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THE EVALUATION OF INTRACRANIAL LESIONS USING DIFFUSION-WEIGHTED MRI

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Conflicts of Interest: Nil

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ABSTRACT

Background: It is crucial for clinicians to distinguish between brain infections and brain tumours because their treatment plans and prognoses are radically different (abscesses from necrotic or cystic brain tumours and encephalitis from diffuse gliomas, for example). Sadly, radiologists and neurologists alike still have a difficult time diagnosing this distinction.
Aims & objectives: We sought to investigate the role of diffusion-weighted MRI in the assessment of intracranial lesions in the current study.
Material and Methods: The current study was a descriptive analysis of patients referred for diffusion weighted MRI scans of the brain who were found to have any of the following conditions: infarction, infectious lesions, tumours, or demyelination degenerative illnesses.
Results: During the study period, 200 patients had DW MRI; the age range with the highest frequency was 51–60 years (36%), followed by 41–50 years (29%). Male patients (67%) outnumbered female patients (33%). 48 percent of patients had infarcts, of which 50 had acute infarcts, 20 had chronic infarcts, and 6 had subacute infarcts. Other were cancers (32%), and there were 30 intra-axial tumours, including 10 GBMs, 4 Low Grade Gliomas, 6 Medulloblastomas, 6 Lymphomas, 2 Anaplastic Astrocytomas, and 1 Hemangioblastoma (2). There were 34 extra-axial tumours, including 20 meningiomas, 8 arachnoid cysts, and 1 pituitary macroadenoma (6). Abscesses (4%), NCC granulomas (3%), and tubercular granulomas (14%) made up 24% of the infected individuals. 3 percent of encephalitis cases had infectious causes. All of the 3% who had demyelination had MS. True diffusion restriction was the most frequent finding on DW MRI, with hyperintensity on T2W images and hypointensity on ADC images noted in 110 patients.
Conclusion: When available, diffuse-weighted imaging should be used regularly as a valuable noninvasive alternative to conventional MRI to arrive at a final diagnosis that cannot be disputed.

Keywords: diffusion-weighted MRI, infarct, ADC, True diffusion restriction

Introduction

Diffusion weighted imaging (DWI), in vivo Proton magnetic resonance spectroscopy (PMRS), or a combination of DWI and PMRS may be used to noninvasively diagnose intracranial cystic lesions[1]. Diffusion-weighted imaging is superior to PMRS because of its quick acquisition time and very simple processing. Diffusion-weighted imaging (DWI) is a reliable method for observing how water molecules flow through tissue[2]. Depending on the tissue type and cell density, diffusion-weighted imaging may reveal radically different signals. The classification of tumour types and provision of a firm diagnosis for some types of tumours are made possible by measuring the diffusion coefficient in brain tumors[3]. Due to restricted and facilitated diffusion, respectively, diffusion-weighted imaging aids in a better delineation of tumour cysts and brain abscesses[4]. As their treatment plans and prognoses are completely different, it is crucial to distinguish between brain infections and brain tumours (such as encephalitis from diffuse gliomas and abscesses from necrotic or cystic brain tumors). Unfortunately, both radiologists and neurologists still have trouble diagnosing this differentiation[5].

Aims & objectives: We sought to investigate the role of diffusion-weighted MRI in the assessment of intracranial lesions in the current study.

MATERIAL AND METHODS

The current study was a descriptive study carried out in a medical college in Central India's Department of Radio Diagnosis. Study time was one and a half years (from January 2019 to June 2020).

Inclusion standards: Patients who underwent MRI brain scans using diffusion weighted imaging and had any of these conditions were referred to the Cancer, tumours, demyelination, infectious lesions, and infarction

Exclusion standards: Patients with cerebral haemorrhage, as well as those who cannot get an MRI because they have pacemakers, iron implants, or aneurysmal clips patients, parents, and guardians were told about the study before providing their informed consent. DWI was used to examine 100 consecutive individuals with cerebral lesions identified by computed tomography or traditional magnetic resonance (MR) imaging.

Cranial MR imaging was carried out using a whole-body 1.5-T MR system (Signa; General Electric Medical Systems, Milwaukee, Wis.) with a quadrature birdcage head coil for radiofrequency transmission and reception and an actively shielded whole-body magnetic field gradient set with a maximum strength of 33 mT/m. FSE T2-WI (TR = 4900 milliseconds, TE = 85 milliseconds, n = 3) and SE T1-WI (TR = 650 milliseconds, TE = 14 milliseconds, n = 2) were two of the common imaging investigations.

A single-shot EPI-SE pulse sequence with the following parameters was used to perform diffusion-weighted EPI in the axial plane: field of view = 24 X 24 cm2, n = 2, slice thickness = 5 mm, interslice gap = 0.5 mm, matrix size = 128 X 256. Diffusion-weighting factors (b) of b = 0 and 1000 seconds/mm2 were used to sequentially apply diffusion sensitising gradients in the three orthogonal directions. The echo spacing was decreased via ramp sampling, which minimised the geometric distortion. Descriptive statistics were used in the statistical analysis.

RESULTS

During the study period, 200 patients had DW MRI; the age range with the highest frequency was 51–60 years (36%), followed by 41–50 years (29%). Male patients (67%) outnumbered female patients (33%).

