



## Case Report

# A diagnostically challenging case of brain abscess with associated hemorrhage

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## ABSTRACT

**Background:** Brain abscesses with associated hemorrhage are rare. Herein, we present a case of brain abscess with associated hemorrhage that posed a diagnostic challenge.

**Case Description:** A 50-year-old male presented with the left homonymous hemianopia and was admitted to our hospital due to a subcortical hemorrhage in the right occipital lobe, which was revealed during a head magnetic resonance imaging (MRI). Subsequent imaging suggested an intra-tumoral hemorrhage, so surgical treatment was planned. However, on hospital day 6, the patient suddenly showed a decrease in consciousness level. Head MRI showed a high signal within the capsule on diffusion-weighted imaging, which spread to the ventricle and subarachnoid space. Brain abscess was suspected; therefore, an abscess drainage surgery was performed emergency. The postoperative course was relatively smooth.

**Conclusion:** A brain abscess that perforates the ventricle has a poor prognosis, which emphasizes the need for early diagnosis and treatment. Although hemorrhage within a brain abscess is rare, it can complicate diagnosis, which, thus, underscores the importance of awareness.

**Keywords:** Brain abscess, Case report, Differential diagnosis, Hemorrhage

## INTRODUCTION

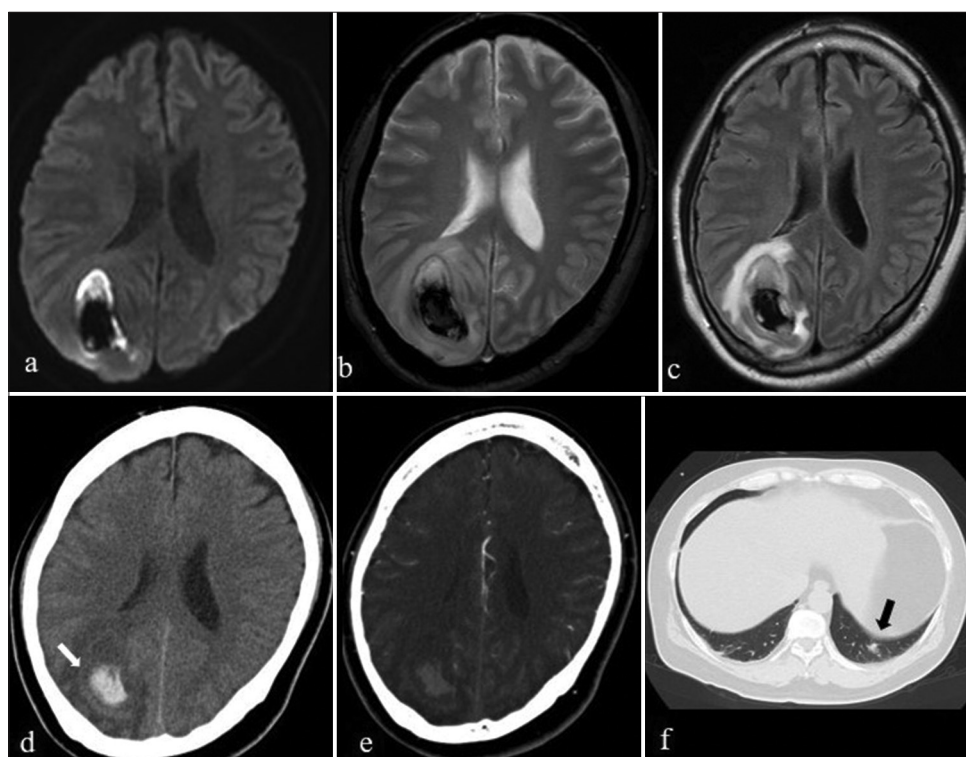
The mortality rate for brain abscesses is 5–32%, with mortality of 39–80% in cases with ventricular perforation.<sup>[18,20,21]</sup> Brain abscess shows ring enhancement on contrast-enhanced computed tomography (CT)/magnetic resonance imaging (MRI) scans and requires differential diagnosis from malignant gliomas and metastatic brain tumors. Hemorrhage within a brain abscess is rare, so intra-tumoral hemorrhage is generally suspected when hemorrhage is observed within a ring enhanced lesion. Herein, we present a case of a brain abscess with associated hemorrhage that presented challenges in differentiation and review the relevant literature.

