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Clinico Radiological Correlation of Pediatric and Neonatal Seizures

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Abstract: ***Institution: Aims & Objectives: To study imaging findings of various pathologic conditions in epileptic children, neonates. Correlating imaging findings with clinical and EEG findings. To decide better diagnostic modalities in different age groups. Materials & Methods: 40 patients with epilepsy (>2 episodes were included) Neurosonogram in 6 patients (<1 year) 15.1%, head CT 15 (37.5%), MRI in all cases. Contrast was given as per requirement. EEG, except 5 cases of trauma. Epilepsy provoked by fever, electrolyte imbalance, dehydration excluded. Result: The most common cause of epilepsy in our study was tuberculosis in this region, being at 22.5% > neurocysticercosis at 15%> Hypoxic Ischemic Encephalopathy at 10%. Conclusion: The imaging modality of choice is MRI. CT plays role in identifying calcification and trauma. USG plays major role in neonates because of its portability. MRI has increased our understanding of the underlying disease process as well as revolutionised evaluation and management of epilepsy.***

Keywords: Epilepsy, Tuberculosis, Neurocysticercosis

1. Introduction

- Seizures are defined as "a transient occurrence of signs and/or symptoms due to abnormal excessive or synchronous neuronal activity in the brain"
- The incidence of epilepsy is 1% [1]. Prevalence rate is 5.59/1000 population with no gender or geographical differences making it a common neurological condition.
- It has lot of psychological, social and functional inabilities in children affected and their families.
- Neuroimaging becomes important and mandatory in the work up for epilepsy in localisation and laterlisation of the seizure focus.

2. Aims and Objectives

1) To study imaging findings of various pathologic conditions seen in epileptic children and neonates.
2) Correlation of imaging findings with clinical and EEG findings.
3) To decide better diagnostic modalities in different age groups.

3. Material and Methods

Prospective data was obtained from evaluation of patients presenting with epilepsy in paediatric OPD and IPD.

A total of 40 patients presenting with epilepsy (> 2 episodes of seizures) were included.

Neuro - sonogram was done in 6 children below age of 1year (15.1%), Head CT was obtained in 15 (37.5%), MRI in all cases. Contrast was given in patients with tumour, suspected vascular malformations, inflammation, and Infectious pathology.

EEG was done in all cases, except in 5 cases of trauma.

Epilepsy provoked by causes such as fever, electrolyte imbalance and dehydration were excluded.

4. Discussion

The role of radio - imaging in partial seizures in children has already been an established fact [2, 3, 4].

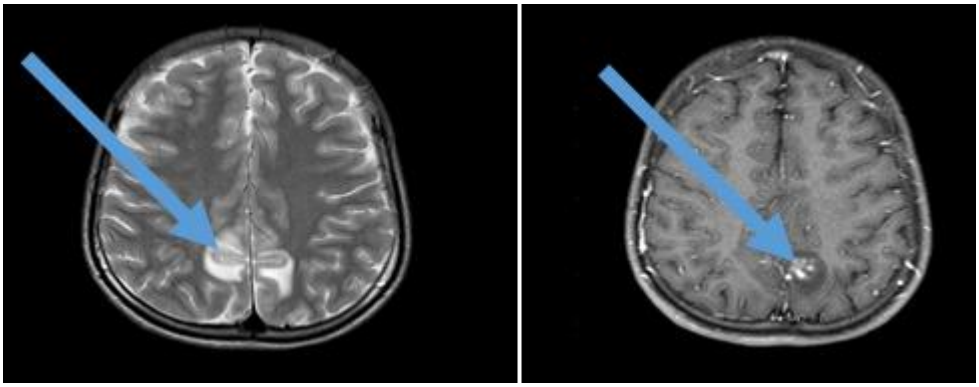
Most of the studies in children with generalized seizures have been done in general population without discriminating between provoked and unprovoked seizures.

Study regarding role of radio - imaging in first apparent unprovoked generalized seizure in childhood population (0 - 18years) is debatable point.

In the present study 40 patients of pediatric age group were studied, who were clinically diagnosed as case of epilepsy, with no provoking factors. Generalized seizure accounted for the majority of our cases (77.5%), which is in agreement with other studies in Africa [6] and India [7], showing preponderance of GTCS of 60 - 90% [5].

