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MAGNETIC RESONANCE IMAGING WITH DIFFUSION RESPONSES IN INTRACRANIAL LESIONS

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ABSTRACT

Diffusion-weighted imaging has been demonstrated to offer an advantage in distinguishing distinct cerebral lesions in adults and children in several investigations. Our thesis is based on the idea that the information supplied is more valuable than traditional MR imaging in diagnosing intracranial abnormalities. Diffusion-weighted imaging indicated considerably varying ADC values across different cerebral lesions, according to the findings of our investigation. Based on ADC values, one instance with the morphological appearance of an arachnoid cyst was diagnosed as an epidermoid cyst. When it comes to stroke, acute stroke has severe diffusion limitation and lower ADC values than chronic stroke, which has high ADC values. Diffusion-weighted imaging and the ADC values that go with it can supplement the morphological information offered by contrast-enhanced MRI. This might have a direct impact on patient care options as well as significant prognostic implications. The diagnostic potential of DWI is rather great.

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1. INTRODUCTION

Intracranial space occupying lesion is a word used to describe any lesion that increases the volume of intracranial contents and causes an increase in intracranial pressure, whether it is vascular, neoplastic, or inflammatory [1, 2]. Intracranial lesions, therefore, are a broad set of lesions that represent an urgent threat to patients' lives, regardless of their local or metastatic origin, benign or malignant character [3, 4]. These lesions have a severe clinical course and should be detected immediately to ensure the best potential outcome. In India, CNS neoplasms account for 1.9 percent of all malignant tumors [5]. According to available Western statistics, the yearly incidence of CNS cancers ranges from 10 to 17 per 100,000 people for intracranial tumors, with half being original and the remainder being metastatic. All pediatric malignancies are accounted for 20% of CNS tumors. In India, CNS neoplasms account for 1.9 percent of all malignant tumors [6]. According to available Western statistics, the yearly incidence of CNS cancers ranges from 10 to 17 per 100,000 people for intracranial tumors, with half being original and the remainder being metastatic. All pediatric malignancies are accounted for 20% of CNS tumors.

Radiological, cytological, and histological methods can all be used to diagnose an intracranial lesion [7]. The latter has the drawback of being intrusive. While CT scans and conventional MRI can offer a tentative diagnosis and the location of a CNS lesion, lumbar puncture, and biopsy can only provide information on the type of the lesion and cannot pinpoint its location. A skull X-ray shows the calcified intracranial lesions and their location; however, it is neither exact nor specific. CT scans and conventional MRIs can offer a tentative diagnosis and localization of a CNS lesion, but their accuracy could be better [8]. Diffusion-weighted imaging

(DWI) is a specialized magnetic resonance imaging method that may assess a wide range of intracranial medical disorders. In a few situations, such as stroke, it offers a definite diagnosis and supplements the information offered by traditional sequencing in many other cerebral disorders [9].

The Brownian motion of molecules is used to generate pictures in diffusion magnetic resonance imaging (MR). DWI shows a decline in diffusion in a vascular area damaged by ischemia in individuals with acute stroke. Reduced diffusion is observed in the core of pyogenic abscesses, which assists in the MR diagnosis of a ring-enhancing brain mass [10]. Furthermore, malignancies such as lymphoma and PNET show decreased diffusion, providing the radiologist with significant information for forming a differential diagnosis of a brain mass lesion. They can also distinguish between glioblastoma, primary cerebral lymphoma, and metastases [11]. When examined within 48 hours of damage, diffusion imaging can also help assess Diffuse Axonal Injury (DAI) in individuals with closed head injuries. DWI has a well-established significance in distinguishing cerebral abscesses from necrotic tumors and arachnoid cysts from epidermoid tumors. Multiple sclerosis, Creutzfeldt-Jakob disease (CJD), herpes encephalitis, and various brain infections are diagnosed with DWI. The imaging characteristics of these lesions using ADC and T1 weighted, T2 weighted, and FLAIR Imaging also aid in differentiating diverse cerebral lesions. The approach most typically employed to get the DWI is ultrafast echo-planar imaging (EPI), which reduces the scanning duration from a few seconds to two minutes while eliminating movement artifacts. As a result, the goal of this study, "Role of Diffusion Weighted Imaging in Intracranial Lesions," was to examine DWI features of diverse intracranial lesions to develop a brief, meaningful, meaningful differential diagnosis and suggest therapy.

