

# Characteristics of Neurological Deficits in Intracranial Tumors: A Literature Review

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## ABSTRACT

Intracranial tumors or brain tumors are abnormal masses in the cranium that can originate from central nervous system cells or from other histopathological types. Brain tumors account for 85% to 90% of all primary central nervous system (CNS) tumors. Intracranial tumors have an incidence of 10-17 cases per 100,000 people. Clinical symptoms vary from one patient to another. The most common symptom is headache, followed by seizures, decreased consciousness, and motor and sensory neurological deficits. Other symptoms that may be found are neurological deficits (smell disturbances, visual disturbances, double vision, numbness or pain in the face, facial muscle weakness, hearing, swallowing, etc.) which are progressive and depend on the location of the tumor, seizures, cognitive decline, balance disorders and personality disorders. These signs and symptoms can be used to determine the location of the tumor before radiological investigations are carried out, according to the disturbed anatomical structure.

**Keywords:** intracranial tumors, neurological deficits, supratentorial, infratentorial, suprainfratentorial

## 1. INTRODUCTION

Intracranial tumors or brain tumors are abnormal masses in the cranium that can originate from cells of the central nervous system or from other histopathological types [2]. Brain tumors are the second dangerous disease that causes death for men aged 20-30 years and the fifth dangerous disease that

causes death for women aged 20-30 years. According to data from the International Agency for Research on Cancer, more than 126,000 people in the world each year suffer from brain tumors and more than 97,000 people died [24].

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## 2. NEUROLOGICAL DEFICIT

Scientifically, there is still no specific explanation regarding the meaning of neurological deficit, but in the KBBI 'deficit' means a deficiency or disturbance in mental or physical function, and 'neurology' means the science of nerves, especially neurological diseases. So it can be concluded that a neurological deficit is a disturbance in mental

or physical function that occurs due to disease in the nerves [33].

### **2.1 Focal Neurological Deficits**

Focal neurological deficits consist of a series of symptoms or signs in which the cause can be localized to an anatomical site in the central nervous system. The pathologic site of the abnormality is usually inferred through history and physical examination before imaging. Clinical localization of suspected lesions is very useful because it assists the radiologist in directing the imaging portion of the evaluation. Focal neurological deficits can develop suddenly or can develop slowly. Once a deficit occurs, it may remain stable, may continue to worsen steadily or gradually or may resolve. Resolution may be partial or complete [44].

### **2.2 Global Neurological Deficits**

Scientifically, there is no specific explanation regarding the meaning of global neurological deficit, but if we refer to the linguistic meaning, the meaning of 'global' according to the KBBI is general and overall. So, if combined with the definition of neurological deficit explained above, global neurological deficit is a disturbance in mental or physical function that occurs due to disease of the nerves in general [12].

## **3. INTRACRANIAL TUMORS OR BRAIN TUMORS**

The term "brain tumor" refers to various groups of neoplasms originating from intracranial tissue, including the meninges (for example: meningioma) with various degrees of malignancy, ranging from benign to malignant or aggressive [17]. Brain tumors or intracranial tumors are neoplasms or space occupying processes (space occupying lesions or space taking lesions) that arise in the skull cavity, both in the supratentorial and infratentorial compartments [5]. Brain tumors, known as intracranial tumors, are masses of abnormal tissue in which cells grow and reproduce uncontrollably, apparently uncontrolled by the mechanisms that control normal cells. More than 150

different brain tumors have been documented, but the two main groups of brain tumors are called primary and metastatic or secondary [39].

Primary brain tumors are brain tumors that develop from the brain cells themselves, whereas Secondary brain tumors are brain tumors that are secondary or metastasize from tumors in other bodies. Some brain tumors originate from the brain tissue itself (primary brain tumor), others originate from tumors in other organs that spread to the brain (secondary brain tumor). Primary brain tumors include tumors that originate from brain tissue or the environment around the brain. Primary tumors are categorized as glial (consisting of glial cells) or non-glial (developing on or within brain structures, including nerves, blood vessels and glands) and benign or malignant. Metastatic brain tumors include tumors that arise elsewhere in the body (such as the breast or lungs) and migrate to the brain, usually through the bloodstream. Metastatic tumors are considered cancerous and malignant [39].

