

:

*, †
* . † . †

_____ :

_____ : 1971 1992 45
 . 17.2 2.2:1 가 14 ,
 (suprasellar) 가 12 12 가 10 ,
 가 7 , 가 28 1982 가
 . 41 59 Gy (48.5 Gy), 19.5 36 Gy (24 Gy)
 2 260 82 .
 _____ : 4 14, 65, 76, 170 ,
 2 . 5 10 95.3% 84.7% , 5 10
 97.6% 88.8% . 4 3 ,
 1 가 48 50 Gy . 28
 15 45 Gy 18
 24 Gy (6 19.5 Gy).
 _____ : 100%
 45 Gy , 19.5 Gy .

: ,

)

72 90%
1 6)

가

_____ 1971 1992 45
 1999 10 9 1999 11 22
 : ,
 Tel : 02)361-7631, 가 21 24
 Fax : 02)312-9033 E-mail : cosuh317@yumc.yonsei.
 ac.kr

가 1982
 가 1977
 가 1982 20
 Gy 가
 7, 8)
 5 39 17.2 10 가
 68.9% 2.2:1 (Fig. 1).
 (suprasellar) 가 14, 12
 12 (

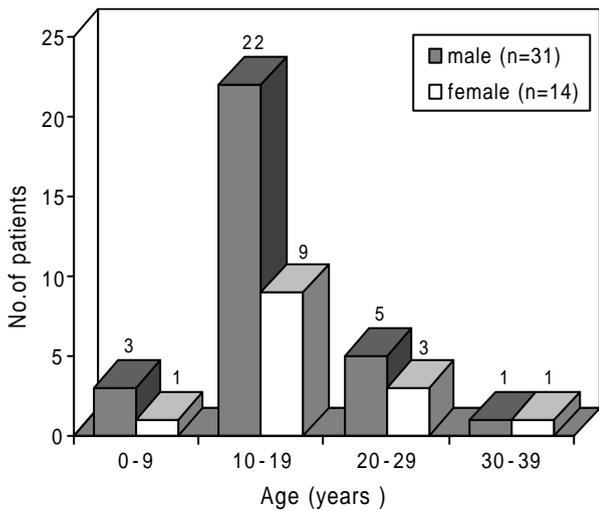


Fig. 1. Distribution of age and gender.

Table 1. Patients Characteristics by Location of Tumor and Gender

Site	No. of Patients		Total
	male	female	
pineal	13	1	14
suprasella	5	7	12
multiple	8	4	12
pituitary	0	2	2
other*	5	0	5

* thalamus 3, basal ganglia 2

Table 1).

4MV 가 Co-60
 1982 1982
 10, 7, 28
 7
 (7/10), 5 (5/7), 9 (9/28)
 (midplane) (isocenter),
 (anterior spinal canal)
 (prescribe)
 1.8 2 Gy 46
 57 Gy (50 Gy), 30 40 Gy (30.8 Gy)
 1.5 Gy
 41 59 Gy (45 Gy), 21 40.5 Gy (30 Gy),
 19.5 36 Gy (24 Gy)

Table 2

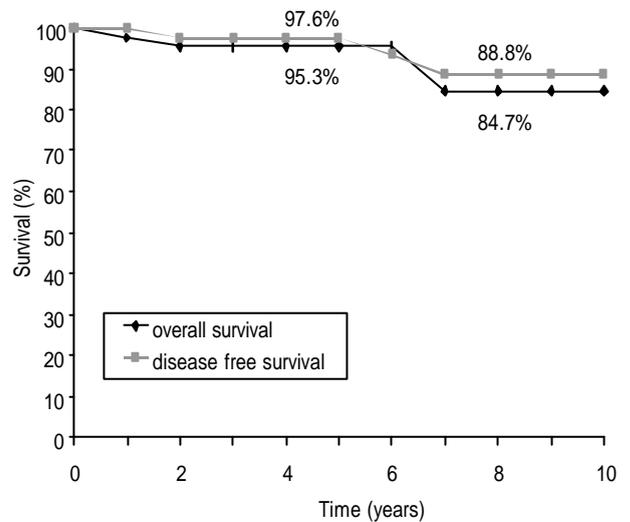


Fig. 2. Actuarial survival and disease free survival.