2. MATERIALS AND METHODS

The study was conducted from December 2017 to June 2019 at the Department of Radiodiagnosis, Sri Lakshmi Narayana Institute of Medical Sciences, with approval from the Institutional Ethical Committee to evaluate the DWI characteristics of ICL.

2.1. Source of data

Patients with suspected Intra Cranial Lesions referred for MRI study to the Department of Radiodiagnosis, Sri Lakshmi Narayana Institute of Medical Sciences were included in the study sample size consisting of 50 patients fulfilling our inclusion/exclusion criteria. The MRI was performed on the referring doctor's recommendation, and no patient was forced to get an MRI for the express purpose of this study.

2.2. Study Period

18 months

2.3. Study Design

Observational

2.4. Inclusion criteria

Patients who were clinically referred for diffusion-weighted brain MRI and were found to have any of the following conditions were eligible to participate in the research.

- Demyelinating disorders
- Infections
- Tumors
- Stroke

2.5. Exclusion criteria

Patients who are detected to have a hypoxic-ischemic injury and traumatic brain injury were excluded from the study.

Claustrophobic patients.

All patients are to give written, informed consent for the study.

2.6. Data Acquisition

Patients referred for a diffusion-weighted MRI of the brain had the procedure once any MRI contraindications were ruled out and permission was obtained. The Seimens 1.5 T MAGNETOM ESSENZA MRI scanner was used for all of the MRI scans in this investigation.

The brain was viewed in T1W, T2W, and DWI sequences with the calculation of ADC values using the ADC maps, and any abnormality was identified. When there are multiple lesions, the most representative lesion was considered. The following characteristics of the lesions were noted.

- The number of lesions
- The location of the lesion
- The size and shape of the lesion
- The presence of calcification, hemorrhage, cystic/necrotic areas
- Presence of surrounding edema, mass effect, involvement of adjacent structures• Degree and type of contrast enhancement wherever gadolinium-based contrast was administered.
- Appearance on diffusion-weighted images and in corresponding ADC maps
- Regions of interest (round shape, at least 10 mm in diameter) were placed on the solid portion of the lesions on the ADC map to obtain a mean ADC value in mm2/sec. ADC values of peri-lesional edema were also calculated wherever applicable.

The observations were recorded on restructured proforma for the study and statistically analyzed.

2.7. Statistics

Descriptive statistics were used to determine the properties and aspects of the obtained data. The data was represented using the mean and percentage. The Chi-square test was used to determine the relationship between variables. The master chart was created using Microsoft Excel.

3. RESULTS

Figure 1 shows that various cerebral lesions have considerably varying ADC values when using diffusion-weighted imaging. Compared to low-grade gliomas, high-grade gliomas have lower ADC values. In comparison to tuberculomas, degenerating neurocysticercosis granulomas had greater ADC values. Compared to arachnoid cysts, epidermoid cysts have much lower ADC values.

