Original Research Paper

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Radiology

MR IMAGING OF THE BRAIN IN CHILDREN WITH DEVELOPMENTAL DELAY

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ABSTRACT In this study a total of hundred children in the age group of 0-5 years presenting with developmental delay referred to Department of Radiology of our institute were included. Detailed history of the patients was obtained with special importance to family history and birth history. MR imaging of the brain was then performed implementing a fixed protocol for all these cases. The data was tabulated using Excel sheets. The patients details, clinical presentation, history and the MRI findings were included in the excel sheet. The predominant pathological imaging findings in these cases were cerebral and cerebellar atrophy, Periventricular leukomalacia, Cystic encephalomalacia, Corpus callosum anomalies, Gliosis, Colpocephaly, Dandy walker variant. After complete evaluation the cases were categorized based on their etiology as Normal (20.83 %), Congenital and developmental (12.5%), Infection (5%), Metabolic and neurodegenerative (2.5%), Neurovascular diseases and trauma (43.33%), Tumors (1.6%).

KEYWORDS : Developmental delay, Periventricular leukomalacia, Cystic encephalomalacia

INTRODUCTION –

The development of a child can be assessed by the time of occurrence and acquisition of a number of motor, social or language skills. Developmental delay is common, affecting 1-3% of the population.

The development of a child can be assessed by the time of occurrence and acquisition of a number of motor, social or language skills. These milestones occur in a particular sequence and in a particular interval after birth. Developmental delay is best defined by the Denver Developmental Screening Test (DDST) and its modified form is Denver Developmental Screening Test II (DDSTII)Developmental delay is characterized by late acquisition of these skills. It often may have features of regression, stability or disease progression. The term delay is often considered a misnomer in this regard as the child fails to catch up with normal growth and continues to have difficulties with learning even later in life. Developmental delay is common, affecting 1-3% of the population. Developmental delay is defined as significant delay (more than two standard deviations below the mean) in one or more of the following developmental domains:

Gross motor
Vision & Fine motor
Hearing, Speech & Language
Social, Emotional & Behavioral

Developmental delay is best defined by the Denver Developmental Screening Test (DDST) and its modified form is Denver Developmental Screening Test II (DDSTII)

The cause for developmental delay is often not established. It may not be always be accounted by a particular organic or syndromic cause and the term is not included in the ICD – 10. A battery of tests may be implemented in the work up of developmental delay, such as, metabolic blood work up, urine work up, genetic analysis and so on. Many of the conditions causing developmental delay show specific changes in the central nervous system of these children and can be identified by a number of features on MRI of the brain which thus forms one of the primary modalities implemented in the work up of children with developmental delay. Brain MRI is thus one of the major evaluations of patients, and based on previous studies, about 60% of cases has abnormal brain MRI. Hence, many of the conditions causing developmental delay show specific changes in the central nervous system of these children and can be identified by a number of features on MRI of the brain which thus forms one of the primary modalities implemented in the work up of children with developmental delay.

MATERIALS AND METHODS –

In this study a total of hundred children in the age group of 0-5 years presenting with developmental delay referred to the Department of Radiology of our institute were included.

INCLUSION CRITERIA –

All the children aged 0-5 years with developmental delay referred for a MRI study of the brain were included in this study.

EXCLUSION CRITERIA –

Children with developmental delay not undergoing an MRI examination of the brain were not included in the study. Children referred for an MRI brain multiple times were considered and included in the study only once.

Detailed history of the patients was obtained with special importance to family history and birth history. Leading questions were asked to inquire about siblings with similar family history. Important details of birth history included completion of term at the time of birth, immediate cry, resuscitative measures implemented and history of NICU stay for any reason. Antenatal history was also noted down wherever significant.

PROTOCOLS –

MRI study of the brain was done using a SIEMENS 0.35 T Magnetom C and a GE 1.5 T Signa Creator Machines .

The sequences obtained were:
Axial T1, T2 and FLAIR images
Coronal T2 WI
Sagittal T1 WI

GRE and Inversion Recovery images
DWI and ADC maps

Contrast study was undertaken wherever necessary.
Average slice thickness was 3 and 5 mm and an interval of 3 to 5 mm was used. #D sequences were taken where required.

