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Case Report

Diffusion-weighted imaging in the early diagnosis of intraventricular rupture of a brain abscess☆,☆☆

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ABSTRACT

Brain abscess is a potentially fatal injury that must be treated promptly to avoid complications that require neurosurgery such as intraventricular rupture. Patients with brain abscess may exhibit a multiple variety of nonspecific symptoms, simulating the presence of neurological diseases such as ischemic stroke or intracranial tumor masses. Early radiological diagnosis with adequate subsequent treatment improves the patient's chances of recovery. We report the case of a 48-year-old male patient with brain abscess complicated by an initial rupture into the ventricle. Magnetic resonance imaging with diffusion-weighted images, and apparent diffusion coefficient maps made it possible to diagnose an intraventricular rupture of the abscess with consequent appropriate neurosurgical treatment.

Introduction

Brain abscess is a focal infection that begins as a localized area of cerebritis and develops into a mass-like lesion within a circumscribed capsule [1]. A brain abscess can result from an accumulation of infected material as a direct extension of infection originating from other areas (such as ear infections, sinusitis and dental abscesses) or from hematogenous spread in cases of bacterial endocarditis, drug abuse or septic embolic pneumonia. Intraventricular rupture of a brain abscess is associated with high mortality and requires early diagnosis and urgent treatment such as ventriculostomy with intraventricular administration of antibiotics [2].

In this report, we present a 48-year-old male patient with frontal lobe abscess complicated by an initial rupture into the ventricle, diagnosed early with a morphological and functional MRI study.

☆ All authors declare that the individuals involved (legally authorized subjects or representatives) gave their informed consent (written or verbal, as appropriate) prior to inclusion in the study.
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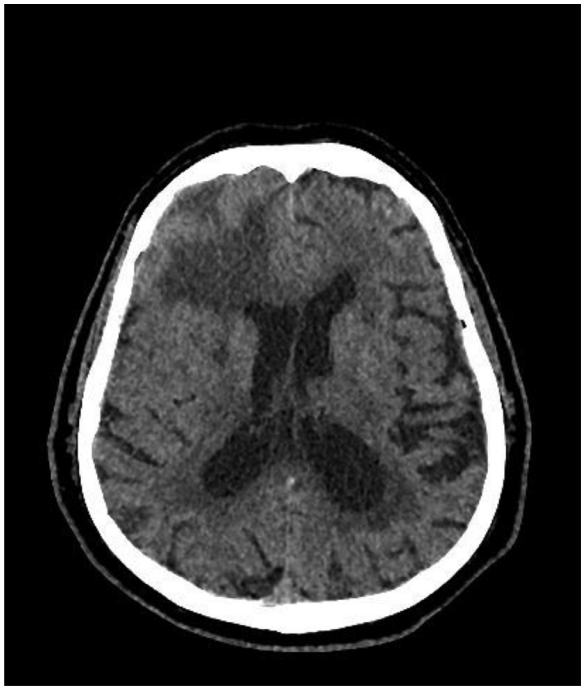

Fig. 1 – Noncontrast axial CT image. Inhomogeneous parenchymal lesion localized to the right frontal lobe with perifocal edematous component.

Case report

A 48-year-old man presented to the emergency room for an episode of headache and lower limb weakness with a fall to the ground and release of the sphincters occurred a few hours earlier. He had no convulsions. Past medical history was negative for oral or pharyngeal disease and for any surgical procedures performed within the previous 6 months. He denied recent abdominal trauma or intravenous drug abuse. The patient was on drug therapy for the treatment of chronic hypertension and type II diabetes mellitus. Physical examination was normal: the patient had a regular heart and respiratory rate and no deficit involving the cranial nerves. In the emergency room he performed an arterial blood gas analysis (ABG) which showed the following values: arterial blood pH 7.48; partial pressure of carbon dioxide 33 mm Hg; oxygen saturation 98%. The blood test showed: white blood cell count 11.8 $\times$ 10^9/L; mean corpuscular hemoglobin concentration 12.3 g/dL; sodium 127 mEq/l; glycaemia 222 mg/dL. Brain CT showed an expansive parenchymal lesion with inhomogeneous signal in the right frontal area starting from the hemispheric convexity, extending caudally to the frontal basal region, with a peripheral edematous component. There was also associated right frontal horn compression and minimal left midline deviation (Fig. 1). No urgent surgical indications emerged from the neurosurgical consultation. Pending MRI examination, Dexamethasone and Levetiracetam therapy was started.

