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RESEARCH ARTICLE

MRI EVALUATION OF BRAIN IN CHILDREN WITH DEVELOPMENTAL DELAY: AN EXPERIENCE OF TWELVE CASES IN A TERTIARY CARE CENTRE OF RURAL INDIA

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Abstract

Background: The term developmental delay denotes a significant delay in one or more developmental domains in humans. The importance of evaluation of a child with developmental delay lies in early diagnosis and treatment and also parental counseling regarding the outcome of their child and to identify any possible risk of recurrence in the siblings. This study is done to evaluate Magnetic Resonance Imaging (MRI) as an investigative modality for evaluation and to correlate the spectrum of findings in such patients with developmental delay.

Methods: This is a prospective observational study done at the Department of Radiodiagnosis, Jorhat Medical College and Hospital from January 2022 to December 2022 with a sample size of 12 cases. All patients were evaluated clinically and underwent an MRI of the brain performed using a 1.5 Tesla MRI scanner. MRI scan was done and findings are recorded.

Results: Among the cases, 3 have white matter disorders, 3 cases have Hypoxic Ischemic Encephalopathy (HIE), 2 cases have Cerebral atrophy with encephalomalacic changes, 1 case showing sub-ependymal heterotopia and 3 cases have normal findings.

Conclusions: The spectrum of developmental delay is wide and MRI brain helps in proper diagnosis. This leads to appropriate treatment and parent counselling. Further, advanced imaging modalities like Functional MRI, MR Spectroscopy, Diffusion Tensor Imaging etc. helps in further evaluation of developmental delay.

Introduction:-

The process of development is continuous and begins from conception which continues up till maturity. However, this process is adversely affected by several factors like genetic, environmental, nutritional and chronic diseases. This can lead to delay in milestone which can be evaluated using four domains of gross motor, fine motor and social and language skills[1].

The estimated prevalence of developmental delay in children is 5 to 10 percent. This is neither a disease nor diagnosis but it is a symptom or clinical presentation with diverse etiologic profile. The diagnosis of developmental delay is done during infancy or early childhood. Many times the diagnosis is done when the child enters the school.

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Early diagnosis and treatment of this condition is of utmost importance for the overall growth and development of the child[2].

Magnetic Resonance Imaging (MRI) of the brain has proven to be one of the major investigations of these patients. Further, advanced imaging modalities like Functional MRI, MR Spectroscopy, Diffusion Tensor Imaging etc. helps in further evaluation of developmental delay[3].

In this study, we present 12 such cases of developmental delay that came for MRI scan of brain to our department.

Methods:-

This is a prospective observational study done at the Department of Radiodiagnosis, Jorhat Medical College and Hospital for a period of 1 year starting from January 2022 to December 2022 with a sample size of 12 cases. MRI was done in 1.5 Tesla MR GE machine with dorsal decubitus position for every patient. The sequences used were: Axial T1TSE, Axial T2TSE, Axial T2 FLAIR. Various anatomical structures like Ventricles, Corpus callosum, etc were systematically assessed

The entire procedure for each patient was done after making the child sleep. Sedation was used in all cases with lorazepam used intravenously at a dose of 0.1 mg/kg body weight under the supervision of a paediatrician. The entire study was undertaken after taking written and informed consent from every patient. All the precautionary measures for performing MRI were taken.

Results:-

Out of 12 cases, 5 patients were male and 7 cases were female. The average age of presentation is 1-3 years with majority of patients are from rural background. Out of the twelve cases, 7 underwent normal delivery, 2 had assisted vaginal delivery and other 3 underwent caesarean section.

Among the cases, 3 cases have white matter disorders, 3 cases have Hypoxic Ischemic Encephalopathy (HIE), 2 cases have Cerebral atrophy with encephalomalacic changes, 1 case showing sub-ependymal heterotopia and 3 cases have normal findings.

Representative Cases:

Case 1: A 2 years old male presented with a history of incomprehensible words with frequent jerky movements. The speech development is delayed but sensory and motor movements are normal.

On axial scan of MRI brain, there is atrophy of the left fronto-parietal cortex with prominent sulci and gyri (Fig.1 a,b). No abnormal signal intensity noted in T1W and T2/FLAIR sequences.