DATA ANALYSIS -

The data obtained was then tabulated using Excel sheets. The patients details, clinical presentation, significant history and the MRI findings were included in the excel sheets.

Based on the MRI findings the children were categorized into two broad categories – normal and abnormal.

A normal brain was defined by the absence of any pathologic process with the presence of normal myelination for the age of the child.

The following abnormal features were predominantly recognized in this study and were defined and labeled based on a specific constellation of findings.

Cerebral and cerebellar atrophy - Cerebral and cerebellar atrophy was defined by the prominence of cerebral sulci, sylvian fissures, basal cisterns, ventricles and cerebellar folia.

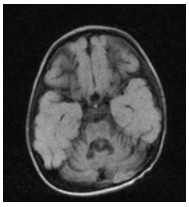

Fig1.

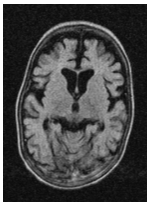

Fig2.

Periventricular leukomalacia – periventricular leukomalacia was defined by the prominence of ventricles with associated white matter loss with sulcal prominence and gyral thinning and thinning of the corpus callosum.

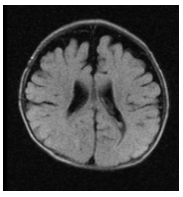

Fig3.

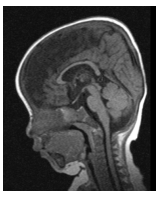

Fig4.

Cystic Encephalomalacia – Cystic encephalomalacia was defined by the presence of white matter lined CSF intensity cystic lesions within the brain parenchyma with / without associated features of old insult.

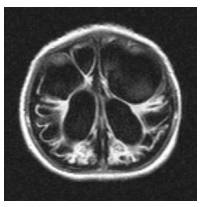

Fig5.

Colpocephaly – Colpocephaly was defined by the prominence of the occipital horns and atria of lateral ventricles with normal frontal horns.

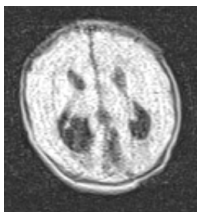

Fig6.

Corpus callosum abnormalities – Corpus callosum abnormalities like thinning of the corpus callosum, agenesis of the corpus callosum were identified.

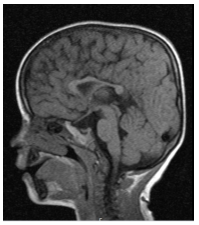

Fig7.

Dandy Walker variant – Dandy Walker variant was identified by the presence of a prominent cistern magna communicating with the fourth ventricle and vermian aplasia to variable extent.

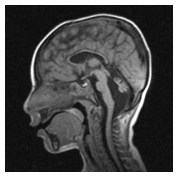

Fig8.

Apart from these pathological features, a few **normal variants** such as arachnoid cysts and persistent cavum septum pellucidum were also identified.

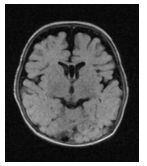

Fig9.

RESULTS –

In this study a total of hundred children with developmental delay as one of the main presenting features were studied.

Apart from developmental delay, the other associated clinical features observed relatively frequently were spastic cerebral palsy, gait disorders, hydrocephalus / microcephaly, seizures, low birth weight, chest and PNS infections. Other associated features were preterm labour, absence of cry immediately after birth and NICU stay.

The commonly encountered pathological findings on MRI were:

- Diffuse cerebral and cerebellar atrophy
- Periventricular leukomalacia
- Cystic encephalomalacia
- Corpus callosum anomalies
- Gliosis
- Colpocephaly
- Dandy walker variant

A few cases with features of infection with meningitis, encephalitis and cerebral abscess were reported. A single case of Joubert syndrome and 2 cases of posterior cranial fossa lesion likely Medulloblastoma were also reported.

When classified into three categories according to age 43.3% of the children were from the 0-1 year age group, 31.6% were between 1-3 years and 25% were between 3-5 years. In the 0-1 year age group 84.6% of the MRI abnormal whereas 15% we normal. In the 1-3 year age group, 76.3% of the cases revealed pathology whereas 23.6% were normal. In 3-5 years, 73.3% of the studies revealed abnormalities whereas 32% were normal.

