Original Article

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Spectrum of Magnetic Resonance imaging in Afebrile Pediatric Epilepsy

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Abstract

Background: Pediatric neurological disorders are commonly encountered. Epilepsy is one of the most common neurological disorder in childhood. Clinically diagnosis is established by two or more unprovoked seizures at least 24 hours apart. It has got considerable importance due to fact that it can cause anxiety in parents. Cortical malformations characterized by abnormal structure of cerebral cortex are one of the major cause for epilepsy. Magnetic resonance imaging is the modality of choice to evaluate the structural anomaly, the cause of seizure disorder and to assess the potential need for surgery. In this study, we tried to evaluate the spectrum of MRI imaging to evaluate afebrile pediatric epilepsy. **Subjects and Methods:** The study was retrospective cross sectional study. We collected data of 400 patients of pediatric epilepsy who underwent non contrast MRI evaluation during June 2017 to January 2019 at department of Radio-diagnosis at GCS Medical college, Hospital and Research Center. Exclusion criteria consist of a recent history of fever and clinical laboratory parameters of any infective cause. MRI was done using 1.5 Tesla equipment. Sequences included Sagittal T1-weighted spin echo (SE), Axial T2-weighted fast spin echo (FSE), Coronal oblique fast fluid attenuated inversion recovery (FLAIR), Axial diffusion weighted single-shot spin-echo echoplanar, Axial 3D inversion recovery prepped fast SPGR (spoiled gradient recalled). **Results:** The most common detected changes were unilateral and bilateral mesial temporal sclerosis (21% & 9% respectively), cortical dysplasia (1.5%), migrational anomalies, neurocutaneous syndromes and few cortical neoplasms (0.5 to 1%). **Conclusion:** MRI in today's world plays a deciding role in diagnostic work-up of a child with epilepsy.

Keywords: MRI, Epilepsy, Afebrile.

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Introduction

Pediatric neurological disorders are commonly encountered. Epilepsy is one of the most common neurological disorder in childhood. Clinically diagnosis is established by two or more unprovoked seizures at least 24 hours apart. It has got considerable importance due to fact that it can cause anxiety in parents.[1-3]

Cortical malformations characterized by abnormal structure of cerebral cortex are one of the major cause for epilepsy. Magnetic resonance imaging is the modality of choice to evaluate the structural anomaly, the cause of seizure disorder and to assess the potential need for surgery.

In this article, we attempt to evaluate the spectrum of MRI imaging to evaluate afebrile pediatric epilepsy. The most common detected changes were unilateral and bilateral mesial temporal sclerosis, cortical dysplasia, migrational anomalies, neurocutaneous syndromes and few cortical neoplasms.

Subjects and Methods

The study was retrospective cross sectional study. We collected data of 400 patients of pediatric epilepsy who underwent non contrast MRI evaluation during June 2017 to January 2019 at department of Radio-diagnosis at GCS Medical College, Hospital and Research Center. Exclusion criteria consist of a recent history of fever and clinical laboratory parameters of any infective cause. MRI was done using 1.5 Tesla equipment. Sequences included Sagittal T1-weighted spin echo (SE), Axial T2-weighted fast spin echo (FSE), Coronal oblique fast fluid attenuated inversion recovery (FLAIR), Axial diffusion weighted single-shot spin-echo echoplanar, Axial 3D inversion recovery prepped fast SPGR (spoiled gradient recalled).

Results

The clinical presentation varied from focal seizures to a neurological deficit, fainting spells and generalized tonic-clonic seizures in some patients. Out of all scans 260 cases has no obvious MR discernible brain lesions.

Mesial temporal sclerosis was one of the common lesions found in our study. It compromised approx. 30 % of the total cases examined. Unilateral Mesial temporal sclerosis was more common, closely followed by bilateral mesial temporal sclerosis.

Table 1: MRI findings in pediatric epilepsy patients

Findings	Number of cases	Percentage
Normal	260	65%
U/L Mesial temporal sclerosis	84	21%
B/L Mesial temporal sclerosis	36	9 %
Tuberous Sclerosis	04	1%
Lissencephaly	02	0.5%
Cortical Neoplasms	04	1 %
Hemimegalancephaly	02	0.5%
Heterotropias	02	0.5%
Focal cortical dysplasias	06	1.5%
Total	400	100 %

Malformation of Cortical development mainly focal cortical dysplasia accounted for 1.5% of the cases.

Tuberous sclerosis also accounted for about 1% of the total cases.

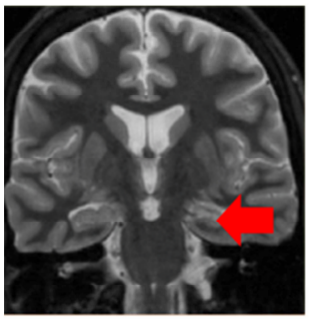
Other causes like megalencephaly, heterotopias and lissencephaly amounted approximately 2 % of total patients. We also detected 4 cases of cortical neoplasm namely dysembryoplastic neuroepithelial tumor consisting of about 1 % of the cases.

