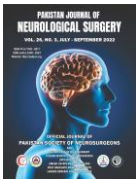

PAKISTAN JOURNAL OF NEUROLOGICAL SURGERY (QUARTERLY) – OFFICIAL JOURNAL OF PAKISTAN SOCIETY OF NEUROSURGEONS

Original Article

Radiologic–Histopathologic: Correlation of Intracranial Tumors Operated in a Tertiary Care Hospital: A Prospective Study

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ABSTRACT

Objective: This study aims to correlate the pre-operative MRI diagnosis with proven histopathological diagnosis of consecutively operated brain tumors.

Material and Methods: The study included 51 cases of brain tumors, evaluated and operated on during the 4 months study period at Jinnah Postgraduate Medical Centre, Karachi. Data of the cases were collected from all patients operated and tissue diagnosis was correlated with MRI brain with contrast (Radiological Diagnosis).

Results: The most common tumors were meningiomas (33.3%). The second most frequent brain tumors were Gliomas (14 cases, 27.4%). Other common tumors were Pituitary Adenoma (13.7%), Pilocytic Astrocytoma (5.8%), Colloid cyst (3.8%), and Non-Keratinizing Squamous Cell Carcinoma (1.9%). Preoperatively, Initial diagnosis on MRIs was proven with histopathologic examinations in 16/19 Meningiomas (84.2%), 13/14 Gliomas (92.3%), 7/7 Pituitary Adenomas (100%), 2/2 Colloid (100%), 1/1 Pineal gland tumor 1/1 Chondrosarcoma (100%), ½ Medulloblastoma (50%), 1/1 Pilocytic astrocytoma (100%), 1/1 Ependymoma (100%), 0/1 Hemangiopericytoma (0%), 0/1 Clival chordoma (0%), 0/1 Craniopharyngioma. Overall, MRIs had a fairly accurate rate for diagnosing brain neoplasms preoperatively (84.3%).

Conclusion: Most of the tumors in this study were benign. We concluded that radiological investigations can predict the histopathological diagnosis correctly in most cases, with only a few discrepancies.

Keywords: Brain tumors, Radiological Diagnosis, Histopathology, Magnetic Resonance Imaging, Craniotomy.

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Date of Submission: 01-11-2023
Date of Revision: 21-02-2023
Date of Acceptance: 18-02-2023
Date of Online Publishing: 05-03-2023
Date of Print: 05-03-2023

DOI: 10.36552/pjns.v27i1.813

INTRODUCTION

The term "intracranial tumor" refers to a variety of benign and aggressive tumors that originate in intracranial tissues and meninges.[1] Brain tumors can be classified in many ways. Based on location, they are divided into supratentorial and infratentorial brain tumors. Primary intracranial neoplasms consist of gliomas, which make up 30 to 50% of all tumors.[2] Supratentorial tumors can

present with clinical features of raised ICP (headache and vomiting), seizures, progressive neurological deficits (weakness of limbs, dysphasia, etc.), mental status changes, and, in the case of pituitary tumors, symptoms due to endocrine disturbances, visual field defects, CSF leak, etc.[3]

Infratentorial tumors show signs and symptoms of a high ICP due to hydrocephalus, such as trouble walking, dizziness, double vision, palsies of the lower cranial nerves, etc. Most pediatric brain tumors are infratentorial (60%), and they are equally divided among brainstem gliomas, cerebellar astrocytomas, and medulloblastomas.[4] Pilocytic astrocytomas are the most common benign posterior fossa tumors of the pediatric age group.[5] Patients with infratentorial tumors can also present with an altered level of consciousness, either due to hydrocephalus, direct brainstem involvement, or compression. Acute hydrocephalus is usually treated with a ventriculoperitoneal shunt or extra-ventricular drain placement before surgical excision of the tumor.

