PATTERN OF RADIATION THERAPY IN THE TREATMENT OF PEDIATRIC BRAIN TUMORS IN SIRIRAJ HOSPITAL

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ABTSRACT

A retrospective study was performed to review the management by radiation therapy (RT) for several types of pediatric brain tumors in a single institution. Of seventy-three children treated at Division of Radiation Oncology, Department of Radiology, Siriraj Faculty of Medicine from January 1990 to August 1999, 9 were equal to or younger than 3 years. The most common pathology was medulloblastoma. The modalities of treatment and the techniques of RT depend on age, pathology and location of tumors with 50% of brain stem tumors and 41% of pineal region tumors were irradiated without tissue diagnosis.

INTRODUCTION

Brain tumors constitute the most common solid neoplasms in childhood.[1,2] These consist of several histological types and location of lesions with different frequency of individual groups from those in adults. The common types of tumors in children are low-grade glioma and primitive neuroectodermal tumor (medulloblastoma). Approximately 50% of brain tumors in children more than 1 year old develop infratentorially. Due to the diversity of these diseases and age-influenced therapeutic modalities especially in radiation therapy (RT), this study was performed to review the conventional management and present some recent approach in RT for individual types of brain tumors in a single institution.

METHODS & MATERIALS

The pediatric patients with brain tumor treated with RT at Division of Radiation Oncology, Department of Radiology, Siriraj Hospital from January 1990 to August 1999 were eligible for this study. All available treatment records were reviewed to collect for the patient characteristics, histopathology of primary tumors, modalities of treatment and techniques of RT.

RESULTS

The total number of patients in this study was 73 , of which 9 were equal to or younger than 3 years. The number of patients distributed by age and histopathology of primary tumor according to the World Health Organization classification [3] is shown in Table 1.

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Table 1 The number of patients distributed by age and pathology of primary tumor

Characteristics	Number of patients
Age : <= 3 years	9
>3 years	64
Pathology: Astrocytoma Grade I	6
Grade II	6
Anaplastic astrocytoma	3
Glioblastoma multiforme	4
Medulloblastoma	16
Ependymoma Low grade	2
High grade	2
Germ cell tumor: Germinoma	9
Nongerminoma	4
Primitive neuroectodermal tumor	2
Craniopharyngioma	1
Choroid plexus papilloma	1
Unknown	17

The median age at diagnosis was 9 years (range 1/3 to 15 years).The most common pathology in this study was medulloblastoma. The tissue diagnosis cannot be obtained from certain location including brain stem lesions in 7, pineal region lesions in 9 and posterior fossa lesion in 1 infant.

The treatment for these tumors depended on location and pathology of tumors. The modalities of treatment are summarized in Table 2.

Table 2 The modalities of treatment for primary tumors

Pathology	Number of patients			
	Sx+RT	Sx+RT+CT	CT+RT	RTalone
Astrocytoma Grade I	4			2
Grade II	1			5
Anaplastic astrocytoma	2			1
Glioblastoma multiforme	4			
Medulloblastoma	14	2		
Ependymoma Low grade	2			
High grade	1	1		
Germ cell tumor: Germinoma	9			
Nongerminoma	2	2		
Primitive neuroectodermal tumor	2			
Craniopharyngioma	1			
Choroid plexus papilloma	1			
Unknown			1	16

Of 14 patients who were diagnosed of brain stem tumor, all were treated by RT alone except one with partial removal prior to RT. Of 7 (50 %) patients who were biopsied for tissue diagnosis, the distribution of pathologic results in brain stem tumors is shown in Table 3.

Table 3 The distribution of pathology in brain stem tumors

Pathology	Number of patients	
	Sx+RT	RT alone
Astrocytoma Grade I		1
Grade II		4
Anaplastic astrocytoma	1#	1
Glioblastoma multiforme		
Unknown		7

Partial removal of tumor

Of 22 patients with pineal region tumors, 13 (59 %) were confirmed for pathology. The increasing tendency to perform biopsy in the years during this study is shown in Table 4.

Table 4 The tendency to perform biopsy for pineal region tumors by years.

Year	No. of Patients	
	No biopsy performed	Biopsy performed
1990	-	1
1991	2	1
1992	1	1
1993	-	1
1994	3	-
1995	-	-
1996	1	-
1997	1	6
1998	-	2
1999	1	1

The distribution of pathologic suptypes and treatment in germ cell tumors are shown in Table 5.

Table 5 The distribution of pathologic subtypes and treatment in germ cell tumors.

Pathology	Number of patients			
	Sx+ RT	Sx+CT+RT	CT+RT	RT alone
Germinoma	8			1
Nongerminoma	2	2		
Unknown			1	8

One of the patients in this group received chemotherapy prior to RT without tissue diagnosis due to highly increased serum tumor marker.

The technique of RT (volume, total dose for primary tumors) are summarized in Table 6 and Table 7.