Table 2. Number of Patients by Treatment Volume and Primary Tumor Dose

Dose (Gy)	Volume		
	Local	W. Brain	CSI*
45	0	0	15
50	10	4	6
50<	0	3	7
Total	10	7	28

* craniospinal irradiation

Table 3. Data of 4 Patients Repeated Radiation Therapy

Case (No.)	Primary Site	RT [†] Volume	RT Dose (Gy)	Recurrence		Status (months)
				Site	Months	
1	pineal	local	50	frontal lobe	170	DWD [†] (183)
2	pineal	local	50	out of RT field [‡]	14	DWD (17)
3	pineal	local	48.5	frontal lobe	65	NED [§] (214)
4	thalamus	W.brain	48	primary & spine	76	DWD (83)

[†]radiation therapy, [‡] dead with disease, [‡] tentative geographic miss treated before CT era, [§] no evidence of disease

Kaplan-Meier

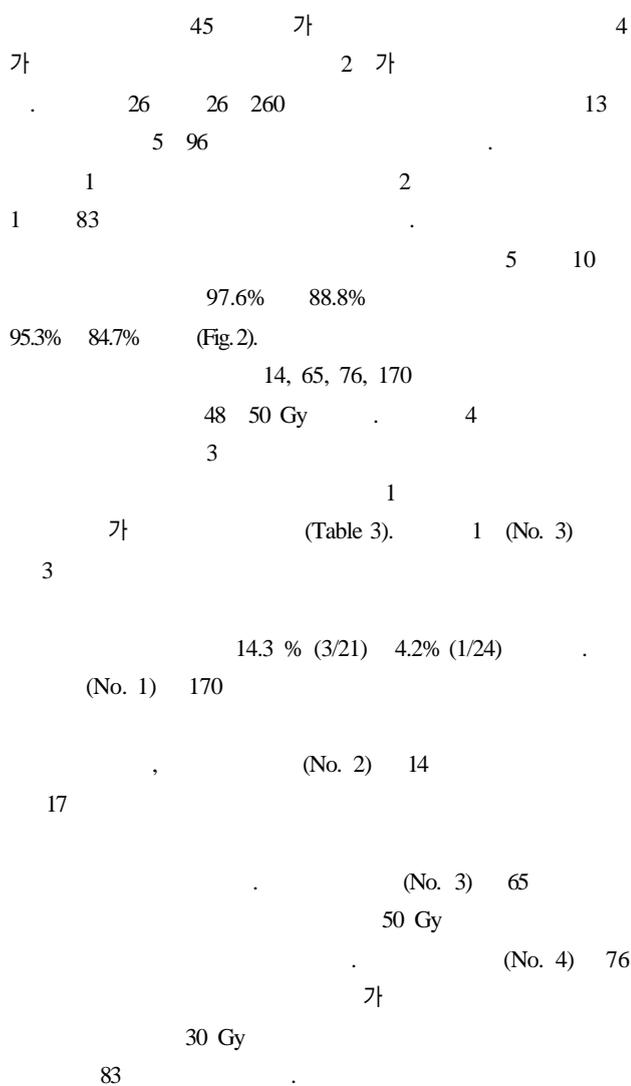


Table 4. Number of Failure Patients by Treatment Volume and Primary Tumor Site

Dose (Gy)	Volume		
	Local	W. Brain	CSI
45	0/ 0	0/0	0/15
50	[‡] 3/10	[†] 1/4	0/ 6
50<	0/ 0	0/3	0/ 7
Total	3/10	1/7	0/28

[‡]out of RT field recurrence, [†] primary & spinal seeding

Table 4 (3/10) (1/7) 28

15
41 45 Gy 18
19.5 24 Gy (6 19.5 Gy)

>50 Gy <50 Gy 9 12)

2 :

13 17) 50 Gy 가 33 Gy 가 29)
 (seminoma) (dysgerminoma) Hardenbergh
 , Linstadt
 17)
 24)
 1) Aydin 18)
 1 16 Gy 1 가 (primitive
 neuroectodermal tumor) Linstadt
 13)
 Fields 46 Gy 24)
 7 1 , Shibamoto 14) 0% (0/12) 23% (9/39)
 18.7 47 Gy 48 52.2 Gy , 54 62 15% 23% 가 .
 Gy 가 28 1
 45 Gy 15 1 0% 4 3
 4 48 50 Gy 3
 45 Gy 20 Gy
 1995
 40Gy, 19.5 Gy
 가 가
 10 30% 13, 19 22) 19, 30 33)
 (9.4%) Allen 19, 30)
 30 Gy, 20 21 Gy
 가 23) 11 1
 15% 24) Buckner 32) 17 (9)
 51 1 16
 1
 가 17
 17, 18, 21, 23 25)
 Royal Marsden Hospital 26)
 2, 27, 28)
 0% 가 가
 (neurocognitive) 가 가 100%
 17) 45 Gy , 19.5 Gy

