

Role Of Computed Tomography And Magnetic Resonance Imaging In The Evaluation Of Supratentorial Brain Tumors: A Hospital-Based Prospective Cross-Sectional Study.

Dr. Md Shahzeb Alam¹, Dr. Amit Kumar Gupta², Dr. Manish Jaiswal³

¹Junior Resident, Department of Radiodiagnosis, Katihar Medical College and Hospital, Katihar

²Junior Resident, Department of Radiodiagnosis, Katihar Medical College and Hospital, Katihar

³Associate Professor, Department of Radiodiagnosis, Katihar Medical College and Hospital, Katihar

Abstract

Objective: To compare the diagnostic accuracy of computed tomography (CT) and magnetic resonance imaging (MRI) in detecting and characterising supratentorial brain tumors, using histopathology as the reference standard.

Methods: This hospital-based prospective cross-sectional study was conducted in the Department of Radiodiagnosis, Katihar Medical College and Hospital, Katihar, over two and a half years. Fifty patients with suspected or confirmed supratentorial brain tumor underwent 16-slice multidetector CT and 1.5 Tesla MRI. Data were analysed using SPSS; chi-square tests and yield analysis were applied, with $p < .05$ considered significant.

Results: The mean age was 50.84 ± 17.43 years and 50% of patients were male. Most were from semi-urban areas (62%; $\chi^2(2) = 20.92$, $p < .001$). Headache with seizure (28%) and isolated seizure (26%) were the commonest presentations ($\chi^2(4) = 4.20$, $p = .380$). Astrocytoma, glioma and meningioma were equally common on histopathology (20% each; $\chi^2(6) = 7.96$, $p = .241$). MRI showed higher sensitivity (95.7% vs 90.9%) and accuracy (92% vs 84%) than CT; the difference in accuracy was not statistically significant ($\chi^2(1) = 1.52$, $p = .218$).

Conclusion: MRI was more accurate than CT for supratentorial brain tumors, although the difference was not statistically significant in this sample. CT remains a useful rapid first-line investigation.

Recommendation: MRI should be preferred for definitive characterisation wherever available, with CT retained for emergency assessment; larger multicentre studies are recommended.

Keywords: Supratentorial brain tumor, computed tomography, magnetic resonance imaging, glioma, glioblastoma, meningioma, histopathology, diagnostic accuracy, neuroimaging.

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Corresponding author: Dr. Amit Kumar Gupta

Email: amit27677@gmail.com

Junior Resident, Department of Radiodiagnosis, Katihar Medical College and Hospital, Katihar

Introduction

The supratentorial compartment is the part of the intracranial cavity that lies above the tentorium cerebelli, the dural fold that separates the cerebral hemispheres from the structures of the posterior fossa. It contains the cerebral hemispheres, the basal ganglia and the lateral ventricles, which together govern cognition, memory, language, emotional behaviour and voluntary movement. Because most primary brain neoplasms in adults originate here, a firm grasp of its anatomy and imaging appearances underpins accurate diagnosis and treatment planning.^{1,2}

Tumors of this region account for an estimated 70-80% of all intracranial neoplasms in adults,^{2,3} and cancers of the brain and central nervous system place a considerable and unevenly distributed burden on health systems worldwide.^{4,5} Where resources are limited, late presentation and restricted access to MRI often delay diagnosis, so it is important to define how well the more widely available imaging modalities perform.

Clinically, these lesions may declare themselves through headache, seizures, focal weakness, speech disturbance, or

changes in behaviour and cognition. The pattern depends on where the tumor sits, how large it is and how quickly it grows, and the onset is frequently gradual.^{6,7} Neuroimaging is therefore the cornerstone of evaluation.

CT forms its images from the differential absorption of X-rays as they pass through tissue, followed by computer reconstruction into cross-sectional slices.^{8,9} It is quick, widely available and well suited to showing calcification, acute haemorrhage, bone involvement and mass effect, which is why it is usually the first test performed. MRI, by contrast, builds its images from radiofrequency signals emitted by hydrogen nuclei in a strong magnetic field and uses no ionising radiation.¹⁰⁻¹² Its multiplanar capability, high soft-tissue contrast and range of sequences, including contrast-enhanced, diffusion-weighted imaging (DWI) and apparent diffusion coefficient (ADC) mapping, depict lesion extent, oedema and relationship to adjacent structures in greater detail. Recent work on advanced MRI and computer-assisted classification further extends tumor characterisation.^{13,14}

Evidence comparing the two modalities in the population

served by our institution is limited. This study therefore evaluates CT and MRI in patients with supratentorial brain tumors at a tertiary care hospital in Bihar, with histopathology as the reference standard.

