

Radiotherapy Results of Brain Astrocytoma and Glioblastoma Multiforme

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A retrospective analysis was performed on 49 patients with astrocytoma or glioblastoma multiforme of brain who received postoperative radiotherapy in the period between February 1979 and December 1985.

Fourteen patients had grade I astrocytoma, 11 patients grade II, 14 patients grade III, and 10 patients glioblastoma multiforme. Three year actuarial survival rates were 85.7%, 44.6% and 23.1% for grade I, II, and III astrocytomas, respectively. One and 2 year actuarial survival rates for patients with glioblastoma multiforme were 54.5% and 27.3%, respectively.

Histologic grade, age, extent of operation and tumor location were revealed to be prognosticators.

Key Words: Astrocytoma, Glioblastoma multiforme, Radiotherapy

INTRODUCTION

Radiotherapy has been used to improve survival and quality of life after surgical treatment of astrocytoma or glioblastoma multiforme of brain. And the effect of postoperative radiotherapy has been proven in many studies¹⁻⁴.

It has been reported that the results of treatment depend on many factors such as histologic grade, age, sex, extent of surgery, dose of radiation, location of tumor, size of tumor, functional performance status and duration of symptoms in varying degree^{3,4}.

To assess the effect of postoperative radiotherapy and importance of prognosticators, a retrospective analysis was performed on results of postoperative radiation therapy for a group of patients with astrocytoma or glioblastoma multiforme who were treated at the Department of Therapeutic Radiology, Seoul National University Hospital, during the period from February 1979 through December 1985.

MATERIALS AND METHODS

In the period from February 1979 to December

1985, 49 patients with histologically confirmed astrocytoma and glioblastoma multiforme of brain were treated postoperatively at the Department of Therapeutic Radiology, Seoul National University Hospital.

All the patients except one were followed until the time of analysis (August 1987) or to the time of death and the median follow-up period was 24 months (Table 1). The age at the time of operation ranged from 2 to 63 years. There were 32 males and 17 females. All the pathologic slides were reviewed by one of authors (JGC) for diagnosis and histologic grading, according to the World Health Organization histologic classification of the CNS tumors⁵. Fourteen patients had grade I, 11 grade II, 14 grade III astrocytomas and 10 glioblastoma multiforme (Table 2).

Table 1. Patient Entry and Follow-Up Status (1979.5-1985.12)

	No. of patients F/U months (median)	
Followed	48	3-72 (25)
alive	23	18-72 (34)
dead	25	3-35 (13)
Lost	1	2
Total	49	2-72 (24)

This work was partly supported by 1987 SNUH Research Fund

According to the surgical records and postoperative CT findings, tumors were totally removed in 5 patients only, partially removed in 35 patients, and biopsy was performed in 9 patients (Table 3). The peak incidence of grade I astrocytoma was in the second decade, grade II in the third decade, grade III in the third to fifth decade, and glioblastoma in the sixth decade (Table 4).

The location of tumors were cerebral hemisphere in 35, cerebellum in 6, deep cerebrum or upper brainstem in 8 (Table 5). And among tumors of cerebral hemisphere the most common site was

Table 2. Patients Characteristics

Characteristics	No. of patients (%)
Age	
Range	2-63 years
Median	27 years
Sex	
Male	32 (65)
Female	17 (35)
Histology	
G I astrocytoma	14 (29)
G II	11 (22)
G III	14 (29)
GM*	10 (20)

* included 3 cases of monstrocellular type

Table 3. Extent of Operation

Extent	I	II	III	GM	Total (%)
Total resection	0	0	3	2	5 (10)
Partial resection	10	9	8	8	35 (71)
Biopsy	4	2	3	0	9 (19)
Total	14	11	14	10	49

Table 4. Histologic Grades by Age

Age	I	II	III	GM	Total
0-9	4	3	1	-	8
10-19	5	1	2	1	9
20-29	3	4	4	1	12
30-39	1	1	3	2	7
40-49	1	1	3	2	7
50-59	-	-	1	3	4
60-	-	1	-	1	2

frontal lobe (14 patients) (Table 6).

All the patients were treated with megavoltage radiation and usual fractionation was 180 or 200 cGy/day, 5 fractions a week. Patients with grade I or grade II astrocytoma were treated with generous volume encompassing the gross tumor with 2 to 3 cm margin in all directions. Some patients with large tumor volume were treated first to whole brain followed by reduced field. In all patients with grade III astrocytoma or glioblastoma but 2 patients, whole brain radiotherapy upto 4,000-4,500 cGy was delivered and then field size was reduced. Total tumor dose ranged from 5,000 to 6,125 cGy, but in 2 patients the dose was less than 5,000 cGy (3,700 and 4,000 cGy) (Table 7).

