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Frequency of Raised Intracranial Pressure in Patients with Brain Tumours; Primary or Secondary to Another Primary Tumour

Amina Jafar[1], Rabia Iqbal[2], Ahmad Taimoor Bajwa[2], Aun Raza[1]

[1]Department of Internal Medicine, Shaukat Khanum Memorial Cancer Hospital and Research Center, Lahore, Punjab, Pakistan.
[2]Department of Internal Medicine, The Brooklyn Hospital Center, New York, USA.

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Corresponding Author: Amina Jafar, Department of Internal Medicine, Shaukat Khanum Memorial Cancer Hospital and Research Center, Lahore, Punjab, Pakistan.
Email: aminajafar69@gmail.com

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ABSTRACT

Objective: "To determine the frequency of raised intracranial pressure in patients with brain tumours." **Study-Design:** Cross-Sectional Study design. **Place & duration of study:** "Department of Medicine, Shaukat Khanum Memorial Cancer Hospital, Lahore," from February, 2024 till October, 2024. **Subjects and method:** 100 patients with brain tumours were enrolled and intracranial pressure was examined. Data was noted in proforma, while entered and analysed in "Statistical Package for Social Sciences (SPSS)" version 20. **Outcome:** Among 100 patients of brain tumors, raised intracranial pressure was observed in 33 (33%) patients. It has been observed that raised ICP was significantly higher in patients above 55 years old (68.4%) as compared to younger age groups ($p<0.05$). **Conclusion:** This study demonstrated that a significant proportion of patients (33% in our cohort) with brain tumors, regardless of whether they are primary or secondary, exhibit raised ICP, highlighting the importance of monitoring and managing ICP in this patient population at an early stage. It would help to prevent further neurological deterioration and use of unnecessary testing in these patients.

INTRODUCTION

The brain is a control and coordination actuator. A cranial disease can have a degenerative, disfiguring, and destabilizing effect on the physiology of the brain. The main effects of the same, however, could differ depending on the situation. In this perspective, a tumor is a unique kind of disease that permanently deforms the brain parenchyma. From a translational standpoint, the literature has not comprehensively addressed deformation mechanics and pressures, particularly the intracranial cerebral pressure (ICP) in a brain with a tumor.[1, 2]

Brain metastases have become more common throughout time, occurring in 15–30% of cancer patients. Even when hydrocephalus is not present, they can nevertheless result in intracranial pressure. There are no established guidelines for the emergency surgical treatment of intracranial hypertension associated with brain metastases.[3, 4] Similarly, it is still unknown what the optimal ICP treatment threshold is and if a single threshold should be applied to all individuals and diseases. ICP monitoring has been supported by the Guidelines for the Management of Severe Traumatic Brain Injury since its establishment, and a therapeutic threshold has been suggested.[5]

Raised intracranial pressure is defined as pressure more than 20mmHg in the cranium. If any of its component increases in volume, it will increase overall pressure. It can be acute or chronic. One of the causes of raised ICP is increase in brain volume due to tumor, hematoma, cerebral oedema or damage to brain parenchyma due to other reasons.[6] According to published research, between 20 and 40 percent of individuals with cancerous tumors experience at least one brain metastasis during their disease. In 5–10% of cases, brain metastases constitute the initial sign of malignancy. More than 80% of individuals with brain metastases exhibit symptoms such localized neurologic impairments or intracranial hypertension.[7]

Traditionally, brain tumor headaches were believed to exhibit certain clinical features, such as getting worse in the morning and/or while lying down, getting worse when performing Valsalva maneuvers, and being accompanied by nausea and/or vomiting. However, research conducted since the development of contemporary neurodiagnostic techniques has revealed.[8] One study found that frequency of raised intracranial pressure was 30% in patients with brain tumour.[9] The purpose of this study is to ascertain how frequently individuals with brain tumors have elevated intracranial pressure. There is a very limited literature that focusses on relation of rising ICP with brain tumors. This study has been designed to look for the frequency difference in raised ICP with primary or secondary brain tumors so that further measures can be defined to avoid this situation at the time of defining management plan for such cancers. It will give a clue that which type of tumors are at a higher risk and needs special attention in this aspect.

METHODOLOGY

This Cross Sectional Study was conducted at Department of Medicine, Shaukat Khanum Memorial Cancer Hospital and Research centre, Lahore during February,2024 till October,2024.By using WHO calculator, sample size was calculated as 100 by keeping confidence level at 95%, margin of error at 9% and percentage of raised intracranial pressure as 30% in cases of brain tumour.[9] Patients who fulfilled following criteria were enrolled by applying non-probability, consecutive Sampling technique.

Inclusion: Age 12 to 80 years old, either gender, confirmed diagnosis of brain tumors (either primary or secondary) were enrolled.

Exclusion: Patients with previous history of raised intracranial pressure and already taken or taking treatment, or with no brain tumour or brain metastasis were excluded.

