Role of Magnetic Resonance Spectroscopy in Discrimination between Tumors and Tumor like Lesions in Brain Masses.

Essay

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بِسْمِ ٱللَّهِ ٱلرَّحْمَٰنِ ٱلرَّحِيمِ

ٱقْرَأْ بِٱسْمِ رَبِّكَ ٱلَّذِى خَلَقَ ﴿١﴾ خَلَقَ ٱلْإِنسَـٰنَ
مِنْ عَلَقٍ ﴿٢﴾ ٱقْرَأْ وَرَبُّكَ ٱلْأَكْرَمُ ﴿٣﴾ ٱلَّذِى عَلَّمَ
بِٱلْقَلَمِ ﴿٤﴾ عَلَّمَ ٱلْإِنسَـٰنَ مَا لَمْ يَعْلَمْ ﴿٥﴾

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Table of Contents

Titles	*Page No.*
List of Abbreviations……	*III*
List of Figures……	*VII*
List of Tables……	*X*
Introduction and aim of work……	*XI*
Chapter 1: Physical basics & technical aspect of MRS ……	*1*
Chapter 2: MRS of normal brain……	*33*
Chapter 3: MRS of brain tumors & tumor like lesion ……	*54*
Chapter 4: MRS in radiation injury……	*103*
Chapter 5: MRS & other Morphofunctional MR modalities in the Diagnosis and Follow-up of brain tumors……	*119*
Chapter 6: Clinical Cases…… ……	*146*
SUMMMARY……	*169*
REFERANCES……	*171*

List of Abbreviations

ϒ	*Gyromagnetic ratio*
1HMRS	*Proton Magnetic Resonance Spectroscopy*
2D	*Two Dimensional*
3D	*Three Dimensional*
AAs	*Amino Acids*
Ac	*Acetate*
ACTH	*Adreno Cortico Trophic Hormone*
AD	*Alzheimer's Disease*
Ala	*Alanine*
B	*The effective magnetic field strength*
Bo	*Magnetic field strength*
CBV	*Cerebral Blood Volume*
CHESS	*Chemical Shift Elected pulse Sequance*
Cho, Ch	*Choline*
Or Co	
cMRI	*Conventional Magnetic Resonance Imaging*
CNS	*Central Nervous System*
Cr	*Creatine*
Crypto	*Crytococcoma*
CSF	*CerebroSpinal Fluid*

CSI	*Chemical Shift Imaging*
CT	*Computed tomography*
DM	*Diabetes Mellitus*
DNETs	*Dysembryoplastic Neuro Epithelial Tumors*
F	*Fluorine*
FDA	*Food and Drug Administration*
FLAIR	*Fluid Attenuation Inversion Recovery*
FSH	*Follicular Stimulating Hormone*
GBM	*Glioblastoma Multiforme*
GC	*Gliomatosis Cerebri*
Glx	*Glutamine & Glutamate*
GM	*Gray Matter*
GFAP	*Glial Fibrillary Acidic Protein*
H	*Hydrogen*
HE	*Hepatic Encephalopathy*
ICH	*Intracranial Haemorrhage*
JPA	*Juvenile Pilocytic Astrocytoma*
Lac	*Lactate*
LCH	*Langerhans Cell Histiocytosis*
LGG	*Low Grade Glioma*
LIP	*Lipids*
mI	*Myo-inositol*

MS	*Multiple Sclersosis*
MVS	*Multi Voxel Spectroscopy*
NAA	*N-Acetyl Aspartate*
NMRS	*Nuclear Magnetic Resonance Spectroscopy*
PKU	*Phenylketonuria*
PML	*Progressive Multifocal Leukoencephalopathy*
PNETs	*Primitive Neuro Ectodermal Tumors*
ppm	*Parts Per Million*
PRESS	*Point Resolved Spectroscopy*
PROBE	*Proton Brain Examination*
PXA	*Pleomorphic Xantho Astrocytoma*
rCBV	*Relative Cerebral Blood Volume*
SBS	*Shaken Baby Syndrome*
SNR	*Signal to Noise Ratio*
SOL	*Space Occupying Lesion*
STEAM	*Stimulated Echo Acquisition Mode*
Succ	*Succinate*
SVS	*Single Voxel Spectroscopy*
TCA	*Tricarboxylic acid*
TE	*Echo Time*
TMS	*TetraMethylSilane*
Toxo	*Toxoplasmosis*

TR	*Time to Repeat*
TSH	*Thyroid Stimulating Hormone*
RF	*Resonance frequency*
VOI	*Volume Of Interest*
WHO	*World Health Organization*
WM	*White Matter*

