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Glial Tumors: Can You Rely on MRI? An Analysis Showing Agreement with Histopathology in Western India

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Abstract:

Background: There is a dearth of evidence on the agreement between Magnetic Resonance Imaging (MRI) and histopathology for glioma in India. This study attempted to describe the profile of patients with glioma and to determine the agreement between MRI and histopathology diagnosis. *Material and Methods:* We conducted a record-based secondary data analysis of 211 patients diagnosed with glioma at the Department of Pathology of Civil Hospital Ahmedabad from October 2015 to October 2017. Biopsies received were processed and slides were examined. The demographic characteristics, clinical profile and MRI diagnosis of the patients were obtained from Laboratory Information System (LIS). Cohen's kappa was calculated for showing agreement between MRI and histopathology. Frozen section examination was done for tissues sent intra-operatively. *Results:* Among 211 patients with glial tumors, 165 (78%) had astrocytoma while 23 (11%) each had oligodendroglioma and ependymoma. Around two-third (64%) of astrocytoma occurred among males and about two-third (64%) of ependymoma were seen among 0-29 years age-group. The kappa agreement value of 0.635 denoted a substantial agreement between the histopathology and MRI for astrocytoma. The kappa agreement value between the two procedures for ependymoma was 0.365 suggesting a fair agreement and for oligodendroglioma was 0.08 suggesting poor agreement. Frozen section examination diagnosed 86% of astrocytoma, 83% of oligodendroglioma and 75% of ependymoma correctly. *Conclusion:* We conclude from the study that neurosurgeons should be cautious in pre-surgical procedures for oligodendroglial and ependymal tumors diagnosed by MRI as there are chances of misdiagnosis. Frozen section examination should be considered in such cases.

Keywords: Astrocytoma, oligodendroglioma, ependymoma, correlation, concordance.

Introduction:

Central nervous system (CNS) tumors are being diagnosed with different procedures. Magnetic Resonance Imaging (MRI) findings might give an early indication towards the presence of such tumors [1]. The incidence of CNS tumors in India ranges from 5 to 10 per 100,000 population with an increasing trend and accounts for 2% of malignancies [2]. Brain tumors account for less than 2% of the overall human cancer burden [2]. However, they cause significant morbidity, and for glioma, the most common histological type of central nervous system neoplasms, the prognosis is still poor [2]. This applies particularly to glioblastomas, the most common and most malignant brain tumors in adults [2].

Studies conducted in Colorado (USA), Vienna (Austria), Japan, Egypt, Germany and Europe reported that MRI showed high pre-operative and intraoperative reliability as an adjunct in glioma patients for planning surgical resection [1,3-6]. Studies from India, South Korea and Europe also documented the use of MRI in diagnostic correlation and in estimating the histologic grades of glioma [7- 9]. However, studies in Japan and Pakistan reported poor agreement between the two modalities of diagnosis with a kappa agreement value of 0.03 for glial neoplasms [10,11].

Most of the published research on glioma is from outside India, mainly because of the fact that they have a good reporting system in their cancer registries. There is not a lot of published literature on primary CNS tumors from India, except a few studies focusing on pediatric brain tumors and lymphomas [12-15]. Besides there are not many studies regarding agreement between MRI findings and histopathology reports in

India. Existing evidence gives conflicting evidence on the agreement between the two modalities of diagnosis. This study attempts to describe the profile of patients with glioma and to determine the agreement between MRI and histopathology diagnosis at a tertiary care hospital of western India.

Material and Methods:

We conducted a record-based secondary data analysis at the Department of Pathology of B.J. Medical College and Civil Hospital Ahmedabad, a 2800 bedded tertiary care government district hospital of Gujarat (western India). The Department of Pathology at this hospital has been accredited by NABL since 2010, the first amongst government-run health service delivery points in Gujarat. The study included data on all patients with primary CNS tumors who were diagnosed from October 2015 to October 2017. We included data on patients of all ages diagnosed with primary CNS tumors at the Department of Pathology of B.J. Medical College and Civil Hospital Ahmedabad from October 2015 to October 2017.

