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# THE ROLE OF DIFFUSION-WEIGHTED IMAGING IN PATIENTS WITH GLIOMA

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**ABSTRACT**

**Background:** Diffusion-weighted images (DWIs) have been used to study various diseases, particularly since echo-planar techniques shorten examination time. Our hypothesis was that DWIs and tumour apparent diffusion coefficients (ADCs) could provide additional useful information in the diagnosis of patients with glioma.

**Methods:** In this study, MRI scans of 10 suspected cases of intracranial gliomas visiting the place of study were studied retrospectively.

**Results:** Of the 10 cases included in this study, 30 % of cases were female and 70 % of cases were males. Majority of cases were seen in 40– 70 yrs. age group. Temporal region were more commonly affected than the fronal, parietal and occipital regions. The number of patients who had headache, decreased vision and seizure constituted 80 %, 20% and 80 % respectively. Contrast enhancement was seen in the 100 % cases and restriction of diffusion with correspondingly low ADC value was seen in 100 % cases.

**Conclusion:** The CE MRI continues to be the gold standard for imaging diagnosis of intracranial glioma. However, DWI may emerge as a useful alternative to confirm the diagnosis in patients having deranged renal parameters.

**KEYWORDS :**

## INTRODUCTION:

Cerebral gliomas are the most common and devastating primary brain tumors. Although these tumors are traditionally considered to be arising from normal glial cells, the origin of the tumors remains undetermined. More recently, neural stem cells or progenitors are proposed to be the source of glioma [1]. Among the gliomas, astrocytic tumors are the most common and usually divided into circumscribed and diffuse tumors. The circumscribed tumors are generally in lower grade occurring in young patients while the diffuse tumors are the most common cerebral tumors in adults belonging to WHO grades, II, III, and IV [2].

As the names imply, circumscribed tumors, such as pilocytic astrocytoma (WHO grade I), are localized with distinct margin and diffuse tumors are notorious in their propensity to infiltrate surrounding parenchyma, irrespective of the grades. The WHO grade II astrocytomas consist of diffusely infiltrative and well-differentiated fibrillary, protoplasmic, or gemistocytic astrocytes with increased cellularity and nuclear atypia but without mitoses, endothelial proliferation, or necrosis. The WHO grade III astrocytomas, anaplastic astrocytomas, show higher cellularity and nuclear atypia than the WHO grade II tumors with mitoses but without endothelial proliferation or necrosis. The WHO grade IV astrocytomas, glioblastoma (formerly, glioblastoma multiforme), are the most common form of astrocytic tumors occurring in the subcortical white matter of the cerebral hemispheres. Glioblastomas are densely cellular and pleomorphic tumors with highly mitotic activity, endothelial proliferation, and necrosis. While the majority of glioblastomas are primary (>90%), arising de novo with a short clinical history and without a precursor tumor, secondary glioblastoma (<10 %)may transform from a lower grade astrocytoma over a period of years [3]. Nonetheless, the histopathological appearances of the primary and secondary glioblastomas are identical.

MR imaging is currently the modality of choice for the evaluation of intracranial gliomas . The advantages of MR imaging over other modalities include capability of multiplanar imaging, direct evaluation of the brain parenchyma and simultaneous visualization of the neural structures. It shows not only the bony involvement but also soft tissue involvement, with serial scans being used to assess the response to the treatment without the ill-effects of radiation.

Presently contrast enhanced MR is the modality of choice for clinching the diagnosis of intracranial gliomas, which shows enhancement of the affected parts of brain . Diffusion weighted imaging (DWI) is a form of MR imaging based upon measuring the random Brownian motion of water molecules within a voxel of tissues [4].The relationship between histology and diffusion is complex, however generally dense cellular tissues or those with cellular swelling exhibit lower diffusion coefficient and are seen as bright signal on higher b values and corresponding low signal on ADC map. DWI has been used in brain for tumor characterization, cerebral ischemia and brain abscess. In brain its role for evaluation of metastasis has been studied [5].

Therefore aim of this study is to compare the sensitivity and specificity of DWI with contrast enhanced MRI in diagnosis of intracranial gliomas. If this sequence has comparable sensitivity and specificity to that of contrast enhanced MR, this will help in diagnosing cases of gliomas with conviction in cases of deranged renal function where contrast administration is contraindicated. It will also reduce the time taken for the investigation besides reducing the cost.MRI plays an important role in the diagnosis of gliomas with a high specificity and sensitivity [6].

## MATERIALS AND METHODS:

Aim of this study was diagnostic test evaluation of Diffusion Weighted Imaging (DWI) - MRI against contrast enhanced MR imaging in diagnosis of gliomas.

This study was done in Department of Radio diagnosisand Imaging of a tertiary care teaching hospital in Patna. MRI scans of all the clinically diagnosed cases of spinal gliomas were done between July 2021 to December 2021 .All age groups of patients and both sexes were included in the study. The scans were done on 1.5T GE MRI machine. We followed our institutional MR Protocol for spine which is given below:-MRI was performed with sagittal T1W, T2W, STIR, T1FS and DW Imaging, Axial T1W,T2W and DW Imaging, Coronal STIR Images were obtained which was followed by multiplanar (axial, coronal, sagittal) post contrast fat sat images. The MRI protocol included T1 sagittal, axial (TR – 457 ms, TE – 14ms); T2 sagittal and axial (TR – 4900 ms, TE – 137ms); and STIR coronal and sagittal (TR – 4000 ms, TE – 70 ms). Slice thickness was 3 mm. Field of view (FOV) was 35 cm (30-40).

