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Astrocytoma Detection with Magnetic Resonance Imaging among Patients attended at a Tertiary Care Hospital in Dhaka City

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Abstract

Background: Accurate detection of astrocytomas is very difficult. **Objective:** The purpose of the present study was to evaluate the usefulness of Magnetic Resonance Imaging (MRI) in detection of intracranial astrocytoma. **Methodology:** This cross sectional study was carried out in the Department of Radiology and Imaging with the collaboration of Department of Neurosurgery and Department of Pathology at Sir Salimullah Medical College (SSMC & MH), Dhaka from January 2013 to December 2013 for a period of one (1) year. Prior to the commencement of this study, the research protocol was approved by the ethical committee (Local Ethical committee) of SSMC. All the patients presented with clinically diagnosed cases of intracranial astrocytoma who were attended in the OPD and IPD were included as study population. The sampling technique was purposive, non-random sampling method. MRI was performed in all cases. The postoperative resected tissues were examined histopathological in the respective department. Then the collected reports were compared with findings of MRI. **Results:** The sample size of the present study was 48 astrocytoma patients. The sensitivity, specificity, positive predictive value, negative predictive value and accuracy of MRI for the diagnosis of astrocytoma are 92.0%, 80.0%, 96.0%, 67.0% and 90.3% respectively. **Conclusion:** In conclusion MRI has a high diagnostic validity for the detection of astrocytoma. *[Journal of National Institute of Neurosciences Bangladesh, July 2022;8(2):202-205]*

Keywords: Magnetic Resonance Imaging; astrocytoma; validity test

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Introduction

Astrocytomas are central nervous system (CNS) neoplasm derived from an immortalized astrocyte[1]. Usually astrocytic tumours are narrow zones of infiltration and diffuse zones of infiltration[2]. The incidence rate of all primary malignant and non-malignant CNS tumours is 20.6 cases per 100,000 which are 7.3 per 100,000 for malignant tumours and 13.3 per 100,000 for non–malignant tumours; furthermore, the rate is higher in females than males[3]. Almost half of all primary brain tumours are gliomas; in addition to that, three quarters of all gliomas are astrocytoma[4].

Astrocytomas are histologically heterogeneous. They

also differ in their growth pattern, location, morphology, imaging features, also in disease progression and clinical course[5]. For detection of intracranial tumour MRI is very useful diagnostic tools. In addition to that MRI scan has made a significant impact on the differential diagnosis of intracranial tumours[6]. Compared with CT-scan, MRI offers greater contrast resolution, including greater sensitivity for the detection of subacute and chronic haemorrhage in association with tumours and other lesions of brain[7]. MRI has the capacity to localize the tumour more accurately. MRI provides important information regarding contrast material enhancement, peritumoural oedema, distant tumour foci, haemorrhage, necrosis, mass effect and so on, which are all helpful in characterizing tumour aggressiveness and hence tumour grade[7]. MRI scan localizes and characterizes the vast majority of intracranial astrocytoma and the same is true of high resolution CT scan[8]. Therefore it has been recommended the use of MRI as a prime modality of investigation in detecting intracranial astrocytoma as it is highly sensitive, available and there is no ionizing radiation hazard. The purpose of the present study was to evaluate the usefulness of MRI in detection of different grades of intracranial astrocytoma.