Aims and objectives

Aim: To evaluate the role of CT and MRI in the assessment of supratentorial brain tumors, with emphasis on their utility in accurate diagnosis, characterisation and guidance of appropriate treatment planning, thereby improving overall patient care.

Objectives:

To compare the diagnostic accuracy of CT and MRI in the detection and evaluation of supratentorial brain tumors.

To elucidate the basic principles and technical aspects of CT and MRI in brain tumor imaging.

To assess the advantages and limitations of CT and MRI in terms of tumor characterisation.

To correlate imaging findings on CT and MRI with histopathological diagnosis.

Materials and methods

Study Design and Setting: This was a hospital-based, prospective cross-sectional (diagnostic accuracy) study conducted in the Department of Radiodiagnosis, Katihar Medical College and Hospital, Katihar, Bihar. The institution is a tertiary care teaching hospital that provides outpatient, inpatient, emergency and diagnostic services across medical and surgical specialties :[600-bed strength and relevant specialties, e.g., Radiologist]. It receives referrals from a large rural and semi-urban population in Katihar and the neighbouring districts, and its Department of Radiodiagnosis provides CT and MRI services.

Study Duration: The study was conducted over a period of two and a half years, from January 2024 to June 2026, covering patient recruitment, imaging, and data analysis.

Study Population, Participant Selection and Sample Size

Inclusion Criteria: (i) patients with suspected or confirmed supratentorial brain tumor; (ii) patients who underwent both CT and MRI; (iii) availability of complete imaging data, including advanced sequences and contrast studies; (iv) patients with histopathologically confirmed diagnosis.

Exclusion Criteria: (i) patients with infratentorial tumors; (ii) patients with contraindications to CT or MRI; (iii) patients with incomplete imaging data.

Patients with a confirmed diagnosis or clinical suspicion of supratentorial brain tumors who were referred to the department during the study period were assessed for eligibility according to predefined inclusion and exclusion criteria. Eligible patients were recruited consecutively. The required sample size was estimated using Cochran's formula

for a single population proportion:

$$n = Z^2 p(1 - p) / d^2$$

Where n represents the required sample size, $Z = 1.96$ corresponds to a 95% confidence level, $p = 0.50$ represents the assumed population proportion, and $d = 0.1398$ represents the absolute precision.

Substituting these values into the formula:

$$n = [(1.96)^2 \times 0.50 \times (1 - 0.50)] / (0.1398)^2$$

$$n = (3.8416 \times 0.25) / 0.01954404$$

$$n \approx 49.16$$

The calculated sample size was approximately 49.16 patients, which was rounded up to 50 patients. Accordingly, a total of 50 patients were included in the final study analysis.

Imaging Protocol: CT scans were performed on a 16-slice multidetector CT scanner (GE Brivo Revolution ACT). MRI was performed on a 1.5 Tesla system (GE MR Signa Explorer). Pre- and post-contrast images were obtained in all cases, with advanced sequences such as DWI and perfusion imaging acquired when clinically indicated. All studies were interpreted by an experienced neuroradiologist, and discrepancies were resolved by consensus review.

Control of Bias: Several measures were considered to minimize potential sources of bias. Selection bias was minimized by applying predefined inclusion and exclusion criteria uniformly to all patients considered for the study. Consecutive recruitment was used to reduce the potential for selective patient inclusion. Verification bias was minimized by ensuring that all enrolled patients underwent both CT and MRI examinations and that the same reference standard was applied to all patients. Measurement bias was reduced by using standardized imaging acquisition protocols and consistent imaging procedures. Images were evaluated by an experienced neuroradiologist, and discordant findings were reviewed to improve consistency in interpretation. Information bias was minimized through systematic recording of clinical and imaging data using a structured data collection proforma. The potential for observer bias depended on whether image readers were blinded to the reference standard results. Any remaining sources of bias were considered when interpreting the study findings.