However, during the hospitalization the patient remained pyretic and soporous. No significant pathologies emerged

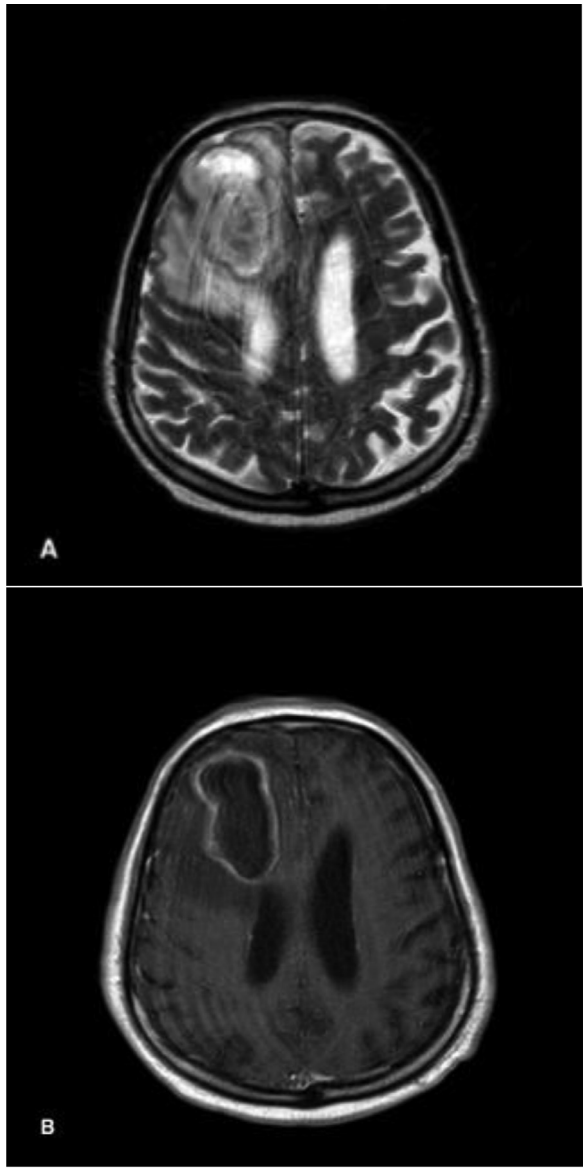

Fig. 2 – Conventional axial magnetic resonance images. (A) T2-weighted image shows a hyperintense abscess with a thin hypointense capsule and peripheral hyperintense edema. (B) T1-weighted image after gadolinium shows a ring-enhancement of peripheral capsule of abscess.

from a chest-abdomen CT scan. Based on the infectious disease consultation, antibiotic therapy with Ceftriaxone, Metronidazole and Linezolid was introduced. The following day a contrast-enhanced magnetic resonance imaging (MRI) showed a ring-enhancing lesion suggestive of a brain abscess (Fig. 2). The lesion presented marked cerebral edema with a reduction of width of right frontal cortical sulci. An initial left convex subfalcina hernia was associated. The spectroscopic examination showed a clear reduction of the main cerebral metabolites and a marked increase of lactates (Fig. 3). The lesion was near the frontal horn of the ventricle, which was neither compressed nor fissured. However, small amounts of markedly hyperintense purulent material in DWI sequences