## CASE REPORT

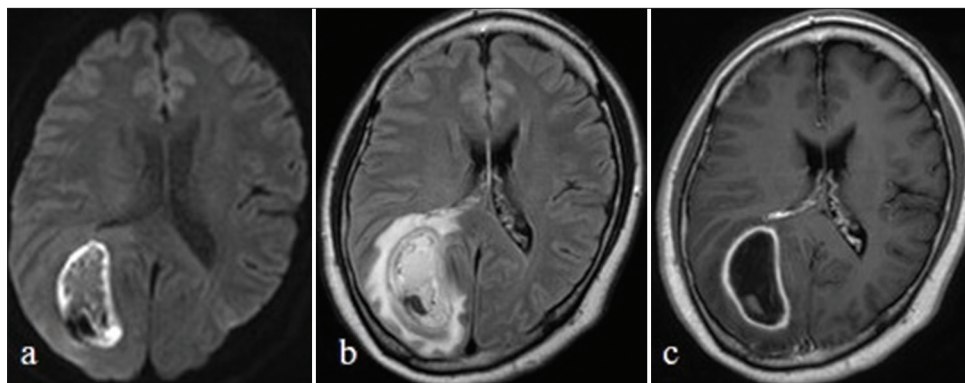
A 50-year-old Japanese male with a history of untreated hypertension and dyslipidemia came to our hospital with complaints of left homonymous hemianopia. Three days ago, he noticed vision problems on the left side suddenly. He visited the hospital due to the persisting symptoms. A head

MRI revealed a hemorrhage in the right occipital lobe of his brain [Figure 1]. A head MRI revealed a hemorrhage in the right occipital lobe of his brain [Figure 1]. On admission, he had a slight fever (37.2°C) and hypertension (152/86 mmHg) along with headache and symptoms of the left homonymous hemianopia. Blood tests showed a slightly increased white blood cell count (12600/ $\mu$ L) and C-reactive protein level (2.8 mg/dL). Head MRI revealed a mixture of low and high signals in the right occipital lobe on diffusion-weighted imaging (DWI)/T2\* with a hemorrhagic lesion measuring 38 mm in maximum diameter and surrounding edema on fluid-attenuated inversion recovery [Figures 1a-c]. Magnetic resonance angiography did not reveal any aneurysms, vascular malformations, or other abnormal findings. A plain head CT revealed hemorrhage with edema in the right occipital lobe, and a capsule with isointense signals was suspected around the hematoma [Figure 1d]. The contrast findings of the capsule were unclear [Figure 1e]. The patient also had a small nodule in the left lower lung field [Figure 1f]. The lung nodule was thought to be due to old inflammatory changes. Due to the patient's untreated hypertension and atypical MRI findings, the diagnosis was hypertensive cerebral subcortical hemorrhage, and conservative treatment was started.

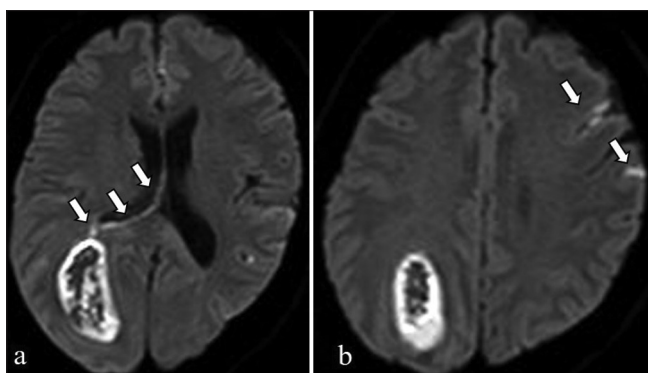
On hospital day 4, a follow-up head CT revealed reduced hemorrhage size but an increase in cystic lesions [Figure 2]. Due to the possibility of intra-tumoral hemorrhage, a contrast-enhanced head MRI was performed, which showed a ring-enhancing effect on T1-weighted imaging in the lesion in the right occipital lobe. A mixture of heterogeneous low and high signal intensities was also observed on DWI within the lesion. Because the DWI findings were atypical for a brain abscess, intra-tumoral hemorrhage was suspected, and surgical treatment was planned. However, on hospital day 6, a sudden decrease in consciousness was noted, with a Glasgow coma scale score of 8 points (E1V3M5). A head MRI showed high DWI signals within the cyst extending into the ventricles and subarachnoid space [Figure 3]. Blood tests indicated an elevated white blood cell count (36200/ $\mu$ L), suggesting a significant inflammatory response. Antibiotic therapy (meropenem 6 g/day + vancomycin 2 g/day) was started for suspected brain ventricle perforation of brain abscess. On hospital day 7, acute hydrocephalus was diagnosed, leading to a burr-hole drainage procedure under local anesthesia. The drainage of foul-smelling dark brown pus confirmed the diagnosis of brain abscess. *Peptostreptococcus* was isolated from the pus culture. Since



**Figure 1:** (a) Diffusion-weighted imaging, (b) T2 star weighted imaging, (c) fluid-attenuated inversion recovery magnetic resonance imaging images obtained at admission reveal a hemorrhagic lesion measuring 38 mm in maximum diameter with surrounding edema in the right occipital lobe. (d) Head and (e) contrast-enhanced head and (f) chest computed tomography images obtained at admission show a suspected capsule with isointense signals and no enhancement around the hematoma (arrow) and a small nodule in the left lower lung field (arrow).