The MRI pulse sequence used for DW-MRI was a single shot echo planar sequence. Sagittal diffusion imaging was performed at TR – 2400 ms, TE– 88 ms, slice thickness – 4 mm, FOV – 35 × 35 cm, number of excitations – 1, and matrix – 128 × 128. Sagittal and axial DW-MRI was performed at b values of 1000. Corresponding ADC maps were generated and evaluated. The study was completed by administration of MR contrast agent (Gadolinium) IV in the dose of 0.02 mmol /kg body.

The sensitivity and specificity of DWI was compared with that of CE MR to evaluate the utility of this sequence in diagnosis of intracranial gliomas .

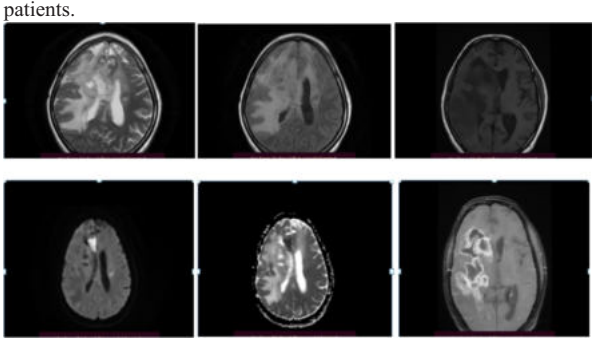
## RESULTS:

A total of 10 clinically diagnosed/suspected cases of gliomas were included in present study. They were subjected to contrast-enhanced MRI of brain after taking informed consent from patients/parents. Various observations and results in respect of clinical and radiological parameters and their significance of association are depicted below:-

All 10 patients were divided into four age groups: ≤ 40 completed years, 41– 60 completed years, 61- 70 completed years and > 70 completed years. The maximum numbers of cases were seen in age

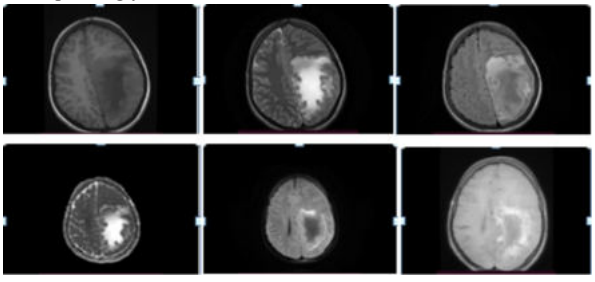
group of 41 – 60 years and these cases amounted to total of 05 (50 %). The minimum number of patients was seen in >70 years age group and amounted to total of 01 cases (10%). In this study the youngest patient was of age 8 years and the oldest patient was of age 78 years. Out of total 10 patients, 03 (30%) were females and 07(70 %) were males. Based on history and clinical details, we divided the patients into three groups like headache, decreased vision and seizure. The number of patients who had headache, decreased vision and seizure were constituted 80 %, 20% and 80 % respectively.

All patients underwent multi-planar T1WI, T2WI/STIR, DWI (Diffusion weighed imaging) with ADC map and contrast enhanced MRI of spine. T1 hypointensity, T2, and Flair hyper intensities were seen in 10(100%), 10(100%) and 10(100%) patients. There was restriction of diffusion with corresponding low ADC values in 100(100%) patients. Contrast enhancement was seen in 10(100%) patients.



**Case1.** A 46 Years/Female Presented With Complain Of Headache And Seizure.

**Fig:1-** (A to F) shows features suggestive of intracranial glioma involving the right fronto-temporo-parietal lobes in the form of hypointense on T1WI and hyperintense on T2/Flair images, showing post contrast enhancement, restriction of diffusion and correspondingly low ADC values.



**Case 2.** A 13 Years/Female Presented With Complain Of Headache, Diminished Vision With Seizure.

**Fig:2-** (A to F) shows features suggestive of gliomas involving left fronto- parieto0occipital lobes in the form is isointense on T1WI and T2/STIR images, showing post contrast enhancement, patchy restriction of diffusion and correspondingly low ADC values.

## CONCLUSION:

The present study was an attempt to establish the role of DWI in gliomas and compare it with contrast enhanced imaging. CE MRI already has an established role in diagnostic work-up of spinal gliomas . However, it suffers from certain disadvantages in form of longer imaging times and risk of complications in patients suffering from renal diseases. DWI is a relatively newer modality of MRI with ever-increasing applications in different parts of body. We evaluated 10 patients of gliomas in our study. We collected their clinical data and performed MRI including CE MRI and DWI. Finally, statistical analysis was performed to compare the findings on DWI to findings on CE MRI.

Our study showed similar age distribution when compared to previous studies with variation in gender distribution. Clinical presentation was similar to previous studies. Our MRI findings were similar to previous studies with a high incidence of T1 hypointensity, T2/ STIR hyperintensity and contrast enhancement. We acknowledge the drawbacks in our study which include lack of histo-pathological analysis, examination by single observer and lack of blinding. On statistical analysis we found a statistically significant correlation between patients presenting with headache and positive MRI findings. Similar correlation was also present between raised seizure and positive MRI findings. No correlation was found between age/ gender/ other clinical symptoms and MRI findings.

On comparing DW MRI with CE MRI we found it to be highly specific for intracranial gliomas but suffering from high sensitivity.

Thus, the CE MRI continues to be the gold standard for imaging diagnosis of intracranial. However, DWI may be good alternative to confirm the diagnosis in deranged renal parameters.

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