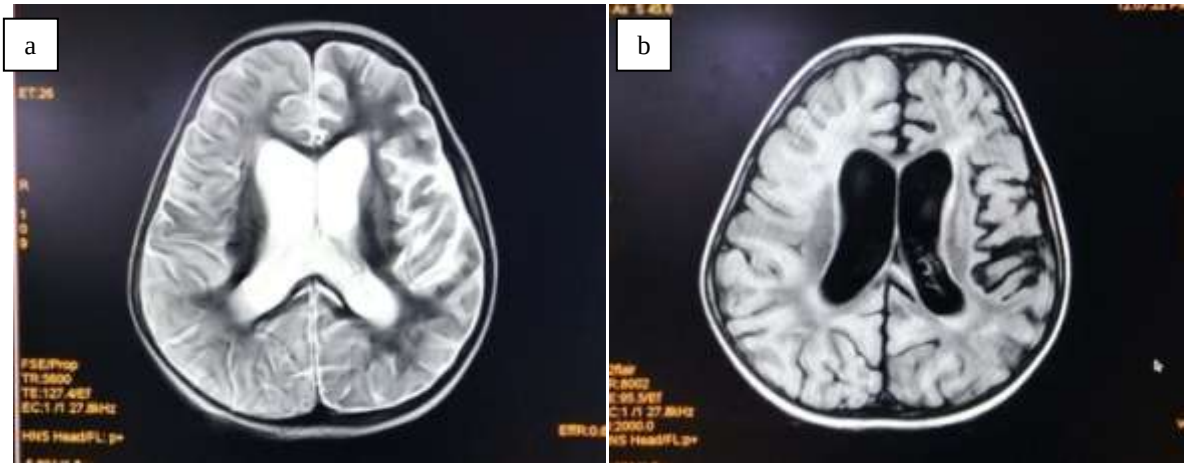

Fig.1:- On axial scan of MRI brain, there is atrophy of the left fronto-parietal cortex with prominent sulci and gyri.

Case 2: An 11 month old female child was brought with a history of occasional abnormal jerky movements. The patient had a history of birth asphyxia.

On axial sections of MRI, there is T2/FLAIR hyperintensity noted in left hippocampus and medial temporal lobe with a T2 hyperintense cystic lesion involving the left hippocampus (Fig. 2 a,b).

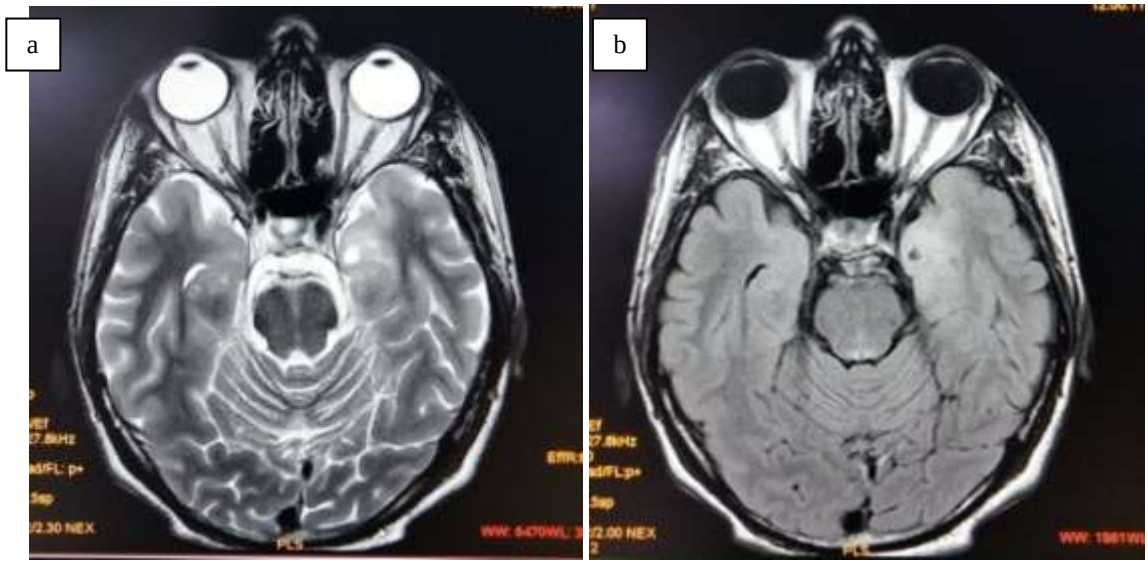

Fig. 2:- On, axial sections of MRI, there is T2/FLAIR hyperintensity noted in left hippocampus and medial temporal lobe with a T2 hyperintense cystic lesion involving the left hippocampus.

Case 3: This is a 1 year 3 months old female who was brought with a history of difficulty in walking with seizure disorder.