Methodology

This study was designed as observational type of cross sectional study and was carried out in the Department of Radiology and Imaging with the collaboration of Department of Neurosurgery and Department of Pathology at Sir Salimullah Medical College (SSMC & MH), Dhaka from January 2013 to December 2013 for a period of one (1) year. Patients who were clinically suspected and CT scan diagnosed cases of intracranial astrocytomas referred to Radiology and Imaging department of DMCH either from OPD or from indoor of DMCH for MRI of brain were included in this study. Prior to the commencement of this study, the research protocol was approved by the ethical committee (Local Ethical committee) of SSMC. The sampling technique was purposive non-random sampling method. All cases having no contraindication for MRI underwent MR examination. Patients were asked for or checked for any metallic or harmful. MR imaging was obtained with 0.3 Tesla machine (HITACHI). T1W image in axial, sagittal and coronal plane were obtained using short TR (500-800ms) and short TE (14-20ms). T2W image in axial and coronal plane were obtained using long TR (3500-4500ms) and long TE (80ms). FLAIR images were also taken. Contrast MRI studies using intravenous Gd-DTPA (Magnevist, 0.1 mmol/Kg) with axial, coronal and sagittal T1W scan were performed in all cases. The average time of examination was 45 minutes but ranges from 30-90 minutes. Slice thickness was 5-6 mm with a field of view 230x230 mm and pictures matrix was 256x256 or 192x256. The postoperative resected tissues were examined histopathological in the respective department. MRI scan findings were compared with histopathological reports. Then the collected reports were compared with findings of MRI. Data were collected using a preformed data collection sheet. Base line information was collected from the patient after exploration of different complaints and sign and symptoms. All information regarding clinical features and histopathological results were recorded in a data collection sheet. Statistical analysis was performed by using window based computer software devised with Statistical Packages for Social Sciences (SPSS-17) (SPSS Inc, Chicago, IL, USA). 95% confidence limit was taken.

Results

A total number of 69 patients were recruited in this study of which 1 patient refused to undergo surgery, 2 patients were unfit for the same and in 4 cases, histopathological reports were not available. Ultimately 62 patients were evaluated finally.

Table 1: Comparison of MRI findings with Histopathological Findings during Diagnosis of Astrocytoma (n=62)

MRI Diagnosis	Histopathological Diagnosis		Total	P value
	Test Positive	Test Negative		
Test Positive	48(92.3%)	2(20.0%)	50(80.6%)	
Test Negative	4(7.7%)	8(80.0%)	12(19.4%)	0.0001
Total	**52(100.0%)**	**10(100.0%)**	**62(100.0%)**	

Both histopathological and MRI positive astrocytoma case is found in 48 cases which indicate true positive. Again, both histopathological and MRI negative astrocytoma case is found in 8 cases which indicate true negative. Histopathological positive but MRI negative case is found in 4 cases which is known as false negative. Histopathological negative but MRI positive case is found in 2 cases which is known as false positive (Table 1).

The sensitivity, specificity, positive predictive value, negative predictive value and accuracy of MRI for the diagnosis of astrocytoma are 92.0% (95% CI 85.2-98.7%), 80.0% (95% CI 70.0-89.9%), 96.0%

(95% CI 91.1-100.9%), 67.0% (95% CI 55.3-78.7%) and 90.3% (95% CI 82.9-97.7%) respectively (Table 2).

Table 2: Validity of MRI Test during diagnosis of Astrocytoma

Validity	Value	95% CI
Sensitivity	92.0%	85.2-98.7%
Specificity	80.0%	70.0-89.9%
Positive Predictive Value	96.0%	91.1-100.9%
Negative Predictive value	67.0%	55.3-78.7%
Accuracy	90.3%	82.9-97.7%

