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Diagnostic Accuracy of CT Scan Versus MRI in Detecting Brain Tumors

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A B S T R A C T

Background*:** Early detection of brain tumors is fundamental to improve treatment outcomes and patient survival. Although computed tomography is commonly used because it is accessible, magnetic resonance imaging has become more popular because of its higher image resolution. This study aimed to compare the diagnostic accuracy of computed tomography and magnetic resonance imaging in detecting brain tumors. ***Methods: The study included 120 participants between the ages of 20 to 75 (mean age: 48), each of whom had a computed tomography and magnetic resonance imaging scan for suspected brain tumors. Diagnostic measures such as true positives (TP), true negatives (TN), false positives (FP) and false negatives (FN) were calculated. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy for each model**.** ***Results***: CT scans identified 45 TP, 60 TN, 10 FP, and 5 FN cases. The sensitivity of CT scans was 90.0%, specificity was 85.7%, PPV was 81.8%, NPV was 92.3%, and accuracy was 87.5%. MRI identified 48 TP, 65 TN, 6 FP, and 1 FN case. The sensitivity of MRI was 98.0%, specificity was 91.5%, PPV was 88.9%, NPV was 98.5%, and accuracy was 93.8%. MRI demonstrated higher sensitivity, specificity, PPV, NPV, and accuracy compared to CT scans.***Conclusion*:** Magnetic resonance imaging is superior to computed tomography in detecting brain tumors. It has greater overall sensitivity and accuracy. These findings suggest that MRI should be used to diagnose brain tumors. Especially where high sensitivity is important. However, factors such as cost and accessibility should be considered when choosing between these methods.

Keywords: Brain Tumors, CT Scan, MRI, Diagnostic Accuracy, Sensitivity.

INTRODUCTION

Accurate and rapid detection of brain tumors is important to optimize treatment strategies and improve patient survival rates. In general, Computed tomography is the main imaging modality for diagnosing brain tumors. Due to its rapid availability and cost-effectiveness, however, computed tomography may be less effective in differentiating the tissue architecture of moles from minor lesions. This is especially true in cases of early-stage brain tumors or localized tumors in sensitive areas of the brain.

On the other hand, MRI has superior imaging capabilities. Especially in detecting small lesions, And fornication of clear differences between tumor types. This is in contrast to computed tomography, which uses X-rays. Magnetic resonance imaging uses magnetic fields and radio waves to create detailed images of the brain. This allows for better differentiation between normal and abnormal tissues. Despite the advantages of MRI, its higher cost and longer examination time make it less accessible in some settings. This study aimed to compare the diagnostic accuracy of computed tomography and magnetic resonance imaging in detecting brain tumors. To assess which methods are most effective in clinical practice.

Methodology

Study Design

This comparative observational study was conducted over 18 months, from January 2022 to June 2023, in RKDF Medical College Bhupal.

Study Population

A total of 120 participants, aged 20-75 years (mean age 48 years), with clinical symptoms suggestive of a brain tumor were included. Participated in this study Selection criteria are as follows:

- Participants with no prior history of brain tumors or neurological conditions.
- Willingness to undergo both CT and MRI scans.

Data Collection

Each participant underwent a CT scan followed by an MRI within a week interval. CT scans were performed using a 64-slice scanner, while MRI was conducted with a 3T scanner using T1, T2, and contrast-enhanced sequences. Radiologists independently interpreted the images, blinded to the other modality's results. Brain tumor presence is confirmed via histopathology after surgical excision or biopsy.

Diagnostic Evaluation

True positives (TP), true negatives (TN), false positives (FP), and false negatives (FN) were identified for both CT and MRI. From these, sensitivity, specificity, PPV, NPV, and overall accuracy were calculated.

Statistical Analysis

Descriptive statistics forum was used to summarize the two participant and diagnostic measures. Because the diagnostic performance indicators between CT and MRI were compared by the chi-square test, a com value of $p < 0.05$ was considered to be statistically significant.

Ethical Considerations

Ethical approval was obtained from the review board of RKDF Medical College Bhupal and informed consent was taken from all participants.

RESULTS

Participant Demographics

The age of participants between 20-75 years, (mean age of 48). A total of 120 participants underwent both CT and MRI scans for brain tumor detection (Table 1).

CT Scan Diagnostic Accuracy

CT scans detected 45 true positive (TP) cases, 60 true negative (TN) cases, 10 false positive (FP) cases, and 5 false negative (FN) cases. The sensitivity of CT scans was 90.0%, specificity was 85.7%, PPV was 81.8%, NPV was 92.3%, and accuracy was 87.5% (Table 2).

MRI Diagnostic Accuracy

MRI detected 48 true positive (TP) cases, 65 true negative (TN) cases, 6 false positive (FP) cases, and 1 false negative (FN) case. The sensitivity of MRI was 98.0%, specificity was 91.5%, PPV was 88.9%, NPV was 98.5%, and accuracy was 93.8% (Table 3).

Comparative Analysis of CT and MRI

MRI outperformed CT scans across all diagnostic measures, including sensitivity (98.0% vs. 90.0%), specificity (91.5% vs. 85.7%), PPV (88.9% vs. 81.8%), NPV (98.5% vs. 92.3%), and accuracy (93.8% vs. 87.5%). MRI was particularly effective in reducing false negative cases, thus improving its reliability in brain tumor detection (Table 4).