5. Cases

Multiple tuberculomas

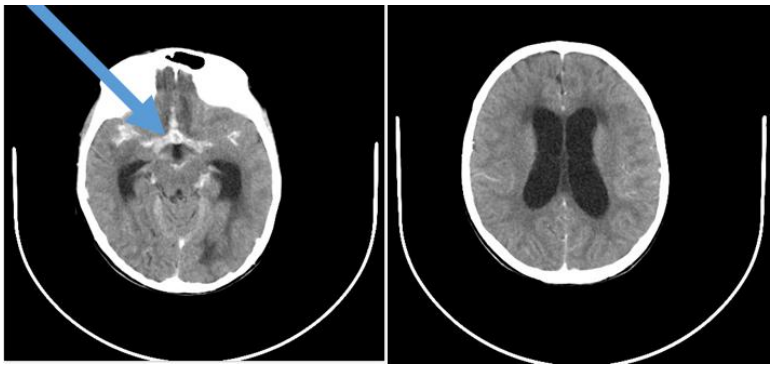


On T2W images hyperintense lesions are seen in cerebral hemispheres on both sides, and in occipital lobe.

All lesions are cortical in nature.

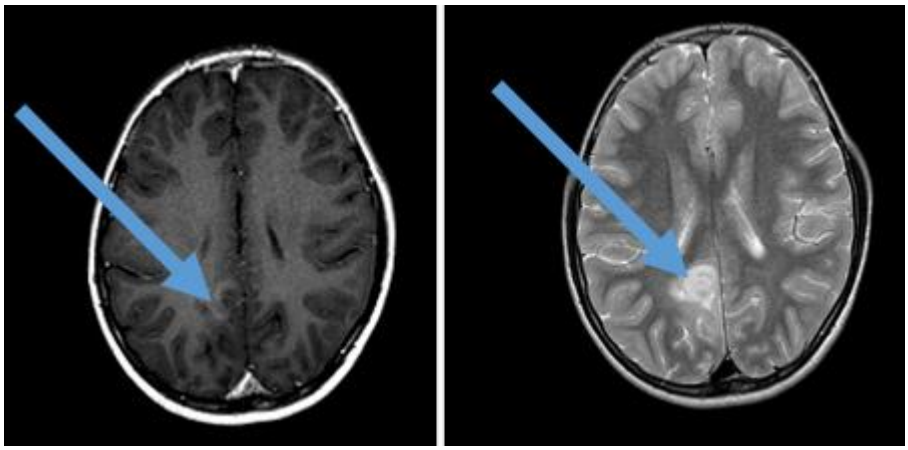
After contrast examination, enhancement is seen in lesions.

Tubercular Meningitis

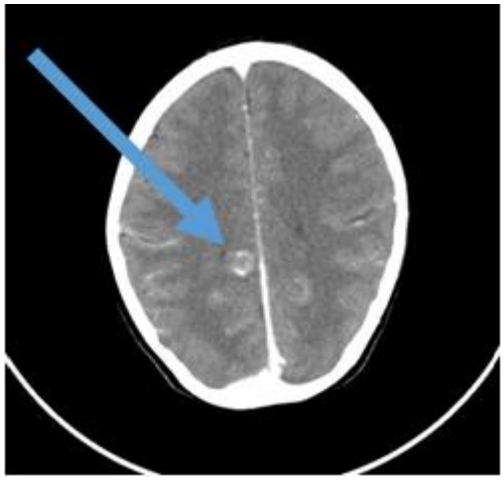


There is dilatation of both lateral ventricles, with increased vascular enhancement of basal cistern on either side of midline. There is caseating granuloma formation seen in the supraseller cistern suggestive of Tuberculoma.

