Role of Magnetic Resonance Imaging in Evaluation of Pediatric Patients with Mental Retardation

Thesis

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List of Abbreviations

Abbr.	Full-term
CMV	: Cytomegalovirus
CSF	: Cerebral Spinal Fluid
DWM	: Dandy-walker malformation
HUS	: Hemolytic Uremic Syndrome
IQ	: Intellectual disability
MR	: Mental retardation
MRI	: Magnetic Resonance Imaging
MSP	: Mucopolysaccharidoses
TS	: Turner syndrome

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Abstract

Introduction: Developmental delay is defined as significant delay in one or more developmental domains. Magnetic Resonance Imaging (MRI) is the best modality to investigate such patients. Evaluation of a child with developmental delay is important not only because it allows early diagnosis and treatment but also helpful for parental counseling regarding the outcome of their child and to identify any possible risk of recurrence in the siblings.

Aims and Objectives: To study the prevalence of normal and abnormal MRI in pediatric patients presenting with developmental delay and further categorize the abnormal MRI based on its morphological features.

Patient and Methods: Thirty five patients with clinical diagnosis of mental retardation were enrolled in this study(20 females and 15 males)with their age ranged from 4 months to 13years.

They were referred from pediatric clinic to MRI unit of Ain Shams University hospitals from September 2015 to March 2016

MRI brain was done by 1.5Tesla MRI scanner (Philips, Achieva. Best the Netherlands) in the MRI unit of Ain Shams University Hospitals with appropriate sequences and planes after making the child sleep/sedated/ anesthetized. Various anatomical structures like Ventricles, Corpus callosum, etc were systematically assessed. The MRI findings were divided into various aetiological subgroups.

Results: Normal MRI findings were seen in 31.4% cases and 68.57% had abnormal findings of which the proportion of Hypoxic ischemic encephalopathy, Congenital & Developmental, Metabolic , encephalitis causing mental retardation and non specific were 29%, 21%, 12.5%, 4.1%, 33.33% respectively. The ventricles and white matter mainly the corpus callosum were the most commonly affected anatomical structures. The diagnostic yield was found to be 68% and higher yield was seen in patients presenting with developmental delay plus.

Conclusion: The clinical diagnosis of developmental delay should not be the end point, but rather a springboard for an effective search for causal factors. MRI is the best investigation with a high yield in such patients.

Keywords: Mental retardation, MRI brain, Pediatric patients

Introduction

Intellectual disability (ID), also called intellectual development disorder (IDD) or general learning disability, and formerly known as mental retardation (MR), is a generalized neurodevelopmental disorder characterized by significantly impaired intellectual and adaptive functions. It is defined by an intelligence quotient (IQ) score below 70, in addition to deficits in two or more adaptive behaviors that affect every day general living ***(Wilmshurst and Linda, 2012)***.

Intellectual disability is subdivided into syndromic intellectual disability, in which intellectual deficits associated with other medical and behavioral signs and symptoms are present, and non-syndromic intellectual disability, in which intellectual deficits appear without other abnormalities ***(Wilmshurst and Linda, 2012)***.

Intellectual disability affects about 2–3% of the general population. 75–90% of the affected people have mild intellectual disability ***(Althaf et al., 2015).***

Magnetic Resonance Imaging (MRI) is the best modality to investigate patient with mental retardation. Evaluation of a child with developmental delay is important not only because it allows early diagnosis and treatment but

also helpful for parental counseling regarding the outcome of their child and to identify any possible risk of recurrence in the siblings ***(Momen et al., 2011)***.

MRI permits better anatomic definition, particularly of the cranial base and posterior fossa. Evaluation of myelination and gray/white differentiation also is superior especially after age 6–9 months. Subtle abnormalities (heterotopias, macro-cisterna magna, abnormalities of the septum pellucidum, etc.) are better delineated on MRI ***(Cynthia et al., 1997).***

MRI has shown a high incidence of subtle cerebral abnormalities and unexpected minor forms of cerebellar cortical dysplasia ***(Daily et al., 2000).***

Aim of the Work

To study the prevalence of normal and abnormal MRI findings in pediatric patients presenting with mental retardation and further categorize the abnormal MRI findings based on its morphological features.

Normal MRI Anatomy of the Brain

Axial MRI anatomy of the brain

MRI scans are obtained parallel to the cantho-meatal line. These scans are divided into posterior fossa cuts and supra-tentorial cuts ***(Naheedy, 2002).***

Posterior fossa cuts:

This set of cuts includes four sections from the foramen magnum to the supra-sellar region.

I. Above the level of foramen magnum:

The cisterna magna lies behind the medulla and below the cerebellar hemispheres. The cerebellar tonsils are the most anterior inferior part of the hemisphers and lie close to the midline. The medulla oblongata contains the inferior portion of the fourth ventricle, called the obex, and its outlet foramina (Magendie, posteriorly in the midline and Luschka bilaterally). (Fig.1) ***(Ryan et al., 2011).***

This section also contains the inferior cerebellar peduncles (restiform bodies) postero-laterally. On higher slices the cerebellum is separated from temporal and occipital lobes anterolaterally by tentorial margins. The superior vermis can be seen between the occipital lobes on section through the thalamus ***(Ryan et al., 2011).***

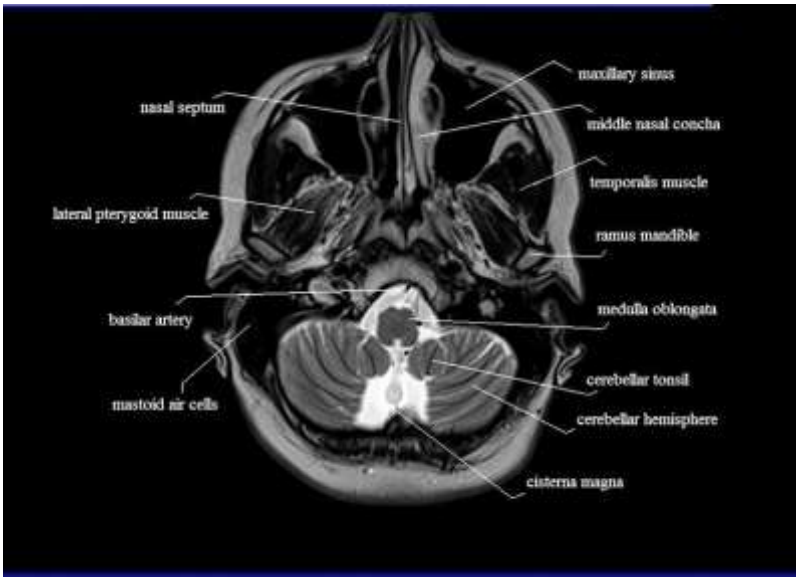

Figure (1): Axial MRI anatomy; T2-WI above level of foramen magnum ***(Quoted from Micheau and Denis, 2008).***

2. At the fourth ventricule level:

The fourth ventricle can be seen as a slit-like CSF filled structure between the brainstem and the cerebellar hemispheres. The larger lower basilar portion of the pons (basis pontis) is seen in front of the fourth ventricle. The pons is outlined by the anterior and lateral mesencephalic cisterns containing CSF ***(Ryan et al., 2011).***

The middle cerebellar peduncles (brachium pontis) are seen connecting the pons to the cerebellar hemispheres. The trigeminal nerves are seen at the antero-lateral aspect of the pons, while the facial nerves and vestibulo-cochlear nerves are seen somewhat more inferiorly and laterally at the ponto-medullary junction (fig. 2) ***(Ryan et al., 2011).***