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Case Report

Acute cerebral hemorrhage mimicking glioblastoma on intraoperative magnetic resonance imaging: A case report ☆,☆☆

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ABSTRACT

Intraoperative magnetic resonance imaging (iMRI) is important in neurosurgical practice, especially for glioma surgery. However, the well-reported possibility to mistake lesions for brain tumors (tumor mimics) with MRI also exists for iMRI. Here, we first report a case of glioblastoma with acute cerebral hemorrhage that mimicked a newly emerged brain tumor on iMRI. A 53-year-old man underwent a second surgery for recurrent glioblastoma. Intraoperatively, iMRI revealed a new, enhanced lesion near the resected area that was absent on preoperative MRI and difficult to differentiate from newly emerged tumors. Here, a recent preoperative MRI was helpful and the new lesion was actually a hematoma. Neurosurgeons must understand that, as acute intracerebral hemorrhaging can mimic brain tumors on iMRI, preoperative MRI should be conducted just before surgery to place iMRI findings in proper context and avoid unnecessary resections.

Introduction

Magnetic resonance imaging (MRI) is now integral to neurosurgical practice as one of the most potent tools for lesion evaluation and differential diagnosis in brain tumor practice [1]. However, MRI sometimes shows lesions that can be mistaken for brain tumors, called "tumor mimics," and this prevalence is 3.4%-4.3% among central nervous system (CNS) lesions [2,3].

Maximal safe resection is essential for treating glioblastoma (GBM) as it extends potential for overall and progression-free survival [4,5]. Intraoperative MRI (iMRI), in turn, helps maximize the extent of resection [6]; however, it can

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potentially reveal tumor mimics that lead to unnecessary resection. As far as we know, there are no reports concerning tumor mimics on iMRI, especially for an acute intracerebral hemorrhage.

Here, we report a case of GBM with acute cerebral hemorrhage during surgery that mimicked a newly emerged brain tumor on iMRI.

Case report

A 53-year-old man with glioblastoma (IDH-wildtype) of the right frontal lobe underwent surgical resection of the tumor, achieving gross total resection (GTR) (Fig. 1). After adjuvant chemoradiation therapy (60 Gray/30 fractions with temozolomide), he was followed up on an outpatient basis with maintenance temozolomide therapy. He was functionally independent with a Karnofsky performance status (KPS) of 80.

Four months later, he exhibited the first generalized tonic-clonic seizure and his daily activities gradually declined to KPS 60. The brain MRI revealed a newly enhanced lesion around the surgical cavity and dissemination in the paraventricular white matter of the left parietal lobe (Fig. 2). We suspected a recurrent GBM and performed the second surgery. On iMRI, after resecting most of the tumor, a newly enhanced lesion appeared on the posterior side of the resected area that was absent on MRI 4 days prior to the surgery. The new lesion was isointense on T1-weighted imaging (WI) and iso-to-high heterogeneous intensity on T2WI with uniform enhancement by Gd-based contrast medium, as well as 2 cm apart from the lesions that had been identified preoperatively (Fig. 3). We ruled out radionecrosis and also considered the possibility of glioma metastasis was low, as a contrast lesion of clearly discernible size appeared at a distance within a few days. However, since the residual tumor could not be ruled out completely, we directly checked that lesion via microscopy, only to find a hematoma without any signs of a tumor (Fig. 4). We finished the surgery after performing hemostasis and photodynamic therapy in the surgical cavity. The newly emerged lesion on iMRI then disappeared on postoperative MRI (Fig. 5). We pathologically confirmed the recurrence of GBM and administered bevacizumab as second-line chemotherapy. Nevertheless, his symptoms did not resolve and gradually worsened. He became severely disabled and was transferred to a long-term care hospital.

Discussion

Although there are no reports concerning tumor mimics on intraoperative MRI, the prevalence on preoperative MRI is 3.4%-4.3% for CNS lesions and vascular etiology is common, ranging from 15.8% to 35.0% among them [2,3]. In the present case, an intraoperative acute cerebral hematoma mimicked a newly emerged GBM lesion on iMRI, which was eventually found to be a hematoma—a recent preoperative MRI was helpful in differentiating this lesion.

