Glioblastoma fed by middle meningeal artery and displaying cyst formation soon after repeated implantation of carmustine wafers: A case report

SHUN YAMAMURO, YUYA HANASHIMA, SODAI YOSHIMURA, HIROYUKI AOKI, KOKI KAMIYA, YUSUKE TAKAMINE, HIROSHI NEGISHI and ATSUO YOSHINO

Department of Neurological Surgery, Nihon University School of Medicine, Tokyo 173-8610, Japan

Received May 31, 2017; Accepted August 23, 2017

DOI: 10.3892/mco.2017.1455

Abstract. The present study reported an unusual case of temporal lobe glioblastoma (GBM) fed from the middle meningeal artery that progressed rapidly. A 66-year-old male was admitted to the Department of Neurosurgery at Nihon University Itabashi Hosipital (Tokyo, Japan) with epilepsy. Magnetic resonance imaging disclosed a small well-enhanced right middle fossa mass lesion, which was relatively boundary-clear and attached to the dura mater. An angiogram showed a stain fed from the right middle meningeal artery. The mass lesion was removed completely by surgery and diagnosed pathologically as GBM. Tumor recurrence was observed 6 months later and a second surgery was performed. Eight pieces of carmustine wafers were implanted in the tumor resection cavity at the first and second surgeries. The patient underwent a third surgery soon after the second surgery, as a cyst had formed in the resection cavity. The tumor became uncontrollable and the patient died at 11 months after the first surgery even though he had undergone multimodality treatment. Since GBM fed by the middle meningeal artery is rare, the timing of surgical treatment is difficult as it is easy to misdiagnose a case like the present one as a meningioma. Furthermore, repeated implantation of carmustine wafers should be considered carefully, since adverse events associated with such wafers may easily occur.

Introduction

Glioblastoma (GBM) is the most frequently occurring primary tumor of the central nervous system and represents one of the most lethal malignancies. Surgical resection and postoperative radiotherapy with concomitant and adjuvant temozolomide (TMZ) are employed as a first-line treatment for GBM (1,2), and more recently bevasizumab and/or carmustine wafers have also been used in Japan (3,4). We report here an unusual case of temporal lobe GBM fed from the middle meningeal artery that underwent double implantation of carmustine wafers and triple surgery.

The present study was approved by the Ethics Committee of Nihon University Itabashi Hospital (Tokyo, Japan) and written informed consent was obtained from the patient and his family.

Case report

A 66-year-old male was admitted to the Department of Neurosurgery at Nihon University Itabashi Hosipital (Tokyo, Japan) with epilepsy. He had complained of headache a week before the epilepsy. Laboratory evaluations including tumor markers demonstrated no abnormalities. His consciousness level was clear and neurological examinations revealed no abnormalities except for headache and deja vu. Magnetic resonance imaging (MRI) disclosed a 1.8 cm-diameter right middle fossa mass lesion which was attached to the dura mater, and displayed low-intensity on T1-weighted MRI and high-intensity on T2-weighted MRI; enhancement was evident following contrast medium administration (Fig. 1A). The lesion was diagnosed preoperatively as a meningioma. However, preoperative MRI one month after the first MRI, disclosed rapid mass growth (Fig. 1B). The patient underwent surgical resection and the tumor was completely removed (Fig. 1C). An angiogram showed a stain fed from the right middle meningeal artery without branches of the internal carotid artery (Fig. 1D and E). The intraoperative findings indicated that the tumor was attached to the dura mater and the tumor border was relatively clear. Eight pieces of carmustine wafers were implanted in the tumor resection cavity. Pathological examinations of the tumor specimen demonstrated a high cellularity, mitosis, pseudopalisading, necrosis, and microvascular proliferation (Fig. 2A). Immunohistochemically, the tumor cells exhibited positive expression for glial fibril acid protein (Fig. 2B), whereas they were negative for cytokeratin and epithelial membrane antigen. These pathological findings were consistent with GBM. The tumor cells were negative for

Correspondence to: Dr Shun Yamamuro, Department of Neurological Surgery, Nihon University School of Medicine, 30-1 Oyaguchi-Kamicho, Itabashi-ku, Tokyo 173-8610, Japan
E-mail: shun.yamamuro@nihon-u.ac.jp

