

Contents

Subjects	Page
List of abbreviations.....	II
List of Figures.....	VI
List of Tables.....	VII
• Introduction.....	1
• Aim of the Work.....	3
• Overview of Pathology of Pediatric Brain Tumors.....	4
• Physics.....	27
• Techniques and Normal Finding.....	65
• Spectroscopy and Diffusion Weighted Images in Pediatric Brain Tumor.....	84
• Summary.....	158
• References.....	161
• Arabic Summary	

List of Abbreviations

NMRS	: Nuclear magnetic resonance spectroscopy
MRI	: Magnetic resonance imaging
CNS	: Central nervous system
DWI	: Diffusion-weighted imaging
ADC	: Diffusion coefficient
BBB	: Blood-brain barrier
CSF	: Cerebro-spinal fluid
WHO	: World Health Organization
JPA	: Juvenile pilocytic astrocytoma
PNET	: Primitive neuroectodermaltum
LCH	: Langerhans cell histocytosis
MR	: Magnetic resonance
NAA	: N-acetylaspartate

List of Figures

<u>No.</u>	<u>Figure</u>	<u>Page</u>
<u>2-1</u>	Schematic illustration shows water molecule movement.	28
<u>2-2</u>	Pulse sequence diagrams.	30
<u>2-3</u>	Graph illustrating the logarithm of relative signal intensity.	32
<u>2-4</u>	Typical motion artifact.	35
<u>2-5</u>	Effects of eddy currents.	40
<u>2-6</u>	Illustration of T2 shine-through effect.	43
<u>2-7</u>	T2 washout artifact.	44
<u>2-8</u>	T2 shine-through and T2 blackout effects.	46
<u>2-9</u>	Anisotropic diffusion.	48
<u>2-10</u>	Diagram showing metabolite frequency relative to water frequency.	51
<u>2-11</u>	(Examples of metabolites (and their frequencies) that are observable at 1H MR spectroscopy.	53
<u>2-12</u>	Voxel misregistration due to chemical shift error caused by spatially varying, frequency-dependent differences of excitation.	61
<u>3-1</u>	Chart illustrates the advantages of quantitative MR imaging.	66
<u>3-2</u>	Series of diffusion-weighted images obtained for diffusion tensor imaging, in which q-space is sampled in at least six different directions and in which a non- diffusion-weighted reference image is obtained.	68
<u>3-3</u>	Axial images acquired through the bodies of the lateral ventricles of a 6-month-old child.	70
<u>3-4</u>	Transverse MR images in five children 17 days to 10 years old at the level of the corona radiata above the bodies of the lateral ventricles (a-e) and at the level of the basal ganglia (f-j).	71
<u>3-5</u>	Graph illustrates age-related changes in peak ADC values of the whole brain.	72

<u>No.</u>	<u>Figure</u>	<u>Page</u>
<u>3-6</u>	1H MR spectrum acquired at 3.0 T from a volume of interest in occipital lobe (20 3 20 3 20 mm3, T1-weighted axial image) of healthy subject with the STEAM sequence (repetition time msec/echo time [TE] msec = 5000/8; 128 repetitions).	77
<u>3-7</u>	17 day old boy.	79
<u>3-8</u>	4 month old girl.	80
<u>3-9</u>	6 month old boy.	81
<u>3-10</u>	10 month old boy.	82
<u>3-11</u>	13 month old boy.	83
<u>4-1</u>	MR spectroscopy image shows high choline (Cho)-to-creatine (Cr) ratio; this finding is consistent with neoplasm. NAA = N-acetyl aspartate.	86
<u>4-2</u>	Example spectra with (A) high risk and (B) low risk features.	89
<u>4-3</u>	Eleven-year-old female with cerebellar PA.	91
<u>4-4</u>	Right internal temporal DNET in a 15-year old child.	92
<u>4-5</u>	MRI of a pilocytic astrocytoma (grade I) of the right nucleocapsular region in a 5-year-old girl. Axial T2weighted image.	94
<u>4-6</u>	Ependymoma (WHO grade 2) in a 15-year-old boy. Without diffusion MR imaging, all reviewers were correct.	96
<u>4-7</u>	Pilocytic astrocytoma in a 6 years old child.	99
<u>4-8</u>	T2 WI.	99
<u>4-9</u>	Medulloblastoma in a 12-year-old boy.	101
<u>4-10</u>	MRI of a medulloblastoma (grade IV) in a 4-year-old boy.	101
<u>4-11</u>	MR spectroscopy of medulloblastoma.	102
<u>4-12</u>	T2 WI.	104
<u>4-13</u>	Low-grade ependymoma and anaplastic ependymoma. Short echo time (TE) MR spectra of a low-grade ependymoma.	105

