and genetic markers, other histological features impact the prognosis of malignancies. In developing countries, like India, where CBTRUS is not yet available, it is difficult to determine the true prevalence of this cancer. Conversely, information on the kind and stage of cancer within a particular hospital may be available in the cancer registry. 6 A person's vision, cognition, movement, behavior, and clarity of thought may all be negatively affected by some brain tumors. It is, therefore, essential to keep an eye on symptoms and provide treatment without delay. Tumors of the brain are very rare. The Central Nervous System (CNS) accounts for 5–10 cases of cancer per 100,000 people in India. World Brain Tumor Day is observed annually on June 8th to raise awareness and further understanding of brain tumors. 7

Types of Brain Tumors

There are various classifications for brain tumors, such as cell type, location, behavior and grade. This classification identifies a few crucial elements, including tumors of the brain.[8-11]

Gliomas

Proliferate from glial cells, which shield and sustain neurons. A malignant, aggressive type of glioma is called Glioblastoma Multiform (GBM). Astrocytes can vary in severity from low grade (less aggressive) to high grade (more aggressive).

Oligodendroglioma

It is made up of glial cells known as oligodendrocytes. Ependymal cells present in the spinal cords root canal or the brain's ventricles are the source of ependymomas. Meningiomas, the covering that protects the brain and spinal cord, are what make meningiomas. Most are benign; however, because of where they are, some may cause symptoms.

Pituitary gland

The pituitary gland, which controls hormones, is where it happens. Benign pituitary adenomas may impact hormone levels. The most prevalent location for medulloblastoma is the cerebellum and it typically affects children. Primitive Neuroectodermal Tumor (PNET) was identified as the condition.

Stages of brain tumors

In the first stage, tumors are often small and contained. It develops slowly and could or might not cause symptoms. Surgical removal, if deemed safe and practical, and regular monitoring tests are other methods for tumor therapy. In Stage 2, the tumor has progressed a little farther. They have the potential to grow in size or even invade nearby tissues. Their progress is still slow. In most cases, the tumor's size is

surgically removed, and further treatments, such as radiation therapy or chemotherapy, are used to target certain malignancies.

At this point, we call the tumor malignant or cancerous. It has the potential to spread and affect structures in the brain. Treatment usually includes surgery, chemotherapy, and radiation therapy to shrink the tumor and limit its development.

Stage 4, commonly known as glioblastoma or brain cancer, is the most advanced and severe form of the disease. As a result of their exponential development, they may metastasize to other parts of the brain and even other bodily organs. Because there is currently no cure, therapies focus on alleviating symptoms and improving quality of life. The need of palliative care, which seeks to alleviate suffering, becomes paramount at this stage.

TNM CLASSIFICATION OF BRAIN TUMOR

T1: Tumor visible, T2: Enlarged,

T3: Near blood,

T4: Near lymph nodes,

NX: Cancer near lymph nodes, No: No lymph nodes visible,

N1: Nearby lymph nodes present, N2: Many lymph nodes involved,

N3: Almost all lymph nodes in the region Effect, MX: Metastasis cannot be measured,

MO: Not seen, M1: Metastasis.

Prevalence of brain tumor

Central nervous system Tumors are a kind of malignancy that may affect the brain and spinal cord. By 2023, the number of Americans diagnosed with brain or spinal cord cancer is projected to reach 24,811—14,281 men and 10,531 women. The likelihood of a person ever developing this tumor is less than 1%. A large majority (85–90%) of malignancies affecting the CNS originate in the brain. Brain and spinal cord cancers accounted for 308,102 cases worldwide in 2020. What follows is a comprehensive guide on adult brain tumors. Research childhood brain tumors. At this stage, the tumor has begun to metastasize, or spread from another area of the body to the brain. These recommendations exclusively address primary adult brain tumors and do not apply to the most frequent types of tumors that metastasis to the brain, including leukemia, lymphoma, melanoma, lung, breast, and kidney cancers. The estimated number of lives lost in the US due to brain and central nervous system cancer in 2023 is 18,990, with 11,020 men and 7,970 women losing their fight. Lesions in the Brain and Spinal Cord and the