On axial sections of MRI, sub-ependymal grey mater signal nodules are noted bilaterally on T2/FLAIR images. So, this is suggestive of sub-ependymal heterotopias (Fig. 3 a, b).

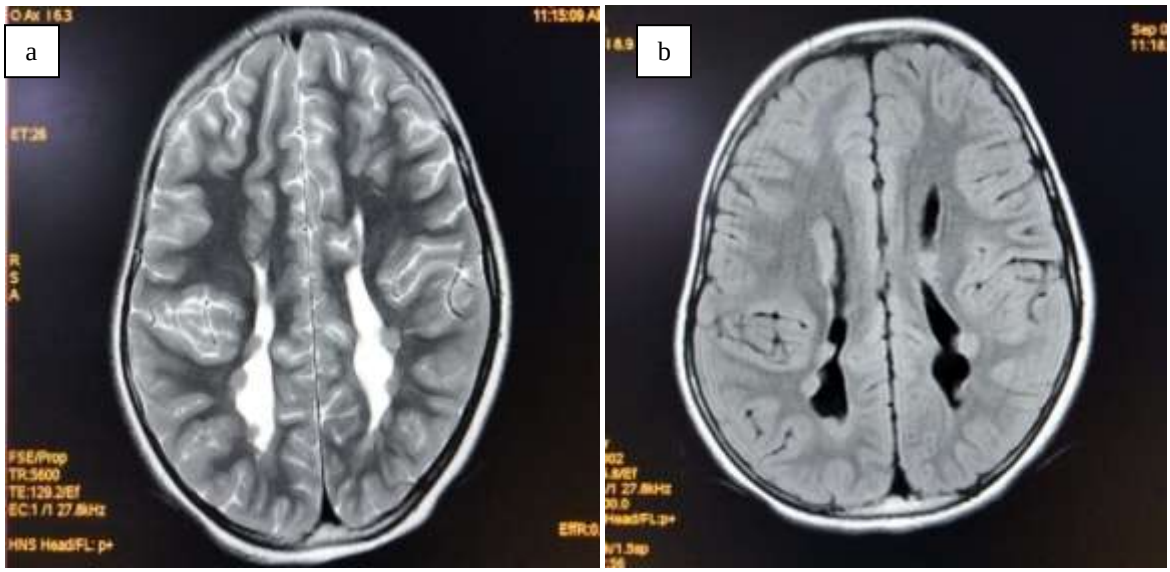

Fig. 3:- Axial sections of MRI. Sub-ependymal grey mater signal nodules are noted bilaterally on T2/FLAIR images, suggestive of sub-ependymal heterotopias.

Case 4: A 3 years old male who is starting to attend pre-school had difficulty in speech production.
On axial sections of MRI Brain, T2/FLAIR shows atrophy of the right cerebral hemisphere with right fronto-parietal cytic encephalomalacia with ex-vacuo dilated right lateral ventricle. (Fig. 4 a, b).

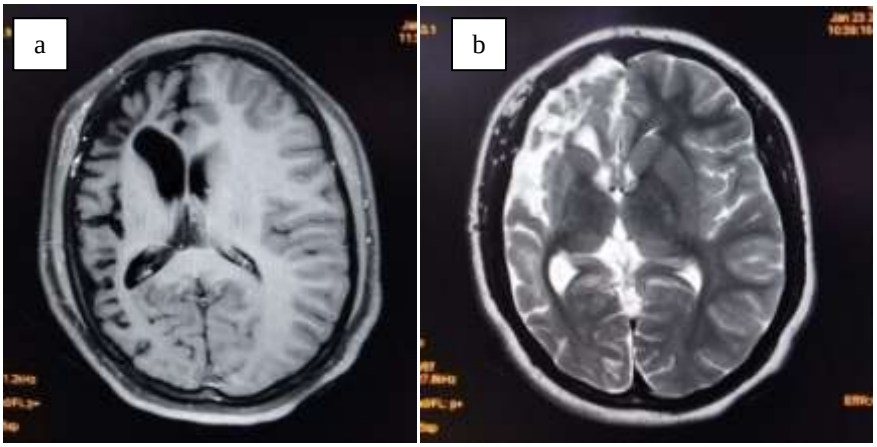

Fig. 4:- On axial sections of MRI Brain, T2/FLAIR shows atrophy of the right cerebral hemisphere with right fronto-parietal cytic encephalomalacia with ex-vacuo dilated right lateral ventricle.

Case 5: A 2 years old female came for MRI brain with history of delayed initiation of walking and speech production with on and off abnormal jerky movements.

