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Original Research Article.

Assessment of Diagnostic Efficacy of CT Scan and MRI in Detecting Brain Tumors

Karnawat Shekhar[1], Vishwas Chakra V[2*]

**[1]Professor and HOD, [2*]Assistant Professor, Department of Radiology,
Ananta Institute of Medical Sciences and Reasearch Center, Rajsamand, Rajasthan, India.**

ABSTRACT

Background: Tumors in the intracranial region can arise from brain, skull, embryonic tissues, spinal cord, pituitary gland and meninges. A complete and thorough evaluation of the patient needs to be performed for the appropriate diagnosis. The steps include complete history, physical examinations with special emphasis on neurologic examination, and diagnostic neuroimaging studies like CT scan and MRI. The aim of the present study is to establish the sensitivity and specificity of CT scan and MRI in diagnosing brain lesions compared to results obtained by biopsy.

Materials and Methods: The present retrospective experimental study was conducted at few Private Radiodiagnostic Centers. The study included all the patients who reported with brain tumor to the OPD of the department. Complete detail about the patient was obtained from the hospital's record. It included patient's demographics, medical history. Patient's confidentiality was maintained throughout the study. The results obtained from CT scan and MRI was compared with those obtained from biopsy. SPSS software was used for analysis.

Results: The present study included 300 subjects who reported to the department with brain tumor. The mean age of the subjects was 32.78 +/- 21.6 years. The sensitivity of CT scan in this study was 82.7% and specificity was 33.3%. The positive predictive value is 94% and negative predictive value was 14%. On applying fischer test, there is no significant difference in the results obtained by biopsy and CT scan. The sensitivity of MRI is 92% and specificity is 33%. The positive predictive value is 94% and negative predictive value is 28%. On applying fischer test, there was no significant difference in the results obtained by MRI and biopsy as the p value was more than 0.05.

Conclusion: From the study we can conclude that both CT scan and MRI are useful assets as diagnostic aids. MRI being more sensitive than CT scan. In cases were biopsy specimens are scarce or biopsy specimens cannot be obtained, they can be diagnosed by imaging modalities.

Keywords: Brain, Imaging, Sensitivity, Specificity.

***Correspondence to:**

Dr. Vishwas Chakra V,
Assistant Professor, Department of Radiology,
Ananta Institute of Medical Sciences and Reasearch Center,
Rajsamand, Rajasthan, India.

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INTRODUCTION

Tumors in the intracranial region can arise from brain, skull, embryonic tissues, spinal cord, pituitary gland and meninges. They can also metastasise to other parts of body. In the United states, the incidence rate of brain tumor is found to be 9.5 in 100000, of which majority are gliomas which account for more than 60% of primary tumors.[1] They generally present with certain have non-specific signs and symptoms like headache, nausea and vomiting. The specific sign associated with tumor depends on its location and these can be paralysis, aphasia, visual field disorders, seizure etc.[2] A complete and thorough evaluation of the patient needs to be performed for the appropriate diagnosis. The steps include complete history, physical examinations with special emphasis on neurologic examination, and diagnostic neuroimaging studies like CT scan and MRI. Both neoplastic and non-neoplastic conditions constitute the differential diagnosis of patients who present with signs and symptoms that are suggestive of brain tumor. The various imaging tests constitute the best modality in differentiating and evaluating the brain lesions. They also help in planning of the surgery and determining the prognosis of the treatment.[3] Both CT scan and magnetic resonance imaging act as an asset in these criteria of diagnosis of intracranial tumors. For diagnosing bone lesions and to evaluate the extent of vascular involvement computed tomography is the imaging modality of choice and it also allows us to evaluate the presence of metastases to base of skull.[4,5] MRI is the modality of choice for diagnosing brain tumors especially in cases of glial tumors.[6] In cases of non-availability of MRI, contrast CT can be used in these cases. For good prognosis, early detection and management of

brain tumors is required. Early detection can be aided by a good imaging modality. The aim of the present study is to establish the sensitivity and specificity of CT scan and MRI in diagnosing brain lesions compared to results obtained by biopsy.