List of Figures

No	address	page
1.1	Magnetic isotopes used in MRS	3
1.2	Single voxel spectroscopy	7
1.3	PRESS	8
1.4	STEAM	9
1.5	Common pulse sequences for single-voxel localization techniques.	10
1.6	MRSI	12
1.7	Circular 2D k-space sampling.	13
1.8	Use of OVS to minimize unwanted signal from outside the brain	14
1.9	phantom PRESS-MRSI & 2DPRESS-MRSI	14
1.10	2D-PRESS-MRSI pulse sequence	16
1.11	Multi-slice 2D MRSI pulse sequence	17
1.12	SVS versus MRSI	19
1.13	Spectrum acquired using echo time (TE) of 30 mseconds	22
1.14	Spectrum acquired using echo time (TE) of 270 mseconds	22
1.15	WATER SUPPRESSION,	23
1.16	FAT SUPPRESSION	24
1.17	Effects of metal artifacts and air–tissue interfaces on field homogeneity in the brain	28
1.18	LOW & HIGH FIELD MRS	30
1.19	Overview of the major processing steps for spectral analysis	31
1.20	Diagrammatic representation data processing of MRS.	32
2.1	Normal spectrum at short TE. Spectrum	34
2.2	Metabolites in parts per million (ppm)	37
2.3	age & regional variation	49
2.4	REGIONAL VARIATION ,CLINICAL CASE	50
2.5	CSF-corrected metabolic images of Cho, Cr, and NAA	51

3.1	*classification of brain tumors into primary and secondary*	*55*
3.2	*Classification of brain tumors*	*56*
3.3	*regional & age distribution of brain tumors.*	*57*
3.4	*Metabolite ratios in pure and mixed astrocytomas.*	*63*
3.5	*Recurrent GBM with high Cho and high lactate*	*64*
3.6	*Elevated Cr signal in grade II astrocytoma infiltrating the thalamus*	*66*
3.7	*Histologically confirmed glioblastoma*	*67*
3.8	*GBM IMAGING,MRS&COLOR CODED METABOLITE MAP,*	*68*
3.9	*Differential diagnosis of gliomatosis (GC) vs. low-grade glioma (LGG)*	*70*
3.10	*glioblastoma with oligodendroglioma component*	*71*
3.11	*MRS of lymphoma*	*72*
3.12	*MRS of Brain metastasis*	*74*
3.13	*MRS of meningioma*	*75*
3.14	*The most common brain tumor like lesions*	*77*
3.15	*Brain abscess in the right basal ganglia*	*79*
3.16	*Brain abscess*	*81*
3.17	*TUMORAL NECROSIS*	*82*
3.18	*MRS of Multiple tuberculous abscesses.*	*83*
3.19	*meningoencephalitis*	*85*
3.20	*MRS OF Subacute infarction*	*86*
3.21	*Periventricular tumefactive demyelinating lesion*	*88*
3.22	*Cortical dysplasia*	*89*
3.23	*TOMOR GRADING BY MRS*	*93*
3.24	*MR spectra taken from normal brain, and different grades of astrocytomas*	*95*
3.25	*Multiple MR spectra and corresponding contrast-enhanced images*	*96*
4.1	*Swiss cheese_like enhancement with feathery margins and central necrosis*	*108*
4.2	*recurrent grade 4 glioma,*	*109*
4.3	*ependymoma shows new contrast enhancing lesions within the irradiated volume suspicious for tumor recurrence*	*111*

4.4	*anaplastic oligodendroglioma after resection , radiation , and chemotherapy.*	*112*
4.5	*anaplastic astrocytoma , after resection , radiation , and chemotherapy*	*114*
4.6	*anaplastic astrocytoma , after resection , radiation , and chemotherapy*	*117*
4.7		*122*
5.1	*tumor characterization by multimodal MRI*	*121*
5.2	*multimodal assessment of lymphoma*	*129*
5.3	*multimodal assessment of medulloblastoma*	*130*
5.4	*multimodal assessment of low grade astrocytoma*	*131*
5.5	*multimodal assessment of GBM*	*132*
5.6	*MRI metabolite maps of high-grade glioma.*	*135*
5.7	*rCBV MR images showing radiation necrosis*	*136*
5.8	*rCBV MR images of low grade gliomas*	*136*
5.9	*Recurrent tumor versus radiation necrosis*	*137*
5.10	*Alokaili Alrgorithm illustrate multimodal MRI imaging*	*145*
6.1	***CASE 1** preoperative imaging*	*147*
6.2	*Follow up 6 months*	*148*
6.3	*Follow up 9 months*	*149*
6.4	***CASE 2** preoperative imaging*	*151*
6.5	*Early Postoperative Follow-up (Within 24 Hours)*	*151*
6.6	*Follow up 2 months*	*152*
6.7	*Follow up 6 months*	*152*
6.8	*Follow up 8 months*	*153*
6.9	*Follow up 13 months*	*154*
6.10	*Follow up 15 months*	*155*
6.11	***Case 3** preoperative imaging*	*156*
6.12	*preoperative imaging*	*157*
6.13	*Early post operative follow up*	*158*
6.14	*Follow up 4 months*	*158*
6.15	*Follow up 10 months*	*159*
6.16	*Follow up 12 months*	*160*

6.17	***Case 4*** *preoperative imaging*	*162*
6.18	*Follow up 6 months*	*163*
6.19	*Follow up 12 months*	*164*
6.20	***Case 5*** *follow up 7 months*	*165*
6.21	*Follow up 7 months*	*166*
6.22	*Follow up 15 months*	*167*
6.23	*Follow up 28 months*	*168*