Table 6 The volume of RT

Pathology	Number of patients		
	CSI	WB & reduced field	local brain
Astrocytoma: Grade I		4	2
Grade II	1	2	3
Anaplastic astrocytoma		2	1
Glioblastoma multiforme		1	2
Medulloblastoma	16		
Ependymoma : Low grade	1	1	
High grade	2		
Germ cell tumor : Germinoma	5	4	
Nongerminoma	4	1	
Peripheral neuroectodermal tumor	2		
Craniopharyngioma			1
Choroid plexus papilloma	1		
Unknown : at brain stem	1		6
at pineal region	5	4	
posterior fossa	1		

CSI= Craniospinal Irradiation , WB= Whole brain

Table 7 The total RT dose @

Pathology	Number of patients			
	Dose at primary (Gy)		Dose at spine(Gy)	
	<=50	>50	<=30	>30
Astrocytoma : Grade I	5	1		
Grade II	2	3		1
Anaplastic astrocytoma	1	2		
Glioblastoma multiforme	1	3		
Medulloblastoma	6	7	9	4
Ependymoma : Low grade	1	1		1
High grade	1	1	1	1
Germ cell tumor: Germinoma	7	1	4	1
Nongerminoma	2	3	1	3
Primitive neuroectodermal tumor	1			
Craniopharyngioma		1		
Choroid plexus papilloma				
Unknown: at brain stem	5	2	1	
at pineal region	5	1	1	2
at posterior fossa	1		1	

@ Exclude 9 patients with incomplete RT .

DISCUSSION

Brain tumors represent the most common solid neoplasm in children treated each year at Siriraj Hospital.[4] The modalities of treatment depend on age at diagnosis, location and pathology of the tumor. Surgery has been traditionally used as the definitive diagnosis and initial therapeutic intervention except for unresectable tumors. The extent of resection is also clearly associated with the outcome for several types of brain tumors in children.[5] RT is acceptable modality as an adjuvant postoperative or definitive treatment in unresectable or inoperable cases.

The patients younger than 3 years account for 12.3 % of all children in this study. The current therapeutic strategies in this group differ from those in older children. In addition to the higher rate of surgical morbidity, RT has consistently been associated with severe neurophychological sequences in developing nervous system.[6-8] The chemotherapy has been investigated to be primary or primary postoperative treatment to delay, diminish or omit RT.[9] However, morbidity from chemotherapy alone was also reported in young children.[10]

For the lesions with high risk of open biopsy or resection such as brain stem or pineal region tumors, RT alone has been the alternative treatment without tissue diagnosis. However, a variety of new techniques such as CT- or MRI-guided stereotactic biopsy can manipulate this problem at present.

Of all 13 patients with brain stem tumors in this study, almost 50% were treated without

tissue diagnosis. The total dose to primary tumors varied from 40 to 56 Gy due to certain factors such as performance status of patients, volume and location of tumor and imaging characteristics. The distinction between subtypes and grading of brain stem gliomas can be apparent on magnetic resonance imaging (MRI). The suptypes classified by imaging findings consist of focal, dorsal exophytic, cervicomedullary and diffuse intrinsic tumors.[11] For the patients to whom biopsy can be accomplished safely, complete resection was not recommended in some cases. The hyperfractionated RT has not been performed in any patient with brain stem tumor in this study due to lack of significant benefit. Pediatric Oncology Group recently reported the result of phase III trial that hyperfractionated RT neither improved survival nor decreased morbidity of treatment compared to those of conventional RT.[12]

Due to the development of current microsurgical approaches, the treatment for pineal region tumors also has been changed. The tissue diagnosis and total resection should be obtained when possible to differentiate the radioresistant or RT not-required tumors such as teratoma . All except 1 patient in this study were biopsied after 1993. The delivery of test dose RT as primary treatment to rule out germinoma from other germ cell tumors has a tendency to markedly decrease at present.

In addition to treatment for the patients with existing neuraxis dissemination detected by MRI and/or cerebrospinal fluid cytology, the prophylactic RT to the entire craniospinal axis is demanded in certain tumors with striking propensity to spread throughout cerebrospinal fluid. These consist of high grade medulloblastoma, high grade ependymoma, pineoblastoma, germinoma, malignant germ cell tumor and primitive neuroectodermal tumor.[13-16] The other 2 patients in this study diagnosed with subependymal giant cell astrocytoma and choroid plexus papilloma also received craniospinal irradiation due to ventricular involvement.

The recommended total dose by conventional RT to primary brain tumors in childhood varies from 45 to 60 Gy depended mainly on pathology and location. The reduced volume of RT to primary tumor only is required during the treatment course because diffuse white matter change and intellectual decline can be apparent following full brain dose of 30 –35 Gy.[17,18] Concerns in morbidity should be more emphasized in certain types of tumor which required combined RT with chemotherapy.[19,20]

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