The biopsy specimens were received in the histopathology laboratory after operative removal of tumors. The biopsy specimens received were fixed in formalin for 24 hours and then the grossing procedures were done the next day. The tissue was then processed in tissue processor. The tissue was embedded in blocks using paraffin the next day. Section cutting and staining using Hematoxylin-Eosin stain was done later on the same day. The slides were then examined under a microscope for histopathological diagnosis. The tissues which were sent for frozen section examination by neurosurgeons were processed in cryostat machine and the results were given within 30 minutes.

The data of all specimens received in the laboratory and entered in the Laboratory Information System (LIS) portal were accessed with the help of the System Manager. The data which was received in a Microsoft Excel sheet underwent data-cleaning and was filtered for retaining data pertaining to diagnosis of glioma only. The data on MRI and frozen section was also obtained from the LIS portal.

Data was analyzed by Epi Info software version 7[16]. Age was described in median with inter-quartile range (IQR). Simple proportions were calculated along with Cohen's kappa agreement between MRI diagnosis and histopathology report [17]. The agreement between frozen section and histopathology was shown using percentages only.

Ethical approval was obtained from B. J. Medical College Ahmedabad. The study was exempted from full review as it involved only secondary data analysis. For maintaining the confidentiality of data, patients were identified by study identification (ID) numbers. The names of the patients were kept in a separate sheet with their ID numbers. The data was accessible only to the principal investigator and the research team. The names of the patients were deleted from the data sheet while analyzing the data.

Results:

Between the years 2015 to 2017, a total of 500 patients were diagnosed with primary central nervous system (CNS) tumors at the Department of Pathology of B.J. Medical College and Civil Hospital Ahmedabad. Among all the patients with primary CNS tumors, 211 (42%) had glial tumors. Among the patients with glial tumors, 165 (78%) had astrocytoma while 23 (11%) each had oligodendroglioma and ependymoma.

The median age of patients with astrocytoma, oligodendroglioma and ependymoma was 36 (IQR 23-45), 40 (IQR 30-48) and 21 (5-38) years respectively (Table I). Nearly half (47%) and almost two-third (61%) of the patients with astrocytoma and oligodendroglioma were in the age-group of 30-49 years respectively. About two-third (64%) of patients with ependymoma were in the age-group of 0-29 years. Almost half of the patients with astrocytoma and oligodendroglioma were male while two-third patients with ependymoma were female. The most common site for astrocytoma, oligodendroglioma and ependymoma was parietal, frontal and spinal regions respectively. Headache was reported to be clinical feature of all the three gliomas with convulsion also being prominent in oligodendroglioma.

Among 165 patients diagnosed with astrocytoma by histopathology, nearly three-fourth (74%) were

correctly diagnosed as the same on MRI (Table II). The kappa agreement value of 0.635 denoted a substantial agreement between the histopathology and MRI for astrocytoma. Among 23 patients each with oligodendroglioma and ependymoma, 1 (4%) and 8 (35%) were correctly diagnosed by MRI respectively. The kappa agreement value between the two procedures for ependymoma was 0.365 suggesting a fair agreement and for oligodendroglioma was 0.08 suggesting poor agreement.

Out of 165 patients with astrocytoma, 28 (17%) were diagnosed as neoplasm and 3 (2%) were diagnosed as meningioma by MRI (Table III). Among 23 patients with oligodendroglioma, 14 (61%) were diagnosed as astrocytoma and 5 (22%) were diagnosed as neoplasm by MRI. Out of 23 patients with ependymoma, 5 (22%) were diagnosed as neoplasm and 4 (17%) were diagnosed as astrocytoma by MRI.

Among the 22 patients with astrocytoma in whom frozen section was done, 19 (86%) were also diagnosed as the same through histopathology (Table IV). Similarly, frozen section diagnosis corroborated with histopathology diagnosis in 5 (83%) patients with oligodendroglioma (n=6) and in 3 (75%) patients with ependymoma (n=4).