We now consider iMRI as a double-edged sword, since it allows us to assess residual tumor mass and surgical complications during surgery without increasing the risk of postoperative infection or bleeding [7]. Notably, it is essential to achieve a maximal safe resection of GBM [4,5]. However, as tumor mimics are a distinct possibility with iMRI, careful interpretation of iMRI findings is therefore crucial. Generally, it is well known that a hyperacute intracerebral hemorrhage shows iso intensity on T1WI and high intensity on T2WI [8]. However, an “intraoperative” acute hematoma often exhibits a high signal intensity on T1WI due to oxidized, regenerated cellulose for hemostasis, which significantly shortens T1 relaxation time [9]. Thus, most neurosurgeons are used to acute intracerebral hematomas showing high intensity on pre-enhanced T1WI. In conjunction, surgically induced enhancements on

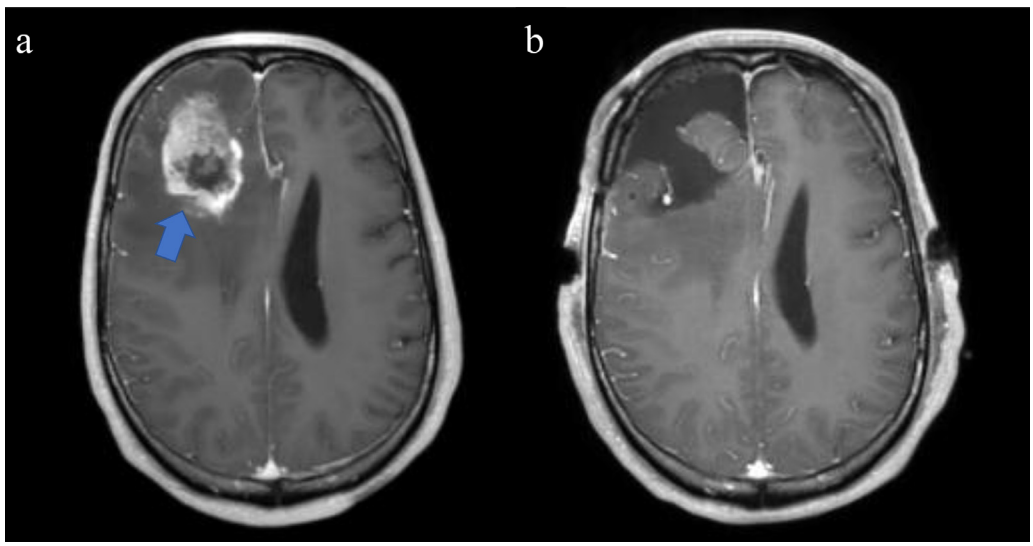

Fig. 1 – MRI before and after the first surgery. (A) A ring-enhanced lesion on the right frontal lobe is visible on preoperative MRI (arrow). (B) No apparent residual tumor as seen on postoperative MRI.

