



Space Occupying Lesions (SOL) of the Brain - Clinical Manifestation with Subtle Neurological Symptoms in Emergency Department

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Authors' contributions

This work was carried out in collaboration between all authors. Author AS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors GYN and ZK managed the analyses of the study. Author ZA managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

A space-occupying lesion of the brain is commonly due to malignancy but could be other underlying pathologies as well [1]. The effects of SOL may be local or due to compression of adjacent brain structures. Patients may also have behavioral disturbances or cognitive dysfunction [2,3].

Aims & Objectives:

1. To identify SOL patients presenting with elusive symptoms in Emergency Department.
2. To avoid diagnostic delay of SOL.

3. To find the underlying cause and to initiate early management.

Methods: This is a retrospective study involving 150 patients who presented in ED Rashid Hospital with neurological symptoms over a period of 12 months commencing from 01/01/2015 until 31/12/2015.

Results: As for presenting symptoms, 81 (54%) presented with Seizures, 31 (21%) with a headache, 17 (11%) had both a headache and vomiting, 8 (5%) with unconsciousness and those by abnormal behavior (3%). Five (3%) were having a motor deficit, and two (1%) had vomiting without a headache and confusion.

As for underlying diagnosis, 78 (52%) were diagnosed with **infectious causes** and 62 (41%) with a **brain tumor**. Among the infectious causes, 58 (74%) presented with seizures, 11 (14%) with an isolated headache and 4 (5%) with both a headache and vomiting.

On the other hand, the headache was the commonest presentation in brain tumor patients, i.e., 18 (29%) followed by seizures in 17 (27%), headache and vomiting in 11 (18%) and neurological deficit in 10 (16%) patients.

Conclusion: A headache with or without vomiting, seizure and acute psychological disturbances may be a warning sign of a wide variety of an intracranial space occupying lesion (SOL) including malignancy.

Keywords: Space-occupying lesion; headache; brain tumor; seizure; emergency department (ED).

1. INTRODUCTION

A space-occupying lesion (SOL) of the brain may result from:

- 1- **Malignancy:** primary or metastatic
- 2- **Inflammatory causes:** Abscess, Tuberculoma, Syphilitic gumma, fungal Granulomas.
- 3- **Parasitic infections:** Cysticercosis, Hydrated cyst, amebic abscess, Schistosoma japonicum.
- 4- **Traumatic brain injury:** Subdural & Extradural hematoma.
- 5- **Congenital causes:** Dermoid, Epidermoid, Teratoma.

Brain tumors may arise from various cells in the central nervous system like neurons and glial cells as Gliomas, astrocytoma, ependymoma, oligodendroglioma, germinoma, medulloblastoma or from appendages like, meningioma, schwannoma, chondroma, osteoma or from pituitary gland like adenoma, craniopharyngioma or there maybe vascular tumors like angiomas, hemangioblastoma, papilloma of choroid plexus or secondary metastasis.

The estimated new cases of brain and other nervous system tumors in the United States in 2013 were 23,130, and the estimated cases of death due to the brain and other nervous system tumors were 14,080.

There are approximately 1500 to 2000 cases of brain abscess diagnosed in the United States

annually, with an estimated 1 in 10,000 were hospitalized for a brain abscess. The infection tends to occur in young men, although infection can occur in all age groups; the male-to-female ratio varies between 2: 1 and 3: 1.

A common manifestation of SOL is a headache and is the worst symptom in about half of the patients [2]. It's dull and constant, occasionally throbbing in nature. Maneuvers that increase the intracranial pressure such as coughing, sneezing, Valsalva maneuver or a change in body position, such as bending over cause worsening of a headache. Severe headaches are infrequent, unless obstructive hydrocephalus or meningeal irritation is present.

Features suggestive of a SOL in a patient complaining of headaches include nausea and vomiting (present in about 40 percent), a change in prior headache pattern, and an abnormal neurologic examination [2].

In patients with tumor-associated emesis, vomiting is triggered by an abrupt change in body position. A headache can be localizing being worse on the same side as the tumor [2] or generalized headache due to raised intracranial pressure (ICP), Tumor-related headaches tend to be worse at night and may awaken the patient. This is thought to be due in part to transient increases in PCO₂, which is a potent vasodilator, during sleep or due to recumbence and decreased cerebral venous return.

A retrospective review of 111 patients with brain tumors showed that headaches were present in 48 percent of cases with either primary or metastatic disease [2]. The headaches were tension-type in 77 percent, migraine-type in 9 percent, and other types in 14 percent.

Seizures are among the most common symptoms of brain tumors. [3,4] with a higher incidence with low-grade primary tumors than with metastasis or high-grade tumors. This was illustrated in a review of 1028 patients with primary brain tumors: the prevalence of seizures was 49, 69, and 85 percent among patients with glioblastoma (GBM), anaplastic glioma, and low-grade glioma, respectively [4].

