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CASE REPORT – OPEN ACCESS

Glioblastoma with Unusual Features: Presentation with Intracerebral Hematoma, Diagnosis with CT Perfusion and Subsequent Cerebral Venous Sinus Thrombosis with Resultant New Hemorrhage

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Background: During the course of primary malignant brain tumors, there is an increased tendency for both intracerebral hemorrhage and venous sinus thrombosis.

Case Report: A 63-year-old man presented with a headache, and a brain computed tomography (CT) scan showed a hematoma in the right occipital lobe. Magnetic resonance imaging (MRI) revealed almost complete rim enhancement, and CT perfusion showed increased cerebral blood volume values. A new bleeding focus and a thrombus extending from the superior sagittal sinus to the cortical vein were seen on CT and MRI scans performed due to the headache that developed the day before surgery. After surgical evacuation of the hematoma, a giant cell glioblastoma diagnosis was made as a result of pathological examination of the lesion.

Conclusion: In challenging cases like this, perfusion techniques are useful. Cerebral venous sinus thrombosis should also be kept in mind during the perioperative and postoperative periods to avoid complications.

Keywords: Glioblastoma, sinus thrombosis, perfusion imaging, cerebral hemorrhage, hematoma

ABSTRACT

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INTRODUCTION

Intracerebral hemorrhage (ICH) is a rare but well-known presentation of primary and metastatic brain tumors. Although computed tomography (CT) and/or magnetic resonance imaging (MRI) can provide many clues to recognize a tumor that mimics intracerebral hematoma, sometimes it can be extremely difficult to diagnose the tumor as the cause of hemorrhage. In this report, we present a case of giant cell glioblastoma that presented with intracerebral hematoma and was diagnosed with the aid of CT perfusion. Another unusual feature of our case is the development of cerebral venous sinus thrombosis (CVST) after the patient presented with a new intracerebral hemorrhage.

CASE REPORT

A 63-year-old man presented with headache, visual defects on the left, nausea, and vomiting. A neurological examination confirmed left quadranopsy.

Brain CT showed a right occipital hematoma and mild perifocal edema. Although the hyperdense components suggesting acute hemorrhage dominated the lesion, hypodense areas intermingled with the hyperdense ones. CT angiography was performed to exclude underlying vascular pathologies that could cause bleeding and provided no additional findings except for a slightly contrast-enhancing 1-mm rim. Dural venous sinuses were patent. MRI (Fig. 1a, b) showed low signal intensity in T1 and T2-weighted images representing acute hematoma and liquid-liquid layering in the anterior portion of the lesion. No noticeable contrast enhancement was identified in any part of the lesion except for the almost complete rim on T1-weighted postcontrast images (Fig. 1c).

CT perfusion showed increased cerebral blood volume (CBV) values at the posterior part of the lesion (Fig. 1d). CBV value was 8.23 ml/100 g in the lesion and 5.83 ml/100 g at the symmetric normal-appearing cortical region in the contralateral normal hemisphere. The CBV value was 2.23 ml/100 g in the normal-appearing white matter of both ipsilateral and contralateral hemispheres. These measurements indicated that the questioned lesion had higher CBV values than both the normal-appearing gray matter and the white matter. After identifying these high CBV regions on perfusion CT, the CT and MR images were re-evaluated; however, the corresponding areas could not be distinguished from hemorrhage.