Intracranial tumors are generally classified as malignant or benign. Furthermore, malignant tumors can be primary or metastatic. Metastatic lesions are more common than primary tumors [30]. In intracranial tumors or brain tumors, each patient has different symptoms depending on the location of the tumor. Brain tumors can attack anyone of varying ages. Patients with brain cancer often present in a state of neuroemergency due to increased intracranial pressure. This is mainly caused by the space pressure effect of peritumoral edema or diffuse edema, in addition to the large size of the mass or ventriculomegaly due to obstruction by the mass [17].

### **3.1 Epidemiology**

Although CNS tumors are rare, they are a significant cause of cancer morbidity and mortality, especially in children and young adults where they are responsible for approximately 30% and 20% of cancer deaths, respectively [31]. In children less than 10 years of age, the most common site

of malignancy in the CNS is the cerebellum. The second and third most common sites were the cerebrum and brainstem, where the frequencies were relatively similar. Among children aged 10 to 19 years, the incidence of cerebellar and brain tumors is decreasing, while cerebral malignancies are increasing. In adults, the most common location by far is the cerebrum [39]. The incidence of primary brain tumors varies with age, gender, and ethnic origin. Malignant brain tumors, such as: glioma, lymphoma, embryonal, and germ cell tumors, tend to occur slightly more frequently in men. However, brain tumors occur more frequently in women than in men in general, especially meningiomas and pituitary tumors [21].

### 3.2 Pathophysiology

Neurological dysfunction can occur as follows:

- Invasion and destruction of brain tissue by tumors
- Direct compression of adjacent tissue by the tumor
- Increased intracranial pressure (because the tumor occupies space inside the skull)
- Bleeding inside or outside the tumor
- Cerebral edema
- Dural venous sinus obstruction (mainly by bone or extradural metastatic tumor)
- Obstruction of cerebrospinal fluid (CSF) drainage occurs early with tumors of the 3rd ventricle or posterior fossa
- Obstruction of CSF absorption (eg, when leukemia or carcinoma involves the meninges)
- Arterial outflow obstruction
- Rarely, paraneoplastic syndrome [13].

In the pathophysiology above, there are many lesion sites in each tumor. Different locations of brain tumors usually cause different symptoms and different treatments. Benign tumors grow slowly. They may become quite large before causing symptoms, in part because there is often no cerebral edema. Primary malignant tumors grow rapidly but rarely spread beyond the CNS. Death is caused by local tumor growth

and thus can be caused by benign or malignant tumors. Therefore, differentiating between benign and malignant is prognostically less important for brain tumors than for other tumors [13].

### 3.3 Examination

The examination begins with an anamnesis examination. Anamnesis functions to find more in-depth information about the course of the patient's illness. Having a good history will really help with supporting examinations, so that patients don't have to do many tests because they don't get the desired results.

Supporting examinations that are usually carried out in patients with intracranial tumors or brain tumors are as follows:

1. CT angiography / magnetic resonance angiography (CTA/MRA), this examination is vascular imaging
2. CT venography / magnetic resonance venography (CTV/MRV), this examination is a venous modality
3. Cerebral angiogram, this examination is performed for intracranial tumors which guarantee critical vascular findings and close affinity with vascular structures [30].

Before carrying out the usual supporting examination, the patient will undergo a laboratory examination. Laboratory examinations are mainly to see the general condition of the patient and his readiness for the therapy he will undergo (surgery, radiation or chemotherapy), namely:

- Whole blood
- Hemostasis
- LDH
- Liver, kidney, blood sugar function
- Hepatitis B and C serology
- Complete electrolytes
- Radiological examination
- CT scan with contrast
- MRI with contrast, MRS, DWI
- PET CT (according to indications) [17].

### 3.4 Diagnosis

Symptoms are things that have an important role in the process of establishing a

diagnosis. By knowing these symptoms, the therapy that will be carried out will be more efficient and structured. Symptoms of brain tumors are divided into general and focal symptoms:

a. General Symptoms

Headache is the most frequent symptom and occurs in approximately 48-56% of brain tumor patients. Headache patterns and locations vary greatly depending on the mechanism and pathophysiology. In general, headaches can be local or global and the intensity and rate of progression can provide insight into the growth rate of the lesion [29].

b. Focal Symptoms

Focal symptoms are usually symptoms that typically occur in a disease, by knowing these focal symptoms it will be easier to eliminate similar symptoms in different diseases. Basically, every disease has typical symptoms, including brain tumors. Focal symptoms of brain tumors can usually provide clues to the location of the lesion. This stems from the fact that focal deficits are created from tumors or the resulting edema pressing on certain parts of the brain parenchyma or cranial nerves. Therefore, from knowledge of brain structure and function, using focal deficits can predict the exact location of the tumor [29].