Seizures may be the presenting symptom or develop subsequently. The frequency and onset of seizures in patients with brain metastases were illustrated in a series of 195 patients, in which seizures were present at diagnosis in 9 percent and subsequently developed in another 10 percent [5]. In two large series of patients with GBM, seizures were the initial manifestation in 18 percent and were present at the time of diagnosis (for an average of one year) in 29 percent [6,7].

The clinical presentation of a seizure is dependent upon the tumor location, e.g., frontal lobe tumors may cause focal tonic-clonic movements involving one limb, while seizures originating within the occipital lobe may cause visual disturbances. Temporal lobe seizures may cause abrupt sudden behavioral changes with or without typical auras, such as abnormal smell, taste, or gastrointestinal symptoms. For patients with focal seizures, a postictal paresis (also known as a Todd's paralysis) may be present. Both primary and metastatic brain tumors can cause status epilepticus, which may occur at the time of tumor diagnosis or subsequently [7].

The occurrence of a seizure is an indication for neuroimaging, which leads to an earlier diagnosis, therefore, patients who present with seizures usually have smaller primary brain tumors or fewer metastatic lesions. A significant rise in ICP can temporarily cut off cerebral perfusion, leading to loss of consciousness or syncope.

A syncopal episode may simulate a seizure since patients suffer the loss of consciousness and may have a few tonic-clonic jerks. Identification of plateau wave-related episodes on EEG of loss

of consciousness is critical, since these events identify patients who require urgent corticosteroids and neurosurgical intervention to reduce elevated ICP rather than treatment with an anticonvulsant.

Behavioral disturbances, mood or personality changes, and cognitive dysfunction, which includes memory problems, is common among patients with SOL. Personality changes are most often associated with lesions of the frontal lobes, periventricular white matter, or corpus callosum.

Most of these deficits are subtle. Patients often complain of having low energy, fatigue, an urge to sleep, and loss of interest in everyday activities. They may become slow and show a lack of spontaneity mimicking depression. Thus neuroimaging should be considered to rule out a brain tumor in patients without a prior history of depression, who experience a new onset of depressive symptoms without an obvious cause.

Sub acute psychosis in a patient without an antecedent psychiatric history is a diagnosis of exclusion that requires diagnostic neuroimaging studies to rule out an organic cause.

Patients may also present with apathy, psychosis, confusion, memory impairment, slowness of thought, or visual hallucinations. Since these changes tend to develop slowly, remain unnoticed for longer periods.

Other focal features of SOL include weakness. The manifestations may be subtle, particularly in the early stages. For upper motor neuron lesions, weakness is generally more pronounced in the flexors of the lower extremities than in the extensors, and more pronounced in the extensors than the flexors in the upper extremities. Tumor-related weakness usually responds to steroids particularly with tumors that are near the motor cortex indicating that the weakness is caused by edema and not by direct tumor involvement.

Cortical sensory deficits can develop in patients whose tumors involve the primary sensory cortex. These sensory deficits usually do not respect a dermatomal or peripheral nerve distribution. Some of the other cortically based sensory deficits include lack of coordination and visuospatial disorientation.

Aphasia which results due to a lesion in the dominant hemisphere, usually left frontal or parietal. Lesions in the nondominant hemisphere

may produce apraxia, which refers to an inability to perform purposeful movements.

There are several forms of visual dysfunctions, the compression of the optic chiasm usually manifests as a bitemporal hemianopsia. A unilateral hemianopsia with a central scotoma can occur in the contralateral eye in the early stages, particularly when the compression is on one side. This scotoma results from partial compression of the Wilbrand's knee in the contralateral optic nerve.

Therefore the examination of the optic nerve and the visual fields is essential to look for by experienced personnel. Only the medial portion of the optic disk may be blurred initially in early papilledema. Venous engorgement and the absence of venous pulsations are also important diagnostic clues in the initial stages.

1.1 Aims and Objectives

1. To identify SOL patients presenting with elusive symptoms in Emergency Department.
2. To avoid diagnostic delay of SOL.
3. To find the underlying cause and to initiate early management.

2. MATERIALS AND METHODS

This is a retrospective study involving 150 patients who presented to ED at Rashid Hospital Dubai with neurological symptoms over a period of 12 months, commencing from 01/01/2015 until 31/12/2015.

- After institutional, ethical and scientific review board approval, 150 patients were included in the study.
- Patients' files were studied from record room, confidentiality was maintained, and their information was exchanged only among selected medical personnel.
- Relevant laboratory investigations were reviewed through an online record.
- All patients had the specified imaging-Brain CT +/- contrast was done.
- Patients' referral to the concerned specialties like Neurosurgery, Infectious diseases for definitive treatment were followed as well.