<u>No.</u>	<u>Figure</u>	<u>Page</u>
<u>4-14</u>	Anaplastic ependymoma in a 4-year-old child.	106
<u>4-15</u>	Anaplastic brain stem glioma in a 15 years old child.	107
<u>4-16</u>	Proton MR spectroscopy (1H MRS) of untreated diffuse intrinsic brainstem glioma (DIBSG).	108
<u>4-17</u>	4-month-old female infant with pathologically proven atypical teratoid-rhabdoid tumor.	110
<u>4-18</u>	Diffuse grade 2 Astocytoma in a 13 years-old child.	112
<u>4-19</u>	Diffuse astrocytoma (grade II) of the right parietal lobe in a 2-year-old boy.	112
<u>4-20</u>	Grade 3 anaplastic astrocytoma in a 12 years old child.	114
<u>4-21</u>	Low-grade astrocytoma and anaplastic astrocytoma.	115
<u>4-22</u>	MR spectroscopy in glioblastomas.	117
<u>4-23</u>	Showing the positioning of a 2 cm × 2 cm × 2 cm single-voxel 1H Magnetic Resonance Spectroscopy (MRS) acquisition of a non biopsied optic pathway glioma and below it the 1H MR spectrum acquired.	119
<u>4-24</u>	Pilocytic astrocytoma (grade I) of the right nucleocapsular region in an 8-year-old girl.	120
<u>4-25</u>	17-year-old boy with intractable seizures secondary to pleomorphic xanthoastrocytoma.	122
<u>4-26</u>	-year-old boy with known history of tuberous sclerosis. Subependymal giant cell astrocytoma was surgically proven.	123
<u>4-27</u>	19-day-old boy with prenatal diagnosis of intracranial mass and hemorrhage. Diagnosis is desmoplastic infantile ganglioglioma.	125
<u>4-28</u>	1-year-old boy with a dysembryoplastic neuroepithelial tumor (grade I).	127
<u>4-29</u>	MR spectroscopy of DNET shows lactate peak.	128

<u>No.</u>	<u>Figure</u>	<u>Page</u>
<u>4-30</u>	Preoperative MR images demonstrating a typical-appearing GG.	129
<u>4-31</u>	A 14-year-old male patient started with automotor seizures without loss of consciousness, which included oroalimentary and distal portions of the extremity automatisms.	130
<u>4-32</u>	High (Gln), glutamine; (Lac), lactate; low (NAA + NAAG) total N-acetyl aspartatin gangliogliom.	130
<u>4-33</u>	11-year-old girl began experiencing left sided facial weakness and headache.	131
<u>4-34</u>	2-year-old boy who presented with loss of balance.	132
<u>4-35</u>	6-year-old girl who presented with seizures. Diagnosis is oligodendroglioma.	133
<u>4-36</u>	5 year-old boy with craniopharyngioma.	135
<u>4-37</u>	MR spectroscopy in a case of craniopharyngioma.	136
<u>4-38</u>	Rathke's cleft cyst.	137
<u>4-39</u>	Suprasellar germinoma in an 11-year-old girl.	138
<u>4-40</u>	Pineal germinoma. Short echo time (TE) MR spectra of a pineal germinoma and MR imaging indicating the region of interest.	139
<u>4-41</u>	10-year-old boy who presented with gelastic seizures secondary to surgically proven hypothalamic hamartoma.	140
<u>4-42</u>	GH-releasing macroadenoma in a 187-cm tall 11-year-old boy with McCune-Albright syndrome.	142
<u>4-43</u>	MRI and proton MRS in right ventricular CPC in a 5-year-old boy with a right ventricular CPC.	145

<u>No.</u>	<u>Figure</u>	<u>Page</u>
<u>4-44</u>	6-year-old girl who presented with headache secondary to large arachnoid cyst.	147
<u>4-45</u>	Calvarial metastases in a 9-year-old boy with stage four neuroblastoma presents with acute onset headache.	148
<u>4-46</u>	Cerebral MRI in a 15-year-old-boy with LCH.	150
<u>4-47</u>	Serial MRI in a patient has pineoblastoma showing incomplete response to chemotherapy.	151
<u>4-48</u>	Pineoblastoma in a 18-month-old boy.	152
<u>4-49</u>	14-year-old boy with biopsy-proven germinoma.	154
<u>4-50</u>	Germinoma in a 12-month-old girl.	155
<u>4-51</u>	11-year-old boy who presented with headache secondary to intracranial teratoma.	156



Introduction





Aim of the Work





Overview of Pathology of Pediatric Brain Tumors





Physics





Techniques and Normal Finding





Spectroscopy and Diffusion Weighted Images in Pediatric Brain Tumor





Summary





References