Neurocysticercosis

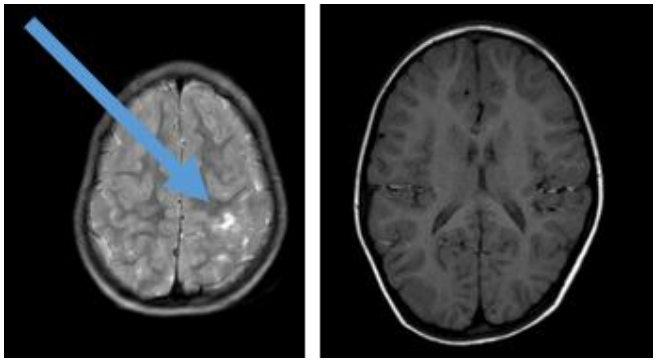


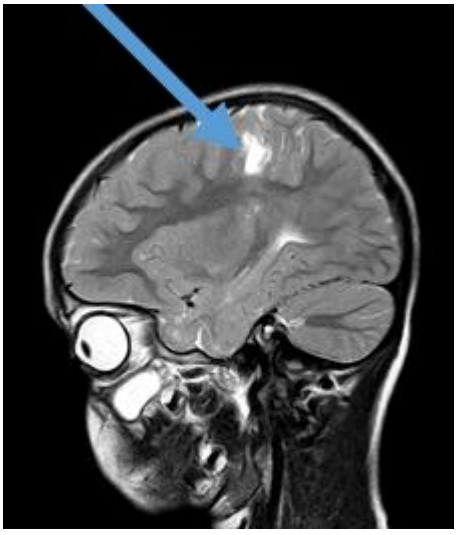
On T1W images central part of lesion is hypointense. T2W images show round hyperintense lesion with minimal peripheral oedema.



Ring enhancing lesion is seen on CT

Hypoxic Ischemic Encephalopathy

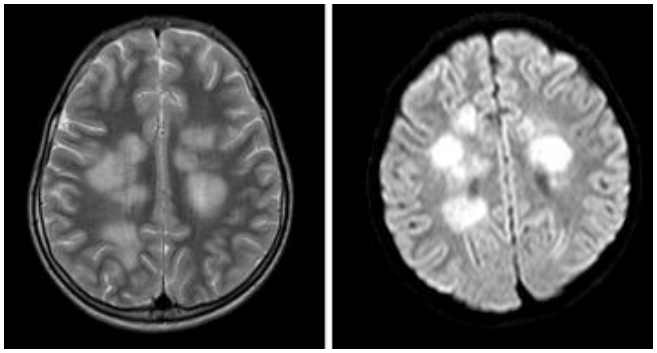


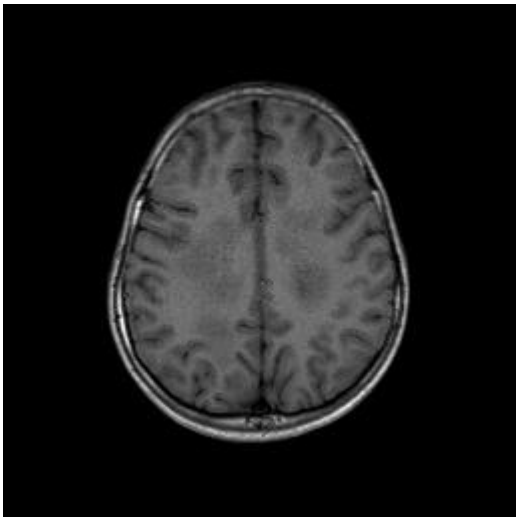


Multiple small hyperintense signals are seen on T2W axial and sagittal images in left temporal and parietal lobe which is hypointense on T1W and FLAIR images, extending to cortex.

There is oedema seen surrounding the lesion. Post contrast examination shows intravascular meningeal enhancement

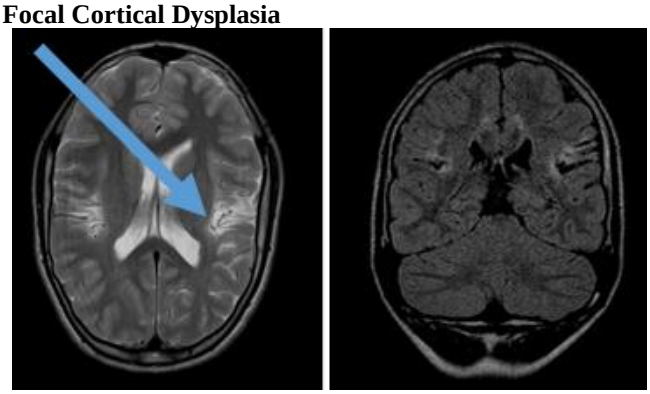
Post Infective Viral Acute Disseminated Encephalomyelitis