Table No. 1: Characteristics of patients with glial tumors

Characteristics	Astrocytoma (n=165) Number (%)	Oligodendroglioma (n=23) Number (%)	Ependymoma (n=23) Number (%)
Age (years) in median (IQR)	36 (23 - 45)	40 (30 - 48)	21 (5 - 38)
Age distribution (in years)			
0-9	7 (4)	0 (0)	7 (30)
10-19	25 (15)	1 (4)	4 (17)
20-29	20 (12)	4 (17)	4 (17)
30-39	36 (22)	6 (26)	3 (13)
40-49	42 (25)	8 (35)	1 (4)
50-59	21 (13)	4 (17)	1 (4)
60-69	9 (5)	0 (0)	3 (13)
70-79	4 (2)	0 (0)	0 (0)
80-89	1 (1)	0 (0)	0 (0)
Male	105 (64)	11 (48)	8 (35)
Site			
Parietal	32 (19)	2 (9)	2 (9)
Frontal	23 (14)	8 (35)	1 (4)
Spinal	7 (4)	1 (4)	12 (52)
Other	103 (62)	12 (52)	8 (35)
Clinical features (multiple answers)			
Headache	90 (55)	12 (52)	12 (52)
Convulsion	47 (28)	11 (48)	3 (13)
Vomiting	22 (13)	3 (13)	5 (22)
Limb weakness	43 (26)	7 (30)	10 (43)

Table No. 2: Agreement between MRI diagnosis and histopathology diagnosis of glial tumours

Glial tumour on MRI	Glial tumour on histology Number (%)	Non-glial tumour on histology Number (%)	Total Number (%)	Kappa agreement value
Astrocytoma				
Yes	122 (74)	37 (11)	159 (32)	0.635
No	43 (26)	298 (89)	341 (68)	
Total	165 (100)	335 (100)	500 (100)	
Ependymoma				
Yes	8 (35)	10 (2)	18 (4)	0.365
No	15 (65)	467 (98)	482 (96)	
Total	23 (100)	477 (100)	500 (100)	
Oligodendroglioma				
Yes	1 (4)	0 (0)	1 (1)	0.08
No	22 (96)	477 (100)	499 (99)	
Total	23 (100)	477 (100)	500 (100)	

Table No. 3: Details of MRI findings in histopathology diagnosis of glial tumors

MRI diagnosis	Histopathology diagnosis		
	Astrocytoma (n=165) Number (%)	Oligodendroglioma (n=23) Number (%)	Ependymoma (n=23) Number (%)
Astrocytoma	122 (74)	14 (61)	4 (17)
Meningioma	3 (2)	1 (4)	3 (13)
Schwannoma	2 (1)	0 (0)	1 (4)
Medulloblastoma	1 (1)	0 (0)	0 (0)
Oligodendroglioma	0 (0)	1 (4)	0 (0)
Ependymoma	2 (1)	1 (4)	8 (35)
Craniopharyngioma	1 (1)	1 (4)	0 (0)
Hemangioblastoma	1 (1)	0 (0)	0 (0)
Neurofibroma	1 (1)	0 (0)	0 (0)
Central neurocytoma	2 (1)	0 (0)	0 (0)
Neoplasm	28 (17)	5 (22)	5 (22)
Metastasis	1 (1)	0 (0)	1 (4)
Pituitary adenoma	1 (1)	0 (0)	0 (0)
Hydrocephalus	0 (0)	0 (0)	1 (4)

Table No. 4: Details of frozen section findings in histopathology diagnosis of glial tumors

Frozen section diagnosis	Histopathology diagnosis		
	Astrocytoma (n=22) Number (%)	Oligodendroglioma (n=6) Number (%)	Ependymoma (n=4) Number (%)
Astrocytoma	19 (86)	0 (0)	1 (25)
Schwannoma	1 (5)	0 (0)	0 (0)
Oligodendroglioma	2 (9)	5 (83)	0 (0)
Ependymoma	0 (0)	0 (0)	3 (75)
Central neurocytoma	0 (0)	1 (17)	0 (0)

Discussion:

Glioma are one of the most common primary CNS tumors in India. Astrocytoma and oligodendroglioma occurred most commonly around 30-49 years, while ependymoma was reported more among the young. Astrocytoma also showed a male predilection. The agreement between MRI and histopathology diagnosis was substantial for astrocytoma while it was fair and poor for oligodendroglioma and ependymoma respectively. Frozen section findings corroborated with the histopathology diagnosis.

