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TO ASSESS THE ROLE OF DIFFUSION WEIGHTED IMAGING, SPECTROSCOPY AND ADC VALUES IN DIFFERENTIATING LOW GRADE FROM HIGH GRADE TUMORS

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Abstract
Background & Method: This prospective study was done in the Department of Radio diagnosis of Index Medical College Hospital & Research Centre, Indore (M.P.) Madhya Pradesh, India. A total of 82 patients presenting with signs, symptoms or radiologically suspicious findings of ICSOLS in pediatric outpatient and inpatient department
Result: Most lesions (74%) did not restrict on DWI, No overlap of ADC values was seen in Grade I & other tumours while maximum overlap was seen among higher grades & MRI is 100% accurate for grading benign tumors.
Conclusion: It is recommended that in all patients with ICSOLs, MRI should be combined with DWI, contrast and MRS which play a crucial role in the diagnostic evaluation of patients. It can categorize the various etiologies of SOLs and highlight the main differential diagnoses for each SOL thus helping in early diagnosis and management and reducing the morbidity and mortality.
Keywords: Weighted imaging, Spectroscopy, ADC & Tumors.
Study Designed: Observational Study.

Introduction:

Diffusion-weighted imaging (DWI) is a form of MR imaging based upon measuring the random Brownian motion of water molecules within a voxel of tissue[1]. In DWI sequence, gradients are applied in such a manner that tissues where diffusion is restricted, appear bright. Highly cellular tissues or those with cellular swelling exhibit lower diffusion coefficients. Diffusion is particularly useful in tumour characterization and intracranial infections. DWI sequence also reveals restricted diffusion in abscessesand tumors of high cellularity (medulloblastoma, ependymoma, and lymphoma). DWI alone is not suitable for the characterization of brain tumors, because solid benign lesions also can show restricted diffusion, and cystic or necrotic malignant lesions have unimpeded diffusion. A combination of DWI and dynamic MRI increases the accuracy of the characterization of benign and malignant lesions[2].

Routine MRI studies of the brain are performed in T1 and T2 axial planes and either T1 sagittal or T2 coronal planes. Slices that are 5 to 10 mm thick are routinely used, but thinner slices with 2- to 4- mm thickness are needed in the evaluation of sellar and posterior fossa regions[3].

On MR scans, the brain has been briefly viewed in infratentorial and supratentorial sections. MRI scans are generally obtained parallel to the AC-PC line in the axial plane with 6-mm slice thickness. Using the sagittal view, the coronal sections are acquired parallel to the brain stem, and the sagittal sections are obtained perpendicular to the axial section[4].

Material & Method

This prospective study was done in the Department of Radio diagnosis of Index Medical College Hospital & Research Centre, Indore (M.P.) Madhya Pradesh, India. A total of 82 patients presenting with signs, symptoms or radiologically suspicious findings of ICSOLS in pediatric outpatient and inpatient department in hospital over a period of 1 and a half years and referred for radioimaging were subjected to a MRI brain evaluation with contrast wherever needed. Other findings like past history, family history, food habits, pattern of headache, CSF analysis, chest Xrays, previous CT scan reports etc, if available, were considered wherever relevant.

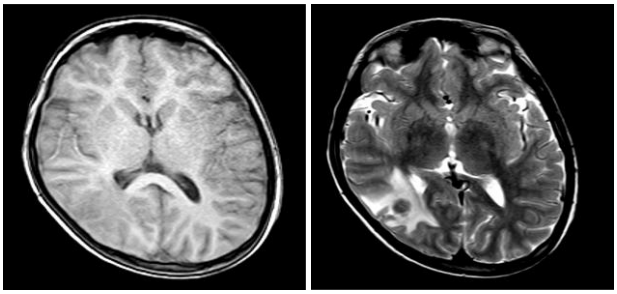
Magnetic Resonance Imaging evaluation of brain using MRI scanner was performed after obtaining informed consent. The study was conducted from July 2018 to May 2019.

Inclusion criteria

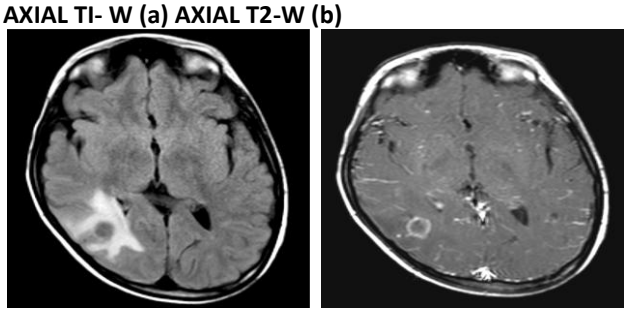
All pediatric patients showing ICSOLS on MRI

Exclusion criteria

1. General contraindications to MRI such as pacemakers, aneurysmal clips, cochlear implants, contrast allergy etc.
2. Patients parents/guardian not willing to give consent.
3. Patients with ICSOLS of traumatic origin.
4. Bony lesions of skull having intracranial extensions.
5. Infarcts



AXIAL TI- W (a) AXIAL T2-W (b)



FLAIR (c) POST CONTRAST (d)

Diagnosis: Tuberculoma figure 1: A relatively well defined T1 isointense and T2 hypointense lesion in cerebral cortex(a and b) Perilesional edema on FLAIR and ring enhancement in post contrast image(c, d).