MATERIALS AND METHODS

The present retrospective experimental study was conducted at few Private Radiodiagnostic Centers. All the subjects were informed about the study and a written consent was obtained from all in their vernacular language. The study included all the patients who reported with brain tumor to the OPD of the department. Complete detail about the patient was obtained from the hospital's record. It included patient's demographics, medical history. The results obtained from CT scan and MRI was compared with those obtained from biopsy. The chief complaint of the patients was also taken into consideration. The lesion was evaluated as benign or malignant by the pathologist and they were not aware about the results obtained by CT scan or MRI. The results obtained on CT scan were classified as cystic or solid, edematous or non edematous, presence or absence of calcification. Based on the reports obtained by CT scan and MRI, the lesions were also classified as benign or malignant. All the data was arranged in a tabulated form and analysed using SPSS software. Fischer test was applied as a test of significance. Probability value of less than 0.05 was considered significant.

RESULTS

The present study included 300 subjects who reported to the department with brain tumor. The mean age of the subjects was 32.78 +/- 21.6 years. Out of these majority were males i.e. 170 males and rest females. There were 237 cases that were confirmed on biopsy. Out of these 14 (5.9%) were benign and rest 223 (94.1%) were malignant.

Table 1 denotes the result obtained by CT scan. There were 258 cases (86%) that were confirmed by CT scan. There were 196 cases that were confirmed malignant by both CT scan and biopsy. There were 7 cases that were confirmed benign by both CT scan and biopsy. The sensitivity of CT scan in this study was 82.7% and specificity was 33.3%. The positive predictive value is 94% and negative predictive value was 14%. On applying fischer test, there is no significant difference in the results obtained by biopsy and CT scan.

Table 2 compares the results obtained by biopsy and MRI. MRI was performed in total of 75 cases. There were 64 cases that were confirmed malignant by both MRI and biopsy. There were only 2 cases that were confirmed benign by both MRI and biopsy. The sensitivity of MRI is 92% and specificity is 33%. The positive predictive value is 94% and negative predictive value is 28%. On applying fischer test, there was no significant difference in the results obtained by MRI and biopsy as the p value was more than 0.05.

Table 1: Distribution of CT scan and biopsy results in diagnosing brain malignancy

CT scan	Biopsy			
	Malignant	Benign	Total	P value
Malignant	196	14	207	
Benign	41	7	48	
Total	237	21	258	>0.05

Table 2: Distribution of MRI and biopsy results in diagnosing brain malignancy

MRI	Biopsy			
	Malignant	Benign	Total	P value
Malignant	64	4	68	
Benign	5	2	7	
Total	69	6	75	>0.05

Table 3: Type of brain lesion based of CT scan criteria and biopsy

CT scan	Biopsy	
	Malignant	Benign
Cystic	234(90.6%)	21(8.1%)
Solid	215(83.3%)	39(15.1%)
Calcification	242(93.7%)	15(5.8%)
Edematous	235(91%)	22(8.5%)
Shifting	245(95%)	10(3.8%)
Enhancement	234(90.1%)	23(8.9%)
Hydrocephaly	181(70.1%)	61(23.6%)

