CONTENTS

LIST OF FIGURES

LIST OF FIGURES

LIST OF FIGURES

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

ADC	Apparent diffusion coefficient
AGAT	Arginine : glycine amidinotransferase
ALD	Adrenoleukodystrophy
ARG	Arginase
ASL	Argininosuccinic acid lyase
ASS	Argininosuccinic acid synthetase
ATP	Adenosine triphosphate
BOLD	Blood oxygen level dependent
BR	Bilirubin
CAT	Computed axial tomography
CCA	Common carotid artery
CDG	Carbohydrate deficient glycoprotein
Cho	Choline
CNS	Central nervous system
CPSI	Carbamyl phosphate synthetase I
Cr	Creatine
CSF	Cerebrospinal fluid
CSP	Cavum Septum Pellucidum
CT	Computed tomography
CTT	Central tegmental tract
DTI	Diffusion tensor imaging
DWI	Diffusion weighted imaging
ECA	External carotid artery
EPI	Echo planar imaging
FA	Fractional anisotropy
FID	Free Induction Decay
FLAIR	Fluid attenuated inversion recovery
fMRI	Functional magnetic resonance imaging
FSE	Fast spin echo
GAMT	Guanidinoacetate methyltransferase
GFAP	Glial fibrillary acidic protein
GRE	Gradient recalled echo
ICA	Internal carotid artery
IR	Inversion recovery

LIST OF ABBREVIATIONS

MGN	Medial geniculate nucleus
MHz/T	Megahertz per tesla
MI	Myo-inositol
MLC	Megalenchephalic leukoenchephalopathy
MLCP	Myosin light chain protein
MRI	Magnetic resonance imaging
MRS	Magnetic resonance spectroscopy
msec	Milli seconds
MSUD	Maple syrup urine disease
NAA	N-acetyl-aspartate
NCLs	Neuronal ceroid lipofuscinosis
OTC	Ornithine transcarboxylase
PCA	Posterior carotid artery
PDHC	Pyruvate dehydrogenase complex
PET	Positron emission tomography
PKU	Phenylketonuria
PLP	Proteolipid protein
ppm	Parts per million
PPT	palmitoyl-protein thioesterase
PRESS	Pointed-resolved spectroscopy sequence
PWI	Perfusion weighted image
rCBV	Relative cerebral blood volume
RF	Radiofrequency
SE	Spin echo
SNR	Signal/noise ratio
STEAM	Stimulated echo acquisition mode
TE	Time to receive echo
TR	Time to repeat sequence
US	Ultrasonography
VWM	Vanishing white matter
WD	Wilson disease