Discussion

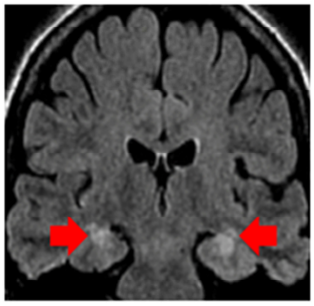
Mesial temporal sclerosis (MTS)

Mesial temporal sclerosis refers to the formation of an epileptogenic focus due to neuronal loss and gliosis of the hippocampus.[4] Other than having a strong association with complex partial, MTS is also known to be the most common structural abnormality in human epilepsy.[5,6]

The two primary MRI findings include hippocampal atrophy which is recognized by asymmetry in the case of unilateral atrophy and increased signal intensity of the hippocampus on T2-weighted images.[7]



Unilateral Mesial Temporal Sclerosis



Bilateral Mesial Temporal Sclerosis

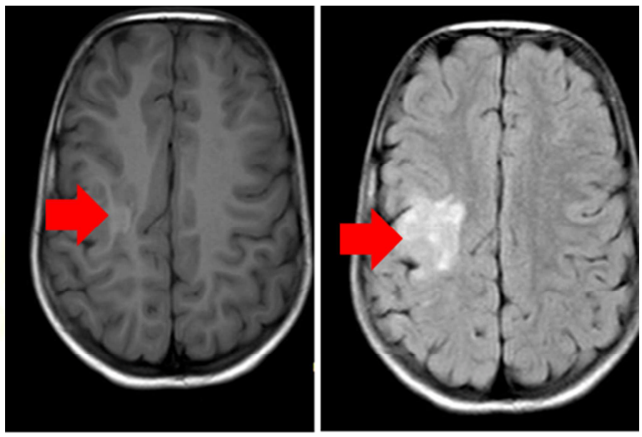
Secondary MR features suggesting MTS include temporal horn dilatation, loss of hippocampal signal on T1WI, loss of hippocampal head digitations, loss of commissural white matter and poor parahippocampal gray-white matter definition.[8-11]

There could be associated ipsilateral atrophy of the temporal lobe, thalamus, and fornix and mamillary body. Quantitative volumetric (3D SPGR) imaging increases sensitivity for MTS detection, particularly in bilateral involvement.[12]

Focal cortical dysplasia (FCD)

FCD is a localized region of the cerebral cortex formed by abnormal neurons and glial cells. FCD Type II is known to be one of the leading causes of epilepsy, both in children and in adults. Most often located in the central and precentral cortex. Managed routinely by surgical resection.[14]

On MRI, it appears as areas of cortical thickening with an indistinct gray-white matter junction. There also occur areas of abnormal signal intensity extending from the gray-white matter junction to margin of the lateral ventricle. These foci show high signal intensity on T2- weighted images and low signal intensity on T1-weighted images.[15]



Focal cortical dysplasia

Ther findings include macrogyria and abnormally widened or deep sulci. In some patients, a linear or curvilinear focus of abnormal signal intensity extends from the cortical-white matter junction to the ventricular surface this is referred to as the trans mantle sign and appears to be unique for FCD Type II when seen.[16]

Hemimegalencephaly

Hemimegalencephaly is the enlarged and dysplastic hamartomatous overgrowth of part or all of the cerebral hemisphere. There is moderate-to-marked enlargement of complete or part of a cerebral hemisphere, which can be normal or dysplastic. (17) Gray white matter junction appears indistinct. Heterotopia and astrocytosis will show variable degrees of abnormal T1 and T2 prolongation of the white matter. The enlarged lateral ventricles showed a characteristic shape of the frontal horns that appears straight and pointed anteriorly and superiorly.

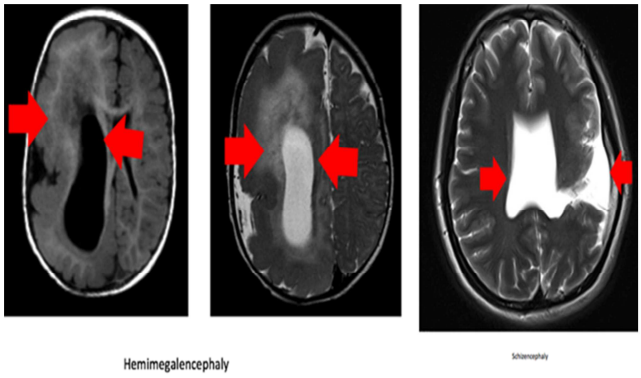
Classic (type I) lissencephaly

It occurs in two forms. The "complete" form will show complete agyria whereas the "incomplete" forms have parietooccipital agyria with frontotemporal pachygyria. There will be a loss of gray-white matter differentiation with cortical thickening and thin subcortical white matter. T2-weighted MR image may show a peripheral band of high signal intensity, commonly in the parietooccipital cortex. Cerebral configuration is oval or an hourglass with shallow Sylvian fissures due to lack of or incomplete

operculization.[19-21]

Cobblestone (type II) lissencephaly

In cobblestone lissecephaly, the patient will have nodular brain surface, ocular anomalies, and congenital muscular disorders.[22]



Hemimegalencephaly

Heterotopia

Heterotopia defines as collections of normal neurons located in unusual locations, anywhere from the subependymal region to the cerebral cortex. There may be associated pachygyria, agenesis of the corpus callosum, Chiari II malformation, arachnoid cyst, schizencephaly, and cephalocele.