Patients were enrolled from medical wards. Informed consent were taken from attendants. Demographics like name, age, gender, duration of tumour, type of tumor (malignant or benign), tumor grade, kind of tumor (primary or secondary), treatment taking for tumour (chemotherapy or radiotherapy), h/o smoking (>5 pack years), h/o diabetes (BSR>200 mg/dl), h/o hypertension (BP≥140/90mmHg) were noted. Then patients with clinical or radiological signs of raised intracranial pressure were noted and their information was filled in the proforma.

Data analysis: "Statistical Package for Social Sciences (SPSS, Version 20)" was used to analyse the data. Frequency and percentage were used to present raised intracranial pressure. Data was stratified for effect modifiers including age, gender, duration of tumor, type of tumor, tumor grade, kind of tumor, treatment taking for tumour, h/o smoking, diabetes, and hypertension. Post-stratification, Chi-square (χ^2-test) was applied to compare raised intracranial pressure in stratified groups, keeping P-value ≤ 0.05 as significant.

RESULTS

In this study, total 100 patients were enrolled with the mean age of 39.07 ± 15.05 years. There were 38 (38%) males and 62 (62%) female patients. out of 100 patients 47 (47%) had history of smoking, 52 (52%) had diabetes while 49 (49%) had history of hypertension. The mean duration of diagnosis was 14.15 ± 6.67 months. Out of 100, 89 (89%) tumors were malignant while 11 (11%) were benign. About 25 (25%) patient had tumor of grade I, 26 (26%) had grade II tumor, 21 (21%) had grade III tumor and 28 (28%) had grade IV tumor. About 47 (47%) patients had primary kind of lesion while 53 (53%) had secondary kind of lesion. Out of 100, 44 (44%) were taking chemotherapy while 56 (56%) were on radiotherapy. The mean intracranial pressure of all the patients was 21.41 ± 11.49 cm H2). Table 1 Out of 100 patients, raised intracranial pressure was observed in 33 (33%) patients. Fig 1

Data was stratified in different age and gender groups. It has been observed that raised ICP was significantly higher in patients above 55 years old (68.4%) as compared to younger age groups (p<0.05). While the risk of raised ICP was almost equal in both; males (36.8%) and females (30.6%, p-value>0.05). In patients who had duration of tumor for more than 18 months has high risk of raised ICP (40%), although the difference was insignificant (p-value>0.05). Frequency of raised IC was high in patients with benign tumor (54.5%) than malignant lesions (30.3%) but difference was insignificant (p-value>0.05). Grading and kind of tumor and treatment has also no significant impact on raised ICP (p-value>0.05). Smoking, diabetes and hypertension are also not associated with raised ICP (P-VALUE>0.05). Table 3

Table 1

Demographic details of patients enrolled (n = 100)

	Mean ± SD, f (%)
Age (years)	39.07 ± 15.05
Gender	
Male	38 (38%)
Female	62 (62%)
History of	
Smoking	47 (47%)
Diabetes	52 (52%)
Hypertension	49 (49%)
Duration of tumor (months)	14.15 ± 6.67
Type of tumor	
Malignant	89 (89%)
Benign	11 (11%)
Grade	
I	25 (25%)
II	26 (26%)
III	21 (21%)

IV	28 (28%)
Kind of lesion	
Primary	47 (47%)
Secondary	53 (53%)
Treatment taking	
Chemotherapy	44 (44%)
Radiotherapy	56 (56%)
Intracranial pressure (cm H2O)	21.41 ± 11.49

Figure I

Raised intracranial pressure in cancer patients (n = 100)