2.1 Inclusion /Exclusion Criteria

1. All age groups were included from both male and female population.

2. All patients who presented to ED Rashid Hospital Dubai with:

- (a) Neurological Symptoms and signs, i.e., Headache, Weakness, Sensory loss, Aphasia, Visual dysfunction, false localizing signs, Seizures, nausea and vomiting, Syncope, behavioral disturbances or cognitive dysfunction.
- (b) CT Brain Showed Space Occupying Lesion (SOL).

Note; Cases excluded were those previously diagnosed as SOL and on definitive treatment, plus newly diagnosed Stroke /demyelinating lesions.

3. RESULTS

3.1 Demographics

A total number of 150 patients were included in this study. 119 (79%) were male, and 31 (21%) were female patients (Table 1).

Table 1. Demographics by gender

Gender	Frequency	Percent
Female	31	20.7
Male	119	79.3
Total	150	100.0

97 (65%) were between the age of 20 to 40 years, whereas 39 (26%) belonged to 40-60 years of age group. 11 (7%) patients were below 20 years, and 3 (2%) were above 60 years (Table 2).

Table 2. Demographics by age

Age groups	Frequency	Percent
Less than 20	11	7.3
20 to 40	97	64.7
40 to 60	39	26.0
More than 60	3	2.0
Total	150	100.0

3.2 Clinical Features

As for presenting symptoms were concerned, 81 (54%) had Seizures, and 31 (21%) had a headache only whereas 17 (11%) had a headache and vomiting. Only 8 (5%) patients presented with unconsciousness followed by abnormal behavior (3%). 5 (3%) were having a motor deficit, and 2 (1%) had vomiting without a headache and confusion).

Table 3. Clinical features

Clinical features	Frequency	Percent
Abnormal behavior	4	2.7
Confusion	2	1.3
A headache	48	32.0
Paralysis	5	3.3
Seizure	81	54.0
Unresponsive	8	5.3
Vomiting	2	1.3
Total	150	100.0

3.3 Underlying Causes

Out of 150 patients, 78 (52%) were diagnosed with infectious causes and 62 (41%) with a brain tumor

Among the female patients, 65% were diagnosed with brain tumor and 32% with infectious causes. On the other hand among male patients, 57% were diagnosed with infectious causes and 35% with a brain tumor (Table 5).

3.4 Correlating Clinical Features with Underlying Causes

Among infectious cause of SOL patients 78 (52%), 58 (74%) presented with seizures, 11 (14%) with an isolated headache and 4 (5%) with a headache and vomiting both.

On the other hand, the headache was a commonest presentation in brain tumor patients,

i.e., 18 (29%) followed by seizures in 17 (27%), headache and vomiting in 11 (18%) and neurological deficit in 10 (16%) patients (Table-6).

Table 4. Underlying causes

Diagnosis	Frequency	Percent
Brain tumor	62	41.3
Infectious cause	78	52.0
Inflammatory cause	1	.7
Metabolic cause	6	4.0
Vascular cause	3	2.0
Total	150	100.0

4. DISCUSSION

Malignancy is one of the common causes of the space-occupying lesions (SOL) of the brain in addition to acute infectious causes, tuberculosis, parasitic diseases, hematomas, metabolic causes and vascular causes. Our study stressed upon the emergency presentation of some benign looking clinical features that could add to the awareness of triage staff in ER department to reach a provisional diagnosis.

Subtle symptoms like a headache, vomiting or seizures without any other evidence should be taken into consideration for full work up if seen in the absence of similar symptoms in the past. A new or an unusual headache in a patient with HIV or other malignancy should raise the suspicion of an intracranial infection [8].