1. **Wara WM, Jenkin DT, Evans A, et al.** Tumors of the pineal and suprasellar region: Childrens Cancer Study Group treatment results 1960-1975. *Cancer* 1979; 43:698-701
2. **Rich TA, Cassidy JR, Strand RD, Winston KR.** Radiation therapy for pineal and suprasellar germ cell tumors. *Cancer* 1985; 55:932-940
3. **Wara WM, Fellows CF, Sheline GE, Wilson CB, Townsend JJ.** Radiation therapy for pineal and suprasellar germinomas. *Radiology* 1977; 124:221-223
4. **Wolden SL, Wara WM, Larson DA, Prados MD, Edwards MS, Sneed PK.** Radiation therapy for primary intracranial germ cell tumors. *Int J Radiat Oncol Biol Phys* 1995; 32:943-949
5. **Huh SJ, Kim IH, Ha SW, et al.** Radiotherapy of intracranial germinomas. *Radiother Oncol* 1996; 38:19-23
6. **Nho YJ, Chang HS, Choi EK, Kim JH.** Radiation therapy of intracranial germinoma. *J Korean Soc Ther Radiol Oncol* 1997; 15:207-213
7. **Suh CO, Kim GE, Suh JH, Park CY, Chu SS.** Radiation therapy of midline pineal tumors and suprasellar germinoma. *J Korean Soc Ther Radiol Oncol* 1983; 1:69-77
8. **Suh CO, Kim GE, Lee KS, et al.** Treatment of pineal region tumors and CNS germ cell tumors; Evolution of treatment policy and results. *J Korean Neurosurg Soc* 1990; 19:814-824
9. **Abay EO, Laws ER, Grado GL, et al.** Pineal tumors in children and adolescents. *J Neurosurg* 1981; 55:889-895
10. **Kersh CR, Constable WC, Eisert DR, et al.** Primary central nervous system germ cell tumors. *Cancer* 1988; 61: 2148-2152
11. **Salazar OM, Castro-Vita H, Bakos RS, Feldstein ML, Keller B, Rubin P.** Radiation therapy for tumors of the pineal region. *Int J Radiat Oncol Biol Phys* 1979; 5:491-499
12. **Sung DI, Harisiadis L, Chang CH.** Midline pineal tumors and suprasellar germinomas: Highly curable by irradiation. *Radiology* 1978; 128:745-751
13. **Fields JN, Fulling KH, Thomas PRM, Marks JE.** Suprasellar germinoma: Radiation therapy. *Radiology* 1987; 164:247-249
14. **Shibamoto Y, Takahashi M, Abe M.** Reduction of the radiation dose for intracranial germinoma: A prospective study. *Br J Cancer* 1994; 70:984-989
15. **Shibamoto Y, Takahashi M, Sasai K.** Prognosis of intracranial germinoma with syncytiotrophoblastic giant cells treated by radiation therapy. *Int J Radiat Oncol Biol Phys* 1997; 37:505-510
16. **Shirato H, Nishio M, Sawamura Y, et al.** Analysis of long term treatment of intracranial germinoma. *Int J Radiat Oncol Biol Phys* 1997; 37:511-515
17. **Hardenbergh PH, Golden J, Billet A, et al.** Intracranial germinoma: The case for lower dose radiation therapy. *Int J Radiat Oncol Biol Phys* 1997; 39:419-426
18. **Aydin F, Ghatak NR, Radie-Keane K, Kinard J, Land SD.** The short term effect of low dose radiation on intracranial germinoma. *Cancer* 1992; 69:2322-2326
19. **Allen JC, Kim JH, Packer RJ.** Neoadjuvant chemotherapy for newly diagnosed germ cell tumors of the central nervous system. *J Neurosurg* 1987; 67:65-70
20. **Amendola BE, McClatchey K, Amendola MA.** pineal region tumors: Analysis of treatment results. *Int J Radiat Oncol Biol Phys* 1984; 10:991-997
21. **Dattoli MJ, Newall J.** Radiation therapy for intracranial germinoma: The case for limited volume treatment. *Int J Radiat Oncol Biol Phys* 1990; 19:429-433
22. **Legido A, Packer RJ, Sutton LN, et al.** suprasellar germinomas in childhood: A reappraisal. *Cancer* 1989; 63: 340-344
23. **Fuller BG, Kapp DS, Cox R.** Radiation therapy for pineal region tumors: 25 new cases and a review of 208 previously reported cases. *Int J Radiat Oncol Biol Phys* 1994; 28: 229-245
24. **Linstadt D, Wara WM, Edwards MSB, Hudgins R, Sheline GE.** Radiotherapy of primary intracranial germinomas: The case against routine craniospinal irradiation. *Int J Radiat Oncol Biol Phys* 1988; 15:291-297
25. **Shibamoto Y, Abe M, Yamashita J, et al.** Treatment results of intracranial germinoma as a function of the irradiated volume. *Int J Radiat Oncol Biol Phys* 1988; 15:285-290
26. **Dearnaley DP, A'Hern RP, Whittaker S, Bloom HJG.** Pineal and CNS germ cell tumors: Royal Marsden Hospital experience 1962-1987. *Int J Radiat Oncol Biol Phys* 1990; 18:773-781
27. **Shapiro WR.** Therapy of adult malignant brain tumors: What have the clinical trials taught us? *Sem Oncol* 1986; 13:38-45
28. **Griffin BR, Griffin TW, Tong DYK, et al.** Pineal region tumors: Results of radiation therapy and indications for elective spinal irradiation. *Int J Radiat Oncol Biol Phys* 1981; 7:605-608
29. **Willman KY, Cox RS, Donaldson SS.** Radiation induced height impairment in pediatric Hodgkin's disease. *Int J Radiat Oncol Biol Phys* 1994; 28:85-92
30. **Allen JC, DaRosso RC, Donahue B, Nirenberg A.** A phase II trial of preirradiation carboplatin in newly diagnosed germinoma of the central nervous system. *Cancer* 1994; 74: 940-944
31. **Fouladi M, Grant R, Baruchel S, et al.** Comparison of survival outcomes in patients with intracranial germinomas treated with radiation alone versus reduced dose radiation and chemotherapy. *Child's Nerv Syst* 1998; 14:596-601
32. **Buckner JC, Peethambaram PP, Smithson WA, et al.** Phase II trial of primary chemotherapy followed by reduced dose radiation for CNS germ cell tumors. *J Clin Oncol* 1999; 17:933-940
33. **Calaminus G, Bamberg M, Baranzelli MC, et al.** Intracranial germ cell tumors: A comprehensive update of the european data. *Neur*