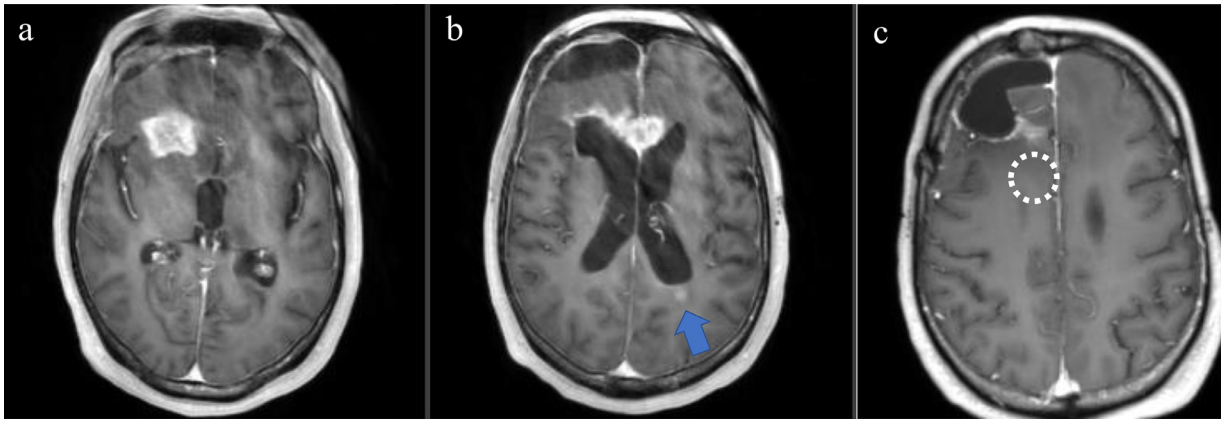

Fig. 2 – Recurrence of the tumor. (A, B) The follow-up MRI, showing the recurrence of GBM at the right frontal lobe extending to the corpus callosum. Dissemination is visible next to the left lateral ventricle (arrow). (C) Preoperative MRI just before the second surgery, showing no enhancement in the area enclosed by dotted circle, where a newly enhanced lesion would appear.

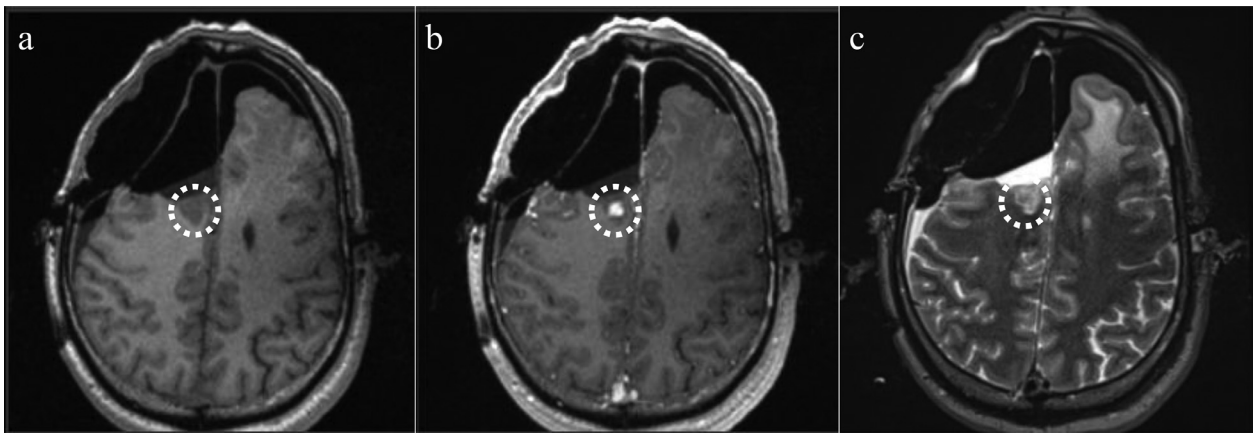

Fig. 3 – A newly enhanced lesion on iMRI at second surgery. (A, B) Comparison of noncontrast TIWI, showing a low intensity lesion in the area enclosed by dotted circle, with contrast-enhanced T1WI reveals homogeneous enhancement which is distinct from the resected cavity. Preoperative MRI (see Fig. 2C) showed no enhanced lesion in the same area. (C) T2WI, showing mixed low and high intensity.

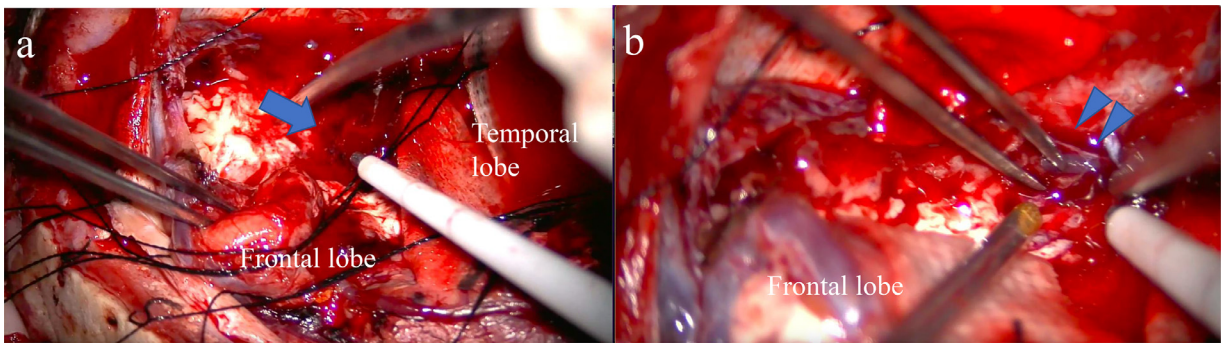

Fig. 4 – Surgical view after iMRI at second surgery. (A) A clot, visible (arrow) in the resected area of frontal lobe where the newly enhanced lesion was seen. (B) After removing the clot, continuous bleeding from small vessels is visible (arrow heads).