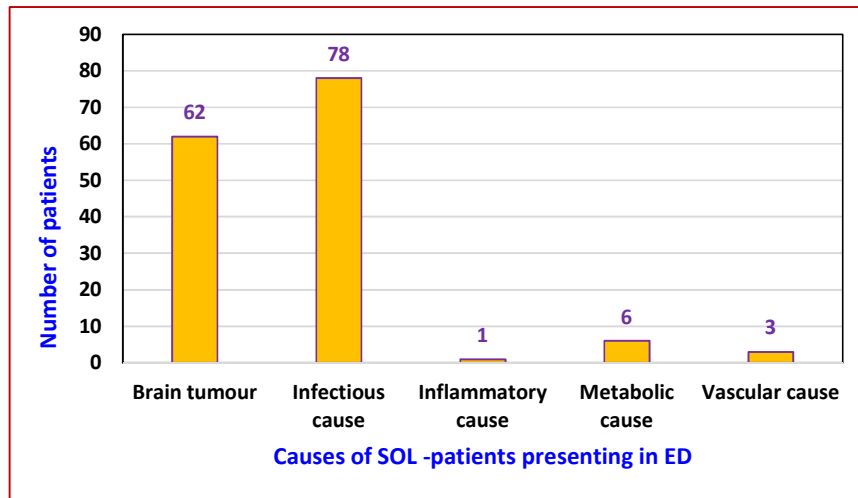


Fig. 1. Underlying causes

Table 5. Underlying causes

Diagnosis	Gender		Total
	Female	Male	
Brain tumor	20 64.5%	42 35.3%	62 41.3%
Infectious cause	10 32.3%	68 57.1%	78 52.0%
Inflammatory cause	0 0.0%	1 0.8%	1 0.7%
Metabolic cause	0 0.0%	6 5.0%	6 4.0%
Vascular cause	1 3.2%	2 1.7%	3 2.0%
Total	31 100.0%	119 100.0%	150 100.0%

Table 6. Correlating clinical features with underlying causes

Signs and causes	Diagnosis					Total
	Brain tumor	Infectious cause	Inflammatory cause	Metabolic cause	Vascular cause	
Abnormal behavior/Confusion	4 6.5%	2 2.6%	0 0.0%	0 0.0%	0 0.0%	6 4.0%
A headache	18 29.0%	11 14.1%	0 0.0%	2 33.3%	0 0.0%	31 20.7%
A headache & vomiting	11 17.7%	4 5.1%	0 0.0%	1 16.7%	1 33.3%	17 11.3%
Paralysis/Neurological deficit/unresponsive	10 16.1%	3 3.8%	0 0.0%	0 0.0%	0 0.0%	13 8.7%
Seizure	17 27.4%	58 74.4%	1 100.0%	3 50.0%	2 66.7%	81 54.0%
Vomiting	2 3.2%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	2 1.3%
Total	62 100.0%	78 100.0%	1 100.0%	6 100.0%	3 100.0%	150 100.0%

Headache patients constitute about 4.5% in Emergency Department [9,10]. Failure to recognize a serious headache can have grave outcomes. It is the job of the Emergency physician to determine the high-risk headaches by certain features like sudden severe headache, new headache different from previous headaches, persistent in nature and association with vomiting or visual disturbances, seizure and altered mental state [11]. Patients over the age of 50 years with sudden and progressively worsening headache are at greater risk of the intracranial mass lesion [12,13].

A retrospective review of 111 patients with brain tumor illustrated that headache was present in 48% of the cases [2]. Our study showed that 29% of the brain tumor patients were having headache alone and 18% presented with a headache and vomiting. A headache constituted about 33% of metabolic causes of SOL and 14% in infectious causes (Table 6).

A seizure is common in brain tumor patients and can affect daily life. It adds substantial morbidity to these patients [14]. Seizures are most common in gliomas and cerebral metastasis and may not be there at initial diagnosis [3,4]. Non-epileptic seizures usually present with sudden behavioral changes and are not associated with typical neurophysiological changes of epilepsy [15,16,17]. Neoplastic as well as vascular and degenerative causes are more common in elderly as compared to young adults and children [18].

A population-based cohort study of 1195 patients with new-onset epilepsy showed that 15% had vascular causes and 6% had brain tumors [19]. It has observed in our study that 74% of the patients with infectious cause had a seizure and 27% of brain tumor patients presented with seizures.

Our population sample has shown that infectious diseases a leading cause of SOL that does not match with International studies as a major cause of SOL. Dubai is a tourist hub internationally and having a big turnover of visitors from Asia and Africa. Because of demographics, patients received in ED fall in this population sample.

SOL can cause nausea and vomiting due to increased intracranial pressure in the brain. Neurogenic nausea and vomiting are usually associated with other symptoms like a headache

or focal neurological deficit. These symptoms may be elusive [20,21].

Muscle weakness is a common presentation in patients with SOL, especially in brain tumor patients and could be subtle in early stages. It has observed that 16% of our brain tumor patients exhibited some sort of neurological deficit.

5. RECOMMENDATIONS

1. Brain tumors should be considered in patients presenting with headaches associated with focal neurological signs and vomiting.
2. New onset headache in adults over age 50 should prompt further workup.
3. A detailed description, past medical history, a physical and neurological examination is very crucial in the evaluation of a first seizure.
4. Abnormal findings on neurological examination remain the single best clinical predictor of intracranial pathology, i.e., altered mental status, visual changes and changes in the patterns of migraine headaches.
5. The presence of one or more high-risk features in patients with headaches, vomiting, recent onset seizures and acute psychological presentations increase the possibility of underlying serious illness and warrants urgent evaluation with neuroimaging and lumbar puncture.

6. CONCLUSION

Headache with or without vomiting, seizure and acute psychological disturbances may be a warning sign of a wide variety of an intracranial space occupying lesion (SOL) including malignancy. Careful attention to the patient history and physical examination and a thoughtful approach to the differential diagnosis will help guide diagnostic workup and management.

CONSENT

It is not applicable.

ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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