Primary Spinal Cord Glioblastoma Multiforme: A Retrospective Study of Patients at a Single Institution

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BACKGROUND AND OBJECTIVE: **Primary spinal cord (PSC) glioblastoma multiforme (GBM) is extremely rare and accounts for only 1.5% of all spinal cord tumors. Therefore, its treatment is still ill defined. To elucidate prognostic factors, we performed a single-institutional retrospective review of the largest series to date of patients with PSC GBM who underwent surgical resection in West China Hospital between 2008 and 2014. A total of 14 patients with PSC GBM were reviewed.**

METHODS: **Demographic, operative, and postoperative factors were recorded. Overall survival (OS) and progression-free survival (PFS) were calculated and compared with the Kaplan-Meier method.**

RESULTS: **Eight males (57%) and 6 females (43%) were involved in the study. Their median age was 28 years (range, 14–56 years). Median Karnofsky Performance Status score was 60 (range, 20–90). Four patients (28.6%) received gross total resection, 5 (35.7%) partial resection, and the remaining 5 (35.7%) biopsy only. Nine patients (64.3%) received postoperative radiotherapy and chemotherapy, 3 (21.4%) chemotherapy only, and 2 (14.3%) neither. Median follow-up period was 15 months (range, 5–26 months). One-year and 2-year survival was 78.5% (11/14) and 7.1% (1/14), respectively. Median OS was 15 months, and median PFS 8 months. Univariate log-rank analysis showed that OS and PFS were significantly associated with patients' age ($P = 0.007$ and $P = 0.04$, respectively) and postoperative radiotherapy ($P = 0.001$ and $P = 0.002$, respectively). However, preoperative Karnofsky Performance Status score affected only OS and did not affect PFS ($P = 0.033$ and $P = 0.106$, respectively).**

CONCLUSIONS: **According to our study, the combination of postoperative radiotherapy and temozolomide chemotherapy can improve prognosis and may serve as a feasible postoperative adjuvant treatment of PSC GBM.**

INTRODUCTION

Among adults, glioblastoma multiforme (GBM) is the most common primary malignant tumor of central nervous system. Nevertheless, most GBMs occur in brain. Primary spinal cord (PSC) GBM is extremely rare, accounting for only 1.5% of all spinal cord tumors.[1,2] To the best of our knowledge, the literature on this topic published in the last 10 years is mainly restricted to single case reports or small case series. The report on the largest-scale PSC GBM case of adults to date is a single-center clinical retrospective study (involving 6 patients) with a long time span from 1990 to 2015.[3] The prognosis of GBM is still poor despite progress in the treatment of gliomas. The overall survival (OS) of patients with PSC GBM is approximately 10–12 months. In contrast, its intracranial counterpart has a better

Key words
- Glioblastoma
- Radiotherapy
- Spinal cord
- Surgery

Abbreviations and Acronyms
ASIA: American Spine Injury Association
EGFR: Epidermal growth factor receptor
EOR: Extent of resection
GBM: Glioblastoma multiforme
GTR: Gross total resection
KM: Kaplan-Meier
KPS: Karnofsky Performance Status
MGMT: O6-methylguanine-DNA methyltransferase
OS: Overall survival
PFS: Progression-free survival
PSC: Primary spinal cord
TMZ: Temozolomide

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Table 1. Clinical Characteristics of 14 Patients with Primary Spinal Cord Glioblastoma Multiforme

Patient Number	Age (years)	Sex	Preoperative Karnofsky Performance Status/American Spine Injury Association Score	Location/Procedure	Postoperative Treatment	Follow-Up	
						Progression-Free Survival (months)	Overall Survival (months)
1	42	F	40/B	T11-T12/biopsy	TMZ	4	9
2	21	F	80/D	C2-C5/partial resection	RT+TMZ	9	17
3	21	M	90/D	T6-T8/partial resection	RT+TMZ	14	20
4	29	M	20/B	T4-T6/GTR	None	2	5
5	41	F	30/C	T12-L1/GTR	None	3	8
6	23	F	80/D	T12-L1/partial resection	RT+TMZ	8	14
7	45	F	60/C	L1/biopsy	TMZ	8	15
8	51	M	50/B	L1-L3/biopsy	RT+TMZ	8	13
9	35	M	70/D	L1-L2/biopsy	RT+TMZ	12	18
10	27	M	90/E	C7-T1/partial resection	RT+TMZ	15	26
11	16	M	70/D	C4-C5/biopsy	RT+TMZ	7	16
12	56	M	60/C	T10/GTR	TMZ	7	10
13	14	F	40/C	T11-L1/GTR	RT+TMZ	14	19
14	26	M	80/C	C3-C4/partial resection	RT+TMZ	8	15

F, female; TMZ, temozolomide; RT, radiation therapy; M, male; GTR, gross total resection.

prognosis of 15–22 months.[4] PSC GBM would result in death as a result of its complications related to progressive involvement, respiratory impairment, and cerebral metastases.[5] Only limited information about PSC GBM is available because of the lack of cases. To identify the natural history and clinical therapeutic factors that influence the prognosis of tumor, we performed a single-institutional study of the largest series of PSC GBM to date and reviewed previous reports.

METHODS

Patient Selection

After obtaining approval from the ethics review board, we carried out a retrospective review of the patients of West China Hospital with primary intramedullary spinal cord tumors and pathologic diagnoses of GBM during the period between 2008 and 2014. Fourteen patients with PSC GBM were identified. All patients were evaluated with enhanced brain and spinal magnetic resonance imaging before the operation and given maximal safe resection during the operation. Demographic and clinical characteristics of all patients who met the study criteria were recorded, including age, sex, presenting symptoms, preoperative and postoperative functional status, tumor location of spine level, type of operation performed, and postoperative therapy.

Treatment Characteristics

Surgical resection was performed on all patients via a posterior approach with laminectomy or hemilaminectomy overlying the involved spinal cord segments. Gross total resection (GTR) is defined as surgical removal of at least 95% of the contrast-enhancing portion of the tumor shown on magnetic resonance imaging. Resection of less than 95% of the tumor is defined as partial resection. Postoperative therapies included radiotherapy and chemotherapy.

Statistical Analysis

OS and progression-free survival (PFS) were calculated with the Kaplan-Meier (KM) method. OS refers to the period from operation to the patient's death or last follow-up. PFS means the period from operation to progression, patient's death, or last follow-up. A log-rank test was used to compare different survival results according to various clinical factors (e.g., age, gender, and Karnofsky Performance Status [KPS]) and therapeutic factors (e.g., the EOR, radiotherapy, and chemotherapy). The statistical analysis was performed by using SPSS version 23.0 software (IBM

Table 2. Molecular Pathologic Features of Patients with Primary Spinal Cord Glioblastoma Multiforme

Molecular Marker	Patients Testing Positive
O^6-Methylguanine-DNA methyltransferase methylation	8/14
Isocitrate dehydrogenase 1 mutation	1/14
Tumor protein p53 mutation	4/14
Epidermal growth factor receptor overexpression	11/14