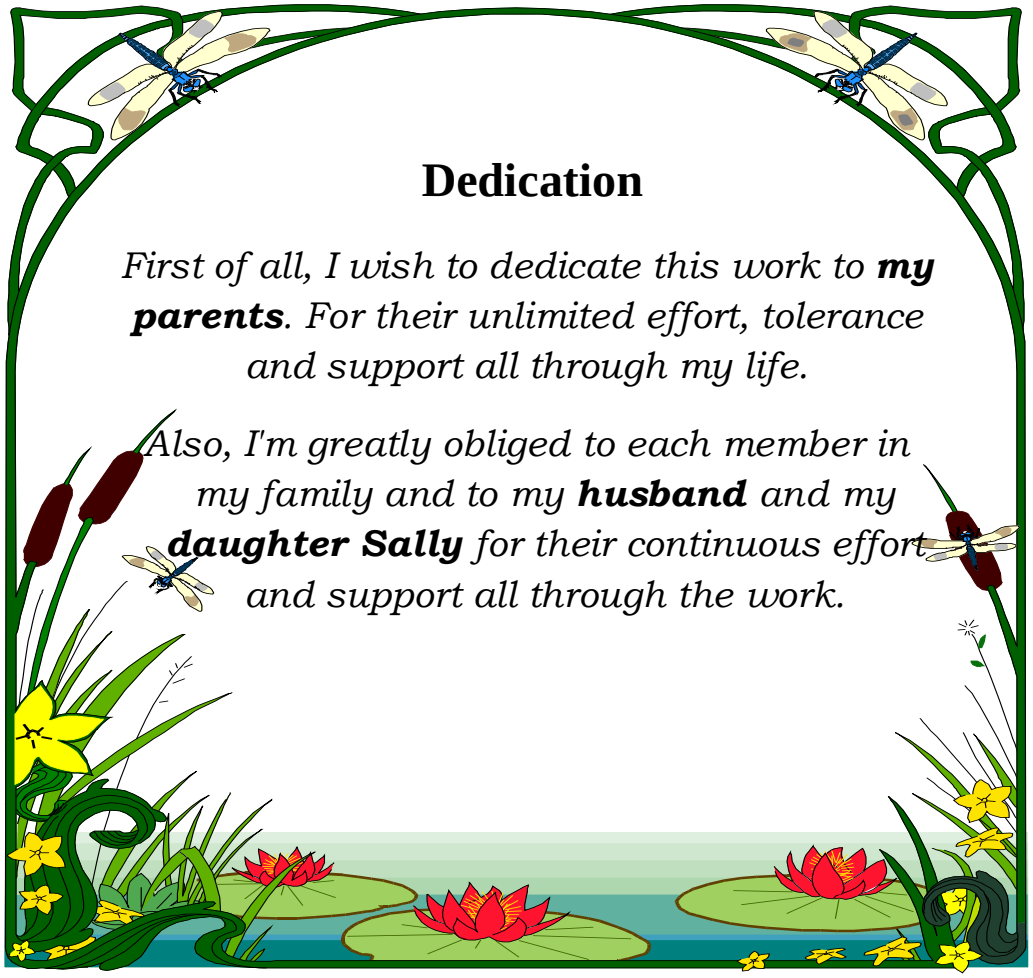
Acknowledgments

First of all I thank Allah the most gracious the most merciful for blessing this work until it has reached its end as a part of his generous gifts throughout my life.

I wish to express my sincere thanks and deepest gratitude to ***Prof. Dr. Sahar Farouk Shaaban*** *, Professor of Radiodiagnosis, Ain Shams University for her kind supervision and constructive guidance. It was through her continuous help and moral support that this work was completed. The experience I had during working with her extended for beyond this work to affect many aspects of my personal and professional life.*

I am deeply indebted to ***Lecture.Dr. Mohamed Sobhi Hassan****, Lecture of Radiodiagnosis, Ain Shams University, for his thoughtful ideas, kind support and encouragement. He devoted much of her time, effort and experience in the supervision of this work till it has seen the light. The experience I had during working with him extended for beyond this work to affect many aspects of my personal and professional life.*

Last but not least, I am very grateful to all my family for their unlimited tolerance and support all through.



Dedication

First of all, I wish to dedicate this work to ***my parents****. For their unlimited effort, tolerance and support all through my life.*

Also, I'm greatly obliged to each member in my family and to my ***husband*** *and my* ***daughter Sally*** *for their continuous effort and support all through the work.*

Protocol

Advanced MRI imaging technique in diagnosis of metabolic and degenerative brain disorders of pediatric age group.

Essay
Submitted for partial fulfillment of the
Master Degree in Radiodiagnosis

By

Nadin fawzy Abd El Aziz Abd El Mageed

M.B., B.Ch Ain Shams University .

Supervised By

Prof. Dr. Sahar Farouk Shaaban.

Professor of Radiodiagnosis Faculty of Medicine – Ain Shams University

Lecture. Dr. Mohamed Sobhi Hassan

lecture of Radiodiagnosis
Faculty of Medicine – Ain Shams University

Faculty of Medicine
Ain Shams University
Department of Radiodiagnosis
2012

Contents:

Introduction

Magnetic resonance imaging (MRI) is a non invasive medical test that helps physicians diagnose and treat medical conditions.

MRI uses a powerful magnetic field, radio frequency pulses and a computer to produce detailed pictures of organs, soft tissues, bone and virtually all other internal body structures. The images can then be examined on a computer monitor, transmitted electronically, printed or copied to a CD. MRI does not use ionizing radiation (x-rays).
Detailed MR images allow physicians to better evaluate various parts of the body and determine the presence of certain diseases that may not be assessed adequately with other imaging methods such as x-ray, ultrasound or computed tomography (also called CT, MDCT or CAT scanning).