The data was compiled and evaluated and divided into 7 categories based on the etiology as follows :

1) Normal (20.83 %)
2) Congenital (12.5%)
3) Infection (5%)
4) Metabolic and neurodegenerative (2.5%)
5) Neurovascular diseases and trauma (43.33%)
6) Congenital and developmental abnormalities of the brain (12.5%)
7) Tumors (1.6%)

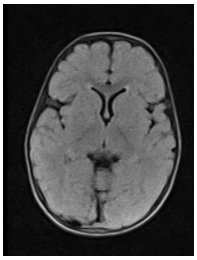

Fig10.
T2 FLAIR image at the level of lateral ventricles showing a normal image of the brain in a 2 year male child with delayed milestones, dysmorphism and spastic diplegic cerebral palsy.

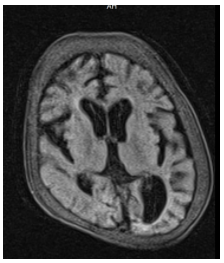

Fig11.
Case of a 12 year male with cerebral palsy and seizures. T2/FLAIR axial section of the brain reveals microcephaly with diffuse calvarial thickening and features of perinatal hypoxic insult.

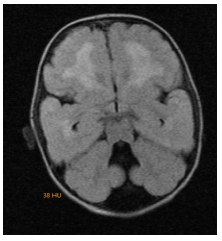

Fig12.
Case of a 2 year female with swelling over occiput. MRI brain reveals Lissencephaly with occipital cephalocele.

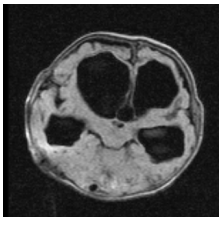

Fig13.
Case of a 3 year old male child with delayed development, exaggerated reflexes and recurrent fever. MRI brain reveals obstructive hydrocephalus with a large right frontal lobe abscess.

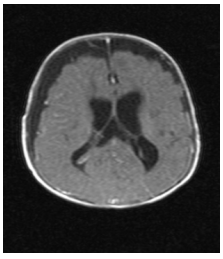

Fig14.
Case of a 10 month female with global developmental delay. MRI reveals leptomeningitis and hydrocephalus with post-infective gliosis / demyelination.

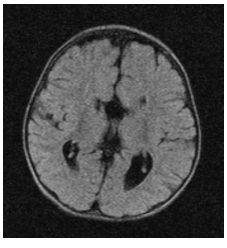

Fig15.
Case of a 2 year female with suspected GM gangliosidosis. MRI reveals colpocephaly.

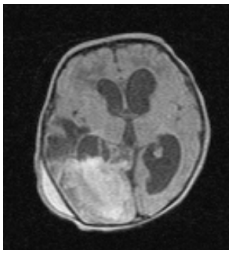

Fig16.
Case of 17 day female with birth asphyxia. MRI reveals hydrocephalus with right parieto-occipital bleed associated with gliosis.

Etiological Classification of Developmental Delay

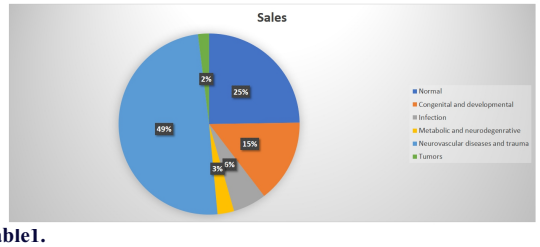

Table1.

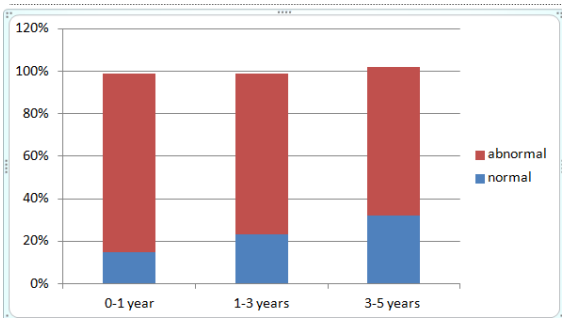

Table2

CONCLUSION –

Hence, we propose MRI of the brain as a first line modality for the etiological diagnosis in children with developmental delay. An integrated approach with detailed clinical and perinatal history with laboratory evaluation and magnetic resonance imaging the brain can yield successful results in reaching a diagnosis and thus help in the management and monitoring the follow up in these cases.

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