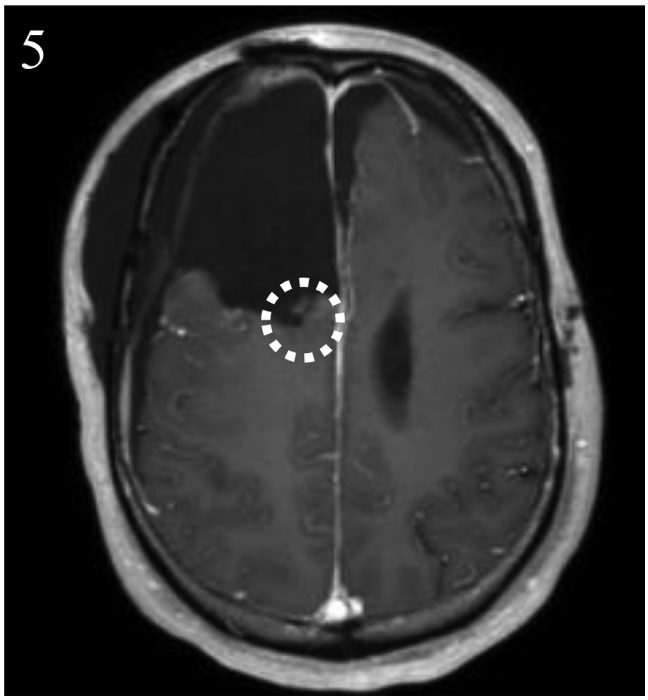

Fig. 5 – Postoperative MRI after second surgery. The enhanced lesion disappeared on contrast-enhanced MRI (area enclosed by dotted circle).

iMRI can occur in intraparenchymal spaces or at the resection margins by disrupting the blood-brain barrier [10]. Additionally, although rare, ongoing bleeding may show enhanced lesions on postenhanced T1WI by extravasation of contrast medium [11,12], leading to tumor mimics as seen in the present case. As such, most neurosurgeons would be unfamiliar with hematomas showing low intensity on pre-enhanced T1WI and high intensity on postenhanced T1WI. This led us to first suspect the newly enhanced lesion as a residual tumor.

A recent preoperative MRI is necessary to differentiate an acute hemorrhage from a residual tumor since GBM is a fast-growing tumor, growing 1.4%-2.1% per day, with a volume doubling time of 21.1-49.6 days [13,14]. In this case, iMRI showed a contrast-enhanced lesion at a new site, which required differentiation from the residual tumor. The preoperative MRI taken 4 days before the surgery showed no enhancement at that site; it is theoretically unlikely that the tumor grew in the 2 cm range within 4 days. On the other hand, even if the new lesion was a hematoma, these tend to increase when extravasation is observed, so it was conscientious to confirm the location of the new lesion and perform hemostasis [12]. Indeed, the new lesion was approachable with the same craniotomy in our case and we found no apparent residual tumor at the site. Nevertheless, if it had been located at a distant site, intraoperative confirmation would have been impossible and it might have become a surgical concern. Hence, we emphasize the importance of evaluating preoperative MRI just prior to the date of surgery, both to evaluate actual tumor size and to differentiate malignancies from tumor mimics.

Conclusion

We experienced a GBM case with a hemorrhage that mimicked a new tumor on intraoperative MRI. Neurosurgeons must understand that acute intracerebral hemorrhage can mimic brain tumors on iMRI and that preoperative MRI should be conducted just before the surgery to prevent misinterpretation of iMRI findings and unnecessary resections.

Patient consent

The authors certify that appropriate written patient consent for the publication of patient information and images was received.

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