ROLE OF MRI BRAIN IN DIAGNOSTIC WORKUP OF CHILDREN PRESENTING WITH DELAYED MILESTONES

Asma Jabeen, Nazia Dildar*, Bushra Nayyar, Sara Khan*****

72 Med Bn Pakistan, *Combined Military Hospital Quetta Pakistan, **Combined Military Hospital Khuzdar Pakistan, ***Pakistan Naval Ship Hafeez Hospital Islamabad Pakistan

ABSTRACT

Objective: To specify the value of brain MRI in the diagnostic workup of unexplained mental retardation/ delayed milestones in children.

Study Design: A descriptive study.

Place and Duration of Study: Armed Forces Institute of Radiological Imaging, Rawalpindi from, October 2013 to March 2014.

Material and Methods: This study included 100 patients of both sexes from 2-10 years of age, who presented with delayed milestones /mental retardation, where no etiological diagnosis could be made following clinical examination and preliminary investigations. MRI machine 1.5 Tesla was used.

Results: One hundred children were included in the study. Age range of patients was 2– 10 years with average age of 5.24 years (SD = 2.48). Majority of patients were males i.e. 60%. Radiological study was normal in 33% patients. Major radiological diagnosis was leukodystrophy in 30% patients followed by cerebral atrophy in 16% patients, congenital malformation in 15% patients and non specific findings in 6% patients. Comparison of radiological diagnosis between both the gender and age groups was done. It was noted that leukodystrophy occurs with equal frequency in both male and female children. However in cases of cerebral atrophy and congenital malformations males were affected more than females. In cases of cerebral atrophy 10% were female and 20% were male children. While in children with congenital malformations 3% were female and 20% were male. Age wise comparison shows that leukodystrophy is mostly seen in children between ages of 2-7 years. Whereas cerebral atrophy and congenital malformations occur almost involving all age groups.

Conclusion: MRI is an important part of the comprehensive evaluation of children with developmental delay, as many specific etiologic and pathophysiologic conditions that lead to developmental delay can be detected easily. However, children with mild neuro developmental delay frequently have normal brain MRI examination. This article is going to highlight importance of MRI as imaging modality of choice.

Keywords: Developmental delay, Leukodystrophy, Magnetic resonance imaging.

INTRODUCTION

Developmental delay /mental retardation are common, affecting 1-3% of the population[1]. It is defined as an incomplete or insufficient general development of mental capacity with sub average intellectual functioning (IQ < 70)[2]. Others however call it as a significant delay (more than two standard deviations below the mean) in one or more of the following developmental domains[3].

Gross motor, Vision and fine motor, Hearing, speech and language, Social, emotional and behavioral, Developmental delay is a descriptive term used for children whose difficulties are apparent earlier in childhood, where a cause is not yet established[4]. It does not imply a particular organic or syndromic cause. Early identification of affected children is important so that they may benefit from early intervention programs. An additional goal in the evaluation of developmental delay in children is the determination of a specific cause for

Correspondence: Dr Asma Jabeen, House No. 38 Street No 3, Askari-IX Rawalpindi, Pakistan (*Email:asmabangash@yahoo.com)*
Received: 26 Sep 2014; revised received: 13 Feb 2015; accepted: 03 Feb 2015

disability[5,6]. This can provide information regarding the possible pathogenesis and prognosis. Several studies suggest that a definite cause for developmental delay can be identified in 40-60% of all patients undergoing evaluation[7]. Multiple etiological factors including prenatal, perinatal and postnatal are involved. Therefore the history of pregnancy, labour and delivery has to be investigated for clues of both intrinsic and extrinsic influences on the fetus and infant development[8,9].

We conducted this study to determine the diagnostic yield of MRI in a cohort of children with developmental delay of unknown origin.

MATERIAL AND METHODS

This descriptive study was conducted in Armed Forces Institute of Radiological Imaging; Rawalpindi in collaboration of pediatric department .Duration of study was 6 months with effect from October 2013 to March 2014. MRI brain was done in 100 children. Patients of both genders ranging from 2 to 10 years, with delayed milestones, where no etiological diagnosis could be made were included in the study. Cases with known history of CNS malformation, like meningitis, encephalitis, obvious malformations like hydrocephalus and recognized syndromes, known to cause developmental delay/ mental retardation were excluded from the study. Patients were included in the study through non probability convenience sampling. The decision to perform MRI evaluation was based on the clinical judgment of the referring pediatrician.