Results

Table 1: Diffusion restriction on DWI

	NO. OF CASES	PERCENT
PRESENT	18	26
ABSENT	52	74

Most lesions (74%) did not restrict on DWI

Table 2: ADC values of all tumors

S.NO.	WHO Grading	TUMOURS	ADC RANGE ($X10^{-3}mm^2/s$)	MEAN ADC($X10^{-3}mm^2/s$)
1.	I	Pilocytic Astrocytoma (PA)	1.4-1.9	1.72
		Hemangioblastoma (HGBL)	1.7-2.2	1.9
		DysembryonicNeuroepithilial Tumor (DNET)	1.8-2.1	1.99
		Ganglioglioma (GG)	2.0-2.8	2.4
2.	II	Low Grade Glioma (LGG)	0.88-1.38	1.2
		Oligodendroglioma (ODG)	0.9-1.3	1.1
		Ependymoma (EPM)	0.9-1.4	1.2
3.	III	Anaplastic Astrocytoma(AA)	0.88-1.02	0.96
4.	IV	GlioblastomaMultiforme(GBM)	0.5-1.2	0.82
		Medulloblastoma (MB)	0.62-0.88	0.72
		Primitive Neuroectodermaltumour (PNET)	-	0.7
5.		Metastasis	0.62-0.88	0.79
6.		Lymphoma	0.55-0.62	0.59

Highest mean ADC was seen in Grade I tumours and lowest in Lymphomas.

Table 3: Mean ADC of different tumour grades

S.NO.	TUMOUR GRADE	MEAN ADC ($X10^{-3}mm^2/s$)	ADC RANGE ($X10^{-3}mm^2/s$)
1	GRADE I	1.9	1.4-2.8
2	GRADE II	1.16	0.88-1.4
3	GRADE III	0.96	0.78-1.02
4	GRADE IV	0.78	0.5-1.2
5	LYMPHOMA	0.59	0.55-0.63

No overlap of ADC values was seen in Grade I & other tumours while maximum overlap was seen among higher grades.

Table 4: comparision of MRI grading with HPE grading of tumors

GRADES	MRI GRADING	HPE GRADING
I	12	12
II	8	6
III	2	1
IV	5	8

MRI is 100% accurate for grading benign tumors.

Discussion

When the morphological characteristics of T1W and T2W images were considered alone, 7 cases were diagnosed in congenital category, 45 in infective category and 18 in neoplastic category with considerable intra and inter category overlap [5]. When morphology was considered along with DWI, there was better characterization of lesions. All congenital lesions (100%) could be correctly diagnosed with infective and neoplastic lesions approaching near to the final HPE diagnosis.

Similarly using conventional MRI along with ADC and MRS, there was better characterization of lesions with successive decrease in the inter and intra category overlap indicating substantial increase in sensitivity and specificity of diagnosis. Considering morphology along with contrast, DWI, ADC and MRS, 100% (6) congenital lesions were diagnosed correctly [6]. 35 out of 36 lesions were correctly diagnosed as infective with only 1 case of abscess found out to be HGA on HPE. 26out of 28 lesions were correctly diagnosed as neoplastic with 1 case of BSG and 1 case of LGA turning out to be tuberculoma.

When intracategory diagnosis was considered, all congenital lesions(100%) were correctly diagnosed with MRI. However in infective category there was some overlap between tuberculoma, NCC and abscess cases due to similar morphological and DWI presentations, and inconspicuous MRS findings[7]. the accuracy of MRI in correctly differentiating infective lesions was 75% in our study. Similarly when neoplastic lesions were considered, the accuracy of MRI in correctly differentiating neoplastic lesions was 85% .

ADC values were further used in grading of tumors. In our study, cut off ADC of >1.4*10-3mm2/s showed 100% accuracy for grading benign tumors.However the accuracy of ADC in differentiating Grade II, III and IV tumors was variable with considerable overlap among these groups[8]. Overall, Higher grade tumors had lower ADC values (<1.0 x 10-3 mm2/s) than lower grade tumors (>1.0 x 10-3 mm2/s). These findings correlate well with the study of Bulabaski et al(70) and Ishtiaq A Chishty et al(94)Z. Rumboldt et al[9].

Conclusion

It is recommended that in all patients with ICSOLs, MRI should be combined with DWI, contrast and MRS which play a crucial role in the diagnostic evaluation of patients. It can categorize the various etiologies of SOLs and highlight the main differential diagnoses for each SOL thus helping in early diagnosis and management and reducing the morbidity and mortality.

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