Evaluation of Continuous Irrigation and Drainage with a Double-Cavity Sleeve Tube to Treat Brain Abscess

Zhenxing Yang[1,2], Li Du[3], Renzhong Liu[2], Zhihong Jian[2], Yu Wan[1]

BACKGROUND: **Brain abscesses carries a high morbidity and mortality, and despite medical advances, it continues to pose diagnostic and therapeutic challenges worldwide. The traditional surgical approaches to treating brain abscess (burr hole aspiration and craniotomy) have both advantages and disadvantages and remain controversial. Here we report a single institution's experience with a new surgical approach for brain abscess.**

METHODS: **We retrospectively analyzed 46 patients with intracranial abscess who underwent continuous irrigation and drainage through a double-cavity sleeve tube placed surgically in conjunction with a 4-week course of intravenous cefotaxime and metronidazole at Renmin Hospital of Wuhan University between January 2008 and December 2016. The patients' medical records were analyzed for demographic data, clinical presentation, predisposing factors, imaging findings, microbiological test results, treatments, surgical techniques, and outcomes.**

RESULTS: **The 46 patients included 29 males and 17 females, ranging in age from 22 to 74 years. A single abscess was detected in 34 patients, whereas 12 patients had multiple abscesses. The average duration of hospitalization was 12.6 days. After treatment, 38 of the 46 patients resumed a normal life despite minor deficits (Glasgow Outcome Score [GOS] 5), 6 patients exhibited slight neurologic deficits (GOS 4), and 2 patients died of severe systemic infection and multiorgan failure. In particular, a patient with a brain abscess broken into the ventricle recovered well (GOS 5). No patient required repeat aspiration or surgical excision.**

CONCLUSIONS: **Continuous brain abscess cavity irrigation and drainage with a double-cavity sleeve tube is an effective treatment for brain abscess and produces excellent results, especially for an abscess broken into the ventricle. It combines the advantages of burr hole aspiration and open craniotomy excision. It is easy to perform and reduces costs and damage to the patient, and also shortens hospitalization time and antibiotic treatment time, greatly reducing the likelihood of reoperation. This approach may be the optimal choice to treat brain abscess.**

INTRODUCTION

Brain abscesses are suppurative infections of the brain parenchyma surrounded by a vascularized capsule. These infections may result from contiguous spread of infection, hematogenous dissemination of bacteria, previous head trauma or neurosurgical procedure, or immunosuppression.[1,2] Brain abscesses are common in both developing countries, with an incidence of up to 8%, and in developed countries, with an incidence of up to 2% of all-space occupying lesions.[3] Although brain abscess continues to have a high morbidity and mortality, modern microbiological diagnostic techniques, broad-spectrum antibiotics, and computed tomography (CT) scan and magnetic

Key words
- Aspiration
- Brain abscess
- Continuous irrigation and drainage
- Craniotomy
- Double-cavity sleeve tube

Abbreviations and Acronyms
ADC: apparent diffusion coefficient
CSF: cerebrospinal fluid
CT: computed tomography
DWI: diffusion-weighted imaging
GCS: Glasgow Coma Score
GOS: Glasgow Outcome Score
IV: intravenous
IVT: intraventricular
MRI: magnetic resonance imaging

From the [1]Department of Physiology, Wuhan University School of Medicine and Departments of [2]Neurosurgery and [3]Anesthesia, Renmin Hospital of Wuhan University, Wuhan, China

To whom correspondence should be addressed: Yu Wan, Ph.D. [E-mail: wanyu@whu.edu.cn]

Zhenxing Yang and Li Du are co–first authors.

Citation: World Neurosurg. (2017) 106:231-239.
http://dx.doi.org/10.1016/j.wneu.2017.05.117

Journal homepage: www.WORLDNEUROSURGERY.org

Available online: www.sciencedirect.com

resonance imaging (MRI) have contributed to improved outcomes in patients with this disorder.

Depending on the size, anatomic location, and characteristics of the abscess, and on the age and neurologic status of the patient, several different treatment options may be considered. Two primary treatments are used to manage brain abscess: burr hole aspiration and open craniotomy excision.[4] The advantages of aspiration are that it is simple, can be used in the cerebritis stage, and has less potential morbidity than surgical trauma. Nonetheless, several reports have advocated excision as the procedure of choice, citing a lower incidence of recurrence and shorter hospitalization,[5-7] thus reducing the likelihood of neurologic sequelae. Despite the advent of modern neurosurgical techniques, including stereotactic brain biopsy and aspiration, better culturing techniques to identify the infectious agent, new antibiotics, and modern noninvasive neuroimaging procedures, the diagnostic and therapeutic complexities of brain abscess still pose a public health challenge for neurosurgeons.

The present report is based on our experience of 46 patients with brain abscess managed with continuous irrigation and drainage with a double-cavity sleeve tube technique over the last 9 years in our hospital. We analyzed the patients' basic medical data, infectious factors, imaging findings, new treatment strategies, and outcomes as a reference for all the neurosurgeons.