MRI studies were carried out in AFIRI in 1.5 Tesla MR Unit. The children were sedated. The following protocol was used. T1WI axial, coronal and sagittal images, T2WI axial coronal and sagittal images and axial fluid attenuated inversion recovery FLAIR. The slice thickness was 5-6 mm on axial images and 3mm on coronal plane. The interspace gap varies from 0.3-0.6 mm. The field of view varied from 18-24 cm. The images on the coronal plane were oriented perpendicular to the hippocampus. All MRI were reported by the same radiologist.

All data collected had been analyzed using SPSS version 10. Descriptive statistics were used to describe the results.Chi square test was applied to compare radiological diagnosis between gender and between age groups. A *p*-value <0.05 was considered as significant.

Table-1: Gender-wise comparison of radiological diagnosis of patients (n=100).

Radiological diagnosis	**Female (n=40)**	**Male (n=60)**	***p*-value**
Normal study	16 (40%)	17 (28.3%)	0.224
Leukodystrophy	15 (37.5%)	15 (25%)	0.181
Cerebral Atrophy	4 (10%)	12 (20%)	0.181
Congenital Malformation	3 (7.5%)	12 (20%)	0.086
Nonspecific findings	2 (5%)	4 (6.7%)	0.731

Table-2: Age-wise comparison of radiological diagnosis of patients (n=100).

Radiological diagnosis	**< 5 years (n=42)**	**5 – 7 years (n=38)**	**> 7 years (n=20)**	***p*-value**
Normal study	13 (31%)	14 (36.8%)	6 (30%)	0.813
Leukodystrophy	14 (33.3%)	14 (36.8%)	2 (10%)	0.087
Cerebral Atrophy	8 (19%)	3 (7.9%)	5 (25%)	0.187
Congenital Malformation	4 (9.5%)	7 (18.4%)	4 (20%)	0.421
Nonspecific findings	3 (7.1%)	0 (0%)	3 (15%)	0.067

RESULTS

One hundred children were included in the study. Age range of patients was 2 – 10 years with average age of 5.24 years (SD=2.48). Majority of patients were males i.e. 60%. Radiological study was normal in 33% patients. Major radiological diagnosis was

leukodystrophy in 30% patients followed by cerebral atrophy in 16% patients, congenital malformation (agenesis of corpus callosum, hydrocephalus, dandy walker variant, cerebral aqueduct stenosis etc) in 15% patients and nonspecific findings (basal ganglia calcifications, arachnoid cysts, hemorrhagic infarct) in 6% patients. (Figure) comparison of radiological diagnosis between both the gender and age groups is shown in table-1 & table-2. Radiological diagnosis was similar between both the gender as well as between age group with insignificant difference.

DISCUSSION

The aim of investigating a child with mental retardation or developmental delay is to reach etiologic diagnosis. Though not always diagnostic, neuroimaging provides useful diagnostic information in a relatively high percentage of retarded children, where no other diagnostic clue is available[11, 12]. The sensitivity of neuroimaging in this study with a 66% rate of positivity exceeds that of other lab tests. These findings are comparable to those of study of Soto