Medulloblastoma is the most common malignant intracranial tumor in the pediatric age group. Nearly 70% of cases affect children younger than 16 years and the peak incidence occurs at 7 years of age.[6] Ependymoma is the third most common malignant intracranial tumor in children. The most frequent location of ependymoma is infratentorial in children.[7] Pilocytic astrocytoma (PCA) occurs near the midline in the pediatric population, while in adults, it can occur laterally as well. Usual locations of PCA along the neuroaxis include the cerebellum (42 – 60%), optic nerves and hypothalamus (9 – 30%), brainstem (9%), spinal cord (2%), and cerebral hemispheres.[8] On contrast-enhanced MRI brain, it appears solidly cum cystic (mural nodule along cyst wall). A mural nodule is homogeneously contrast-enhancing, while the wall of the cyst is non-enhancing in 50% of cases. Hemangioblastoma is a benign neoplasm that comprises stromal and capillary cells.[9] It is the most common benign intra-axial tumor of the posterior fossa. It appears as a solid cum cystic lesion on the MRI brain with contrast. It has a mural nodule along the cyst wall (similar to a pilocytic astrocytoma). It can be differentiated from PCA by serpiginous flow void signals in or near the hemangioblastoma, representing the highly vascular nature of this neoplasm.

Usually, brain tumors are investigated with the help of radiology, which includes an MRI brain with and without contrast which shows the nature, location, and extent of the lesion. CT scan brain with 3D reconstruction is performed to see normal sinus anatomy, bony hyperostosis, erosions, etc. Depending on the findings of these radiological investigations, further workup is done. After all the preoperative investigations, these tumors are either treated surgically or via radiotherapy. If surgery has opted for a certain tumor, then depending on the involvement of surrounding structures, the tumor is partially or completely excised. Patients are then further treated based on histopathology. The surgical planning is done according to the preoperative radiological investigations and it is correlated with histopathology to guide further treatment and prognosis of the patient. The objective of this study is to correlate radiological diagnosis with histopathology of intracranial brain tumors operated in a public hospital.

MATERIALS AND METHODS

Study Design and Setting

This was a prospective study conducted at the neurosurgery department of Jinnah Postgraduate Medical Centre, Karachi, for 4 months from July 10 to November 10, 2022. We included 57 patients with MRI-confirmed brain tumors, with 6 patients lost to follow-up. So, a total of 51 patients were included in the study.

Inclusion Criteria

Patients of all age groups, diagnosed clinically and radiologically with a brain tumor and operated on, were included.

Exclusion Criteria

Patients who were lost to follow-up had previously undergone surgery for a brain tumor or had inconclusive histopathology were excluded.

Collection of Data

All patients were admitted to the department for detailed clinical examination and preoperative workup. The details regarding the demographic data and pre-operative radiological diagnosis were collected. For radiological diagnosis, we included 2 radiologists to make their diagnosis on an MRI brain with contrast. All the patients were operated on by qualified neurosurgeons using standard surgical techniques and protocols and were observed in at least a high-dependency unit (HDU) in the department. The tissue taken from the tumor excision was collected in formalin and sent to the histopathology department. The histopathology reports were collected by the primary investigator.

Table 1: Frequency of Histopathological Diagnosis of Brain Tumors.

Histopathological Diagnosis	Frequency	Percentages
Colloid Cyst	02	3.9%
Meningioma	17	33.3%
Gliomas	14	27.5%
Pituitary Adenomas	07	13.7%
Hemangiopericytoma	01	1.9%
Pineal tumor	01	1.9%
Medulloblastomas	01	1.9%
Pilocytic astrocytoma	03	5.8%
Ependymoma	01	1.9%
Clival chordoma	01	1.9%
Chondrosarcoma	01	1.9%
Pleomorphic xanthoastrocytoma	01	1.9%
Fungal mass initially considered as meningioma on MRI	01	1.9%

Data Analysis

The data of all individual patients was formulated on the SPSS. The histopathological diagnosis was compared with the radiological diagnosis.

RESULTS

Age Distribution

The demographic characteristics showed that the majority of the patients i.e., 18 (35.2%), were of age 21 to 40 years. The mean age was 28.5 ± 7.24 years.

Gender Distribution

The majority of the brain tumor patients were from the male gender accounting for 64.7% (33), while females were 35.3% (18). The male-to-female ratio was 1.83:1, with a male preponderance.