Currently, MRI is the most sensitive imaging test of the head (particularly in the brain) in routine clinical practice.

There are advanced techniques are known as diffusion-weighted, perfusion, magnetization transfer, functional MRI and MR spectroscopy. An important issue is that they can provide quantitative estimates of structural and functional characteristics that are below the voxel resolution. **(Pagani et al 2008)**

Proton magnetic resonance (MR) spectroscopy is a complementary method to MR imaging for understanding disease processes in the pediatric brain. By demonstrating the presence of various metabolites in the sampled tissue, MR spectroscopy helps in the understanding of abnormalities detected by MR imaging or clinical examination.
This capability is especially pertinent in the pediatric brain, where the manifestation of pathology is superimposed upon a background of normal or abnormal brain development. **(Cecil et al, 2002)**

Diffusion tensor imaging (DTI), is a new MR-based technique allowing, in - vivo, the assessment of the water diffusive transport in cerebral tissues, depending on the molecular and biochemical environment. Over the past decade, DTI has become an indispensable part of the MR evaluation of pediatric brain in the clinical practice. Quantitative analysis of fractional anisotropy (FA) and apparent diffusion coefficient (ADC), the two most common indices used to describe the diffusion characteristics, helps the comprehension of the childhood brain maturation and enables the early detection of several brain diseases. DTI also allows us to look at anisotropic diffusion within white matter tracts. To better demonstrate the location and orientation of the white matter tracts, new and/or more sophisticated methods such as Color-Encoded Map and Fiber

Tracking have been proposed. We review the theoretical background of DT-MRI, and some of its commonest applications, particularly in Pediatric Neuroradiology.**(BERNARDI et al ,2005).**

Imaging of the brain, magnetic resonance imaging (MRI) in particular, is a key adjunctive tool in the diagnosis of degenerative , metabolic and toxic disorders such as, mitochondrial encephalopathies, disorders of iron or copper metabolism, exposure to carbon monoxide, radiotherapy, immunosuppressive agents, toluene, and recreational drugs**.(Arora et al ,2008).**

The neurodegenerative diseases of infancy and childhood include disorders in which there is progressive loss of neurological function due to structural abnormalities of the central nervous system ,a classification is offered grouping the neurodegenerative disorders into five major categories: polioencephalopathies, leukoencephalopathies, corencephalopathies, spinocerebellopathies, and diffuse encephalopathies. Disorders in each subgroup may be either genetic or nongenetic. Neurodegenerative diseases have multiple causes, including metabolic, viral, immunopathic, environmental, and epileptogenic. The cause of many remains unknown**.(Paul et al, 2004).**

Metabolic Disorders **:** Inborn errors of the metabolism form a heterogeneous, ever-expanding group of disorders ,involving white and gray matter. A large number of them are leukodystrophies, affecting primarily myelin and producing dysmyelination or hypomyelination**.** A different group of diseases is characterized by breakdown of normally formed white matter and are called demyelinating ***diseases.*** Many of them are acquired (such as multiple sclerosis), but have a strong genetic predisposition.

DT-MRI appears to be a very promising technique in the assessment of white matter diseases. Some authors consider DTI superior to conventional MRI in differentiating dysmyelinating disorders from demyelinating disorders. **(BERNARDI et al ,2005) .**

In vivo magnetic resonance spectroscopy (MRS) addresses metabolic pathways and their steady states in different tissue types. The brain has by tradition, and due to technical limitations in other organs, been one of the tissues most studied by MRS, and both ^{1}H- and ^{31}P-MRS have been used. Although ^{31}P-MRS is outstanding for the evaluation of sources of metabolic energy in the brain, ^{1}H-MRS has become the major clinically applied method in neurospectroscopy, as it provides information on markers of neuronal function, myelin, cell membranes, and metabolic active compounds.**(Isabella et al ,2001).**

In this essay, we review the neuroimaging findings of common degenerative and metabolic disorders focusing on the role of advanced MRI techniques in evaluation and diagnosis of metabolic and degenerative disorders .

.

Aim of the work:

To emphasis the role of advanced MRI techniques in diagnosis of metabolic and degenerative brain disorders of pediatric age group.

Contents: