

Prevalence and Trends in the Neuropsychological Burden of Patients having Intracranial Tumors with Respect to Neurosurgical Intervention

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Keywords

Behavioural changes · Behavioural symptoms · Brain tumours · Neuropsychiatric inventory

Abstract

Background: The burden of neuropsychological symptoms evidenced by behavioral changes among patients with intracranial tumors has not been studied in detail. **Purpose:** This study was conducted to prospectively assess the neuropsychological symptoms in patients with intracranial tumors undergoing treatment. **Methods:** A longitudinal study was conducted using purposive sampling to assess the neuropsychological symptoms in conscious and consenting patients with intracranial tumors who were availing treatment from a tertiary care center. Neuropsychiatric Inventory Questionnaire (NPI-Q), which identifies 12 behavioral disturbances, was assessed at baseline, and later at 1 month and 6 months after treatment, and scored as symptom severity as well as symptom scores. **Results:** Among the 34 patients

studied, all had experienced at least one neuropsychological symptom. The commonest neuropsychological symptoms at baseline were anxiety (82%), agitation (75%), irritability (74%), depression (74%), and sleep disturbances (70%). The neuropsychiatric symptom and severity scores were 5.84 (SD ± 2.7) and 11.8 (± 7.1) at baseline, which reduced significantly to 4.3 (± 3.1) and 5.6 (± 3.2) at 1 month, and further to 2.3 (± 2.9) and 3.6 (± 3.2) at 6 months, respectively. The neuropsychological symptoms persistent at 6 months were anxiety (33%), depression (33%), sleep disturbances (33%), agitation (25%), irritability (25%), and disinhibition (25%). **Conclusion:** There is substantial neuropsychological burden among patients with intracranial tumors. The severity score improved immediately after surgery, while the symptom score improved gradually. The variable spectrum of improvement in neuropsychological symptoms at 6 months after surgical treatment needs further consideration. Addressing these symptoms should be one of the long-term goals of the neuro-oncology teams.

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Introduction

Intracranial tumors are one of the common causes of morbidity worldwide in people of all ages [1, 2]. Individuals with intracranial tumors often suffer from various levels of physical, neuropsychological, and cognitive dysfunction during their lifetime [3–7] affecting their the activities of daily living (ADL), interpersonal relationships, education, work, and profession thus leading to a poor functional status and quality of life (QoL) [3–5]. The neuropsychiatric symptoms reported by various authors include depression [5], mood disorders, psychotic symptoms, personality changes, disinhibition, apathy, and emotional outbreaks [8]. Identifying the symptoms related to neuropsychological changes becomes essential to aid in various behavioral therapies to improve the QoL of patients and caregivers [9].

The importance of identifying and managing the neuropsychological symptoms is growing as the survival of these patients is increasing. Evidence shows that patients with behavioral symptoms are difficult to be managed, thus increasing the caregivers' burden [5]. These symptoms may be present in the patients since the onset of disease or sometimes may develop later during the disease and treatment process [10, 11]. However, there is a paucity of studies done on prospective assessment of neuropsychological symptoms at various time points of the disease process. With this in mind, the present study was undertaken to assess the neuropsychological symptoms of the patients with intracranial tumors at baseline, at 1 month, and 6 months after the initiation of treatment.

Methods

A longitudinal study was done to assess the neuropsychological symptoms in patients with intracranial tumors. Using purposive sampling, 34 conscious and consenting patients with intracranial tumors who were availing treatment from the Department of Neurosurgery, PGIMER, Chandigarh, were enrolled. Ethical clearance was obtained from Institute Ethics Committee, and written consent was taken from all study subjects and guardians.