Key words: glioblastoma, middle meningeal artery, carmustine wafers, cyst formation, multiple implantations

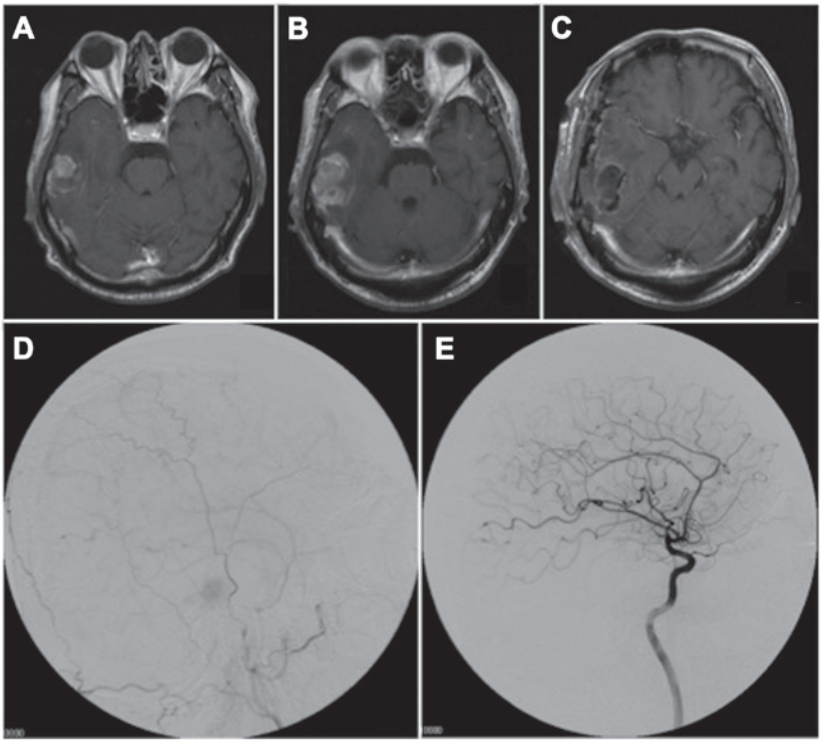

Figure 1. Radiological findings before and after the first operation. (A) Initial MRI (axial gadolinium-enhanced T1-weighted MRI). (B) Pre-first operation MRI (axial gadolinium-enhanced T1-weighted MRI). (C) Post-first operation MRI (axial gadolinium-enhanced T1-weighted MRI). (D and E) Pre-first operation cerebral angiograms. (D) The angiography revealed tumor stain fed by the right meningeal artery. (E) No tumor stain was observed on the cerebral angiogram of the internal carotid artery.

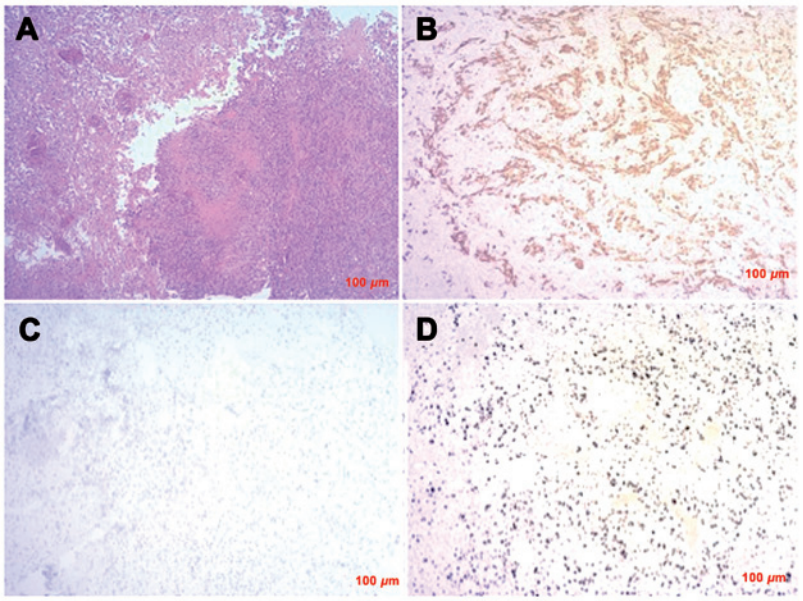

Figure 2. Pathological findings. (A) Photomicrograph demonstrating high cellularity, mitosis, pseudopalisading necrosis and microvascular proliferation (hematoxylin and eosin stain, original magnification x50). (B-D) Immunohistochemical staining revealing positive expression for glial fibril acid protein,[(B) original magnification x50], negative expression for IDH1-R132H [(C) original magnification x50], and an MIB-1 labeling index of 55% [(D) original magnification x50].