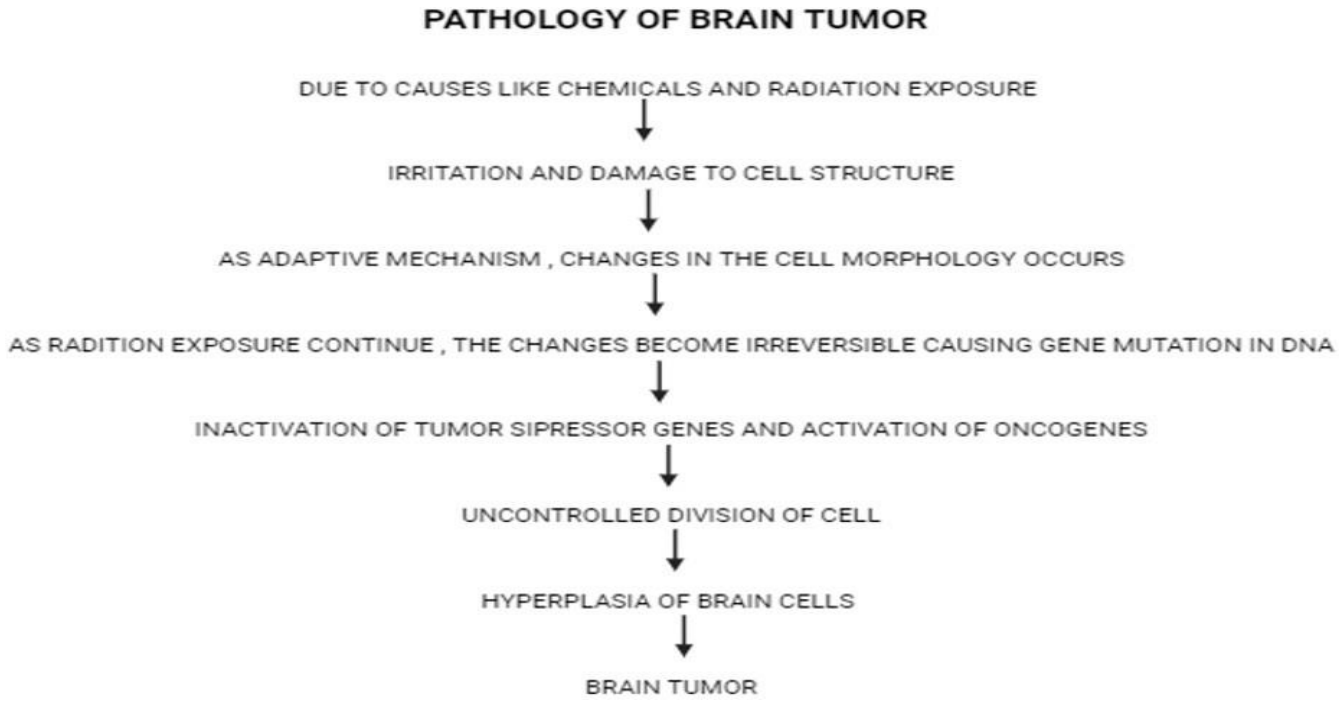

Figure 1: Pathophysiology of Brain Tumors (Self-Created).

Ministry of Health.[12] Pathophysiology of Brain tumor discussed in Figure 1.

Diagnostic Evaluation

Medical history and physical examination

The doctor will start by taking a detailed medical history, making note of the severity and duration of any previous diseases or symptoms. 14, 15 A physical examination will next be conducted. Next, you'll get a comprehensive physical examination and a brain scan to evaluate your mental acuity, reasoning, and motor skills. Route. Magnetic resonance imaging (MRI) may provide detailed pictures of the brain, revealing tumors' shapes, sizes, and locations. 16

Computed Tomography (CT) scans

To evaluate brain cancers when an MRI is not accessible or needed urgently, CT scans may also be used. Using CT scans, which provide detailed cross-sectional pictures of the brain, abnormalities may be detected. For an accurate diagnosis of a brain tumor, a blood test is usually required, which involves taking a small sample of the tumor to be examined under a microscope. This is within reach during the removal of tumors surgically or via less invasive techniques, such as stereotactic biopsy. 17

Blood tests

Blood samples may be used to test for various hormones, tumor indicators, liver and kidney function, and overall wellness. But blood tests aren't enough to rule out brain diseases. 18

Functional Imaging

Brain activity may be quantified and mapped to important cognitive processes like language and speech using functional imaging techniques such as functional magnetic resonance imaging (fMRI), positron emission tomography (PET), or magnetoencephalography (MEG). In order to reduce the likelihood of functional impairment, these considerations may be used to guide surgical planning. 19,20

Symptoms of Brain Tumour

Neurological symptoms

Depending on the tumor's location, a variety of neurological issues may be present, including headache, seizures, cognitive decline, limb weakness or numbness, trouble speaking or understanding