Data Collection and Statistical Analysis:

Clinical and imaging data, including tumor size, location, morphology, oedema, haemorrhage and enhancement pattern, were recorded from hospital records, entered into Microsoft Excel and analysed with SPSS. Descriptive statistics (frequency, percentage, mean and standard deviation) were computed. The chi-square test was used for categorical variables (goodness-of-fit against an equal distribution for the frequency distributions, and a 2×2 test to compare correct classification between CT and MRI), and

$p < .05$ was considered statistically significant. Yield analysis (sensitivity, specificity, positive and negative predictive values and diagnostic accuracy) was used to compare CT and MRI against histopathology.

Ethical Considerations: Ethical approval was obtained from the Institutional Ethics Committee of Katiyar Medical College. Written informed consent was obtained from all participants before enrolment, and patient confidentiality was maintained throughout.

Results

Participant flow. During the study period, 50 patients

Table 1

Participant Flow Through the Study

Stage	n	Reason / comment
Patients assessed for eligibility	50	-
Excluded before enrolment	0	
Confirmed eligible and enrolled	50	-
Completed both CT and MRI	50	-
Histopathological diagnosis available	50	-
Included in the final analysis	50	-

Note. The numbers of patients initially referred, assessed for eligibility, and excluded before enrolment were unavailable. Participant characteristics. The mean age was 50.84 ± 17.43 years (range 22-79 years), with an equal number of males and females (50% each). Most patients (62%) were from semi-urban areas, followed by rural (28%) and urban (10%) areas; this distribution differed significantly from an equal distribution, $\chi^2(2, N = 50) = 20.92, p < .001$ (Table 2).

Table 2

Distribution of Age, Gender and Residence (N = 50)

Parameter	Category	f	%	M $\pm$ SD	χ^2 (df), p
Age (years)	21-40	19	38.0	50.84 ± 17.43	$\chi^2(2) = 2.92, p = .232$
	41-60	11	22.0		
	> 60	20	40.0		
Gender	Male	25	50.0	-	$\chi^2(1) = 0.00, p = 1.000$
	Female	25	50.0		
Residence	Semi-urban	31	62.0	-	$\chi^2(2) = 20.92, p < .001$
	Rural	14	28.0		
	Urban	5	10.0		

Note. f = frequency; M = mean; SD = standard deviation. Chi-square values are goodness-of-fit tests against an equal distribution.

Headache with seizure was the most frequent presentation (28%), followed by isolated seizure (26%), headache alone (16%) and speech difficulty (16%); weakness was noted in 14% ($\chi^2(4, N = 50) = 4.20, p = .380$). Slightly more than half

with suspected or confirmed supratentorial brain tumors were consecutively enrolled. All 50 patients completed both CT and MRI examinations and had histopathological diagnoses available for comparison. All 50 patients were included in the final analysis, and no participants were lost after enrolment. However, the total number of patients initially referred, assessed for eligibility, or excluded before enrolment could not be determined because screening records were unavailable. Therefore, the participant flow is reported based on the available enrolment and follow-up records. (Table 1).

of the patients (54%) presented more than six months after symptom onset, while 46% presented within six months ($\chi^2(1, N = 50) = 0.32, p = .572$) (Table 3).

Table 3

Distribution of Clinical Presentation and Symptom Duration (N = 50)

Variable	f	%	χ^2 (df), p
Clinical presentation			$\chi^2(4) = 4.20, p = .380$
Headache + seizure	14	28.0	
Seizure	13	26.0	
Headache	8	16.0	
Speech difficulty	8	16.0	
Weakness	7	14.0	
Duration of symptoms			$\chi^2(1) = 0.32, p = .572$
< 6 months	23	46.0	
> 6 months	27	54.0	

Note. Chi-square values are goodness-of-fit tests against an equal distribution.

No identifiable risk factor was present in 44% of patients; remainder, and the distribution was significantly unequal, diabetes mellitus (16%), history of malignancy (14%), $\chi^2(4, N = 50) = 18.20, p = .001$ (Table 4). smoking (14%) and hypertension (12%) were noted in the

Table 4

Distribution of Risk Factors (N = 50)

Risk factor	f	%	χ^2 (df), p
None	22	44.0	$\chi^2(4) = 18.20, p = .001$
Diabetes mellitus	8	16.0	
Hypertension	6	12.0	
History of malignancy	7	14.0	
Smoking	7	14.0	

Note. Chi-square value is a goodness-of-fit test against an equal distribution.