### 3.5 Management

Brain cancer diagnosis can be invasive or non-invasive [42]. Treatment for brain tumors is total resection if possible and performing an open biopsy, stereotactic biopsy, or partial resection. Next, staging is carried out and the patient is given craniospinal radiation, chemoradiation, or radiation with adjuvant chemotherapy depending on the results of the staging [17]. Brain tumors require specialized and complex treatment by neurooncologists, medical oncologists, radiation oncologists, and brain tumor neurosurgeons. Primary care providers must be familiar with their management, as they are on the front lines of

diagnosis, care coordination, and management of complications [26].

Adult intracranial tumors are best managed by a multidisciplinary team of physicians. Management options include observational surveillance, surgical resection, chemotherapy, radiation therapy, or a combination thereof. No two intracranial tumors are the same, which means that no two intracranial tumors are managed the same [30]. Management of brain tumors is usually based on the pathophysiology and location of the lesion found. The location of the intracranial tumor along with its size and mass effect determines its clinical presentation [30]. However, in general there are several treatments that can be done:

1. Airway protection
2. Dexamethasone for increased intracranial pressure
3. Mannitol for herniation
4. Definitive therapy with excision, radiation therapy, chemotherapy, or a combination [13].

## 4. NEUROLOGICAL DEFICITS IN INTRACRANIAL TUMORS BASED ON LOCATION

### 4.1 Supratentorial

Based on its location, supratentorial tumors are tumors that are located in 4 lobes, namely frontal, parietal, occipital and temporal. If there is interference in these 4 lobes

#### 1. Frontal Lobe

According to the Neurosurgical Oncology Module at Dr. Soetomo (2016) deficit disorders that occur as follows:

- a. Anosmia
- b. Papilloedema and visual impairment. Swelling of the optic nerve
- c. Ataxic gait
- d. Mental disorders
- e. Hemiparesis (contralateral)
- f. Dysphasia (Broca's)
- g. Incontinence
- h. Foster Kennedy syndrome
- i. Aphasia [27]

#### 2. Parietal Lobe

According to the Neurosurgical Oncology Module at Dr. Soetomo (2016) deficit disorders that occur as follows:

- a. Seizures
- b. Motor and sensory disorders
- c. Hemiparesis
- d. Hemiesthesia [27]

### 3. Temporal Lobe

According to the Neurosurgical Oncology Module at Dr. Soetomo (2016) deficit disorders that occur as follows:

- a. Speech disorders
- b. Memory impairment
- c. Behavioral disorders
- d. Mood disorders
- e. Auditory and visual pathways [27]

### 4. Occipital Lobe

If there is interference in the occipital lobe, it will interfere with the patient's visual field of vision [19].

#### 4.2 Infratentorial

Based on its location, infratentorial tumors are tumors that are located in the brain stem and cerebellum (little brain).

##### 1. Brain Stem

According to the Neurosurgical Oncology Module at Dr. Soetomo (2016) deficit disorders that occur as follows:

- a. Cranial nerve disorders
- b. Impaired vital functions [27]

##### 2. Cerebellum

There are several disorders including:

- a. Intentional Tremor  
Tremors when doing activities
- b. Dysmetria  
Failure to detect movement and position of objects
- c. Dysdiadochokinesia  
Failure of coordination when making sudden movements
- d. Dyssynergia  
Failure of muscle group coordination
- e. Astasia and abasia  
Astasia causes the patient to have difficulty standing upright and abasia makes it difficult to walk

- f. Truncal ataxia  
Gait appears like a drunk person
- g. Dysarthria and dysarthroponia  
The eyes experience nystagmus and decreased tone [36].

## 5. CONCLUSION

The neurological deficits that occur in each patient are very varied and vary depending on the location of the tumor.

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