Periventricular (subependymal) heterotopias

These abut the ventricular wall. Most common location is trigone and occipital horns of the lateral ventricles. They are usually bilateral with a predilection for the right cerebral hemisphere. On MRI, they appear as round-to- oval nodules, isointense to the cortex on all pulse sequences, with no post-contrast enhancement.[23]

Subcortical heterotopias

They may be involving the subcortical or deep white matter. The overlying cortex appears thin with shallow sulci. The affected hemisphere may decrease in size. SCH may have a nodular, curvilinear, or mixed form.[24]

MR spectroscopy can differentiate heterotopia from a low-grade glioma. Heterotopia will show metabolites similar to those of normal brain parenchyma. Low-grade gliomas will show a decrease of N-acetyl-aspartate and increase of choline peak.[25,26]

Band (laminar) heterotopia

It is due to an early arrest of neuronal migration. Band heterotopia will have a smooth layer of the gray matter that often follows the curvature of the overlying cortex. On MR imaging, it shows the typical 3-layer cake (continuous double cortex) in which there is an interposition of thin white matter band between the cortex and the subcortical layer of band heterotopias. The cortex may be relatively normal or pachygyria.[27]

Schizencephaly

Schizencephaly appears as a CSF-filled cleft which extends medially from the subarachnoid space to ventricular system. Dysmorphic gray matter lines the wall of the cleft. The cleft may be small or large, unilateral or bilateral. The gray matter may extend to the lateral ventricle as subependymal heterotopia. The anomaly may be of the open-lip or closed-lip type. Closed-lip schizencephaly has gray matter lined lips, which are in contact with each other. Open-lip schizencephaly will have separated lips and a cleft of CSF extending to the underlying ventricles.It may show association with optic nerve hypoplasia, septo-optic dysplasia, absent septum pellucidum, pachygyria, PMG, heterotopia, and arachnoid cysts.[28]

Tuberous sclerosis

Salient features of TSC are cortical tubers, white matter radial migration lines, subependymal nodules and subependymal giant cell astrocytomas.

Tubers

The cerebrum is the most common location of tubers, predominantly (90%) in the frontal lobes. Tubers typically appear as areas of increased signal intensity in the cortical and subcortical regions on T2-weighted and FLAIR MR images.The majority of tubers are multiple in numbers. Unlike cortical tubers, cerebellar tubers are usually wedge-shaped and not epileptogenic. Tubers are rare in the brainstem and spinal cord.[29,30]

Subependymal nodules

These are areas of confluent hypertrophic tissue located at the walls of lateral ventricles. Though caudothalamic groove in the region of the foramen of Monro is the most common location of these nodules, they can occur anywhere along the ventricular surface.

Subependymal giant cell astrocytoma

Subependymal giant cell astrocytomas grow in an indolent manner which results in ventricular obstruction and hydrocephalus.

Radial migration lines

These lines are primarily located in the subcortical white matter and are sometimes in association with tubers. They occur along expected path of cortical migration and represents heterotopic glia and neurons.[31]

Microcephaly

A patient suffering from tuberous sclerosis has been found to have decreased cerebral gray and white matter volume than those of age-matched controls. Statistically, significant microencephaly is seen in both TSC patients with and those without a history of epilepsy.[32]

Cortical Neoplasms

The superficial cerebral gliomas are important because of various underdescribed features. They tend to manifest in younger patients with refractory seizures and resection of these tumors is often curative. The majority of them are graded as WHO grade I tumors except pleomorphic xanthoastrocytoma. Characteristic imaging features include involvement of the cortical gray matter, soft- tissue and

cystic components, and enhancement of the soft tissue portion of the mass

Dysembryoplastic neuroepithelial tumor

The temporal lobe is the most common site (62%), followed by the frontal lobe (31%). The majority of dysembryoplastic neuroepithelial tumors confines to the cortical gray matter, but may also arise within the caudate nucleus, cerebellum, or pons.

At MR imaging, DNET most commonly seen as cortical masses that are T1-hypointense and T2-hyperintense with no perifocal vasogenic edema. Some lesions may appear as a bulky gyrus, producing a soap-bubble appearance at the cortical margin. About one-third of dysembryoplastic neuroepithelial tumors enhances following intravenous administration of contrast material.[33]

Conclusion

MR imaging is a valuable tool for the diagnosis of disorders of cortical malformation and others disorders. It helps in demonstrating the morphology, distribution, and extent of cortical disorders. Moreover, it can identify the associated congenital anomalies and related syndromes. MRI in today's world plays a deciding role in diagnostic work-up of a child with epilepsy.

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