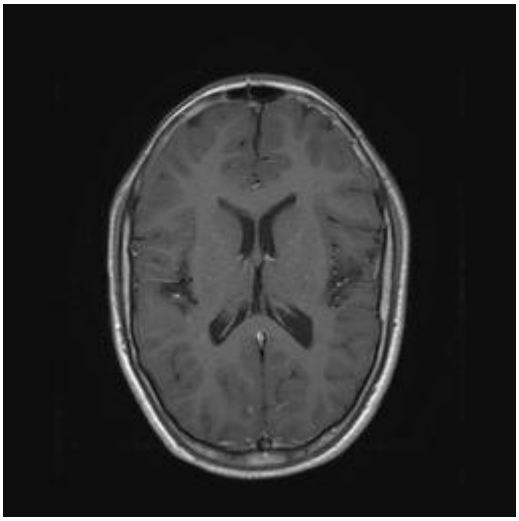




Multiple lobulated well defined lesions which are asymmetric in size involving bilateral basal ganglia white matter area in periventricular regions, subcortical region and brainstem which are hyperintense on T2W, FLAIR and DIFFUSION weighted images and iso to hypointense on T1W images. Post contrast examination do not show any abnormal enhancement.

Focal Cortical Dysplasia

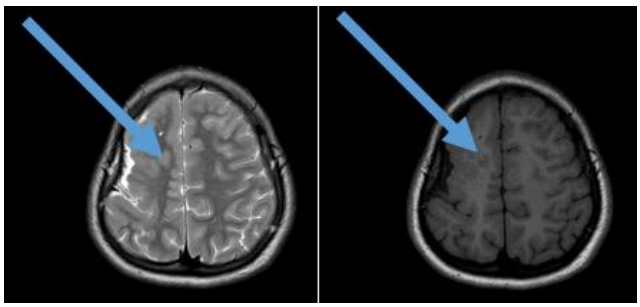




Lesions which are hyperintense on T2W images, FLAIR and DIFFUSION images and hypointense on T1W images, seen at cortical region at the junction of grey - white matter close to post central sulci on both sides, more on left side.

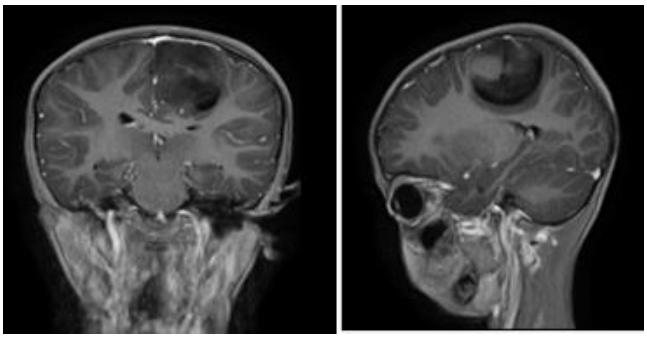
There is narrowing of grey - white matter junction with microgyria at the cortical region more on left side better seen on T2W and FLAIR images. Post contrast examination do not show any abnormal enhancement.

Grey matter heterotropia



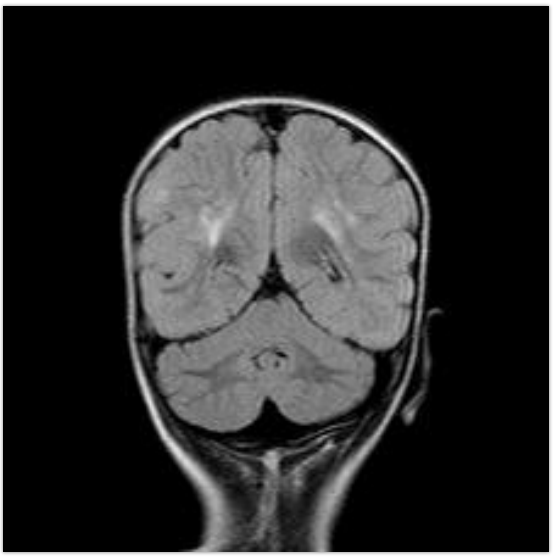
There are grey matter like intensity areas seen in right frontal white matter suggestive of grey matter heterotropia.