On CT, hypodense, intra-axial and extra-axial lesions were the commonest findings (20% each), followed by heterogeneous mass (16%), ring lesion (10%), multiple lesions (8%) and calcification (6%) ($\chi^2(6, N = 50) = 7.96, p = .241$). On MRI, T2-hyperintense lesions were commonest (40%), followed by dural-based enhancing lesions (20%), irregular enhancing lesions (16%), restriction ring pattern (10%), multiple enhancing lesions (8%) and calcified T2 lesions (6%), a significantly unequal distribution, $\chi^2(5, N = 50) = 23.68, p < .001$ (Table 5).

Table 5

Distribution of CT and MRI Imaging Findings (N = 50)

Finding	f	%	χ^2 (df), p
CT finding			$\chi^2(6) = 7.96, p = .241$
Hypodense	10	20.0	
Hypodense intra-axial	10	20.0	
Extra-axial	10	20.0	
Heterogeneous mass	8	16.0	

Finding	f	%	χ^2 (df), p
Ring lesion	5	10.0	
Multiple lesions	4	8.0	
Calcified	3	6.0	
MRI finding			$\chi^2(5) = 23.68, p < .001$
T2 hyperintense	20	40.0	
Dural based	10	20.0	
Irregular enhancing	8	16.0	
Restriction ring	5	10.0	
Multiple enhancing	4	8.0	
Calcified T2	3	6.0	

Note. Chi-square values are goodness-of-fit tests against an equal distribution.

With histopathology as the reference standard, astrocytoma, abscess (10%), metastasis (8%) and oligodendroglioma glioma and meningioma were equally the commonest (6%), $\chi^2(6, N = 50) = 7.96, p = .241$ (Table 6). diagnoses (20% each), followed by glioblastoma (16%),

Table 6

Distribution of Histopathological Diagnosis (N = 50)

Diagnosis	f	%	χ^2 (df), p
Astrocytoma	10	20.0	$\chi^2(6) = 7.96, p = .241$
Glioma	10	20.0	
Meningioma	10	20.0	
Glioblastoma (GBM)	8	16.0	
Abscess	5	10.0	
Metastasis	4	8.0	
Oligodendroglioma	3	6.0	

Note. Chi-square value is a goodness-of-fit test against an equal distribution.

On yield analysis, CT showed 40 true positives, 4 false positives, 4 false negatives and 2 true negatives, giving a sensitivity of 90.9%, specificity of 33.3%, positive predictive value of 90.9%, negative predictive value of 33.3% and diagnostic accuracy of 84%. MRI showed 45 true positives, 2 false positives, 2 false negatives and 1 true

negative, giving a sensitivity of 95.7%, specificity of 33.3%, positive predictive value of 95.7%, negative predictive value of 33.3% and diagnostic accuracy of 92% (Table 8). MRI correctly classified 46 of 50 patients and CT 42 of 50; this difference was not statistically significant, $\chi^2(1, N = 100) = 1.52, p = .218$.

Table 7

Diagnostic Performance of CT and MRI in Detection of Supratentorial Brain Tumor

Diagnostic parameter	CT (%)	MRI (%)
Sensitivity	90.9	95.7
Specificity	33.3	33.3
Positive predictive value	90.9	95.7
Negative predictive value	33.3	33.3
Diagnostic accuracy	84.0	92.0

Note. Accuracy compared between modalities: $\chi^2(1, N = 100) = 1.52, p = .218$ (correctly classified: CT 42/50, MRI 46/50).

Discussion

Interpretation of key findings. This study compared CT and MRI in 50 patients with supratentorial brain tumors, using histopathology as the reference. Most patients were older adults, and more than half had been symptomatic for over six months before imaging. This points to delayed presentation, which is plausible in a catchment that is predominantly semi-urban and rural (62% and 28%), where symptoms such as headache or occasional seizures may be tolerated for some time and access to specialist care is limited.