Tumor Frequencies

The tumor frequencies, as confirmed by Histopathology is shown in Table 1. The most common tumor was Meningiomas (17 cases, 33.3%). The second most frequent brain tumor was Gliomas (14 cases, 27.5%). Other tumors included Pituitary Adenoma (7 cases, 13.7%), Pilocytic Astrocytoma (3 cases – 5.8%), Medulloblastoma (1 case – 1.9%), Fungal mass 1 case – 1.9%), Colloid cyst (2 cases – 3.8%), Pineal Gland Tumor (1 case – 1.9%), Ependymoma (1 case – 1.9%), Chondrosarcoma (1 case – 1.9%), Non-Keratinizing Squamous Cell Carcinoma (1 case – 1.9%), Lymphoproliferative Disorder (1 case – 1.9%), Pleomorphic Xanthoastrocytoma (1 case – 1.9%), and

Table 2: Differentiation of brain tumors on Radiology and Histopathology (n = 51).

Diagnosis on MRI		Diagnosis on Histopathology	
Tumor Type	**No. of Cases**	**Tumor Type**	**No. of Cases**
Colloid Cyst	02	Colloid cysts	02
Meningiomas	19	Meningiomas	16
- Typical	13	- Grade 1	- 11
- Atypical	03	- Grade 2	- 03
		Embryonal rhabdomyosarcoma	01
		Fungal infection	01
		Glioblastoma grade 4	01
Hemangiopericytoma	01	Meningioma grade	01
Gliomas	14	Gliomas	13
- High grade	- 13	- Glioblastoma grade 4	- 06
- Low grade	- 01	- Diffuse astrocytoma grade 2	- 04
		- Oligodendroglioma grade 3	- 03
		Pleomorphic xanthoastrocytoma grade 2	01
Pituitary Adenomas	07	Pituitary Adenomas	07
Pineal gland tumor	01	Pineal tumor of intermediate differentiation	01
Posterior fossa SOL	04	Posterior fossa SOL	03
- Medulloblastoma	- 02	- 1 Medulloblastoma grade 4	- 01
- Pilocytic astrocytoma	- 01	- 2 Pilocytic astrocytoma	- 02
- Ependymoma	- 01	Ependymoma grade 3	01
Clival chordoma	01	Poorly differentiated – squamous cell carcinoma (non-Keratinizing)	01
Sellar/ suprasellar	02	Sellar/ suprasellar	02
- Chondrosarcoma	- 01	Chondrosarcoma	- 01
- Craniopharyngioma	- 01	The Craniopharyngioma turned out to be a pilocytic astrocytoma	- 01
Total	51		

Embryonal Rhabdomyosarcoma (1 case – 1.9%).

Radio-histopathological Correlation

Radio-histopathological correlation is given in table 2, showing that most of the pre-operative diagnoses of brain tumors were confirmed on the histopathology with few exceptions.

The accuracy of preoperative radiological diagnosis on histopathology was varying for different types of tumors, given in Table 3. The accuracy for a few common tumors was; Meningiomas (84.2%), Gliomas (92.3%), and Pituitary Adenomas (100%). Overall, MRIs had a

Table 3: Accuracy of Radiological diagnosis confirmed by Histopathology (n = 51).

Tumor	Radiological Diagnosis	Histopathological Confirmation	Accuracy
Colloid Cyst	02	02	100%
Meningioma	19	16	84.2%
Hemangiopericytoma	01	0	0%
Gliomas	14	13	92.8%
Pituitary Adenomas	07	07	100%
Pineal tumor	01	01	100%
Medulloblastomas	02	01	50%
Pilocytic astrocytoma	01	1	100%
Ependymoma	01	1	100%
Clival chordoma	01	0	0%
Chondrosarcoma	01	1	100%
Craniopharyngioma	01	0	0%
Total	51	43	84.3%

fairly accurate rate for diagnosing brain neoplasms preoperatively (84.3%).