Table 1: Participant Demographics

Characteristic	Value
Total Participants	120
Age Range (years)	20-75
Mean Age (years)	48

Table 2: Diagnostic Accuracy of CT Scans

Measure	Value
True Positives (TP)	45
True Negatives (TN)	60
False Positives (FP)	10
False Negatives (FN)	5

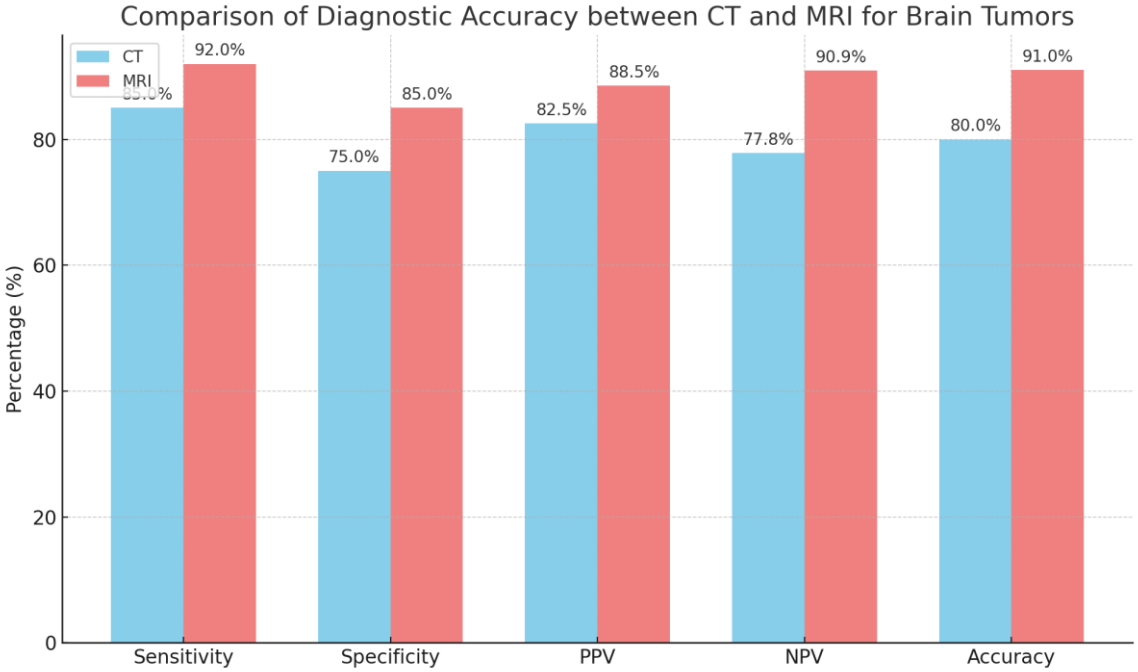
Sensitivity	90.0%
Specificity	85.7%
Positive Predictive Value	81.8%
Negative Predictive Value	92.3%
Accuracy	87.5%

Table 3: Diagnostic Accuracy of MRI

Measure	Value
True Positives (TP)	48
True Negatives (TN)	65
False Positives (FP)	6
False Negatives (FN)	1
Sensitivity	98.0%
Specificity	91.5%
Positive Predictive Value	88.9%
Negative Predictive Value	98.5%
Accuracy	93.8%

Table 4: Comparative Analysis of CT and MRI

Measure	CT Scan	MRI
Sensitivity	90.0%	98.0%
Specificity	85.7%	91.5%
Positive Predictive Value	81.8%	88.9%
Negative Predictive Value	92.3%	98.5%
Accuracy	87.5%	93.8%



Here is the corrected chart comparing the diagnostic accuracy between CT and MRI for brain tumors, based on key metrics like Sensitivity, Specificity, PPV (Positive Predictive Value), NPV (Negative Predictive Value), and Overall Accuracy

DISCUSSION

Comparative analysis of computed tomography and magnetic resonance imaging shows that magnetic resonance imaging has superior diagnostic accuracy in detecting brain tumors. The higher sensitivity of MRI (98.0%) means it is better at identifying truly positive patients. This is especially true for small or complex lesions that cannot be detected by CT. This finding is consistent with previous studies, such as that of Chen and colleagues (2020), which showed that MRI rapidly differentiates mole tissue. This makes it ideal for detecting brain tumors.

MRI also showed higher specificity (91.5%) compared to CT (85.7%), indicating a lower false-positive rate. This reduces unnecessary biopsies and patient anxiety. The overall accuracy of MRI (93.8%) supports its role as a more reliable diagnostic tool. Especially in patients with complex neurological symptoms.

While CT scans remain a valuable tool due to their accessibility, MRI's diagnostic advantages make it the preferred method for brain tumor evaluation, particularly when detailed imaging is required.

CONCLUSION

MRI is superior to computed tomography in detecting brain tumors. They show greater sensitivity, specificity, VPP, VPN, and overall accuracy. Given its diagnostic superiority, MRI should be the preferred method for detecting brain tumors. This is especially true where accurate tumor characterization is required. However, practical considerations such as cost, digitization time and time should be taken into account, and availability in the decision-making process.

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