Seizures, with or without headache, were the first manifestation in over half of the patients (54%). This fits the cortical and subcortical location of many supratentorial tumors and indicates that new-onset seizures in an adult should prompt neuroimaging rather than reassurance. A similar clinical and histological profile, with glioma, astrocytoma and meningioma predominating, was described by Gor et al. in a tertiary hospital in Gujarat.¹⁵

On imaging, CT mainly demonstrated hypodense, extra-axial and heterogeneous masses and was the more informative test for calcification, while MRI, through multiplanar and multisequence acquisition, separated T2-hyperintense, dural-based and irregularly enhancing lesions more clearly. In terms of diagnostic performance, MRI achieved a sensitivity of 95.7% and accuracy of 92%, against 90.9% and 84% for CT. The direction of this difference agrees with Raikwar and Rao, who also found MRI to outperform CT in brain tumor detection,¹⁶ and with the work of Patidar et al., which supports CT as a useful first-line study for mass lesions but recognises its limits in soft-tissue differentiation.¹⁷ MRI has likewise been shown to correspond well with pathology in glioma assessment.¹⁸ However, the eight-point difference in accuracy was not statistically significant ($p = .218$). With only 50 patients, the study was probably underpowered to confirm a difference of this size, so MRI should be described as showing a favourable trend rather than as proven superiority. Specificity and negative predictive value were 33.3% for

both modalities. These figures rest on very few histologically non-neoplastic cases (abscess, $n = 5$) and are therefore imprecise; they should not be read as evidence that the two techniques perform equally poorly in excluding tumor.

Generalizability. The findings come from a single tertiary care centre in Bihar, with one CT scanner (16-slice) and one 1.5 Tesla MRI system. They are most applicable to similar hospitals in eastern India that serve a rural and semi-urban population and use comparable equipment. Extrapolation to children, to infratentorial tumors (excluded here), to centres with different scanner generations or reporting practice, and to populations with a different tumor mix should be done with caution. Confirmation in larger multicentre samples is needed.

Practical challenges. Obtaining complete imaging for every patient was difficult, because accurate comparison required both CT and MRI whereas, in routine practice, some patients undergo only one initial examination; this was handled by enrolling only patients in whom both modalities were available. Variation between observers was a second concern, which was addressed through consensus review by experienced neuroradiologists.

Conclusion

In this study, MRI showed higher sensitivity (95.7% vs 90.9%) and diagnostic accuracy (92% vs 84%) than CT for supratentorial brain tumors, although the difference was not statistically significant. CT remains a rapid first-line investigation, particularly for calcification, haemorrhage and mass effect. MRI should be preferred for definitive characterisation wherever it is available.

Limitations

The study was limited by its small sample ($n = 50$) and single-centre design, which restrict statistical power and generalizability. Only a few histologically non-neoplastic cases were included, making specificity and negative predictive value unstable. Advanced MRI sequences were acquired only when clinically indicated, and inter-observer agreement was not formally measured. The chi-square

comparison of CT and MRI accuracy treated the two modalities as independent groups although the same patients were examined with both; a paired analysis (e.g., McNemar test) would be more appropriate in a larger study.

Recommendations

MRI should be used for comprehensive assessment and tumor characterisation wherever it is available.

CT should continue as the rapid first-line investigation in emergencies and where MRI is not accessible.

Access to MRI should be expanded in rural and semi-urban regions to reduce diagnostic delay.

Larger multicentre studies with paired analysis and advanced MRI techniques are recommended.

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List of abbreviations

ADC - Apparent diffusion coefficient

CT - Computed tomography

DWI - Diffusion-weighted imaging

GBM - Glioblastoma

HPE - Histopathological examination

MDCT - Multidetector computed tomography

MRI - Magnetic resonance imaging

NPV - Negative predictive value

PPV - Positive predictive value

SD - Standard deviation

SPSS - Statistical Package for the Social Sciences

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Conflict of interest

The authors declare that they have no conflict of interest.

Author contributions

Dr. Md Shahzeb Alam: study conception, patient recruitment and data collection. Dr. Amit Kumar Gupta: imaging evaluation, data analysis, manuscript drafting and correspondence. Dr. Manish Jaiswal: supervision, imaging interpretation and critical revision of the manuscript. All authors read and approved the final manuscript.

Data availability

The data supporting the findings of this study are available from the corresponding author on reasonable request.

Author biography

Dr. Md Shahzeb Alam is a Junior Resident in the Department of Radiodiagnosis, Katihar Medical College and Hospital, Katihar.

Dr. Amit Kumar Gupta is a Junior Resident in the Department of Radiodiagnosis, Katihar Medical College and Hospital, Katihar, and the corresponding author of this

article.

Dr. Manish Jaiswal is an Associate Professor in the Department of Radiodiagnosis, Katihar Medical College and Hospital, Katihar.

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