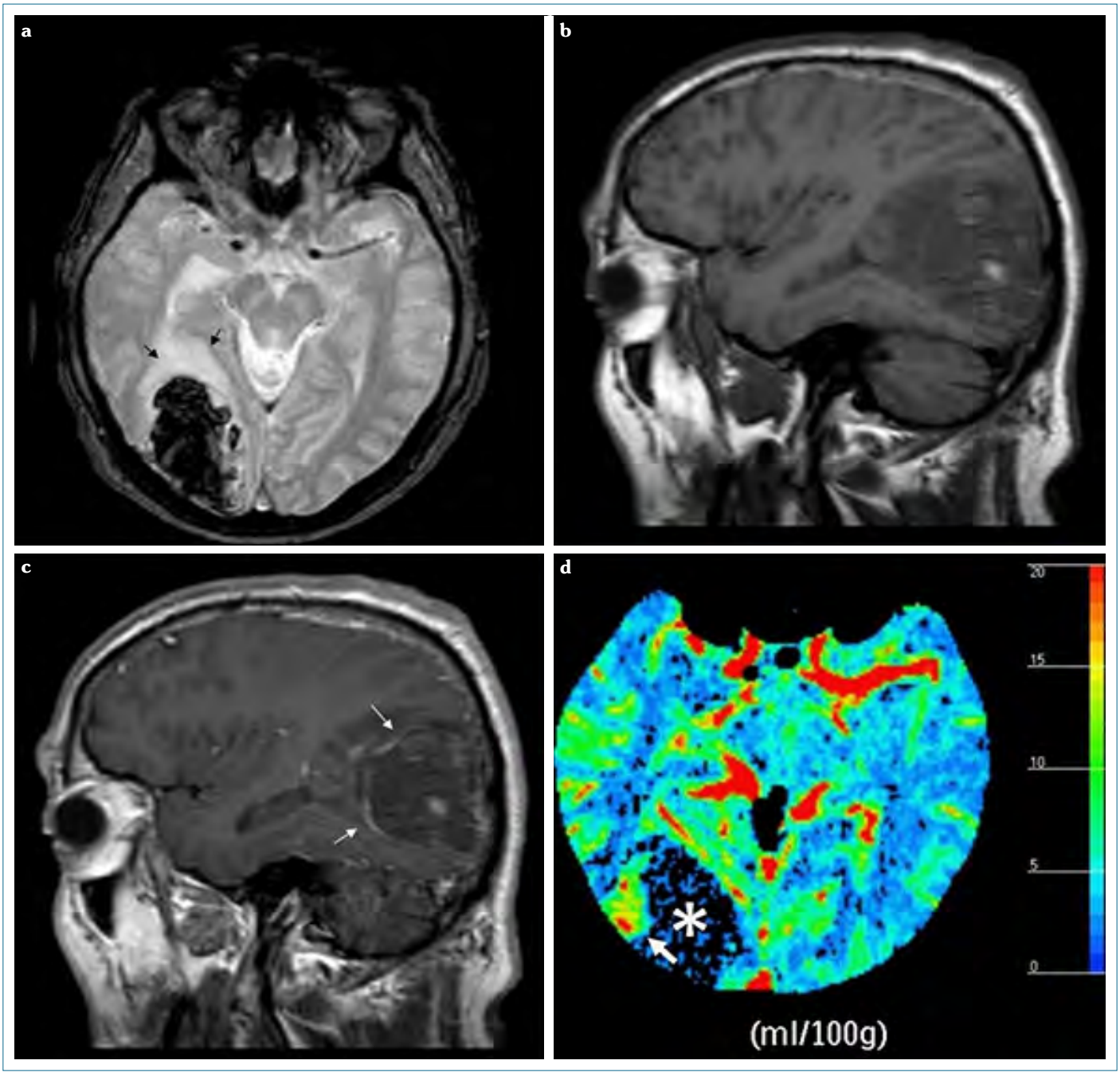

Figure 1. (a) Axial gradient echo T2-weighted image shows acute hematoma in right occipital lobe and anterior vasogenic edema (arrows). (b) In the sagittal T1-weighted image, the lesion appears mostly hypointense; however, there are also hyperintense foci likely representing methemoglobin formation. (c) Post-contrast T1-weighted sagittal image demonstrates thin capsular enhancement (arrows). (d) Cerebral blood volume (CBV) map of CT perfusion imaging. There is high CBV tissue (arrow) in the postero-lateral part of the hematoma which is devoid of signal (asterisk)

CT: Computed tomography

Because the high CBV regions suggested a tumoral process, an exploratory surgical evacuation was planned. However, the day before surgery, the patient developed a new severe headache. CT and subsequent MR imaging revealed edematous swelling of the right parietal lobe with a few foci of new intracerebral hemorrhage apart from the previous hemorrhage (Fig. 2a). CT and MR venography (Fig. 2b) depicted segmental thrombosis of the superior sagittal sinus extending into a cortical vein. We reviewed the initial CT angiography again and confirmed that the thrombosed sinus segment was patent previously. The patient was put on low molecular weight heparin treatment. After the clinical findings subsided, the patient underwent surgery. The hematoma was evacuated along with the tumoral tissue encountered in the areas with increased CBV values on perfusion CT.