ASTROCYTOMA



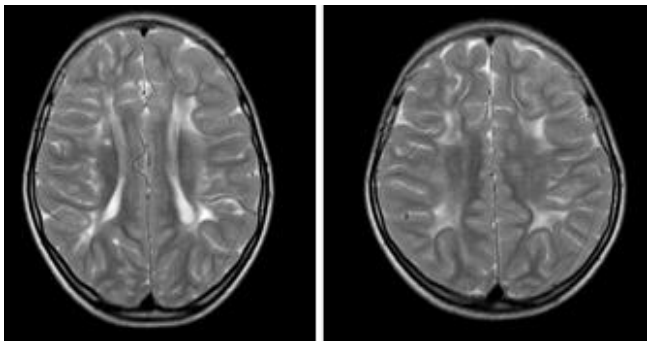
Ill defined hypointense mass lesion is seen in fronto - parietal region possibility of glioma/astrocytoma

Periventricular Leukomalacia



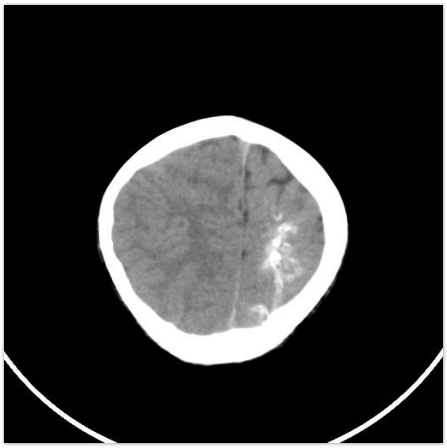
There are bilateral symmetrical white matter hyperintense lesions seen at parieto - occipital and temporal lobe on either side

Post Infarct Demyelination



Hyperintensities seen in periventricular white matter region on T2W images

Sturge Weber Syndrome



There is reduction in size of left cerebral hemisphere and shift of falx more towards left side suggestive of changes of cerebral corticalhemi atrophy. There is patchy gyrial calcification is seen.

MRI and CT Scan

Of 3 patients with normal CT scan, there were significant MRI findings which were not seen on CT scan. This difference in diagnostic ability of CT and MRI was shown by previous studies also [3, 4].

This could be reasonably explained by multiplanar imaging capability, improved contrast of soft tissue, and high anatomical resolution of MRI over CT.

Our finding corresponds with Jackson et al, 2006 [6], that it could be reasonable to forego CT and perform MRI.

We found positive MRI study in 57.5% cases which is higher than previous studies by Resta et al. [7] r 51.3%. probably because of strict exclusion criteria's, which shows that patient selection, plays an important role in MR positivity rates.

Though CT Scan played major role in identifying 5 cases of trauma. CT Scan is also useful for identifying calcification.

Correlation of MRI & EEG findings:

EEG findings	Normal - 24		Positive - 16	
MRI findings	Positive - 11	Normal - 13	Positive - 12	Normal - 4
	Total MRI positive cases		*23*	

MRI and EEG

In present study Electroencephalogram was done in all cases except 5 cases of trauma, in which it was positive in 16 cases (40%) and normal in 24 cases (60%). This was comparable to prior studies [8].

In 16 cases with positive EEG, 12 (75%) had abnormal MRI, which was in accordance with previous studies, which showed that MRI abnormalities are usually associated with an abnormal EEG [9].
EEG helps in establishing the diagnosis of seizures, characterizing syndromes, and providing prognosis [10].

Out of 24 patient with normal EEG, 11 (45.8%) had abnormal MRI findings, so though presence of an abnormal EEG in patient could suggest positive MRI finding, but obviously a normal EEG doesn't rule out brain abnormality. This shows that MRI has higher chances of finding epileptogenic focus as compared to EEG alone. It could be inferred that EEG could be helpful, but not alone.