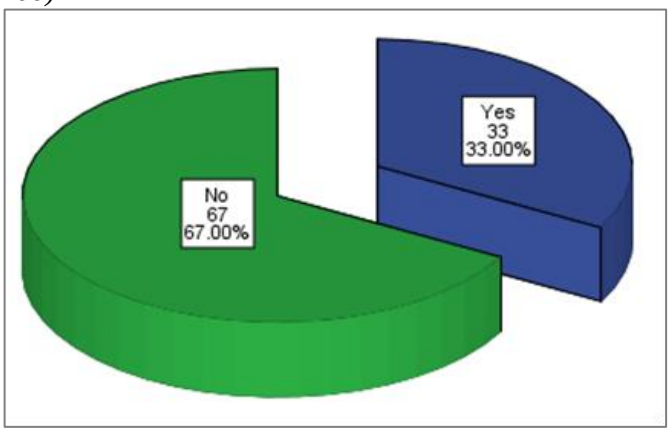

Table 2

Comparison of raised ICP in patients divided in different groups

		Raised ICP		Total	p-value
		Yes (n = 33)	No (n = 67)		
Age (years)	15-25	7 (29.2%)	17 (70.8%)	24	0.003
	26-40	6 (22.2%)	21 (77.8%)	27	
	41-55	7 (23.3%)	23 (76.7%)	30	
	>55	13 (68.4%)	6 (31.6%)	19	
Gender	Male	14 (36.8%)	24 (63.2%)	38	0.522
	Female	19 (30.6%)	43 (69.4%)	62	
Duration of tumor	<6 months	6 (33.3%)	12 (66.7%)	18	0.563
	6-12 months	8 (36.4%)	14 (63.6%)	22	
	13-18 months	7 (23.3%)	23 (76.7%)	30	
	>18 months	12 (40.0%)	18 (60.0%)	30	
Type of lesion	Malignant	27 (30.3%)	62 (69.7%)	89	0.107
	Benign	6 (54.5%)	5 (45.5%)	11	
Grade	I	9 (36.0%)	16 (64.0%)	25	0.829
	II	10 (38.5%)	16 (61.5%)	26	
	III	6 (28.6%)	15 (71.4%)	21	
	IV	8 (28.6%)	20 (71.4%)	28	
Kind	Primary	16 (34.0%)	31 (66.0%)	47	0.835
	Secondary	17 (32.1%)	36 (67.9%)	53	
Treatment	Chemotherapy	16 (36.4%)	28 (63.6%)	44	0.526
	Radiotherapy	17 (30.4%)	39 (69.6%)	56	
Smoking	Yes	18 (38.3%)	29 (61.7%)	47	0.289
	No	15 (28.3%)	38 (71.7%)	53	
Diabetes	Yes	17 (32.7%)	35 (67.3%)	52	0.946
	No	16 (33.3%)	32 (66.7%)	48	
Hypertension	Yes	15 (30.6%)	34 (69.4%)	49	0.619
	No	18 (35.3%)	33 (64.7%)	51	

DISCUSSION

This study highlights the frequency of raised intracranial pressure in patients with brain tumors and its association with various demographic and clinical parameters. The data analysis illustrated that 33% of patients who have any kind of brain lesion, had a clinical or radiological diagnosis of raised intracranial pressure at any point of their treatment. A significant association was observed between age and raised ICP, with patients older than 55 years showing a markedly higher prevalence (68.4%, $p<0.05$). This could be due to age-related changes in brain compliance, associated comorbidities like prior strokes, reduced compensatory mechanisms, and increased tumor-related edema in older individuals. However, there was no gender discrimination associated with raised ICP, suggesting that the risk of increased pressure is independent of sex-based physiological differences as seen in prior researches as well.

Trend of ICP increases in patients with tumors lasting for more than 18 months (40%), although it was not significant (p-value>0.05). The literature suggests that tumor progression, chronic edema and CSF absorption issues can contribute raised ICP over time[10]. However, studies often focus on tumor progression rather than duration, making this study a useful contribution. Further research with a larger sample size might clarify whether tumor duration is an independent risk factor. Similarly, another insignificant (p-value>0.05) trend is seen that raised ICP is more common in benign tumors (54.5%) as compared to malignant tumors (30.3%). This finding can be explained by the location and size of benign tumors, which can lead to mass effect and obstructive hydrocephalus despite their non-invasive nature. Malignant tumors, on the other hand, may infiltrate surrounding structures but not necessarily cause significant mass effect.

Primary or secondary brain tumors had no effect on frequency of raised ICP (34% in primary and 32.1% in secondary). Similarly, mode of treatment, chemotherapy versus radiotherapy also had no significant impact on occurrence of raised ICP. It demonstrates that brain

lesions causing CSF obstruction are the main culprit for raised ICP, no matter what kind of lesion it is[10]. Lifestyle and comorbid conditions, including smoking, diabetes, and hypertension, did not exhibit a significant correlation with raised ICP. While these factors are known contributors to vascular and cerebrovascular pathology, their direct impact on ICP in brain tumor patients remains unclear. Further researches could explore whether underlying microvascular changes in these conditions influence cerebrospinal fluid dynamics or peri-tumoral edema.

Previous literature demonstrates that raised ICP is seen in 80% of patients with brain metastatsis[7], and **20-70%** of total brain tumor cases, depending on tumor type, location, and study criteria. In the past studies only pediatric versus adult differences in raised ICP were shown which could be due to any reason (not specifically tumors)[11] ,but this study is focused that higher age groups of patient with brain tumors have increased frequency of raised ICP. Some literature suggest higher ICP in malignant tumors due to rapid growth and vascular permeability[12], but this data support the idea that mass effect plays a more critical role than malignancy itself**.**

Despite providing valuable insights, this study has certain limitations. The relatively small sample size (n=100) may limit the generalizability of the findings. Additionally, the study did not account for the specific locations of brain tumors, which could have a direct impact on ICP variations. Future studies with larger cohorts and detailed neuroimaging assessments can further elucidate the precise mechanisms underlying raised ICP in different tumor subtypes.

CONCLUSION

In conclusion, raised ICP is a common complication in brain tumor patients, with older age emerging as a significant risk factor. The findings highlight the need for vigilant monitoring of intracranial pressure, especially in elderly patients and those with longstanding tumors. Further research is warranted to explore the interplay between tumor characteristics, cerebrospinal fluid dynamics, and ICP regulation in brain tumor patients.

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