Neuropsychiatric behavioral changes in patients were assessed before surgery, later at 1 month and 6 months following surgery. These symptoms were assessed using the Neuropsychiatric Inventory Questionnaire (NPI-Q) which identifies 12 behavioral disturbances occurring in patients such as delusions, hallucinations, dysphoria, anxiety, agitation/aggression, euphoria, disinhibition, irritability, apathy, motor activity, sleep disturbance, and appetite disorder. Information about their behavior is obtained from the primary caregiver who is familiar with the patient's behaviors. The interview was conducted in the absence of the patient to obtain accurate report on patient behavior. NPI-Q is reported to have high reliability, sensitivity, and validity [12]. Scoring was carried out

Table 1. Sociodemographic profile of patients

Variables	n (%)
Age, years, mean \pm SD	46.18 \pm 11.02
Gender	
Female	16 (47)
Male	18 (53)
Education	
Illiterate and primary	16 (48)
Elementary to senior secondary	12 (35)
Graduate and above	6 (17)
Marital status	
Married	32 (96)
Unmarried	2 (4)
Occupation	
Unemployed	22 (64)
Employed	11 (32)
Student	1 (4)

both as symptom severity score and symptom score. The average number of neuropsychological symptoms present in the patients at baseline, 1 month, and 6 months after surgery were also calculated.

Results

Out of 34 patients with intracranial tumors enrolled, 30 patients were followed up at 1 month and at 6 months as 2 patients died, and 2 patients were lost to follow-up. As per the sociodemographic data of patients in Table 1, the mean age of the patients was 46.18 \pm 11.02 years with a range of 29–70 years. A total of 53% were men and 47% were women. The majority of the patients (96%) were married. Furthermore, 48% of them were illiterate and 32% were employed.

The clinical profile of the patients (Table 2) reveals that 85% of the patients had supratentorial tumors, and in 50% of the patients, the tumor was located on the left side of the brain. Among the tumors located in the midline (14%), majority were pituitary adenomas. Axial tumors were present in 55% of the patients, and 39% of the patients were having malignant tumors. Duration of illness at first visit was less than 1 month in 64% of the patients. All patients had undergone surgical intervention. In addition, 33% and 15% of the patients had received radiotherapy and chemotherapy, respectively.

All the patients had experienced at least one neuropsychological symptom. The neuropsychiatric symptom and severity scores were 5.84 (SD +2.7) and 11.8 (+7.1) at

Table 2. Clinical profile of the patients

Variables	n (%)
Tumor location	
Supratentorial	29 (85)
Infratentorial	6 (15)
Tumor side	
Right	12 (36)
Left	17 (50)
Middle	5 (14)
Tumor location	
Axial	19 (55)
Extra axial	15 (45)
Tumor type	
Benign	21 (61)
Malignant	13 (39)
Duration of illness at first visit, months	
<1	22 (64)
>1	12 (36)
Surgical intervention	34 (100)
Radiotherapy received	11 (33)
Chemotherapy received	(15)

Table 3. Neuropsychological symptoms in patients

Neuropsychological symptoms	1st visit, n (%)	1 month, n (%)	6 months, n (%)
Delusion	5 (21)	3 (18)	0 (0)
Hallucination	5 (21)	2 (11)	1 (9)
Agitation	18 (75)	10 (59)	3 (25)
Depression	17 (74)	11 (64)	4 (33)
Anxiety	19 (82)	15 (88)	4 (33)
Elation	8 (35)	2 (12)	0 (0)
Apathy	7 (30)	2 (12)	1 (9)
Disinhibition	11 (46)	7 (41)	3 (25)
Irritability	18 (75)	12 (71)	3 (25)
Motor symptoms	9 (39)	8 (47)	1 (9)
Night time behavior/sleep disturbances	16 (70)	13 (77)	4 (33)
Appetite disorder	12 (52)	7 (42)	1 (9)

baseline, which reduced significantly to 4.3 (+3.1) and 5.6 (+3.2) at 1 month, and further to 2.3 (+2.9) and 3.6 (+3.2) at 6 months, respectively, after surgery (Fig. 1). As can be seen, the severity improved immediately after surgery, while the symptom score improved gradually.

As shown in Figure 2, there was a significant reduction of the number of neuropsychological symptoms at each visit ($p < 0.001$). The mean of the number of symptoms before surgery was 6.17, followed by 5.25 at 1 month and only 2.08 at 6 months.