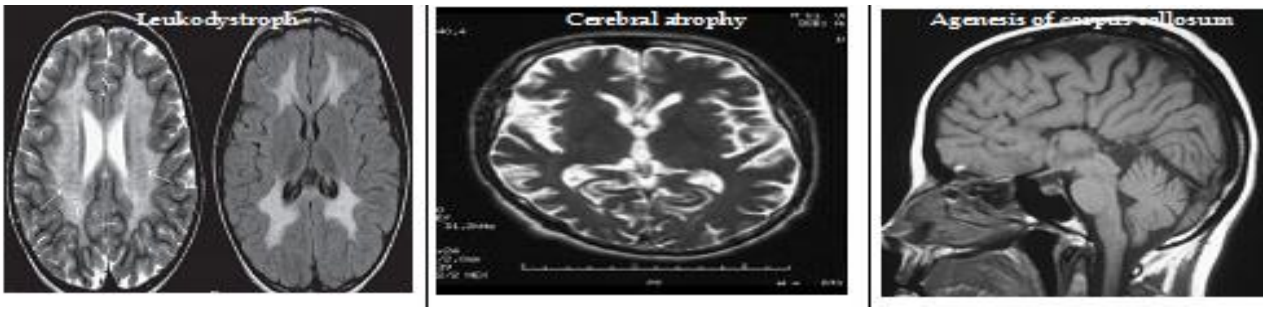

Figure: Showing commonly found MRI findings.

Ares who reported a 50% positivity of MRI in idiopathic developmental delay[13]. This can be attributed to the versatility of imaging in providing diagnostic information about a variety of conditions associated with abnormal morphology, structural malformation, metabolic disorders, vascular or infective insults[14, 15].

In this study the most common finding was leukodystrophy i.e 30%, which is comparable to the study carried out by J. L. Bonkowsky where incidence of leukodystrophy was 26%[16]. The radiological findings in almost all of these patients was bilateral symmetrical confluent areas of signal change in periventricular white matter with sparing of subcortical U-fibers, which appear low on T1WI, high on T2WI and FLAIR sequence with usually no enhancement. However three patients showed a linear punctate enhancement pattern within the lesion. Leukodystrophies are disorders which are characterized by the progressive destruction of myelin owing to the accumulation of various catabolize depending on the specific enzyme deficiency. Children often present clinically with progressive mental or motor deterioration. Although most of these conditions are not treatable, establishing a diagnosis is valuable in providing a prognosis and enables parental genetic counseling.

The second most common causative factor for mental retardation was cerebral atrophy. It includes both cases with generalized cerebral atrophy and front temporal atrophy. One patient also had cerebellar atrophy. Findings which suggest cerebral atrophy was dilatation of intra and extra cerebral CSF spaces. Though very nonspecific generalized cerebral atrophy is also a feature of some metabolic disorders and its presence warrants a proper work up for a metabolic cause[17,18].

Third group was of congenital malformations which include pachygyria, holoprosencephaly, dandy walker variant, hydrocephalus and agenesis of corpus callosum. Six out of hundred patients had nonspecific findings like basal ganglia calcifications

The application of neuroimaging does not facilitate any specific management in the retarded children, nor does it alter the patient's developmental status. Nevertheless, it is immensely useful in providing valuable information regarding an etiological basis for retardation[18,19]. This greatly helps the clinician in counseling the concerned families. In addition an etiologic diagnosis provides for a more accurate prognosis[20,21]. In the present study, after neuroimaging, the positive results help the families in finding some solace that there was some physical factor in the brain beyond their control that accounted for this lifelong problem. Finding causes help them to accept the problem better and stop their efforts for diagnosis and pay more attention to training.

CONCLUSION

It is recommended that if an etiologic diagnosis is not readily apparent after a detailed history, examination and initial investigations, magnetic resonance imaging should be the standard clinical practice for a child with global developmental delay. MRI can easily detect many specific etiologic and pathophysiologic conditions that lead to mental retardation which will greatly help the clinician.

CONFLICT OF INTEREST

This study has no conflict of interest to declare. Abstract and results of this study were accepted and presented in an oral presentationat the International conference on Medical Education, organised by Association for Excellence in Medical Education(AEME) and held on 07th-09th March 2014 at University of Health Sciences(UHS) Lahore, Pakistan. No funding was received from any agency or institution.