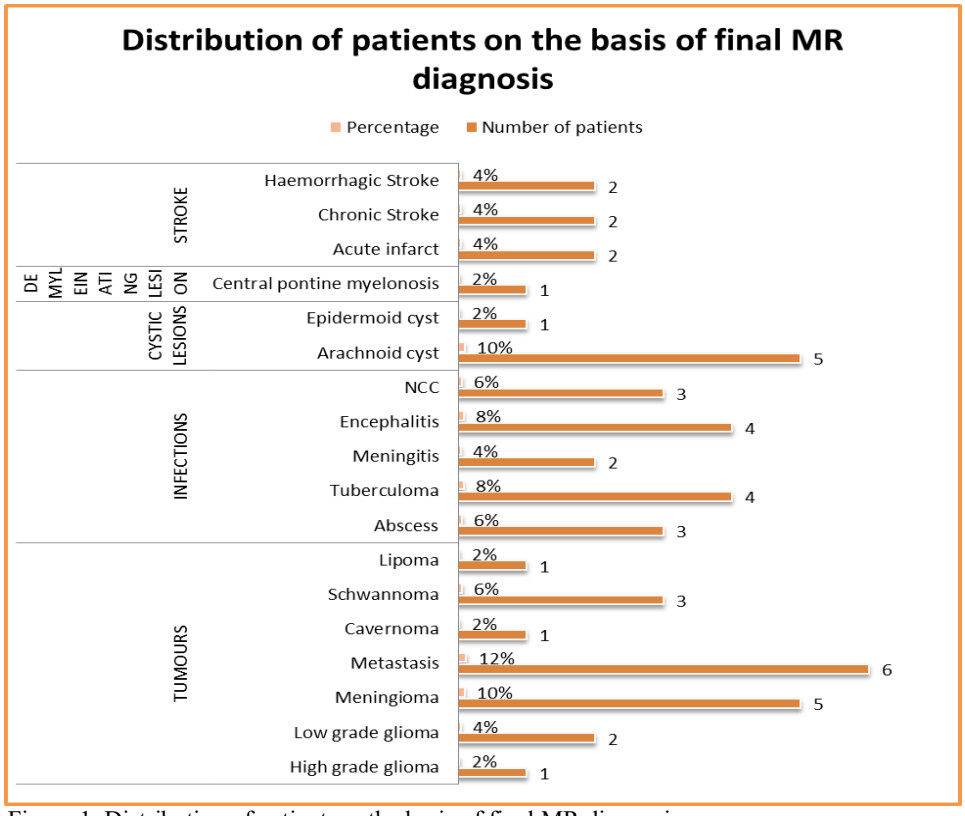

Figure 1. Distribution of patientson the basis of final MR diagnosis.

Based on ADC values, one instance with the morphological appearance of an arachnoid cyst was diagnosed as an epidermoid cyst. When it comes to stroke, acute stroke has lower ADC values than chronic

stroke. ADC values of meningiomas are lower than those of Schwannomas. The ADC values of metastases vary depending on their type. Except for one early presentation (two days), pyrogenic abscesses had lower ADC values than encephalitis. In our analysis, the vast majority of patients were. Infectious pathology (32%) was the most prevalent, with Tuberculomas (8%) and Encephalitis (8%) being the most common lesions. Intracranial neoplastic lesions accounted for 38 percent of the patients, with Metastasis (12%) and Meningiomas (10%) being the most common. The most prevalent non-neoplastic cystic lesions were arachnoid cysts (10 percent).

4. DISCUSSION

Magnetic resonance imaging (MRI) to characterize cerebral lesions has become commonplace. Because of its excellent contrast resolution, ability to acquire pictures in the axial, coronal, and sagittal planes, and lack of ionizing radiation, it is preferred over CT. Imaging's function is no longer restricted to giving anatomical information [11]. Using a diagnostic algorithm that combines advanced MR imaging characteristics with traditional MR imaging results might aid a practicing radiologist in making a more precise diagnosis for an intracranial lesion. In situations of cerebral ischemia, DWI has been shown to have a role in earlier diagnosis and documenting of the level of brain involvement. It's a method that captures a picture in a single breath-hold and doesn't require a contrast material. According to the research, intracranial lesions, like ischemic lesions, display typical characteristics in diffusion-weighted imaging. Many studies have demonstrated that diffusion-weighted imaging has an advantage in discriminating diverse cerebral pathologies in adults and children. Our research is based on the notion that the information supplied by DWIs and ADCs may be used to identify intracranial lesions more effectively than traditional MR imaging.

In this investigation, we used conventional MRI sequences and DW imaging to examine 50 patients with Intracranial Lesions who met the inclusion and exclusion criteria. Most patients in our research were between the ages of 61 and 70 (22 percent), followed by those between the ages of 21 and 30 (12%). (18 percent). The average age of the patients was 43 years. In our study, there was no sex preponderance, with 54 percent of patients being male and 46 percent female. Similar findings were discovered in research undertaken by Shrishail Patil et al. at Gulbarga Medical College titled "Evaluation of Intracranial Lesions by Diffusion-Weighted Imaging," in which 31 (41%) of the 115 patients investigated were females and 84 (59%) were men [12]. The average age of ladies was 50, and the average age of males was 44. Most lesions in our study were intra-axial (66%) and extra-axial (34%), respectively. The most common location of involvement in intra-axial lesions was the frontal lobe, while the most common site of involvement in extra-axial lesions was the lobar convexity. The bulk of instances in this research is stroked, accounting for 16 percent of all occurrences. DWI has a 100 percent sensitivity and specificity in detecting acute ischemia. The difference in sensitivity between DWI and standard MRI sequences is initially greater and diminishes as time progresses. The findings of this study match those of Gonzalez et al., who found that DWI is superior to conventional MRI in the identification and characterization of acute infarcts [13].