**Figure 2:** (a) Diffusion-weighted imaging, (b) fluid-attenuated inversion recovery, and (c) contrast-enhanced T1W magnetic resonance imaging images obtained on hospital day 4 reveal an increase in and a ring-enhancing effect of the cystic lesion.



**Figure 3:** (a and b) Diffusion-weighted imaging magnetic resonance imaging images obtained on hospital day 6 reveal a high signal within the cyst spreading to the ventricles and subarachnoid space (arrows).

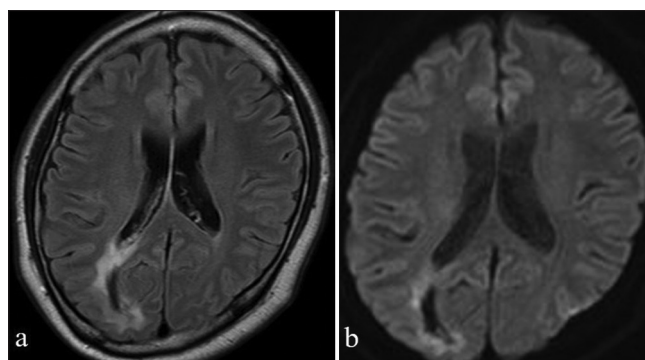
the dental oral surgery department diagnosed periodontal disease, it was determined that the brain abscess was caused by periodontal disease.

After surgery, the patient's level of consciousness improved. The antibiotics were adjusted to ceftriaxone 4 g/day from hospital day 16 and amoxicillin/clavulanate 750 mg/day starting on hospital day 50. On hospital day 53, the patient was discharged home with a modified Rankin scale score of 2 on the resolution of the inflammatory reaction. Antibiotics were administered for 8 weeks, starting on hospital day 6. Subsequent outpatient follow-up showed no recurrence of the brain abscess [Figure 4].

## DISCUSSION

Brain abscess with associated hemorrhage is rare, with only 15 reported cases within the abscess<sup>[1,2,4-8,11,12,14-16,19,23]</sup> and nine cases with hemorrhage observed within the abscess on CT at the initial visit [Table 1].<sup>[4,5,7,8,11,14,16,19,23]</sup>

The abscess formation process from encephalitis to brain abscess comprises four stages based on the period from



**Figure 4:** (a) Diffusion-weighted imaging, (b) fluid-attenuated inversion recovery magnetic resonance imaging images obtained 3 months after discharge.

the first symptoms to a head CT scan: early cerebritis stage (1–3 days), late cerebritis stage (4–9 days), early capsule stage (10–13 days), and late capsule stage (after 14 days).<sup>[3,18]</sup> In the early cerebritis stage, CT findings do not indicate abnormalities or irregular low-density areas, as they are close to iso-density. This progresses to developing strong, low-density areas and surrounding edema with indistinct borders in the late cerebritis stage. As the abscess enlarges, a capsule is formed, reaching maximum size and achieving sufficient capsule enhancement in the early capsule stage. In the late capsule stage, there is a decrease in abscess size with a more homogeneous and stronger enhancement effect on the capsule. In addition, hemorrhage from the capsule during the transition from the late cerebritis stage to the early capsule stage and from the capsule during the late cerebritis stage has been reported.<sup>[6,22]</sup>

During capsule formation, blood flow is weaker on the medullary compared with the cortical side, which results in capsule thinning on the ventricular side, possibly leading to ventricular perforation.<sup>[22]</sup> Cyst enlargement was noticed after admission [Figure 3], followed by ventricular perforation of the abscess. Based on these observations, we concluded that