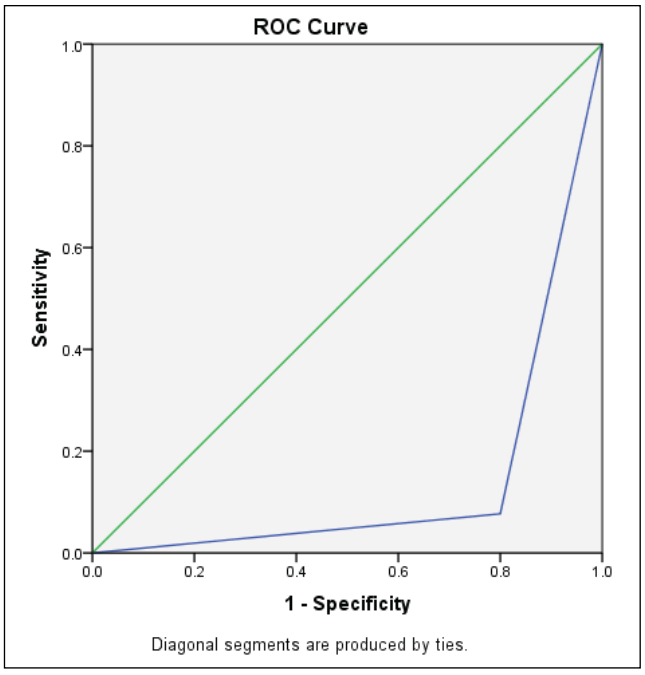

Figure I: ROC curve of MRI for the Detection of Astrocytoma of Brain

Discussion

Brain tumors account for 85.0% to 90.0% of all primary CNS tumors[9]. The worldwide incidence rate of primary malignant brain and CNS in 2008 was 3.8 per 100,000 in males and 3.1 per 100,000 in females[10]. The incidence rates were higher in more developed countries (males: 5.8 per 100,000; females: 4.4 per 100,000) than in less developed countries (males: 3.2 per 100,000; females: 2.8 per 100,000)[11]. Two thirds of all brain tumours are primary neoplasms. Almost half of all primary brain tumours are gliomas; in addition to that, three quarters of all gliomas are astrocytoma[4]. Astrocytomas are histologically heterogeneous. They also differ in their growth pattern, location, morphology, imaging features, as well as in disease progression and clinical course[5].

Table 3: Area under the Curve (AUC) of MRI for Detection of Astrocytoma

Area	P value	95% Confidence Interval	
		Lower Bound	Upper Bound
0.138	0.0001	0.000	0.290

The test result variable(s): MRI has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased. a. Under the nonparametric assumption; b. Null hypothesis: true area = 0.5.

In the past plain X-ray was used previously to detect intracranial tumour. In addition to that cerebral angiography and pneumocephalography were also done; however, none of which was conclusive[12]. With the advent of CT and MRI there is a revolutionary change in the detection of intracranial tumour. The comparison of MRI findings with histopathological findings during diagnosis of astrocytoma is recorded. Both histopathological and MRI positive astrocytoma case is found in 48 cases which indicate true positive. Again, both histopathological and MRI negative astrocytoma case is found in 8 cases which indicate true negative. Histopathological positive but MRI negative case is found in 4 cases which is known as false negative. Histopathological negative but MRI positive case is found in 2 cases which are known as false positive. The validity of MRI during diagnosis of astrocytoma is recorded. The sensitivity, specificity, positive predictive value, negative predictive value and accuracy of MRI for the diagnosis of astrocytoma are 92.0% (95% CI 85.2-98.7%), 80.0% (95% CI 70.0-89.9%), 96.0% (95% CI 91.1-100.9%), 67.0% (95% CI 55.3-78.7%) and 90.3% (95% CI 82.9-97.7%) respectively. From this result it is very clear that both the sensitivity and specificity of MRI for the detection of astrocytoma are above 80.0%. Therefore, the detection capacity of MRI of positive astrocytoma is very high among the patients. Similar to the present study result Geets et al[6] have reported that MRI scan has made a significant impact on the differential diagnosis of intracranial tumours. Boss et al7 have added that MRI gives better contrast resolution than CT scan with a greater sensitivity for the detection of subacute and chronic haemorrhage in association with tumours and other lesions of brain which is consistent with the present study result.

MRI of brain allows accurate localization as to the likely histological type[10]. It has been explained that accuracy of lesion localization on MRI is enhanced by its direct multiplanar capability. Furthermore, MRI lacks ionizing radiation. Delineation of posterior cranial fossa soft tissue anatomy is better visualized with MRI than CT as

because MRI lacks beam-hardening artefact[6]. In this study astrocytoma detection rate is very high by MRI which supports this issue. Nevertheless, MRI provides important information regarding contrast material enhancement, peritumoural oedema, distant tumour foci, haemorrhage, necrosis, mass effect and so on, which are all helpful in characterizing tumour aggressiveness and hence tumour grade[6]. All these capacity enhance the astrocytoma detection by MRI. MRI scan localizes and characterizes the vast majority of intracranial astrocytoma and the same is true of high resolution CT scan[8]. Therefore it has been recommended the use of MRI as a prime modality of investigation in detecting intracranial astrocytoma as it is highly sensitive, available and there is no ionizing radiation hazard.

Conclusion

In conclusion, the findings of this study permit to conclude that MRI is an effective tool for the diagnosis of astrocytoma. Sensitivity, specificity and accuracy of MRI for the diagnosis of astrocytoma are high.

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