METHODS

Patient Evaluation

Forty-six patients with brain abscesses verified by postoperative pathology were treated surgically between January 2008 and December 2016 at the department of Neurosurgery in Renmin Hospital of Wuhan University. From clinical and neuroimaging records, the following information was documented for each patient: sex, age, neurologic status at admission, clinical presentation, predisposing factors, number and anatomic location of lesions, surgical techniques, organisms cultured, duration and type of antibiotic therapy, mean diameter of brain abscess on images before and after irrigation and drainage operation, hospitalization time, and neurologic outcome (Table 1). Preoperative and postoperative CT scans and MRI with enhancement were obtained for all patients. For conventional MRI, pyogenic brain abscesses were identified by a hypointense signal in T1-weighted images and a hyperintense signal in T2-weighted images, with a ring-shaped enhancement and extensive surrounding edema. Conventional MRI with diffusion weighted imaging (DWI) and apparent diffusion coefficient (ADC) mapping were performed when it was difficult to discriminate brain abscesses from cystic or necrotic tumors. With a few exceptions, pyogenic abscesses show a hyperintense signal on DWI MRI and hypointense signal on ADC mapping MRI, whereas tumor cystic or necrotic regions show a hypointense signal on DWI and a hyperintense signal on ADC.

Antibiotic Treatment

Initial empirical antimicrobial therapies were selected based on the portal of entry and the anatomical location of the abscess. Initial empirical antimicrobial therapy included a combination of vancomycin, ceftriaxone, and metronidazole. After 3 and 5 days later, treatment either was maintained or was changed based on the results of susceptibility testing. Antibiotic therapy was continued for at least 4 weeks, based on the therapeutic response and neuroimaging findings. Infectious disease specialists regularly supervised this treatment.

Surgical Therapy

Patients with an abscess >2.5 cm in mean diameter were recommended for surgical treatment. The abscess was punctured under ultrasound guidance or CT-guided stereotactic and then placed into a double-cavity sleeve tube. In patients with multiple abscesses, the largest abscess was punctured. The double-cavity sleeve tube constitutes an inner tube 2 mm in diameter and an outer tube 5 mm in diameter. The outer end of the tube is closed and the side holes are evenly distributed. The inner tube is flushed with gentamicin saline (80 mg of gentamicin dissolved in 500 mL of isotonic saline), and the flushing liquid is drained from the outer tube through the side holes.

Pus aspirated from the abscess was promptly sent to the laboratory for bacteriological examination. As much pus was aspirated as possible. The double-cavity sleeve tube was drawn out from subcutaneous tunnel and fixed on the scalp. One end of the tube was connected to a bag of gentamicin saline or sensitive antibiotic saline, and the other end was connected to a drainage bag for 24 hours of continuous irrigation and drainage. The volume of liquid irrigated was always <1000 mL/24 hours, and drained from the abscess cavity was recorded daily. At 7–10 days later, when the drainage liquid became clear, the drainage tube was removed.

RESULTS

Clinical characteristics of the patients in our series are summarized in Table 1. The 46 patients included 29 males (63%) and 17 females (37%), for a male:female ratio of 1.7:1. The mean patient age was 46.2 ± 16.7 years (range, 22–74 years). The most frequent clinical presentations included headache in 28 patients (50%); fever in 15 (26.8%); nausea or vomiting in 6 (10.7%); focal neurologic deficits, such as visual and hearing loss, in 5 (8.9%); and seizures in 2 (3.6%). Two patients presented with purulent scalp drainage from a previous craniotomy site, and 1 patient had purulent ear drainage. On admission, consciousness was clear or minimally disturbed (Glasgow Coma Score [GCS] 14–15) in 31 patients (67.4%), moderately disturbed (GCS 9–13) in 11 (23.9%), and severely disturbed (GCS 3–8) in 4 (8.7%).

The patients had widely varying predisposing factors and comorbidities. The most common predisposing factors included post–head trauma (7 patients; 15.2%), chronic otitis media (9 patients; 19.7%), hematogenous spread (9 patients; 19.7%), and post-neurosurgery (2 patients; 4.3%); however, 15 patients (32.6%) had no identifiable predisposing risk factors. One patient was immunosuppressed on admission.

All patients underwent CT scans and MRI. Thirty-four patients (73.9%) had a solitary abscess, and 12 (26.1%) had multiple abscesses. The classic CT findings of a hypodense ring-enhancing parenchymal lesion with perilesional edema were seen in all patients. On conventional MRI, pyogenic brain abscesses were identified by a hypointense signal in T1-weighted images and a hyperintense signal in T2-weighted images, with ring-shaped enhancement and extensive surrounding edema. Abscesses produced a hyperintense signal on DWI MRI and a hypointense signal