IDH1-R132H and EGFR (Fig. 2C). The MIB-1 labeling index was 55% (Fig. 2D). The patient underwent TMZ chemotherapy with 60 gray radiation therapy and was discharged from hospital, with a Karnofsky Performance Status score of 100, at 70 days after the first surgery.

Six months later, after five courses of TMZ maintenance therapy, evidence of tumor recurrence was found around the resection cavity (Fig. 3A). The patient underwent a second operation via the same approach as for the first operation, and the tumor was again completely removed (Fig. 3B). Eight

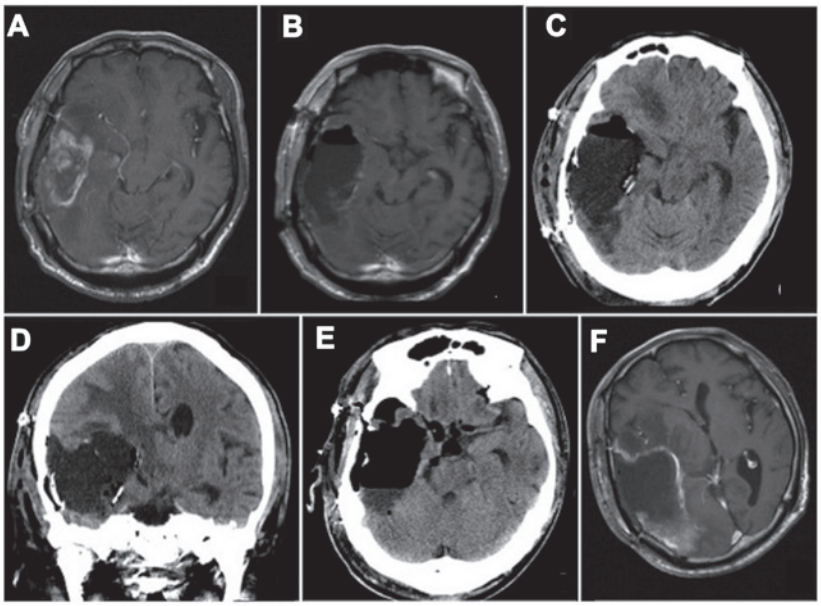

Figure 3. Radiological findings before and after the second/third operations. (A) Pre-second operation MRI (axial gadolinium-enhanced T1-weighted MRI). (B) Post-second operation MRI (axial gadolinium-enhanced T1-weighted MRI). (C and D) Pre-third operation CT scans demonstrating a cyst in the resection cavity [(C) axial; (D) coronal]. (E) Post-third operation CT scan (axial). (F) MRI after the last recurrence (axial gadolinium-enhanced T1-weighted MRI).

pieces of carmustine wafers were implanted in the cavity. Pathological examinations of the tumor specimen demonstrated the same pattern as for the first tumor specimen. Five days after the second surgery, a third operation was performed because a cyst formed in the surgical cavity (Fig. 3C and D). The cyst was opened to the basal cisterns and the carmustine wafers were removed at the third operation (Fig. 3E). The cyst contents were found to comprise cerebrospinal fluid with slight xanthochromia. The opened cyst reformed within a few days after the third operation, and tumor recurrence was found at 25 days after the third operation (Fig. 3F). Despite another four courses of TMZ maintenance therapy with additional administration of bevasizumab, the tumor became uncontrollable and the patient died at 11 months after the first operation.

Discussion

The extent of resection by surgery affects survival time in GBM patients (5,6). A better prognosis might therefor be predicted for right temporal lobe localized GBM, since total removal can be carried out.

The present case was initially diagnosed as meningioma, because the tumor stain was clearly seen from the middle meningeal artery but not from the internal carotid artery. Only a few case reports of such GBMs have been described (7,8). The timing of surgical treatment may easily be delayed if the lesion is misdiagnosed as a meningioma, and may be of concern for the prognosis of GBM patients.