Survival was counted from the day of operation,

Table 5. Tumor Location

Site	I	II	III	GM	Total
Cerebrum	7	6	12	10	35
Cerebellum	4	2	0	0	6
Deep cerebral brainstem	3	3	2	0	8

Table 6. Tumor Location in Cerebral Hemisphere

Location*	No. of pts (%)
Rt	17 (47)
Lt	19 (53)
Frontal lobe	14 (40)
Parietal lobe	4 (11)
Temporal lobe	4 (11)
Occipital lobe	1 (3)
2 lobes	11 (32)
3 lobes	1 (3)
Total	35

* both sides in 1 case

Table 7. Radiation Dose

Dose (cGy)	I	II	III	GM	Total
-5,000	4	1	4	2	11
5,001-5,500	7	3	1	1	12
5,501-6,000	3	5	9	5	22
6,001-	0	2	0	2	4

and life table method⁶⁾ was used to calculate the survival rate and log-rank test⁷⁾ was used to compare pairs of survival data.

RESULTS

The 3 year survivals were 85.7%, 44.6%, and 23.1% for patients with grade I, II, and III astrocytomas, respectively. For glioblastomas survival was 54.5% and 27.3% at 1 and 2 years, respectively (Fig 1).

Of the 14 patients with grade I astrocytomas, 13 are still alive with median survival of 27 months.

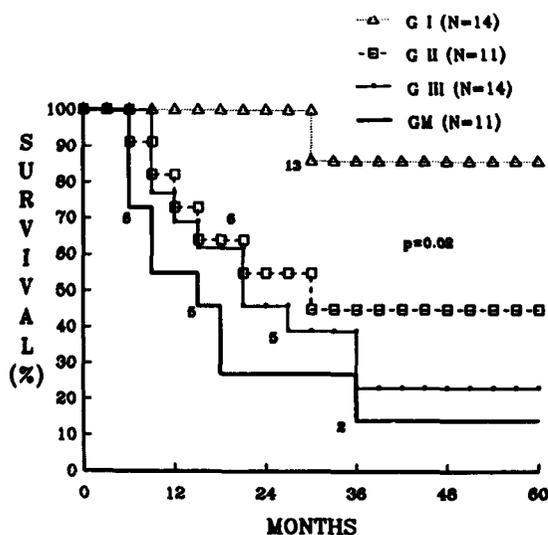


Fig. 1. Actuarial survival according to histologic grade.

One patient had local recurrence at 14 months after first treatment and this patient is still alive for 7 months after second operation. Of the 11 patients with grade II astrocytomas, 5 are alive for 27, 34, 39, 50 and 59 months each, and of the 14 patients with grade III astrocytoma, 3 are alive for 39, 50 and 53 months each. Of the 10 patients with glioblastoma, 2 are alive for more than 25 months. One of these 2 patients is alive 52 months after surgery, and this case was giant cell variety of glioblastoma multiforme.

The survival was different by the age of the patients, i. e., 3 year survival rate for grade I & II astrocytoma was 83.9% in patients younger than 20 years of age while it was 47.7% for patients older than 20 years of age. Two year survival rate for grade III astrocytoma and glioblastoma multiforme was 28.6% in patients younger than 40 years of age while it was 11.1% for the patients older than 40 years of age (Fig 2 & 3).

The survival varied also by the anatomic site; 3 year survival rate was 83.3% in patients with tumor in cerebellum, 62.5% in deep cerebrum and upper brainstem, and 27.6% in cerebral hemisphere (Fig 4).

Survival also varied along the extent of surgery; 3 year survival rate was 60.0% for total removal group, 45.7% for partial removal group, and 27.8% for biopsy only group (Fig 5). Of the 3 patients with grade III astrocytoma, whose tumor being completely removed, 2 patients are still alive at 39 and 53 months, and one died 34 months after treatment. All 3 patients with biopsy only died 7, 18 and 33

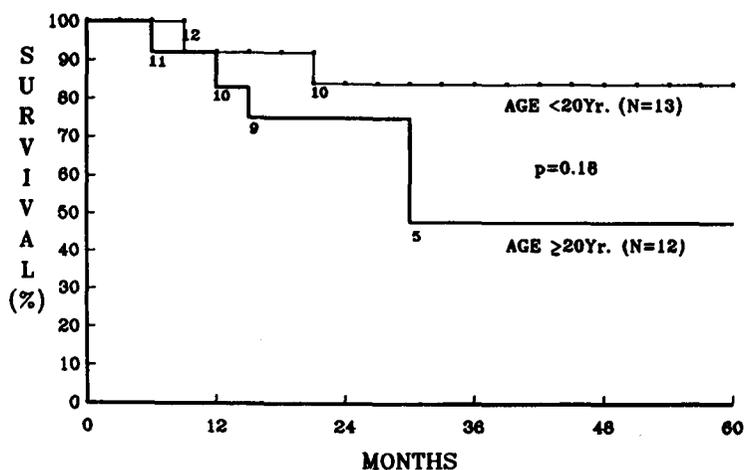


Fig. 2. Actuarial survival of grade I and grade II astrocytoma according to age.

sification, which is quite different from glioblastoma multiforme arising from undifferentiated glial cells rather than astrocyte.