On axial sections of MRI Brain, T2/FLAIR shows right-sided sub-dural collection with pachygyria and lissencephaly of the adjacent brain parenchyma and shifting of the brain to contralateral side. (Fig.5 a,b).

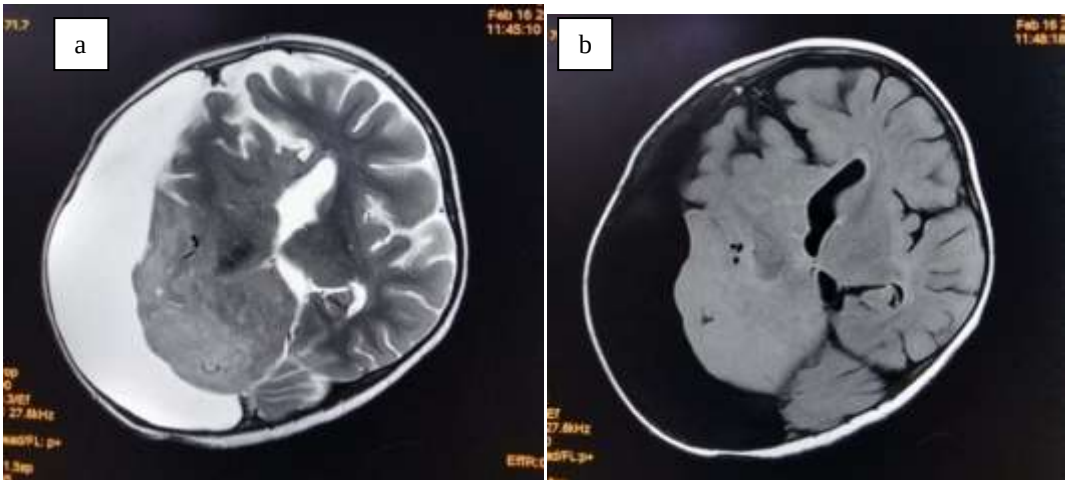

Fig. 5:- On axial sections of MRI Brain, T2/FLAIR shows right-sided sub-dural collection with pachygyria and lissencephaly of the adjacent brain parenchyma and shifting of the brain to contralateral side.

Case 6: A 3 years old male came for MRI brain with history of on and off seizure and delayed speech development with rest of the other developmental milestones normal.

On axial sections of MRI Brain, T2/FLAIR shows left sided enlargement of lateral ventricle (predominantly frontal horn) with smoothening and thickeneing of the surrounding fronto-parietal cortex. (Fig.6 a,b).

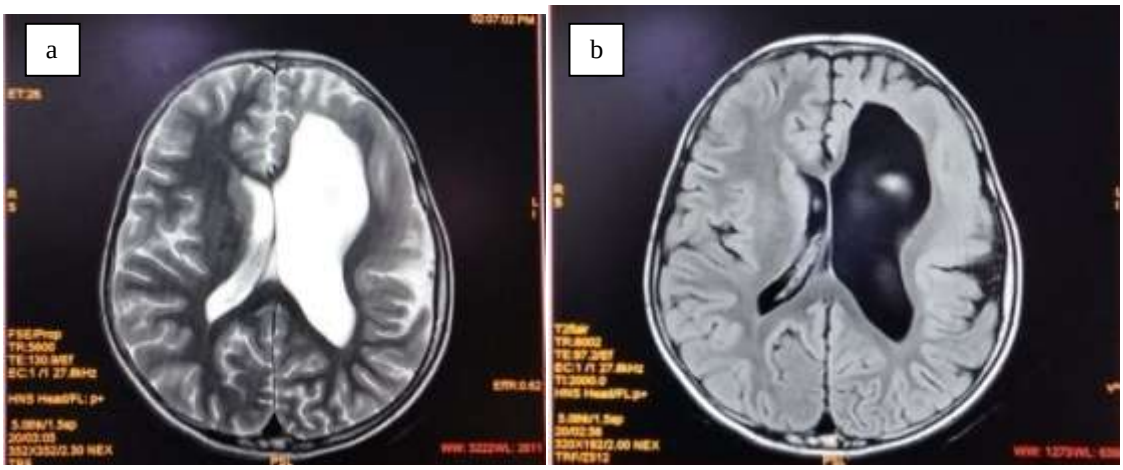

Fig. 6:- On axial sections of MRI Brain, T2/FLAIR shows left sided enlargement of lateral ventricle (predominantly frontal horn) with smoothening and thickeneing of the surrounding fronto-parietal cortex.