**Table 1:** Review of reported cases of hemorrhage within the brain abscess on CT at the time of the initial visit

Authors & Year	Age (years)	Sex	Location	Comorbidities	Operation	Pathogenic bacteria	clinical course	Pathogenesis of hemorrhage
Casado-Naranjo et al, 1989 <sup>[4]</sup>	29	M	Multiple bilateral cerebral hemispheres	Acquired immunodeficiency syndrome	non	Toxoplasma gondii tachyzoites Encysted bradyzoites	died	NA
Nakagawa et al, 1989 <sup>[11]</sup>	11days	M	Rt. temporal	meningitis	BDS	Escherichia coli	AWoN	NA
Jamjoom et al, 1990 <sup>[7]</sup>	68	M	cerebellum	non	BAE	Diphtheroids Bacteroides	AWoN	*1
Devi et al, 1993 <sup>[5]</sup>	9moths	M	Lt. fronto-temporal	parotid abscess	BDS	Staphylococcus aureus	died	*2
Umezawa et al, 2004 <sup>[19]</sup>	40	M	Lt. putamen	Diabetes Hypertension Dyslipidemia	BAE	Staphylococcus aureus	AWiN	*1
Kaplan et al, 2005 <sup>[8]</sup>	6	M	Rt. temporal	Falot's tetralogy	BDS	Culture negative	died	*1
Robinson & Goulding, 2005 <sup>[14]</sup>	71	M	Rt. fronto-parietal	infective endocarditis	non	Staphylococcus aureus	died	*1
Terakawa et al, 2007 <sup>[16]</sup>	68	F	Lt. temporal	non	BDS	Prevotella Peptostreptococcus species	AWoN	*1 and *2
Yoon et al, 2019 <sup>[23]</sup>	44	M	Rt. fronto-temporal	Diabetes Hypertension	BDS	Staphylococcus saprophyticus	AWoN	NA
Present case	50	M	Rt.occipital	Hypertension Dyslipidemia	BDS	Peptostreptococcus	AWiN	*1 and *2

BDS = burr hole drainage surgery; BAE = brain abscess excision; AWoN = alive without neurological deficit; AWiN = alive with neurological deficit; NA = not available.

\*1 = the rupture of new blood vessels that proliferate during the formation of the abscess capsule.

\*2 = vascular rupture due to failure of thrombus formation in surrounding blood vessels caused by the expansion of the abscess.

the formation process of the brain abscess at admission was in the late cerebritis stage.

Common initial symptoms of brain abscesses often involve fever and headache.<sup>[22]</sup> Our patient had left homonymous hemianopsia and a slight fever 3 days before admission. We concluded that the brain abscess was in the late cerebritis stage, even considering the timing of the initial symptoms.

The cause of hemorrhage within brain abscesses is not fully understood. Still, potential reasons may include the rupture of newly formed blood vessels during the development of the abscess capsule<sup>[2,6-8,12,14-16,19]</sup> or vascular rupture due to failure of thrombus formation in surrounding blood vessels caused by the expansion of the abscess.<sup>[5]</sup> Inflammatory reactions<sup>[15]</sup> and hypoxia<sup>[8]</sup> may also cause vascular proliferation. In this case, the hemorrhage is thought to have been caused by an underlying factor.

If a ring-shaped contrast effect is visible in a mass lesion, it is essential to consider the potential for a brain abscess, metastatic brain tumor, or malignant glioma. In addition, intratumoral hemorrhage is generally suspected when

hemorrhage is observed within a mass lesion.<sup>[2,5,6,12,15,16,23]</sup> A head MRI is considered the most helpful method to distinguish between brain abscesses and tumors, with notable high-signal intensity on DWI within the tumor being a key finding (sensitivity 96% and specificity 96%).<sup>[13]</sup> Other valuable findings include the dual rim sign of susceptibility-weighted imaging (SWI)<sup>[9,17]</sup> and the multimodal elevation of amino acids in the abscess cavity of magnetic resonance spectroscopy (MRS).<sup>[10]</sup> However, it has been reported that when hemorrhage occurs within a brain abscess, the inside of the abscess does not show typical high-signal intensity on DWI,<sup>[16]</sup> so caution is required while making the differential diagnosis. In addition, MRS is reportedly useful for distinguishing between brain abscesses and brain tumors when hemorrhage is present<sup>[14,19]</sup> and should be performed whenever possible. This case did not demonstrate typical DWI findings within the capsule, which complicated the diagnosis. However, the patient had clinical symptoms such as a slight fever, and we believe that a brain abscess should have been suspected earlier. When hemorrhage occurs within a focal lesion with a ring-shaped contrast effect, it is crucial to consider the rare possibility of hemorrhage in the brain

abscess and to make an early diagnosis based on a detailed medical history and clinical course.

## CONCLUSION

This study presents a case of brain abscess accompanied by hemorrhage. The hemorrhage occurred during the late encephalitis stage, and it was believed to have been caused by the rupture of new blood vessels that had developed with the formation of the capsule or vascular rupture due to failure of thrombus formation in surrounding blood vessels caused by the expansion of the abscess. The mortality rate after intraventricular perforation of brain abscesses is very high; therefore, early detection and intervention are crucial. The possibility of a brain abscess should be considered if a capsule is suspected to be around the hemorrhage area. Although rare, early diagnosis and treatment based on medical history and clinical findings are important.

## Ethical approval

The Institutional Review Board approval is not required.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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## Conflicts of interest

There are no conflicts of interest.

## Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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