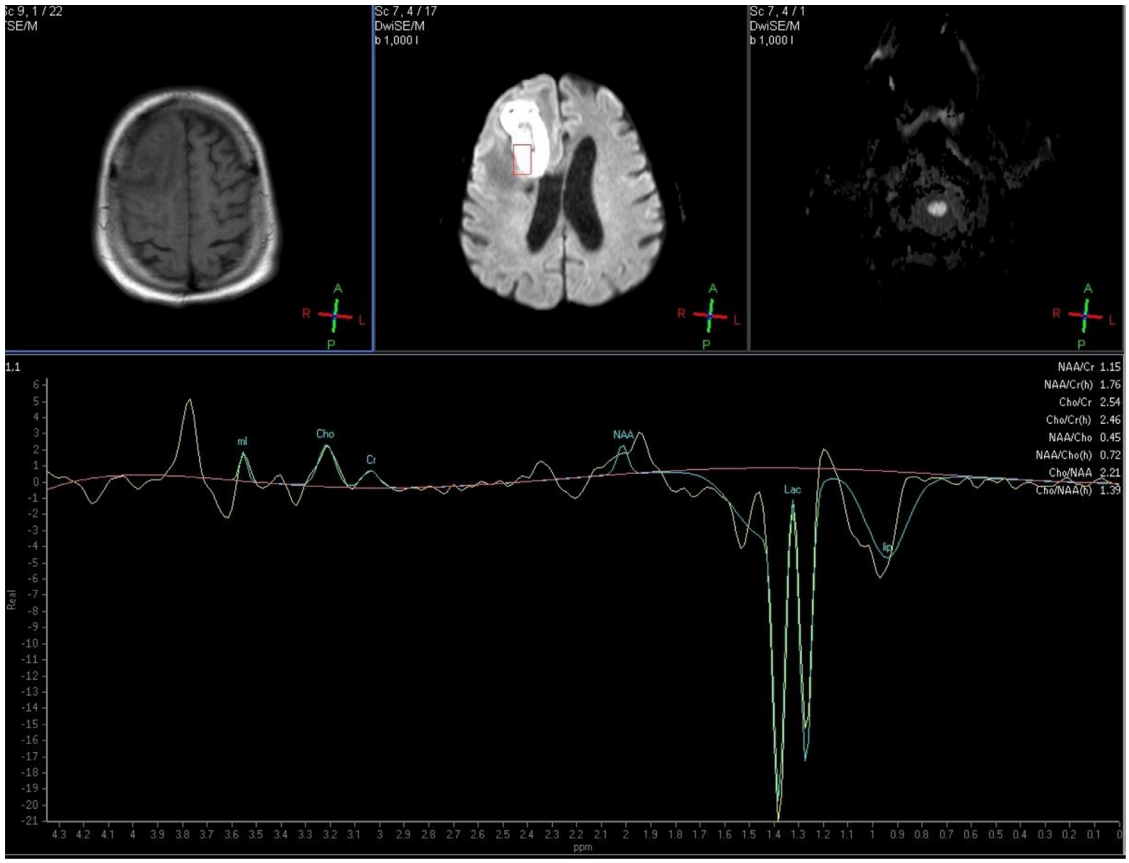

Fig. 3 – Magnetic resonance spectroscopy. The study shows an elevated lactate peak with low N-acetylaspartate (NAA), choline and creatine peaks.

were recognized within the trigones bilaterally (Fig. 4). Two days later, the patient underwent urgent neurosurgery to evacuate the frontal lesion. Bacteriological examination allowed the isolation of Steptococcus intermedius. Metronidazole was then discontinued and drug therapy continued with Linezolid and Ceftriaxone. Transthoracic echocardiography, orthopantomography, and abdominal ultrasound showed no pathological signs. After two weeks, the patient underwent a further CT scan which showed a reduced abscess volume surrounded by edema. Mannitol therapy was then administered. The clinical course was favorable after a long period of neurological rehabilitation.

Discussion

Brain abscess is a focal infection of the brain parenchyma that begins as a limited area of cerebritis and evolves into a capsule-bound collection of pus [1]. Its incidence in industrialized countries is around 2% [3]. In most cases, the symptoms and clinical signs of patients with brain abscess are nonspecific and patients may mimic other clinical entities such as stroke or other intracranial lesions. The classic triad of headache, fever and focal neurological deficits is present in about 20% of cases upon admission [4]. Given its high mortality rate, brain abscess is a potentially fatal injury that must be diagnosed with radiological examinations and treated promptly with an appropriate multidisciplinary medical and surgical approach. Notably, mortality has dropped to 10% over the past 2 decades, largely thanks to advances in imaging such as the advent of MRI [4].

In the early stages of cerebritis, noncontrast CT shows a low-attenuating lesion with associated mass effect. In the stages following capsule formation, contrast-enhanced CT shows a lesion with increased peripheral ring and central necrotic zone, surrounded by variable peripheral edema [5]. If readily available, MRI would preferably be the first exam to be requested in suspected brain abscess as it allows for early identification of complication-prone lesions and offers a high contrast resolution to discern any additional satellite lesions [6]. MRI findings also depend on the stage of evolution of the pyogenic lesions. Early stage brain abscess may have a low T1-weighted imaging signal (T1WI) and a high T2-weighted imaging signal (T2WI). In the later stages, the abscess appears as a ring enhancing lesion after administration of gadolinium. The central necrotic zone is hypointense in T1WI and hyperintense in both T2WI and DWI sequences with low ADC values.