MRI and USG

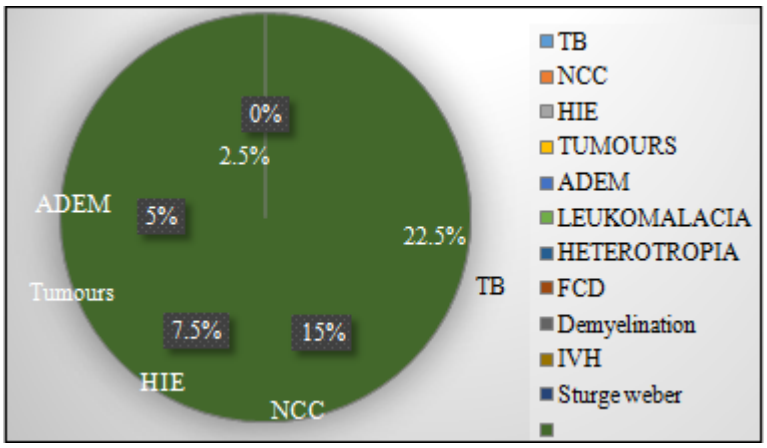
In our study USG was carried out in patients of neonatal age group.

USG played a pivotal role in diagnosing a case of intraventricular haemorrhage in neonatal age group and also helped in case of periventricular leukomalacia in neonatal age group.

USG in Neonates.	MRI in Neonates
Quick to perform	Takes time.
Can be performed in unstable neonate.	MRI is best deferred in an unstable neonate until the acute clinical situation resolves.
Valuable tool for quickly ascertaining whether intracranial haemorrhage particularly intraventricular haemorrhage has occurred.	Because of long scanning time difficult to maintain neonate stable without motion.
Limitation is poor detection rate of cortical lesions or subarachnoid blood.	Cortical lesions and subarachnoid blod are best evaluated by MRI.

Conditions we came across in this study and percentage.

S. No	Cause	No. of Cases	Percentage (%)
1	Tuberculosis - TBM and Tuberculomas	9	22.5
2	Neurocysticercosis	6	15
3	Hypoxic ischemic encephalopathy	3	7.5
4	Tumours	2	5
5	ADEM	2	5
6	Leukomalcia	1	2.5
7	Grey matter heterotropia	1	2.5
8	Focal cortical dysplasia	1	2.5
9	Demyelination	1	2.5
10	Intraventricular haemorrhage	1	2.5
11	Sturge weber syndrome	1	2.5
	TOTAL	28	



Pie chart showing distribution of conditions causing seizures in childhood age grioup in this study.

The most common cause of epilepsy in our study was tuberculosis in this region, being at 22.5% % which

consisted cases of both tuberculoma and tubercular meningitis.

This was followed shortly by neurocysticercosis at 15%

This was followed by Hypoxic Ischemic Encephalopathy at 10%.

This correlates well with studies done in other tropical countries, where infection still predominate as the most common cause of epilepsy. The studies in developed countries showed that the most common cause for epilepsy, were cerebral dysgenesis, and followed by hypoxic - ischemic lesions, non - accidental injuries, infections, metabolic diseases and tumours.

Correlation of type of seizure with Positive findings

Serial no.	Type of seizures	Cases	
		Positive	Normal	Total
1	GTCS	20 (66%)	11 (34%)	31 (77.5%)
2	CPS	08 (86%)	01 (14%)	9

This table shows that cases with CPS had more chance of positive finding as compared to GTCS.

Age Distribution

S. No	Age Group	Total Cases	Positive Findings	%
1	0 - 1 year	7	5	19.40%
2	2 - 6 years	9	6	21.50%
3	7 - 12 years	11	8	27.70%
4	13 - 18 years	13	9	31.40%
		40	28	

6. Conclusion

- Imaging of children with epilepsy is a challenging subject and requires an understanding of the wide spectrum of pathology that affects the paediatric population.
- Structural neuroimaging is recommended for all children with recently diagnosed localization - related or generalized epilepsy who do not have the clinical and EEG features characteristic of classical idiopathic focal or gen - eralized epilepsy and for any child younger than 2 years of age. These children have the highest likelihood of identifying a symptomatic etiology for their seizures.
- The imaging modality of choice is MRI because of its superior resolution compared to CT. CT plays role in identifying calcification and trauma. USG plays major role in neonates because of its portability
- MRI has increased our understanding of the underlying disease process as well as revolutionised evaluation and management of epilepsy. For medically refractory epilepsy it is crucial to precisely identify epileptogenic foci that are potentially amenable to surgical resection for possible cure.

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