List of tables

1.1	*Difference between SVS & MRSI.*	*16*
2.1	*metabolite ratios*	*42*
2.2	*A list of sixteen common chemical shift assignments in brain MRS*	*43*
3.1	*regional & age distribution of brain tumors.*	*57*
3.2	*WHO grading versus other grading systems*	*59*
3.3	*summery of MRS FINDINGS IN TUMORS & PSEUDOTUMORAL LESIONS*	*90*

INTRODUCTION & AIM OF THIS WORK

There are two types of brain tumors : primary brain tumors that originate in the brain and metastatic (secondary) brain tumors that originate from cancer cells that have migrated from other parts of the body. A primary brain tumor rarely spreads beyond the central nervous system, and death results from uncontrolled tumor growth within the limited space of the skull. Metastatic brain cancer indicates advanced disease and has a poor prognosis ***(Nakamura et al., 2007).***

Primary brain tumors can be cancerous or noncancerous. Both types take up space in the brain and may cause serious symptoms and complications. All cancerous brain tumors are life threatening (malignant) because they have an aggressive and invasive nature. A noncancerous primary brain tumor is life threatening when it compromises vital structures. Brain cancer is the leading cause of cancer-related death in patients younger than age 35 ***(Nakamura et al., 2007).***

Primary brain tumors account for 50% of intracranial tumors and secondary brain cancer accounts for the remaining cases. Approximately 17,000 people in the United States are diagnosed with primary cancer each year and nearly 13,000 die of the disease. The annual incidence of primary brain cancer in children is about 3 per 100,000.Secondary brain cancer occurs in 20–30% of patients with metastatic disease and incidence increases with age. In the United States, about 100,000 cases of secondary brain cancer are diagnosed each year **(wolf , 2011)**

The diagnosis of brain tumors by magnetic resonance imaging (MRI) is usually based on basic unenhanced T1- and T2-weighted images and post contrast T1-weighted images. Conventional MRI techniques are not sufficient for the grading and specification of brain tumors. Furthermore, several pseudotumor lesions, such as arachnoid cysts, heterotopic gray matter, tubers of tuberous sclerosis, cavernous

hemangiomas, aneurysms, granulomas, abscesses, radiation necrosis and acute demyelination with a mass effect can mimic brain tumors on MRI **(Louis et al., 2007).**

Proton Magnetic Resonance Spectroscopy (^{1}H-MRS) can differentiate benign from malignant tumors **(Louis et al., 2007).**

^{1}H-MRS is superior to MRI in the detection of tumor growth in morphologically normal tissue and in the differential diagnosis of untreated intracranial space-occupying lesions (SOLs) **(Louis et al., 2007).**

^{1}H-MRS has not only been used to identify tumors, but also to noninvasively grade and classify brain tumors ***(Essig et al., 2007).***

^{1}H-MRS is especially useful in cases where MRI demonstrates enhancement, but it is difficult to determine whether it is radiation necrosis (positive treatment response) or recurrence (negative treatment response), and upon ^{1}H-MRS diagnosis of recurrence, the surgeon becomes able to proceed quickly to treatment instead of waiting for symptoms of recurrence or biopsy confirmation **(Lin , et al, 2005)**

Discrimination between brain abscess and cystic tumors with similar neuroimaging appearance can be achieved by 1H MRS, which is very important for determining the treatment strategy ***(Essig et al., 2007).***

The spectral pattern of intracranial tumors usually includes reduction in N-acetyl aspartate (NAA) level and NAA/Creatine (Cr) ratio, decreased creatine (Cr) level, Increase in Choline (Cho) and Cho/NAA and Cho/Cr ratios, also higher Lactate peak is seen in higher grade tumors, and the presence of lipids is a strong indication of tissue

necrosis. mI/Cr ratio is usually higher in lower grade than in higher grade tumors , While the spectral pattern of brain abscess is characterized by the presence of amino acids, acetate, and succinate. ***(Essig et al., 2007).***

MRS may have an important role to play in guiding the surgeon to the area of highest abnormal spectral changes in the brain lesion prior to stereotactic surgery for histological diagnosis and tumor staging. As multivoxel spectroscopy accesses the lesion in its complete extension and is able to identify the area with the greatest increase in Cho levels, hence greater tumor activity, which is the ideal site for biopsy. **(wolf , 2011)**

MRS cannot totally replace brain biopsy for histological diagnosis, but might be able to better delineate and define tumor boundaries and separate an infiltrative growing glioma from normal brain tissue, thereby helping in presurgical planning of brain neoplasm. ***(Essig et al., 2007).***

MRS has been shown to be a helpful tool in evaluation of a new contrast-enhancing lesion at the site of a previously identified and treated primary intracranial neoplasm, differentiating recurrent tumor from radiation injury. Recurrent tumors are characterized by reappearance of high choline peak, while in radiation injury the choline peak is absent or depressed. **(wolf , 2011)**