REFERENCES

1. Verbruggen KT, Meiners LC, Sijens PE, Lunsing RJ, Vanspronsen FJ. MRI and proton magnetic resonance spectroscopy of brain in the diagnostic evaluation of developmental delay. Eur J Paediatr Neurol 2009 Mar; 13(2):181-90.
2. Docobert F, Grabar S, Merzoug V, Kalifa G, Ponsot G, Adamsbaum C, et al. Unexplained mental retardation: is brain MRI useful? Radiol 2005; 35(6):587-96.
3. Soto Ares G, Deries B, Delmaire C, Ruchoux MM. Cerebellar cortical dysplasia: MRI aspects and significance. J Radiol 2004 Jun; 85(6 Pt1):729-40.
4. Chateil JF, Girault JM, Pedespan JM, Dousset V, Castell JF, Diard F. Agyria-Pachygyria and Pachygyria in children: Contribution of imaging. Arch Pediatr 1994 Jun; 1(6):551-60.
5. Conway RL, Pressman BD, Dobyns WB, Danielpour M. Neuroimaging findings in macrocepahly-capillary malformation. Am J Med Genet A 2007 Dec15; 143 A (24):2981-3008.
6. Kacinski M, Kubik A, Herman-Sucharska I, Paciorek A, Kroczka S, Zajac A. MRI brain imaging data in children with cavum septi pellucid and vergae. Przegl Lek 2007; 64 (11):923-8.
7. Klein O, Pierre-Kahn A, Boddaert N, Parisot D, Brunelle F. Dandy walker malformation;prenatal diagnosis and prognosis. Childs Nerv Syst 2003 Aug; 19(7-8):484-9.
8. Demaeral P, Wilms G, Marchal G. Rostral vermian cortical dysplasia: MRI. Neuroradiology 1999 Mar; 41(3):190-4.
9. Gabrielli O, Polonara G, Regnicolo L, Petroni V. Correlation between cerebral MRI abnormalities and mental retardation. A J Med Genet A 2004 Mar 15; 125 A (3): 224-31.
10. Mannorkoski M, Heiskala H, Raininko R, Abergl Sarna S, Wirtavour K. Brain MRI of siblings from families with two or more children with learning or intellectual disabilities. Acta Radiol 2009 May; 50 (4): 437-45.
11. Gabrielli O, Salvolini, Coppa GV. MRI in the malformative syndromes with mental retardation. Pediatr Radiol 1990; 21 (1):16-9.
12. Sasaki M, Takanashi J, Tada H, Sakuma H, Furushima W, Sato N. Diffuse cerebral hypomyelination with cerebellar atrophy and hypoplasia of corpus callosum. Brain Dev 2009 Sep; 31(8):582-7.
13. Soto-Ares, Joyes B, Delmaire C, Vallee L, Pruvo JP. MRI imaging in mental retardation. J Neuroradiol. 2005;; 32(4):224-38.
14. Bodensteiner JB, Schaefer GB, Craft JM. Cavum septi pellucidi and cavum vergae in normal and developmentally delayed population. J Child Neurol 1998 Mar; 13(3):120-1.
15. Alorainy IA. Pattern of congenital brain malformations at a referral hospital in Saudi Arabia: MRI study. Ann Saud Med 2006 Jan-Feb; 26(1):28-37.
16. J.L.Bonkowsky, C.Nelson, J.L.Kingston. The burden of inherited leukodystrophies in children. Neurology. Aug 24,2010; 75(8) : 718 – 725.
17. Bouhadiba Z, Dacher J, Monroc M, Vanhulle C, JF, Kalifa G. MRI of brain in the evaluation of children with developmental delay. J Radiol 2000 Aug; 81(8):870-3.
18. Grosso S, Scattolin R, Paolo G, Di Bartolo RM, Morgese G, Balestri P. Association of Chiari I malformation, mental retardation, speech delay and epilepsy: a specific disorder. Neurosurgery 2001 Nov; 49(5):1099-103.
19. Miall LS, Cornette LG, Tanner SF, Arthur RJ, Levene MI. Posterior fossa abnormalities seen on MRI brain in a cohort of newborn infants. J Perinatol 2003 Jul-Aug; 23(5):396-403.
20. Sasaki Adams D, Elbabaa SK, Jewells V, Carter L, Campbell JW, Ritter AM. The Dandy walker variant: a case series of 24 paediatric patients and evaluation of associated abnormalities, incidence of hydrocephalus and developmental outcome. J Neurosurg Pediatr 2008 Sep; 2(3): 194-9.
21. Soto Ares G, Joves B, Lemaitre MD. MRI in children with mental retardation. Pediatr Radiol 2003 May; 33(5):334-45.