



ORIGINAL ARTICLE

# Gas-containing brain abscess: Etiology, clinical characteristics, and outcome



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## KEYWORDS

Brain abscess;  
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**Abstract** Gas-containing brain abscess remains a life-threatening disease that requires immediate diagnostic and therapeutic intervention. The aim of this study is to report on a series of gas-containing brain abscess and discuss its pathological mechanism and therapeutic consideration. This study included 11 patients with gas-containing brain abscess at Kaohsiung Chang Gung Memorial Hospital, Kaohsiung, Taiwan during a 27-year period. The predisposing factors to infection included hematogenous spread in five patients, contiguous infection in one patient, and abnormal fistulous communication due to head injury in four patients. In one patient, the predisposing factor might be contiguous infection from frontal sinusitis or abnormal fistulous communication due to previous sinus surgery. *Klebsiella pneumoniae* was the most common causative pathogen that was isolated from the gas-containing abscess not related to skull base defect. Among these 11 patients, six underwent excision and five accepted aspiration for the surgical treatment of abscess. In the five patients who underwent aspiration, two required repeated craniotomy to excise the recurrent abscess and repair the abnormal fistulous communication through the skull base. When encountered with a gas-containing abscess in patients with an impaired host defense mechanism, *K. pneumoniae* infection should be suspected, and further attention should be paid to discovering if other metastatic septic abscesses exist. For patients with a history of basilar skull fracture or surgery involving the skull base, craniotomy is indicated to excise the abscess and repair the potential fistulous communication through the cranium. Aspiration may be a reasonable alternative to treat deep-seated lesions, lesions in an eloquent area, patients with severe concomitant medical disease, or patients without a history of basilar skull fracture or surgery involving the skull

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base. Prompt diagnosis, appropriate antibiotic use, and meticulous surgical treatment are the only way to obtain a favorable outcome.

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## Introduction

Even with enormous advances in diagnostic imaging techniques, neurosurgical techniques, and antibiotic therapy, brain abscess remains a life-threatening disease that requires immediate diagnostic and therapeutic intervention. Gas-containing brain abscess is very rare and has been reported to result from bacterial fermentation or escape of air into the cranium through an abnormal communication between the exterior and the cranium [1]. The reported causative pathogens of gas-containing brain abscess include *Clostridium perfringens*, *Klebsiella pneumoniae*, *Peptostreptococcus* species, and *Fusobacterium nucleatum* [2–6]. The management of gas-containing brain abscess is still controversial. The presence of gas within the abscess has been considered an indication for surgical excision [1]. However, aspiration of abscess content only also results in good outcome [2,6]. Herein, we report on a series of gas-containing brain abscess and discuss its pathologic mechanism and therapeutic consideration. Our research is done in an effort to improve the therapeutic strategy of this potentially fatal disease.

## Materials and methods

During a 27-year period (1986–2012), 246 patients at Kaohsiung Chang Gung Memorial Hospital, Kaohsiung, Taiwan were retrospectively identified to have pyogenic brain abscess. Inclusion criteria for pyogenic brain abscess were as follows: (1) classical clinical manifestations, including fever, headache, focal neurological signs, and/or altered consciousness; (2) characteristic findings on computed tomographic (CT) and/or magnetic resonance imaging (MRI) scans; and (3) evidence of brain abscess observed during surgery or histopathological examination. Specimens obtained from patients were cultured for aerobic and anaerobic bacteria, mycobacteria, and fungi. In patients with negative cultures, brain abscess was diagnosed according to the classic clinical and radiographic findings and good therapeutic response to combined surgical and antibiotic treatment. Among these 246 patients, gas was noted within the abscess cavity on CT scan in 14 patients (Fig. 1). However, three patients with gas-containing abscess who sustained craniotomy within 1 month before the diagnosis of brain abscess were excluded in this study because it was difficult to clarify the origin of air.

For these 11 patients with gas-containing abscess, the presenting symptoms, underlying disease, predisposing factors of infection, site of abscess, therapeutic methods, outcome, and complication during follow-up were retrospectively reviewed. Predisposing factors for brain abscess

include contiguous infection from a parameningeal focus, hematogenous spread from a distant infection site, and abnormal fistulous communication due to previous surgery or head trauma. Neuroradiographic studies were reviewed carefully, and the number, size, and location of abscesses were recorded. Therapeutic choice was judged according to clinical status, neuroradiographic findings, and therapeutic response. The duration of antibiotic treatment depended on therapeutic response. Surgical treatment consisted of either aspiration or excision. Aspiration was defined as aspiration of the abscess content with a ventricular catheter through a burr hole or small craniotomy, leaving the capsule intact. Craniotomy and resection of the abscess was defined as excision. Functional outcome was evaluated 3 months after patient discharge by the Glasgow Outcome Scale (GOS) score as follows: 1 = death, 2 = persistent vegetative state, 3 = severe disability, 4 = moderate disability, and 5 = good recovery [7]. Any adverse event related to the brain abscess during the follow-up period was considered as a follow-up complication.

## Results

After excluding three patients who developed gas-containing abscess following recent craniotomy, 11 patients with gas-containing brain abscess were included in this study. Our study found two categories of gas-containing



**Figure 1.** An enhanced computed tomographic scan showed a faintly ring-enhanced lesion with air–fluid level in the left frontal lobe.

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