Table 1: Symptoms and Causes/Risk Factors.[13]

Clinical symptoms of brain tumors	Causes/Risk Factors of Brain Tumors
Brain tumor clinical signs include: Seizures of headaches, Pneumonia and vomiting Elevated ICP Symptomatic dysfunction weakened muscles, Sense of Aphasia: Speech impairment, Brain edema, Modifications in mode, Control of body temperature, Changes in the pustular alterations in breathing pattern Perplexity.	Unknown Congenital-at birth Heredity-by the birth Encephalitis-inflammation of the brain, usually caused by bacteria Obesity-problems with the production of brain fat History of epilepsy Age (old) Smoking/drinking Mutation.

words and problems seeing or understanding. Abnormalities in hearing, balance and coordination. Symptoms and Causes/ Risk Factors[13] will be discussed in (Table 1).

HERNIATION

An elevation in intracranial pressure causes a situation in which the brain deviates from its normal alignment. Since this might be deadly, immediate medical assistance is required. Cerebrospinal Fluid (CSF) may cause hydrocephalus if a tumor blocks its flow. An buildup of fluid in the brain causes this sickness, which manifests as a headache, nausea, impaired vision, and difficulty walking, among other symptoms. 21,22

Stroke

Brain tumors may cause stroke symptoms by blocking blood flow to the brain. Symptoms such as clumsiness, trouble speaking, blurred vision, weakness, or paralysis might emerge as a consequence. Changes in mood, tension, pressure, and memory are among the cognitive and behavioral effects that tumors may bring about. Tumors in the pituitary gland or other areas of the brain that produce hormones may disrupt hormone levels, leading to endocrine dysfunction. Weight gain or loss, abnormal menstrual bleeding, abnormal growth, and extreme fatigue are all possible signs.

Seizures are caused by electrical problems. Seizures; symptoms may include twitching muscles, loss of consciousness, jerking movements, or blurred vision. Radiation, chemotherapy, and surgery all include the risk of potential side effects during treatment. Damage to tissues, exhaustion, bleeding, infection, and cognitive impairment are all on the list. Social and psychological impacts: Patients and their loved ones may go through emotional and mental upheaval, including fear, despair, financial troubles, and changes in relationships due to the side effects of brain cancer treatment.

Radiation therapy

1. External Beam Radiation Therapy (EBRT) is one type of radiation therapy.

2. Radiation Therapy with Stereotactic Effects.

Radiation Therapy with new External Beams (EBRT)

For brain cancers, it is the most often used type of radiation therapy. It entails delivering radiation from outside the body to the tumor site. Tumors can be targeted with minimal harm to healthy tissue using contemporary techniques like Stereotactic Radiosurgery (SRS) and Magnetic Resonance Imaging (IMRT). Direct Treatment: Electrodes may occasionally be positioned directly on or close to the tumor. This method, also known as internal radiation treatment or direct radiation therapy, exposes the tumor to high doses of radiation while it is still near the tissue.

Immune Therapy

Pembrolizumab: Increase the power of T cells

Nivolumab or pidiva: also known as pidiva: fortifies the immune system. Numerous symptoms include headache, seizures, disorientation and weakness. Or numbness in the extremities, problems with balance and coordination, difficulties speaking or understanding words and changes in vision or hearing. Shifts in awareness as well as papilledema, or eye disc swelling. Herniation: A condition where the brain pushes against its natural position is brought on by an increase in intracranial pressure. This can be fatal, so you should get medical help right away.

Hydrocephalus

By obstructing the Cerebrospinal Fluid (CSF), certain malignancies can result in hydrocephalus. This disorder results in an accumulation of fluid in the brain, which can produce symptoms like headache, nausea, impaired vision and trouble walking. This may result in loss of coordination, speech difficulties, vision problems, weakness, or paralysis. Behavior and cognition: Tumors can have an impact on behavior and cognition, leading to changes in mood, stress, pressure and memory.