Abstract

Radiation Therapy of Intracranial Germinomas : Optimum Radiation Dose and Treatment Volume

Sei Kyung Chang, M.D.* , Chang Ok Suh, M.D.† , and Gwi Eon Kim, M.D.†

*Department of Radiation Oncology, Eulji Medical College, Taejon, Korea

†Department of Radiation Oncology, Yonsei University College of Medicine, Seoul, Korea

Purpose : To evaluate the possibility of decreasing the radiation dose and to determine optimum treatment volume in intracranial germinomas.

Materials and Methods : Forty five patients with pathologically-verified or presumed germinomas by a radiosensitivity test who had been treated with radiotherapy (RT) alone between 1971 and 1992 were retrospectively analyzed. The average age was 17.2 years with 68.9% of the patients being between the ages of 10 and 20. The male and female ratio was 2.2:1. The locations of the primary tumors were at the pineal regions in 14 patients; the suprasellar regions in 12 patients; and multiple sites in 12 patients. Treatment volumes varied from a small local field (10) to the whole brain (7) or entire neuroaxis irradiation(28). All the cases after 1982 received craniospinal irradiation (CSI). Radiation doses were 41-59 Gy (median 48.5 Gy) to the primary tumor site and 19.5-36 Gy (median 24 Gy) to the neuroaxis. The median follow-up period was 82 months with a range of 2-260 months.

Results : All the patients showed complete response after RT. Four patients suffered from recurrence 14, 65, 76, and 170 months after RT, respectively, and two patients died with intercurrent disease. One of four recurrent cases was salvaged by re-irradiation. Therefore, a 5 and 10 year overall survival was 95.3 % and 84.7 % respectively. Five and ten year disease-free survival was 97.6 % and 88.8 % respectively. All the recurrences occurred in the patients who received local RT (3/10) or whole brain RT (1/7) with a radiation dose of 48-50 Gy. None of the patients who received CSI suffered recurrence. There was no recurrence among the 15 patients who received 45 Gy to the primary site and the 18 patients who received 24 Gy (6 patients received 19.5 Gy) to the neuroaxis.

Conclusion : CSI is recommended for the treatment of intracranial germinomas. The radiation dose can be safely decreased to 45 Gy on a primary tumor site and 19.5 Gy on the spine.

Key Words : Intracranial germinomas, Radiation therapy