Histological features and immunohistochemical profile were consistent with giant cell glioblastoma (WHO grade 4) (Fig. 2c). The

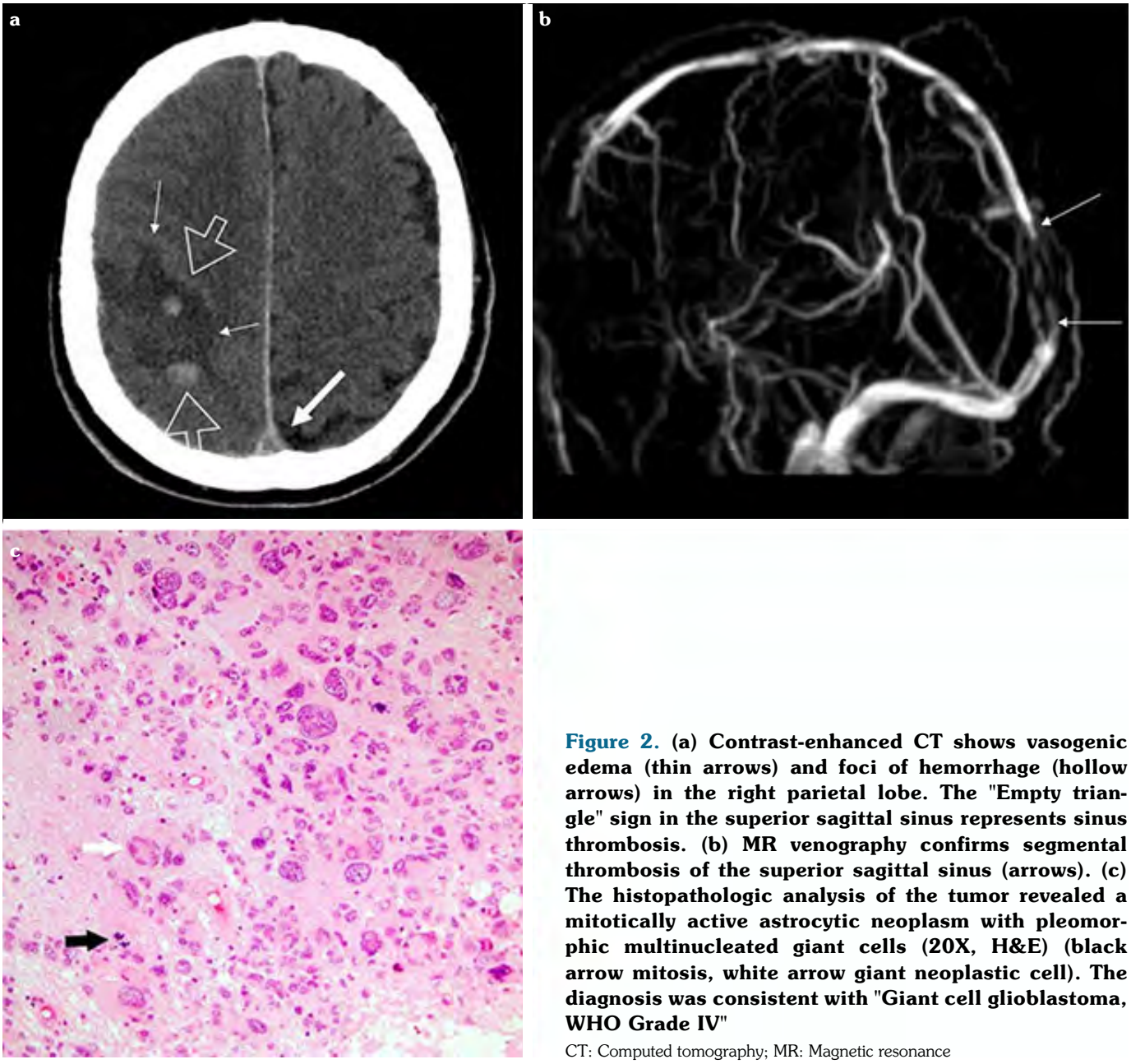

Figure 2. (a) Contrast-enhanced CT shows vasogenic edema (thin arrows) and foci of hemorrhage (hollow arrows) in the right parietal lobe. The "Empty triangle" sign in the superior sagittal sinus represents sinus thrombosis. (b) MR venography confirms segmental thrombosis of the superior sagittal sinus (arrows). (c) The histopathologic analysis of the tumor revealed a mitotically active astrocytic neoplasm with pleomorphic multinucleated giant cells (20X, H&E) (black arrow mitosis, white arrow giant neoplastic cell). The diagnosis was consistent with "Giant cell glioblastoma, WHO Grade IV"

CT: Computed tomography; MR: Magnetic resonance

patient received postoperative chemoradiotherapy treatment. After 20 months, local tumor recurrence was observed and surgically resected. Eight months after the first recurrence, he underwent a third surgery for the second recurrence and died four months after the last surgical intervention.