Endocrine Dysfunction

Tumors close to the pituitary gland or other hormone- producing regions are indicative of endocrine dysfunction. Hormone imbalances brought on by brain disorders might result in symptoms like growth anomalies, irregular menstruation, exhaustion and weight fluctuations. Seizures: Because of electrical irregularities in the brain, several neurological illnesses can result in seizures. Seizures; These could show up as convulsions, jerking of the muscles, altered awareness, or eyesight problems. Adverse reactions to therapy: Complications can also arise from treatments

Table 2: Chemo Drugs Used to Treat Brain and Spinal Cord Tumors.[24]

Sl. No.	Brand name	Composition	Dosage Form	M.R.P (in Rupees)
1.	Shree Pharma	Carboplatin (450 mg)	Injection (liquid)	1300
2.	GLS Pharma	Carmustine (100 mg)	Injection (liquid)	3999
3.	Cipla	Cisplatin (50 mg)	Injection (liquid)	250
4.	Cadila	Etoposide (50 mg)	Capsule	400/Box

including chemotherapy, radiation therapy and surgery. These include tissue damage, weariness, haemorrhage, infection and cognitive decline. And social effects, such as relationship changes, financial hardship, anxiety, sadness and stress. Chemo Drugs Used to Treat Brain

and Spinal Cord Tumors discussed in Table 2.[24]

Hydration

Make sure to drink plenty of water and other drinks to keep yourself hydrated. Two signs of dehydration are fatigue and headaches. When dealing with brain cancer, it is essential to adjust caloric intake based on the patient's appetite and metabolic rate. As a digestive aid, rice helps prevent constipation, a side effect that may arise as a result of several medications or treatments. Hazelnuts, chia seeds, and other seeds. Omega-3 fatty acids may help reduce inflammation and may even have positive effects on the brain. These meals have the potential to make you sick, weak, and in pain. But for others, cutting less on caffeinated drinks like coffee and tea might make them feel more alert and focused. A nutritionist may help you create a personalized meal plan that takes into account your dietary restrictions, personal preferences, and any health issues you may be managing. Add it to your diet to fix nutritional deficiencies or boost your health in general. Seeing a doctor before starting a new supplement regimen is essential since they may interact with prescription medications or treatments.

Treatment of brain tumors

1. Drilling: This technique involves opening the skull with a drill in order to drain local fluid and blood from beneath the dura. 20
2. In order to alleviate intracranial pressure, heal the wounded region, drain blood, and remove a wound, a craniotomy is performed by opening the dura mater and extracting the bone marrow from the skull.
3. A craniotomy is performed to remove the bones from the skull.

The fourth procedure is cranioplasty, which involves fixing the skull due to malformation, Truma, or previous surgery by using prosthetics to replace bones that have been injured or removed. 23

Prevention of Brain Tumours

Brain tumor prevention involves dealing with modifiable risk factors, living a healthy lifestyle and early identification. Some measures may reduce the risk of brain tumors.[25-27]

Reduce environmental toxins

Ionizing radiation, particularly in children, is a known brain tumor risk factor. This risk may be reduced by avoiding unneeded medical imaging like CT scans. Pesticides, solvents and industrial chemicals: Long-term exposure increases risk. Occupational safety measures decrease exposure.

Healthy Eating and Living

Antioxidant-Rich Diet: Fruits, vegetables and antioxidants lessen cancer risk, especially brain tumors. These nutrients reduce tumor-causing oxidative stress.

CONCLUSION

The increasing prevalence and changing epidemiological patterns of brain tumors pose a significant threat to public health in India and beyond. Factors such as an aging population, changing lifestyle preferences, and limited access to healthcare all contribute to making this problem worse. Reforms in mental health care and research have the potential to improve outcomes, but there are still significant challenges to overcome, especially in developing countries like India. As AI continues to mature, new applications will emerge that provide new insights into cancer detection, diagnosis, and treatment planning. Precision medicine, gene therapy, immunotherapy, nanotechnology, and targeted medication delivery all work together to provide patients with individualized treatments. But these upgrades shouldn't be out of reach financially for any patient, especially those in underprivileged communities. Many brain problems affect tumor control. Efforts should primarily focus on improving access to timely diagnoses, specialized care, and novel treatments, especially in disadvantaged communities. Comprehensive cancer treatment also includes efforts to address social and economic issues, increase public awareness, and assist cancer patients.

SUMMARY

Brain tumors are a major public health concern in India, and they are becoming more common as a result of factors including advancing age, changes in lifestyle, and better diagnostic tools. They are in the top ten most common cancers in the country, but there are still challenges, such as gaps in diagnosis and treatment availability, especially in rural areas. India has a higher incidence of gliomas, especially glioblastoma, and a younger average age of onset compared to other countries. Diagnostic imaging using MRI and CT scans is common for brain tumors because of the potential effects on various neurological functions. Advancements in precision medicine have sparked hope for better outcomes from the treatment options, which include immunotherapy, radiation therapy, and surgery. Improving therapy for brain tumors in India requires attention to socioeconomic factors, healthcare accessibility, and innovative research.

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