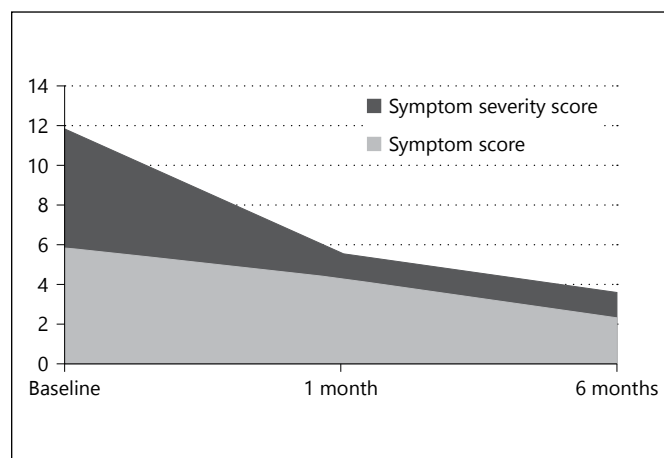
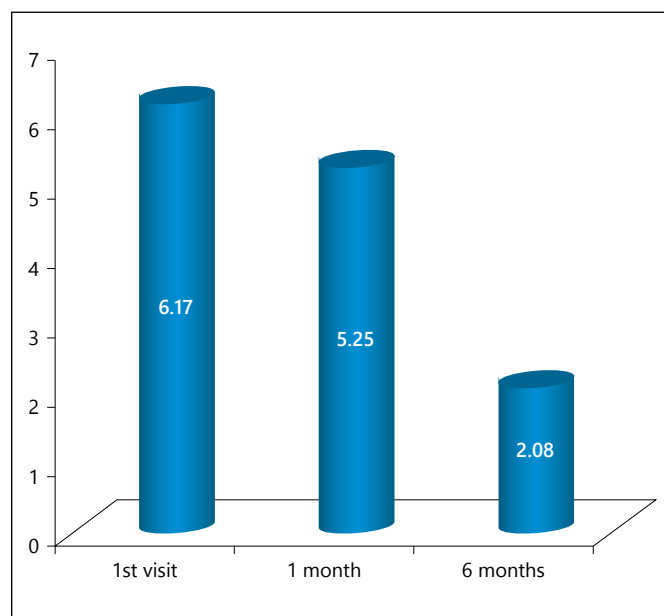
**Fig. 1.** Trends in neuropsychological symptom severity and symptom scores.**Fig. 2.** Mean number of neuropsychological symptoms in patients.

Table 3 shows the neuropsychological symptoms present in the patients before surgery, and later at 1 month and 6 months following surgery. The commonest neuropsychological symptoms at baseline were anxiety (82%), agitation (75%), irritability (74%), depression (74%), and sleep disturbances (70%). Even though the similar pattern was followed at 1 month of follow-up, the number of patients with anxiety and sleep disturbances was increased as compared to the first visit. At 6 months of follow-up, the proportion of the patients

who presented with each of these symptoms was less as compared to the first visit and 1 month. Depression, anxiety, and sleep disturbances were present in 33% each, followed by agitation, irritability, and disinhibition in 25% each.

Even though delusion was present in 21% before surgery and 18% at 1 month, none of the patients reported the same at 6 months. The number of patients who reported other symptoms like hallucination, elation, apathy, and motor symptoms at first visit and 1 month were even lesser; it had decreased further at 6 months of follow-up. While there was an improvement in the neuropsychological symptoms at 6 months, symptoms of agitation, depression, anxiety, disinhibition, irritability, night time behavior/sleep disturbances persisted even at 6 months.

Discussion

Neuropsychological symptoms in patients with intracranial tumors are well evident in literature [3–5, 8, 13–16]. However, there is paucity on prospective analysis of neuropsychological dysfunction in these patients with respect to surgery. The present study focused on the trends of neuropsychological symptoms from before surgery till 6 months after surgery.