Restricted diffusion was seen in 100 percent of acute infarcts in this investigation. T2WI revealed no changes in acute infarcts. As a result, DWI was more effective than T2WI in detecting acute infarcts. All patients with persistent infarcts had aberrant signals on T2WI and DWI. As a result, there was no difference in their susceptibility to infarcts in later phases. According to Rima K et al., restricted diffusion was found in all patients on DW MR images taken within 24 hours of symptoms beginning and in 94 percent of patients examined two weeks after ictus [14]. The signal on DWI and ADC images in chronic infarcts varies and depends on a mix of T2 signal and higher ADC values. The development of cystic encephalomalacia also affects the T2 signal.

Patients with infectious etiology accounted for 32 percent of instances in our analysis, with tuberculomas (8 percent) and encephalitis (8 percent) being the most prevalent, followed by NCC (6 percent). The pyogenic abscess was detected in three patients (6 percent), followed by meningitis (4 percent). On DWI, the Tuberculomas had varying signal intensities, ranging from hypointense core to hyperintense core. The T2 hyperintense center represents central liquefaction necrosis in tuberculoma, while T2 hypointense center represents solid caseation. DWI demonstrates varying signal intensities depending on tuberculoma status. There was no discernible difference in DWI between tuberculomas with hyperintense and hypointense cores. Batra and Tripathi [15] found similar results in their DWI analysis of 17 focal cerebral tubercular lesions [16].

DWI is now widely available and is used to evaluate practically every case that undergoes MRI. However, in the majority of cases, merely a visual sense of limitation or no restriction is sought. In our research, we discovered that while most intracranial lesions exhibited no limitation when compared to the gray-white matter of the brain, they all had similar mean ADC values. Other researchers discovered ADC levels that were comparable or somewhat varied in the various cerebral lesions. In the differential diagnosis of numerous cerebral diseases, using distinctive mean ADC values in conjunction with location and conventional MR morphology may be of substantial assistance. Quantitative DWI, rather than a mere visual sense of restriction/no restriction, would be more useful in evaluating cerebral lesions.

5. CONCLUSION

Our investigation used conventional MRI sequences and DW imaging to assess lesions and whether they met the inclusion and exclusion criteria. Most patients in our research were between the ages of 61 and 70 (22 percent), followed by those between the ages of 21 and 30 (12%). (18 percent). The average age of the patients was 43 years. In our study, there was no sex preponderance, with 54 percent of patients being male and 46 percent female. Most lesions in our study were intra-axial (66%) and extra-axial (34%), respectively. The most common location of involvement in intra-axial lesions was the frontal lobe, while the most common site of involvement in extra-axial lesions was the lobar convexity. Intracranial neoplastic lesions accounted for 38 percent of the cases in our research, with Metastasis (12 percent) and Meningioma (10 percent) being the most prevalent, followed by Infectious pathology (32 percent), with Tuberculomas (8 percent) and encephalitis (8 percent) is being the most common. The most prevalent non-neoplastic cystic lesions were arachnoid cysts (10 percent).

According to our findings, diffusion-weighted imaging indicated considerably varying ADC values across various cerebral lesions. Compared to low-grade gliomas, high-grade gliomas have diffusion limitations and lower ADC values. In comparison to tuberculomas, degenerating neurocysticercosis granulomas had greater ADC values. Unlike arachnoid cysts, epidermoid cysts have severe diffusion limitations and lower ADC values. Based on ADC values, one instance with the morphological appearance of an arachnoid cyst was diagnosed as an epidermoid cyst. When it comes to stroke, acute stroke has severe diffusion limitation and lower ADC values than chronic stroke, which has high ADC values. ADC values of meningiomas are lower than those of Schwannomas. The ADC values of metastases vary depending on their type. Except for one early presentation (two days), pyrogenic abscesses had lower ADC values than encephalitis. Diffusion-weighted imaging and the ADC values that go with it can supplement the morphological data offered by contrast-enhanced MRI. This might have a direct impact on patient care options as well as significant prognostic implications. The diagnostic potential of DWI is rather great.

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COMPETING INTEREST

The authors declare no conflict of interest.

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