Several studies have demonstrated the usefulness of DWI sequences in the differential diagnosis between brain abscesses and cystic or necrotic brain lesions [7,8]. In particular, DWI images usually show restricted diffusion and bright

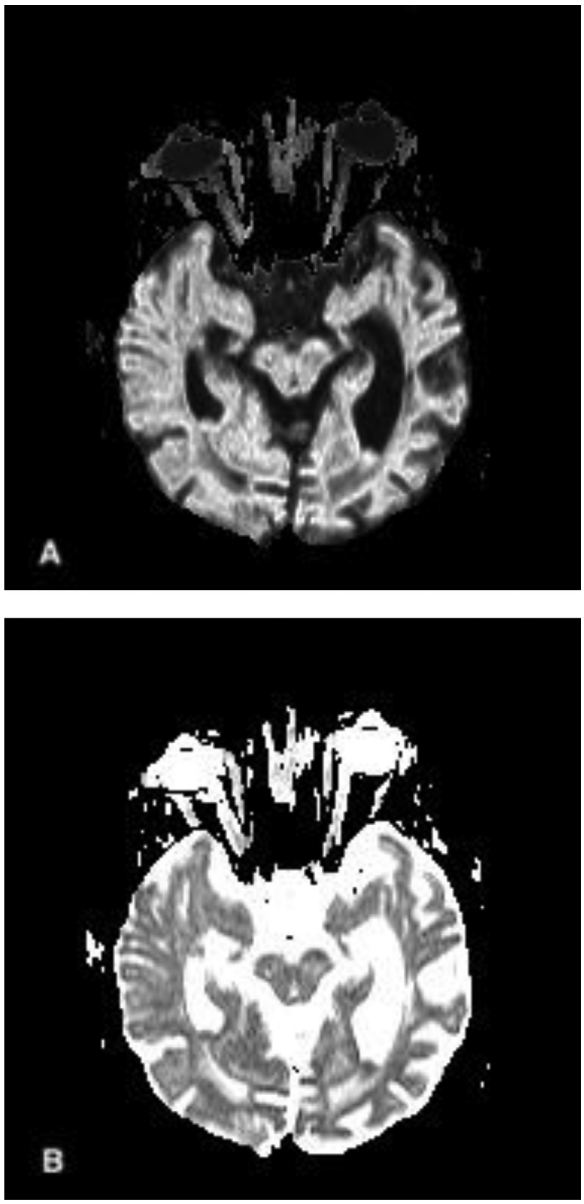

Fig. 4 – Axial diffusion-weighted magnetic resonance image and apparent diffusion coefficient (ADC) map. (A) Diffusion-weighted image shows hyperintense purulent material in the trigone of each lateral ventricle. (B) ADC map show hypointense intraventricular pus at the same level as the image A.

signal, unlike necrotic neoplasms which usually do not have restricted diffusion. Furthermore, in combination with DWI sequences, magnetic resonance spectroscopy significantly increases the diagnostic accuracy of intracranial lesions [9]. In particular, abscess lesions shows characteristic peaks corresponding to lactate, aminoacids, and lipids. The potential usefulness of magnetic resonance spectroscopy for the diagnosis of etiologic agent of infectionand for the evaluation of medical-surgical response has already been demonstrated [10].

In our case the hyperintensity present in the atrium of each lateral ventricle shown in the DWI sequence, similar to that present in the abscess cavity, leads back to the presence of purulent material in the cerebrospinal fluid and suggests the complicated evolution of the brain abscess which ruptured into the cerebral ventricles.

In conclusion, we describe a 48-year-old male patient with a frontal lobe brain abscess rupturing into the ventricle, diagnosed early by MRI examination. In particular, the complementary use of DWI images and ADC maps was relevant in the assessment of the initial intraventricular extension. This case highlights the essential role of magnetic resonance imaging in the early diagnosis of complicated brain abscess, allowing the implementation of the best therapeutic strategy for each subject and consequently increasing the patient's chances of survival.

Conclusion

Intraventricular rupture of a brain abscess is associated with high mortality, therefore early radiological diagnosis may allow for adequate clinical treatment and improve patient survival. The morphological and functional study of MRI improves the early diagnosis of brain abscess. In particular, the complementary use of DWI images and ADC maps is critical in assessing the initial intraventricular extension of the brain abscess.

Human rights statements

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1964 and its later amendments. Informed consent was obtained from all patients for being included in the study.

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