DISCUSSION

Primary malignant brain tumors may present with bleeding, or bleeding may be observed throughout their course. The incidence of intratumoral ICH is reported to be up to 10%, and the rate of presenting with spontaneous ICH as the initial symptom of intracerebral tumor has been reported as 0.5 to 3.4% in case series (1). The etiology of glioblastoma-related bleeding is not well known. The invasion of large vascular structures by the tumor and the presence of atypical perforating vessels in the necrotic areas of the tumor are thought to trigger intratumoral hemorrhage (2). Given this information, tumors are included in the differential diagnosis of intracerebral hemorrhage. It is generally possible to delineate an underlying tumor with contrast-enhanced radiological examinations. However, not all tumors show contrast enhancement. Tumor enhancement reflects the lack of a blood-tumor barrier and the resultant pooling of paramagnetic contrast material in the water-containing interstitial space. The contrast agent enhances the relaxation of water protons nearby, and the water in the enhancing tissue is visualized as high signal intensity on T1-weighted images (3). The same mechanism applies for CT imaging: accumulation of iodinated material in the interstitium. In normal brain tissue, intravascularly injected contrast medium cannot pass into the interstitium through the intact blood-brain barrier. Tumors without

a blood-brain barrier, such as metastases from outside the central nervous system, almost always enhance after intravascular contrast material injection on CT or MR imaging. However, gliomas may have a functioning blood-tumor barrier and may not enhance after contrast injection. Within the hematoma, we did not distinguish any contrast-enhancing tissue on either CT or MR images, but we did distinguish some tissue with CBV values higher than the contralateral normal brain cortex on perfusion CT. This finding suggested the presence of a tumor which was proven surgically.

Although contrast enhancement is not expected in tissue with a preserved blood-brain barrier, the capillary bed within the tissue does enhance during the first passage of the contrast medium, and the enhancement declines in successive passages. This enhancement versus time is monitored with perfusion imaging. Perfusion CT is based on the physical-mathematical "tracer kinetic model" (4), which assumes that the contrast bolus is instantaneous, is introduced into a single vessel, passes through a capillary network, remains totally intravascular, and flows out through a single venous conduit. Based on the integration of the time-density curves and deconvolution calculations, the software generates the pixel-based color-coded parametric maps: CBV, cerebral blood flow (CBF), and mean transit time (MTT). CBV represents the blood volume in the capillary-tissue level. Tumor blood volume is a good surrogate for mean microvascular density, a measure of angiogenesis, and an important prognostic indicator. Perfusion CT in our case showed the presence of a capillary-rich tissue within the hematoma, which led to the diagnosis.

Perfusion imaging may be performed with CT or MR imaging. Both modalities have their advantages and disadvantages. We preferred to use CT perfusion to avoid the susceptibility effects that would result from the hematoma in MR perfusion.

The increased incidence of thrombosis in cases with brain tumors has long been known. In a study, the incidence of CVST was found to be 1.53% (5). Recent case reports and a study have drawn attention to CVST associated with brain tumors (6–8). Raper et al. (6) reported six cases of CVST remote from the site of the intracranial tumor. Two of these tumors were glioblastoma, whereas the others were different. Three cases of CVST were diagnosed before or at the time of surgery, while the remaining cases were detected in a delayed fashion. In the study consisting of 163 patients with glioblastoma, 12 of them had CVST (7.4%) (8). Eleven of these patients developed thrombosis before the initiation of any treatment. The thrombosis was more likely to be present on the same side of the tumor and associated with a greater likelihood of extracranial venous thromboembolism. In these studies, none of the cases developed venous infarction or hemorrhage resulting from the CVST. In most previous cases, sinus thrombosis was detected either incidentally or by symptoms like headaches. However, in our patient, he developed cerebral edema and hemorrhage in the compromised area. It seems that brain tumors, especially glioblastoma, patients have a considerable risk of CVST, worsening the already dismal prognosis.

CONCLUSION

In some instances, the presentation of glioblastoma may be challenging. As in our case, glioblastoma may present as ICH. Perfusion techniques are helpful in these circumstances. In the course of glioblastoma or other intracerebral tumors, CVST can also be observed, which should be kept in mind during the perioperative and postoperative period to avoid complications.

Informed Consent: Written informed consent was obtained from patient who participated in this study.

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Conflict of Interest: The authors have no conflict of interest to declare.

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