Cyst formation is known to occur as an adverse event of carmustine wafer implantation for malignant gliomas (9), and there have been several reports of space-occupying cysts in the cavity, which required additional surgical treatment (10-13). Yoshida *et al* reported that adverse events associated with implantation of carmustine wafers tend to occur in the repeated surgery for the malignant gliomas (11). Although there have been few reports on multiple implantation of carmustine wafers, the risk of adverse events, including cyst formation, might be high when double implantation is performed as in the present case. Basic research has not been done about the mechanism of cyst formation induced by carmustine wafers implantation, so that further studies including basic researches are clearly needed to clarify the mechanism.

In conclusion, we have described an atypical and suggestive case of GBM. We need to be aware GBM should not be excluded in preoperative diagnoses made from imaging studies, even if the tumor is fed only by the middle meningeal artery. Moreover, careful attention should be exercised when carmustine wafers have to be implanted in repeated surgery.

References

1. Stupp R, Mason WP, van den Bent MJ, Weller M, Fisher B, Taphoorn MJ, Belanger K, Brandes AA, Marosi C, Bogdahn U, *et al*: Radiotherapy plus concomitant and adjuvant temozolomide for glioblastoma. N Engl J Med 352: 987-996, 2005.
2. Stupp R, Hegi ME, Mason WP, van den Bent MJ, Taphoorn MJ, Janzer RC, Ludwin SK, Allgeier A, Fisher B, Belanger K, *et al*: Effects of radiotherapy with concomitant and adjuvant temozolomide versus radiotherapy alone on survival in glioblastoma in a randomised phase III study: 5-year analysis of the EORTC-NCIC trial. Lancet Oncol 10: 459-466, 2009.
3. Chinot OL, Wick W, Mason W, Henriksson R, Saran F, Nishikawa R, Carpentier AF, Hoang-Xuan K, Kavan P, Cernea D, *et al*: Bevacizumab plus radiotherapy-temozolomide for newly diagnosed glioblastoma. N Engl J Med 370: 709-722, 2014.
4. Aoki T, Nishikawa R, Sugiyama K, Nonoguchi N, Kawabata N, Mishima K, Adachi J, Kurisu K, Yamasaki F, Tominaga T, *et al*: A multicenter phase I/II study of the BCNU implant (Gliadel(®) Wafer) for Japanese patients with malignant gliomas. Neurol Med Chir (Tokyo) 54: 290-301, 2014.
5. Lacroix M, Abi-Said D, Fourney DR, Gokaslan ZL, Shi W, DeMonte F, Lang FF, McCutcheon IE, Hassenbusch SJ, Holland E, *et al*: A multivariate analysis of 416 patients with glioblastoma multiforme: Prognosis, extent of resection, and survival. J Neurosurg 95: 190-198, 2001.

6. Sanai N, Polley MY, McDermott MW, Parsa AT and Berger MS: An extent of resection threshold for newly diagnosed glioblastomas. J Neurosurg 115: 3-8, 2011.
7. Okuyama T, Saito K, Hirano A, Takahashi A, Inagaki T, Inamura S and Nakazato Y: Glioblastoma fed by meningeal branches of the external carotid artery: A case report. No Shinkei Geka 27: 447-452, 1999 (In Japanese).
8. Patel M, Son Nguyen H, Doan N, Gelsomino M, Shabani S and Mueller W: Glioblastoma mimicking meningioma: Report of 2 cases. World Neurosurg 95: 624. e9-624.e13, 2016.
9. Chowdhary SA, Ryken T and Newton HB: Survival outcomes and safety of carmustine wafers in the treatment of high-grade gliomas: A meta-analysis. J Neurooncol 122: 367-382, 2015.
10. Dörner L, Ulmer S, Rohr A, Mehdorn HM and Nabavi A: Space-occupying cyst development in the resection cavity of malignant gliomas following Gliadel® implantation-Incidence, therapeutic strategies, and outcome. J Clin Neurosci 18: 347-351, 2011.
11. Yoshida M, Yamaguchi S, Ishi Y, Endo S, Motegi H, Kobayashi H, Asaoka K, Kamoshima Y, Terasaka Y and Houkin K: Risk factors for adverse events after implantation of BCNU wafers in high-grade gliomas. No Shinkei Geka 43: 603-610, 2015 (In Japanese).