Surgical decompression and excision of the tumor mass is one of the major prerequisites if radiation is to have its maximal effect⁹⁾.

The value of postoperative radiotherapy in patients with resected brain astrocytoma and glioblastoma multiforme has been documented by several reports^{2-4,9-14)}. Fazekas²⁾ reported the effect of postoperative radiotherapy after partial removal of low grade astrocytomas. According to his data, 5 year survival rate for patients with postoperative radiotherapy is 41% as compared to 13% for those who did not receive radiation therapy. Sheline⁴⁾ reviewed data of his own and published series. He reported a 25% 5 year survival rate for patients who were irradiated after partial resection of grade II astrocytoma and no 5 year survivor among patients who had partial resection only. He also reported an average 5 year survival rate of 16% for grade III astrocytoma with irradiation and 2% without irradiation.

Our results confirm the prognostic importance of histologic grading in astrocytoma and the separation of glioblastoma multiforme from grade III astrocytoma. Survival of grade III astrocytoma patients is higher than usual probably because 3 of 11 tumors were removed completely. Of the patients with glioblastoma, 50% died within 7 months after treatment and 80% died within 16 months and only 2 patients survived. The 52 months survivor had giant cell (monstrocellular) glioblastoma which is known as less malignant^{15,16)}, although remaining 2 patients with giant cell glioblastoma died at 5 and 15 months after treatment, respectively.

Survival was significantly different between younger and older age groups, but this might have been exaggerated because more low grade tumors and more cerebellar tumors were included in younger age group.

Comparison of the survival rates by tumor location showed best prognosis in patients with cerebellar astrocytoma and better prognosis with tumors of deep cerebrum and upper brainstem than those in cerebral hemisphere, partially because of lower grades in the former, as in other reports^{17,18)}.

It is likely that maximal tumor excision can extend life by reducing tumor burden before radiation therapy and delaying regrowth^{19,21)}. In our series of grade III astrocytoma, survival after total

resection is better than that after partial resection, and biopsy only case had the worst result. But no statistical significance could be given because of the small number of cases.

The optimal dose of radiation for the treatment of astrocytoma and glioblastoma remains as an area of uncertainty. But Walker et al¹³⁾, and Salazar et al¹¹⁾, observed the dose effect relationship in the treatment of malignant glioma. According to the series of Walker et al. (Brain Tumor Study Group protocols between 1966 and 1975), the median survivals of malignant glioma patients were 13.5, 28, 36 and 42 weeks for 4,500 cGy or less, 5,000 cGy, 5,500 cGy and 6,000 cGy, respectively. And the specific relations between 5,000 cGy and 6,000 cGy indicated a 1.3 times increase in median life span associated with higher dose. In our series of grade III astrocytoma, median survival was longer in patients with higher dose.

CONCLUSIONS

49 cases of astrocytoma and glioblastoma of brain treated with post-operative radiotherapy in the period between February 1979 and December 1985 were analysed and the following results were obtained.

1. The 3 year actuarial survival rates were 85.7%, 44.6%, and 23.1% for grade I, II, and III astrocytomas, respectively. And 1 and 2 year survival rates for glioblastoma were 54.5% and 27.3%, respectively.

2. Histologic grade, age, extent of operation and tumor location were significant prognostic factors.

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＝ 국문초록 ＝

성상세포종과 교아세포종의 방사선치료성적

서울대학교 의과대학 치료방사선과학교실

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지 제 근

성상세포종과 교아세포종으로 1979년부터 1985년까지 7년간 서울대학교병원 치료방사선과에서 수술후 방사선치료를 시행한 49명의 환자에 대해 후향적 분석을 시행하여 다음과 같은 결과를 얻었다.

1. 3년 전체 생존율은 grade I, II, III 성상세포종에 대해 각각 85.7%, 44.6%, 23.1%였으며, 교아세포종의 1년 및 2년 전체생존율은 각각 54.5%, 27.3%였다.
2. 종양의 분화도, 환자의 나이, 병소의 위치, 절제정도 등이 예후에 영향을 미치는 인자로 나타났다.