Graph 1: Percentage of types of lesions on CT

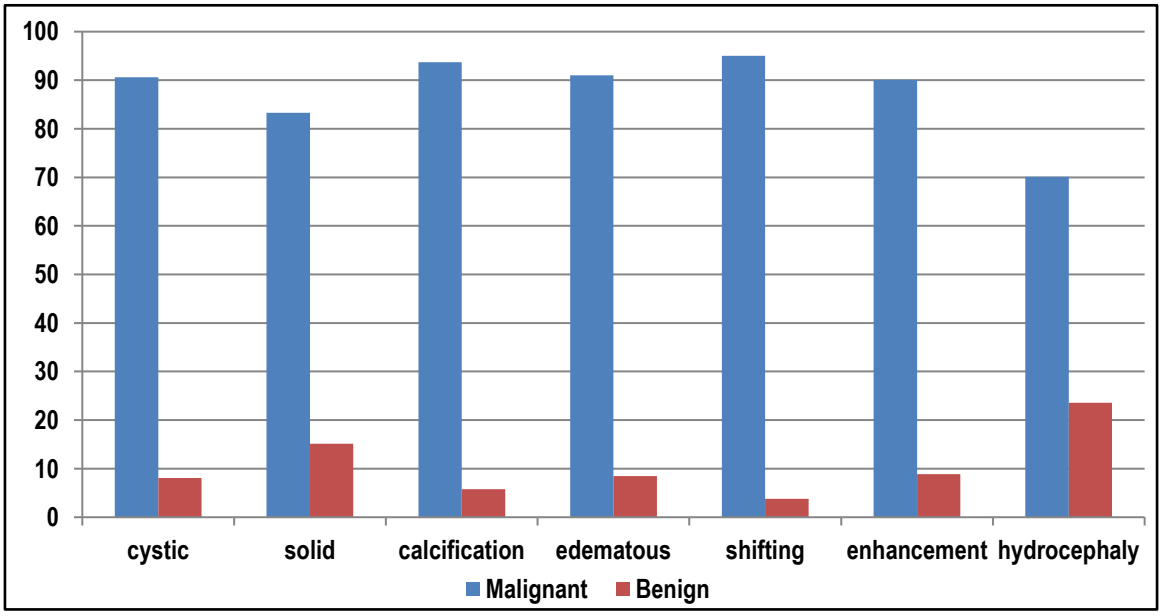

Table 3, graph 1 shows type of brain lesions of CT scan criteria. There were 90.6% malignant lesions and 8.1% benign lesions that were cystic. There were 83.3% malignant lesions and 15.1% benign lesions that were solid. There were 93.7% malignant lesions and 5.8% benign lesions that had calcification. There were 91% malignant lesions and 8.5% benign lesions that showed edematous changes. There were 70.1% malignant lesions and 23.6% benign lesions that showed hydrocephaly.

DISCUSSION

Brain is a complex neurological structure. Tumor of brain is defined as abnormal collection of neurological masses in brain. They present with varied signs and symptoms. Early management is necessary for better prognosis. For diagnosing these cases various imaging modalities are used. As per our study both CT scan and MRI are sensitive diagnostic modalities but they lack specificity. Both of them showed high positive predictive value and low negative predictive value and therefore they can be a useful and reliable diagnostic tool in evaluating any kind of brain lesions. There were evidences from our study that indicate that presence of cystic change, edema, enhancement etc all indicate malignant change. In our study there were 90.6% malignant lesions and 8.1% benign lesions that were cystic. There were 83.3% malignant lesions and 15.1% benign lesions that were solid. There were 93.7% malignant lesions and 5.8% benign lesions that had calcification. There were 91% malignant lesions and 8.5% benign lesions that showed edematous changes. Another imaging modality i.e. perfusion imaging helps in determine the grade of CNS tumors based on the degree of vascularity of the tumor. Perfusion is a better indicator of grade of tumor as compared to the contrast enhancement.[7,8] In a study conducted by Massager N et al in the year 2000, MRI showed accuracy of 63%.[9] In our study, the sensitivity of CT scan in this study was 82.7% and specificity was 33.3%. The positive predictive value is 94% and negative predictive value was 14%. On applying fischer test, there is no significant difference in the results obtained by biopsy and CT scan. As per a study conducted by Mc gee J et al in Japan, MRI displayed an accuracy of 100%, 92.4% and 82% in diagnosing Ependymoma, Schwannoma and metastatic tumors.[10] There were few researches that were conducted to estimate the sensitivity and specificity of CT scan in diagnosing brain tumors. In a study by Miller the sensitivity was 89% and the specificity was 82% whereas in another study conducted in Italy, the sensitivity was noted to be 92% and specificity 99%.[11,12]

According to our study, The sensitivity of MRI is 92% and specificity is 33%. The positive predictive value is 94% and negative predictive value is 28%. On applying fischer test, there was no significant difference in the results obtained by MRI and biopsy as the p value was more than 0.05.

In a study conducted by Khan K et al to determine the accuracy of CT in diagnosing brain tumors in children, he found that 86.6% cases were similar in both biopsy and CT whereas in 13.3% cases the histopathology was different.[13]

In a study conducted by Rudack C et al in the year 2007, they found that the efficacy of CT and MRI was similar to that of both combined with ultrasound in detecting salivary gland malignancy.[14] In another study conducted by Taghipour Zahir SH et al, the sensitivity and specificity, of CT scan when compared with biopsy were 83% and 10% respectively. In his study, the sensitivity and specificity of MRI was 92% and 25%.[15] Feiden W et al conducted a study and concluded that stereotactic biopsy provides highest diagnostic accuracy compared to normal biopsy in detection of brain lesions.[16]

CONCLUSION

From the study we can conclude that both CT scan and MRI are useful assets as diagnostic aids. MRI being more sensitive than CT scan. In cases were biopsy specimens are scarce or biopsy specimens cannot be obtained, they can be diagnosed by imaging modalities. The diagnostic accuracy of MRI was more compared to CT scan in this study.

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