Neuropsychiatric symptoms reported by various authors include depression, 5 disinhibitions, apathy, mood disorders, psychotic symptoms, personality changes, fatigue, emotional outbreaks [8], fear and uncertainty to hope, and loss [13–19]. Clinically significant anxiety level is reported by patients with frontal tumors [17]. Pre-operative behavioral symptoms are reported in patients with high-grade meningiomas. These are found to be associated with brain edema, tumor size, and microscopic invasion of the tumor. But there was no association of these symptoms with the prognosis of the patients [20]. Neuropsychological symptoms of the patients with an intracranial tumor may be impacted by the treatment modalities like surgery, chemotherapy, radiotherapy, or ventriculoperitoneal shunt [3, 21–23]. These behavioral symptoms could be due to difficulties in mentalizing emotion and intentions. Mentalization and emotional regulations are more impaired in patients with temporal, limbic, and insular lesions [24].

All patients in our study had at least one neuropsychological symptom. Approximately, 70–80% of the patients experienced symptoms like anxiety, agitation, irritability, depression, and sleep disturbances. Even at 6 months of

follow-up, these symptoms persisted in 25–33% of the patients. Each of the behavioral symptoms present in the patients need specific attention to improve their functional status [9]. Neuropsychological symptoms in these patients also can lead to poor QoL and can be influenced by different phases of disease [25].

Neuropsychological symptoms seen in these patients may prevent them from fulfilling their familial, professional and social roles, or obligations. It results in limited participation of the patient in fulfilling the ADL and increases the care demands and time from the caregivers. Caregiver burden is reported to be high with more neuropsychiatric inventory symptoms present in the patient. Symptoms of agitation, depression, irritability, and disturbed night-time behavior are reported to influence the severity of the burden experienced by the caregiver [26, 27]. Patients who are irritable and agitated are difficult to be convinced to do any activities because of their rebellious nature [5]. Caregivers may have to give assistance to many of the activities and give repeated directions and reminders for the activities done by the patients [5, 28]. Caregivers of patients with neuropsychological symptoms are reported providing more assistance with ADL than those without [29]. More time and energy have to be invested when patients with neuropsychiatric symptoms do not cooperate with caregivers during the care. Also, those patients who are anxious can become victims of distorted thinking and reasoning, making them more prone to depression and other symptoms leading to diminished caregivers' mastery. Neuropsychological symptoms are more explicit as compared to functional and cognitive status. Patients may not be having the insight or awareness about these changes and may not be even willing to accept them.

The behavioral symptoms present in the patient also lead to depression, insomnia, and post-traumatic stress disorders among caregivers [13, 30–32]. Caregiver burden is also reported among demented patients in neurological as well as psychiatric conditions [33].

It becomes, therefore, important to assess the neuropsychological symptoms in patients so that appropriate behavioral interventions can be planned for patients and effective training can be provided to the caregivers to handle these changes. Using composite test batteries or a combination of individual tests is optimal and essential to identify neuropsychological impairment in various domains in patients with intracranial lesions [34]. Even though guidelines are available to manage these symptoms, they are often not suitable for the patients with intracranial lesions, and they need to be more evi-

dence-based and tuned to the local milieu of patients [17, 35]. Irregular follow-up visits of the patients due to socioeconomic barriers also become a major concern in identifying and managing the outcome [36].

Generalizability of present study is limited as it was a single-centered study using small sample size. Multi-centered studies using large sample size will help to identify various significant factors influencing the behavioral symptoms. A long-term follow-up of behavioral symptoms will aid in rehabilitation, which can be individualized for the patients with and without improvement in the behavioral symptoms. Findings from the present study could be a base to develop counseling and behavioral therapies for the patients with intracranial tumors and caregiver empowerment programs for their caregivers. So the assessment of neuropsychological symptoms of these

patients during follow-up visits are essential steps in patients' recovery and aids in an individualized therapeutic plan that can be executed through nurse-led teaching programs or telephonic follow-ups.

Conclusion

There is substantial neuropsychological burden among patients with intracranial tumors. The severity score improved immediately after surgery, while the symptom score improved gradually. The variable spectrum of improvement in neuropsychological symptoms at 6 months after surgical treatment needs further consideration. Addressing these symptoms should be one of the long-term goals of the neuro-oncology teams.

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