Case 7: A 3 year old female came for MRI brain with history of global developmental delay.

On axial sections of MRI Brain, T2/FLAIR signal hyperintensity involving the bilateral centrum semiovale. (Fig.7 a,b).

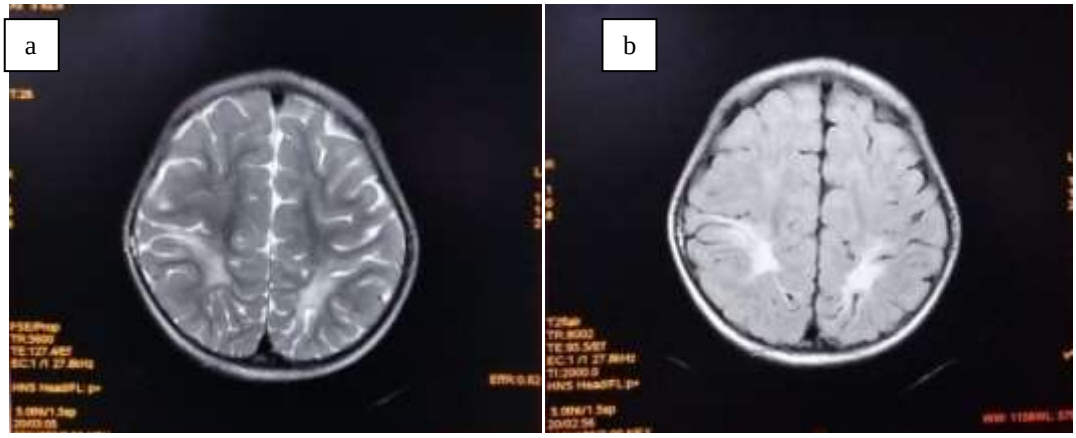

Fig. 7:- On axial sections of MRI Brain, T2/FLAIR signal hyperintensity involving the bilateral centrum semiovale.

Discussion:-

The study conducted by Bent O. Kjos et al and others showed that developmental delay is diagnosed in a child in whom there is a significant lag (2 standard deviations below the mean in one domain or 1.5 standard deviations in any two domains) in acquiring age-appropriate developmental milestones. The domains of development evaluated are gross motor function, fine motor function, speech/language, personal/social milestones, and cognition. The study also described global developmental delay (GDD) as an under-achievement in two or more domains. Insufficient progress in a single domain is termed a specific developmental delay (SDD) [1].

The study conducted by Harneet S. Randhawa et al depicted that developmental delay has multiple etiologies and many of which such as the degree of perinatal hypoxic insult and structural brain abnormalities cannot be diagnosed without the use of neuroimaging. Some of the etiologies of developmental delay include perinatal hypoxic insult, structural brain abnormalities, metabolic defects, toxins, infections, genetic syndromes, and environmental factors. The study showed MRI as the first-line investigation for non-syndromic developmental delay[2].

The study conducted by TA Dasan et al concluded that specific cause of developmental delay many a times remain not fully known. In majority of patients where diagnosis remains inconclusive by other non-imaging modalities, MRI provides useful diagnostic information[3].

In a study done by Elanchezhian et al, it was concluded that magnetic resonance imaging will reveal brain abnormalities in about one third of non-autistic children with developmental retardation of unknown cause, neurologic deficits, seizures, or a small head size[4]. In another study done by Elanchezhian et al, MRI of brain shows association of brain anomalies with different etiologies of developmental delay[5].

The study conducted by Rini Palve et al shows that clinical diagnosis of developmental delay should be a propulsive force for an effective diagnosis for causative factors. MRI is the best investigation for effective diagnosis of such patients[6].

The study of HJ Williams et al highlighted the limitation of ultrasound and computerised tomography (CT) in diagnosing children with developmental delay. However, ultrasonography can be used as the initial screening investigation in infants with developmental delay to exclude gross cerebral malformations and hydrocephalus. CT is mainly used during emergency in acute presentations to identify processes such as haemorrhage, oedema, infarction or mass lesions. CT can also be used in situations when MRI is not readily available. It is also more sensitive than MRI for identifying intracranial calcification[7].

Conclusion:-

Developmental delay in children is one of the most important hindrance to the overall development of a child and it has multiple causative factors. Early diagnosis and treatment of these etiologies are of utmost importance. Ultrasound and CT has limited role in the diagnosis of developmental delay. MRI provides the best imaging modality. Position Emission Tomography also has a limited role in the diagnosis of children with developmental delay.

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Not required

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