In the absence of published literature in India, ependymoma occurring among the younger age groups and astrocytoma showing a male predilection were novel findings. The clinical profile of the patients with glioma in India also seem to be different from what are reported in other countries. The diagnosis of glioma through histopathology remains the gold standard, with the role of MRI being restricted to boundaries of surgical resection or grading of tumors. The findings of frozen section during surgical resection remains supplemental and elemental for taking intraoperative decisions.

The present study found a substantial agreement between MRI and histopathology for the diagnosis of astrocytoma and a fair agreement for the diagnosis of oligodendroglioma. For astrocytoma, the Cohen's kappa agreement value was 0.635 and that for oligodendroglioma was 0.08. A study in Sweden found that the concordance between conventional MRI and histopathology gave a kappa value of 0.38 [18]. The study further reported that conventional MRI had almost perfect concordance for low-grade astrocytoma, but poor concordance for high-grade astrocytoma [18]. A study in Pakistan comparing agreement for space-occupying lesions between these two modalities of diagnosis found a very low value of 0.05 indicating a poor agreement [10]. For glial tumors, their study reported as value as low as 0.03, indicating a poor agreement [10]. However, their study found the superiority of magnetic resonance spectroscopy (MRS) over MRI to be the most concordant with histopathology for glial tumors [10]. However, another study from Pakistan reported a good sensitivity of MRI in diagnosing astrocytoma and oligodendroglioma [19]. MRI was found to have low sensitivity in diagnosing astrocytoma and low-grade oligodendroglioma in a multi-center European study [18]. The study in Europe also reported that 57% of astrocytoma cases were wrongly diagnosed as some other tumors [18].

The present study found that astrocytoma was most common in the 30-49 years age group with median of 36 (IQR 23-45) years. This is supported by existing evidence which states that the median and mean ages of patients with diffuse astrocytoma are in the mid-30s [20]. In one population-based study, the mean patient age at biopsy was 46 years [21]. The present study also found that oligodendroglioma was most common in the 30-49 years age group with a median of 40 (IQR 30-48) years. Existing evidence indicates that most of these tumors arise in adults, with a peak incidence in patients aged 35 - 44 years [20,21]. Out of 23 ependymomas in the present study, 64% were in the

age group of 0-29 years with a median of 21 (IQR 5-38) years. This was a contrasting finding with evidence suggesting its development in patients of any age, with reported patient ages ranging from birth to 81 years [22]. The present study found that overall, the astrocytoma was more common among males (64%) as compared to the females. There is no gender predilection suggested in existing literature for astrocytoma [22]. However, anaplastic astrocytoma and glioblastoma has been reported to have a slightly higher male preponderance [20,21].

In the present study, the most common site of astrocytoma was parietal region followed by frontal region. Also, in the present study, oligodendroglioma was most common in the frontal region and ependymoma was most common in the spine. Existing evidence report that astrocytoma can be located in any region of the CNS, but most commonly develop supratentorially in the frontal lobe [23]. Evidence from Switzerland and USA report that the most frequently affected sites of astrocytoma were the temporal lobe (affected in 31% of cases), the parietal lobe (in 24%), the frontal lobe (in 23%), and the occipital lobe (in 16%) [20,22]. As found in the present study for oligodendroglioma, it has been reported that the frontal lobe is the most common location (involved in >50% of all patients) followed in order of decreasing frequency by the temporal, parietal, and occipital lobes [22]. As found in the present study, ependymomas occur most commonly along the ventricular system, spinal canal and posterior fossa [22, 24, 25].