Table 1: General characteristic

General characteristic	No. of patients
Age group	
0-10	12
11–20	18
21–30	10
31–40	8
41–50	58
51–60	72
61–70	22
Gender	
Male	67
Female	33

Infarcts were seen in 48 percent of patients, of which 50 were acute, 20 were chronic, and 6 were subacute. Other were cancers (32%), and there were 30 intra-axial tumours, including 10 GBMs, 4

Low Grade Gliomas, 6 Medulloblastomas, 6 Lymphomas, 2 Anaplastic Astrocytomas, and 1 Hemangioblastoma (2). There were 34 extra-axial tumours, including 20 meningiomas, 8 arachnoid cysts, and 1 pituitary macroadenoma (6). Abscesses (4%), NCC granulomas (3%), and tubercular granulomas (14%) made up 24% of the infected individuals. 3 percent of encephalitis cases had infectious causes. All of the 3% who had demyelination had MS.

Table 2: Etiology DW-MRI picture

	Etiology	true diffusion restriction	no signal change on T2W images	hypointensity on DWI and T2 FLAIR	T2 shine through	T2 washout	total
1	Infarcts						96
A	acute infarcts	44	6				50
B	chronic infarcts			10	10		20
C	subacute infarcts	4			2		6
2	Tumours						64
A	Intra-axial						30
i	GBM	8			2		10
ii	Low grade glioma				2	2	4
iii	Medulloblastomas	6					6
iv	Lymphomas	6					6
v	anaplastic astrocytoma				2		2
vi	hemangioblastoma					2	2
B	Extra-axial						34
i	Meningiomas	12		6	2		20
ii	arachnoid cysts		8				8
iii	pituitary macroadenoma	6					6
3	Infective conditions						48
A	tubercular granulomas	10			4	14	28
B	NCC granulomas					6	6
C	Abscesses	8					8
D	Encephalitis	2			2	2	6
4	Demyelination		4			2	6

True diffusion limitation was the most frequent finding on DW MRI, with hyperintensity on T2W images and hypointensity on ADC images identified in 55 cases.

Table 3: Primary finding on DW MRI

Primary finding on DW MRI	No. of patients
True diffusion restriction - hyperintensity on T2W images hypointensity on ADC images	110
No signal change on T2W images	18
Hypointensity on DWI and T2 FLAIR images with hyperintensity on ADC images	16
T2 shine through	26
T2 washout	30

DISCUSSION

DWI investigates the molecular property of particle diffusivity within an area. It is predicated on the administration of two gradients at predetermined intervals of time, with the goal of generating a signal solely from molecules that experience both gradients at the same location[6]. Thus, on DWI, the brain areas that exhibit "limited diffusion" are hyperintense. It is necessary to confirm this restricted diffusion, which shows up as a hyperintense area on DWI, with maps of the apparent diffusion coefficient (ADC) created by a computer, which reveal a comparable hypointense area[7]. This evidence disqualifies the T2-shine through effect. The distinction between significant intracranial lesions, such as brain abscess, arachnoid cyst, cystic/necrotic tumour, and epidermoid tumour, can be made using diffusion weighted imaging (DWI)[8]. One can distinguish between vascular, inflammatory, metabolic, infectious, and nonvascular illnesses with precision using quantitative analysis. In a related study, Pradeep Kumar found that in 56 cases (or 50.9% of the total cases examined), infarcts made up the majority of the lesions. 34 cases (or 60.7%) of them were acute infarcts, whereas 3 (5.3%) were subacute infarcts and 19 (33.9%) were chronic infarcts. Diffusion limitation was present in every instance of acute infarcts and in 66.7% of subacute infarcts. True limitation was reported in 7 cases of intraaxial malignancies. Glioblastoma multiforme displayed real diffusion restriction in 75% of cases. Diffusion limitation was seen in 100% of medulloblastomas and 100% of lymphomas[9]. Similar results were seen in the current investigation. After taking localizers in all three planes, Kamini Gupta analysed 67 patients who had conventional MR sequences coupled with DW and MRS. Metastases were the most frequent type of brain tumour, followed by glioblastoma multiforme (GBM). The ratio of men to women was 1.5:1. The most frequent presenting complaint was a headache[10]. GBM and metastases had equal apparent diffusion coefficient (ADC) values, however low grade gliomas had greater ADC values. When compared to low grade gliomas, GBM, metastases, and lymphomas had higher choline levels in the areas of diffusion restriction and lower NAA levels. Brain tumour detection and the differentiation between low-grade and high-grade tumours are made much easier by using DW imaging with ADC values and MRS in conjunction with conventional MRI. These abscesses must be distinguished from necrotic neoplasms, which typically have high ADC values within the core, using DWI[11]. Both tubercular and pyogenic abscesses showed diffusion restriction with a low ADC value, according to Luthra G et al. Both bacterial and tubercular abscesses have a central limitation in diffusion as a result of the highly viscous necrotic tissue present. DWI has a high sensitivity and specificity for the identification of brain abscess as opposed to nonabscess cystic mass lesions, according to Reddy JS. The high specificity and sensitivity of the DWI in the current and earlier investigations show that the DWI can be replicated across different trials. Due to the difference in the contents of the cavities of both the aetiology revealed by differences in macromolecular concentration, cell density, and fluid viscosity, DWI has a high specificity and sensitivity for differentiating abscess from nonabscess lesions[12].

CONCLUSION

The identification of acute infarcts and the characterization of infarcts have both been successfully accomplished using diffusion weighted MRI. When accessible, diffuse-weighted imaging should be used regularly as a beneficial noninvasive alternative to conventional MRI to arrive at a final diagnosis that cannot be disputed.

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