DISCUSSION

In patients with intracranial tumors, the purpose of imaging is to determine the nature, precise location, and involvement of the surrounding structures by the tumor. Imaging is used for diagnosing and planning treatment. Brain tumors are a common pathology.[10] Common clinical manifestations are morning headache, nausea, vomiting, fits, visual changes, personality change, vertigo, and paralysis or paresis of one side.[11]

In our study, an 84.3% correlation was found between preoperative radiological diagnosis and postoperative histological diagnosis. In other study groups, the correlation ranged from 70% to 94%. So, our results were in between these ranges.

In our study, meningiomas were the most common tumors, followed by gliomas. Meningiomas were seen in 17 out of 51 (33.3%) patients, while gliomas were found in 14 out of 51 (27.4%) patients. Pituitary adenomas (13.7%) were the third most common tumors. Similar to our findings, MohammedA et al.[12] Also documented that the most commonly encountered brain tumor was a meningioma, which accounted for 30.8% (70/227) of the total number, followed by astrocytic tumors at 29.1% (66/227), and pituitary adenomas at 6.2% (14/227). The high incidence of meningiomas in our study is also similar to findings from the CBTRUS[13] in the United States (35%), and Das et al,[14] in Singapore (35.1%). Idowu et al,[15] in Nigeria (35%), Dho YS et al,[16] in the Republic of Korea (37.3%), and Nakamura H et al,[17] in Japan (36.8%), all concluded that meningiomas are the most frequent occurring brain tumor.

In comparison, our study showed the most common brain tumors are meningiomas, gliomas, and pituitary adenomas. According to Wanis HA et al,[18,] the most common intracranial tumors were glioblastomas and other astrocytomas, meningiomas, and oligodendrogliomas. In contrast, in a study by McKinney PA,[19] the majority of brain tumors (86%) were gliomas which included astrocytomas, glioblastomas, oligodendroblastomas, and unspecified gliomas.

In our study, males were affected more as compared to females (M: F = 1.83:1). The most common age group affected was 20 – 40 years of age, and the mean age was 28.5 ± 7.24 years. In a study by Mohammed A et al,[20] the predominant age group affected by brain tumors was between 40 and 49 years (23.5%), and the male-to-female ratio was 1.2:1. In our study, meningiomas were more common in the age group of 20 – 40 years. Gliomas were more common above the age of 60. In a study by Ihwan et al,[21] meningiomas most often occurred in patients aged between 41 and 60 years (67.8%).

In our study, the radiological–histopathological correlation of gliomas was more accurate (92.8%) as compared to meningiomas (84.2%), while for pituitary adenomas, it was 100%. In comparison, a study conducted by Ishita et al. showed a correlation of 97.7% for meningeal tumors, 85.1% for gliomas, and 100% for sellar tumors.[22] In a study similar to ours, Rhun E et al,[23] discovered that intracranial tumors are more common in men (58% vs. 41% in women), whereas in ours (64.7% in men and 35.3% in women).

Finally, there were some limitations in our study: small sample size and more sophisticated MRI techniques like spectroscopy were not used. The lack of use of tumor markers for brain tumors is another weakness in our study.

CONCLUSION

Conventional MRI accuracy for diagnosing intracranial tumors is satisfactory in most instances but it should not be completely relied upon. In cases of inconsistencies in radiological reporting, neurosurgeons are encouraged to

discuss with the radiologists to achieve clear preoperative diagnoses.

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Additional Information

Disclosures: Authors report no conflict of interest.
Ethical Review Board Approval: The study was conformed to the ethical review board requirements.
Human Subjects: Consent was obtained by all patients/participants in this study.
Conflicts of Interest:
In compliance with the ICMJE uniform disclosure form, all authors declare the following:
Financial Relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.
Other Relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.
Financial Relationships: None.

AUTHORS' CONTRIBUTION

S. No.	Author's Full Name	Intellectual Contribution to Paper in Terms of:
1.	Raheel Gohar	Study design and methodology.
2.	Farrukh Javeed	Literature review and referencing.
3.	Lal Rehman	Final review and approval.
4.	Iram Bokhari	Data collection and calculations.
5.	Arfa Qasim	Interpretation of results.
6.	Sehrish Altaf	Analysis of data.