In the present study, headache followed by convulsion and limb weakness were the commonest symptom among the patients with astrocytoma. Convulsions, speech difficulties and changes in sensation or vision are said to be common presenting symptoms in astrocytoma in other studies [22]. In the present study, headache followed by convulsion and limb weakness was the commonest symptom among the patients with oligodendroglioma, which corroborates with existing evidence [26-28]. In the present study, headache, limb weakness and vomiting were the commonest symptom among the patients with ependymoma. In ependymomas, the clinical manifestations depend on tumor localization [22]. The ependymomas of the posterior fossa present with headache, nausea, vomiting, and dizziness; whereas spinal ependymomas present with back pain and focal motor and sensory deficits or paraparesis [22].

Conclusion:

We conclude from the study that neurosurgeons should be cautious in pre-surgical procedures for oligodendroglial and ependymal tumors diagnosed by MRI as there are chances of misdiagnosis. Frozen section examination should be considered in such cases. Large multi-centric studies should confirm the agreement found in the study to generalize the findings to the larger population of India.

Conflict of Interest - Nil
Sources of Support - Nil

References

1. Kubben P, Wesseling P, Lammens M, Schijns OMG, Ter Laak Poort M, van Overbeeke J, et al. Correlation between contrast enhancement on intraoperative magnetic resonance imaging and histopathology in glioblastoma. Surgical Neurology International 2012; 3(1):158.
2. Stewart BW, Wild CP. World cancer report 2014. Lyon, France: WHO Press, Geneva, Switzerland; 2014.
3. Roessler K, Donat M, Lanzenberger R, Novak K, Geissler A, Gartus A, et al. Evaluation of preoperative high magnetic field motor functional MRI (3 Tesla) in glioma patients by navigated electrocortical stimulation and postoperative outcome. *Journal of Neurology, Neurosurgery and Psychiatry* 2005; 76(8):1152-1157.
4. Watanabe M, Tanaka R, Takeda N. Magnetic resonance imaging and histopathology of cerebral gliomas. *Neuroradiology* 1992; 34(6):463- 469.
5. Mansour MH, Behairy H, Alwalilyi M, Elkhole H, Shaban M, Alaghory I, et al. Complementation of magnetic resonance spectroscopy (MRS) and histopathology in diagnosing focal brain lesions. *Life Science Journal* 2014; 11(12):891- 899.
6. Freund M, Hähnel S, Sommer C, Martmann M, Kiessling M, Tronnier V, et al. CT and MRI findings in gliomatosis cerebri: A neuroradiologic and neuropathologic review of diffuse infiltrating brain neoplasms. *European Radiology* 2001; 11(2):309-316.
7. Lee SJ, Kim JH, Kim YM, Lee GK, Lee EJ, Park IS, et al. Perfusion MR Imaging in Gliomas: Comparison with

Histologic Tumor Grade. *Korean Journal of Radiology* 2001; 2(1):1-7.
8. Kumar RA, Khandelwal N, Sodhi KS, Pathak A, Mittal BR, Radotra BD, et al. Comparison between contrast-enhanced magnetic resonance imaging and technetium 99m glucohepatonic acid single photon emission computed tomography with histopathologic correlation in gliomas. *Journal of Computer Assisted Tomography* 2006; 30(5):723-733.
9. Julià-Sapé M, Acosta D, Majós C, Moreno-Torres À, Wesseling P, Acebes JJ, et al. Comparison between neuroimaging classifications and histopathological diagnoses using an international multicenter brain tumor magnetic resonance imaging database. *Journal of Neurosurgery* 2006; 105(1):6 -14.
10. Dogar T, Imran A, Hasan M, Jaffar R, Bajwa R, Qureshi I. Space Occupying Lesions of Central Nervous System: a Radiological and Histopathological Correlation. *Biomedica* 2015; 31(1):15-20.
11. Iwama T, Yamada H, Sakai N, Andoh T, Nakashima T, Hirata T, et al. Correlation between magnetic resonance imaging and histopathology of intracranial glioma. *Neurological Research* 1991; 13(1):48-54.
12. Agarwal P, Menon S, Smruti B, Singhal B. Primary central nervous system lymphoma: A profile of 26 cases from western India. *Neurology India* 2009;57(6):756-763.
13. Devi AA, Sharma TD, Singh YI, Sonia H. Clinicopathological Profile of Patients with Non-Hodgkin's Lymphoma at a Regional Cancer Center in Northeast India. *Journal of the Scientific Society* 2017; 44:140 - 144.
14. Hazarika M, Krishnatreya M, Bhuyan C, Saikia J, Kataki AC, Nandy P, et al. Overview of Childhood Cancers at a Regional Cancer Centre in North-East India. *Asian Pacific Journal of Cancer Prevention* 2014; 15(18):7817-7819.
15. Suresh SG, Srinivasan A, Scott JX, Rao SM, Chidambaram B, Chandrasekar S. Profile and Outcome of Pediatric Brain Tumors – Experience from a Tertiary Care Pediatric Oncology Unit in South India. *Journal of Pediatric Neurosciences* 2017; 12(3):237-244.
16. Dean AG, Arner T, Sunki G, Friedman R, Lantinga M, Sangam S, et al. Epi Info: A database and statistics program for public health professionals. 2011.
17. Landis JR, Koch GG. The Measurement of Observer Agreement for Categorical Data. *Biometrics* 1977; 33(1):159-174.
18. Abul-Kasim K, Thurnher M, Puchner S, Sundgren P. Multimodal magnetic resonance imaging increases the overall diagnostic accuracy in brain tumours: Correlation with histopathology. *South African Journal of Radiology* 2013; 17(1):4 -10.
19. Chishty IA, Rafique MZ, Hussain M, Akhtar W, Ahmed MN, Sajjad Z, et al. MRI characterization and histopathological correlation of primary intra-axial brain glioma. *Journal of the Liaquat University of Medical and Health Sciences* 2010; 9(2):64 - 69.
20. Ostrom QT, Gittleman H, Liao P, Rouse C, Chen Y, Dowling J, et al. CBTRUS statistical report: primary brain and central nervous system tumors diagnosed in the United States in 2007-2011. *Neuro-oncology* 2014;16(iv):1–63.
21. Ohgaki H, Kleihues P. Epidemiology and etiology of gliomas. *Acta Neuropathologica* 2005; 109(1):93- 108.
22. Louis DN, Perry A, Reifenberger G, von Deimling A, Figarella-Branger D, Cavenee WK, et al. The 2016 World Health Organization Classification of Tumors of the Central Nervous System: a summary. *Acta Neuropathologica* 2016; 131(6):803 - 820.
23. Stockhammer F, Misch M, Helms HJ, Lengler U, Prall F, Von Deimling A, et al. IDH1/2 mutations in WHO grade II astrocytomas associated with localization and seizure as the initial symptom. *Seizure* 2012; 21(3): 194-197.
24. Kudo H, Oi S, Tamaki N, Nishida Y, Matsumoto S. Ependymoma diagnosed in the first year of life in Japan in collaboration with the International Society for Pediatric Neurosurgery. *Child's Nervous System* 1990; 6(7):375-378.
25. Purdy E, Johnston DL, Bartels U, Fryer C, Carret AS, Crooks B, et al. Ependymoma in children under the age of 3 years: A report from the Canadian Pediatric Brain Tumour Consortium. *Journal of Neuro-Oncology* 2014; 117(2):359 - 364.
26. Mirsattari SM, Chong JJR, Hammond RR, Megyesi JF, Macdonald DR, Lee DH, et al. Do epileptic seizures predict outcome in patients with oligodendroglioma? *Epilepsy Research* 2011; 94(1–2):39-44.
27. Lebrun C, Fontaine D, Ramaioli A, Vandenbos F, Chanalet S, Lonjon M, et al. Long-term outcome of oligodendrogliomas.*Neurology* 2004;62(10):1783-1787.
28. Olson JD, Riedel E, DeAngelis LM. Long-term outcome of low-grade oligodendroglioma and mixed glioma. *Neurology* 2000; 54(7):1442-1448.

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