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Clinical study

Predictors of clinical outcomes among patients with brain abscess in Thailand

Thanyalak Amornpojnimman, Pat Korathanakhun *

Division of Neurology, Department of Internal Medicine, Faculty of Medicine, Prince of Songkla University, Thailand

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ABSTRACT

Although brain abscess is a fatal neurological infection, the studies in Thailand are quite limited and outdate. This study aims to identify predictors of mortality among patients with brain abscess in Thailand. Patients with a diagnosis of brain abscess admitted to Songklanagarind Hospital, a referral tertiary care hospital in southern Thailand, between 2002 and 2017 were enrolled into this retrospective case control study. Demographic data, neurological status, clinical presentations, predisposing factors, microbiological profiles, neuroimaging findings, treatments, and outcomes were collected from electronic medical records. Predictors of death outcome were analyzed by univariate and multivariate logistic regression analysis. Among eighty-one patients enrolled into the study, forty-seven patients (58.0%) were male and 34 patients (42.0%) were female. The overall mean age (±SD) was 47.68 (±16.92) years old. The major predisposing factors of brain abscess were an immunocompromised state (42.0%) and the extension of a paracranial infections (24.7%). The common clinical presentations included headache (61.7%), fever (50.6%), and hemiplegia (34.6%). Eleven patients (13.6%) were dead at hospital discharge. The independent factor associated with death outcome identified by multivariate analysis was confusion (odds ratio 7.67, 95% CI 1.95–30.14; p = 0.003). In summary, the current study shows that an immunocompromised state is a significant predisposing factor of brain abscess. The independent factor associated with death outcome was confusion which was correlated with septic encephalopathy.

1. Introduction

Brain abscess is an intraparenchymal suppurative infectious condition of the brain caused by various microorganisms which potentially resulting in a life-threatening condition. Among brain abscess survivors, some patients experienced several catastrophic neurological sequelae, for example weakness, aphasia, and epilepsy, leading to an independent state.

In developed countries, the incidence of brain abscess approximately accounted for 1–2% of all intracranial space-occupying lesions as compared to 8% in developing countries [1]. The difference in the brain abscess incidence is due in part to the problematic emergence of human immunodeficiency virus (HIV) infection. In addition, the increasing numbers of cancer patients who receive chemotherapy, autoimmune disease patients treated with steroids, and transplant recipients who inevitably need immunosuppressant therapy lead to an immunocompromised state that causes the host to be vulnerable to infectious disease [1,2].

With the continuous novel discoveries in the medical sciences, advances in cranial imaging technology, new neurosurgical techniques, and antimicrobial regimens over the past decades, the mortality of brain abscess has significantly decreased from 40 to 60% to <10% in the developed countries [3]. Unfortunately, the mortality rate in developing countries remains at 20–30% [1,4].

Despite Thailand being located in a tropical region, studies on brain abscess are quite limited and outdated. Most of the published data in the Thai population were collected during a period when advanced neuroimaging techniques were not widely available. This issue contributed to late diagnosis and treatment which directly impacted the clinical outcomes [5–7]. Therefore, our study aims to identify predictors of mortality among patients with brain abscess in Thailand.

2. Materials and methods

2.1. Samples

This is a retrospective case control study conducted at Songklanagarind Hospital, faculty of medicine, Prince of Songkla University which is the tertiary referral center in southern Thailand. The

* Corresponding author at: Department of Internal Medicine, Faculty of Medicine, Prince of Songkla University, Hat Yai, Songkhla 90110, Thailand.
E-mail address: patosk120@gmail.com (P. Korathanakhun).

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electronic medical records of inpatients diagnosed with brain abscess between January 2002 and June 2017 were reviewed. We used the International Statistical Classification of Diseases and Related Health Problems Tenth Revision (ICD-10) code G060 (intracranial abscess) and A17.8 (other tuberculosis of nervous system) to identify patients.

2.2. Inclusion and exclusion criteria

The patients enrolled into this study must meet these criteria: (1) classical clinical manifestations of brain abscess including headache, fever, altered mental status or a combination of these presentations; (2) computed tomography (CT) or magnetic resonance imaging (MRI) or both of the brain showed intraparenchymal brain abscess; and (3) evidence of brain abscess seen on exploratory aspiration or collection of appropriate microbiological specimens or both. In cases that were not treated surgically, the diagnosis of brain abscess was established by clinical manifestations and neuroimaging findings.

The excluded patients were those with other forms of intracranial empyema, such as epidural abscess or subdural empyema. Patients with a provisional diagnosis of cerebral toxoplasmosis without a microbiological profile were not enrolled in this study due to vague clinical evidence.

2.3. Clinical data

Demographic data, neurological status on admission, clinical presentations, predisposing factors, microbiological profiles, neuroimaging findings, treatments, and outcomes were collected from the electronic medical records.

In regard of the neuroimaging data measurements, the volume of the brain abscess (cubic millimeter, mm^3) was calculated by the formula $0.5 \times X \times Y \times Z$ where X, Y, and Z were the largest diameter of the brain abscess (millimeter, mm.) along the X, Y, and Z axis [2]. To identify the risk for abscess rupture, the distance was measured by the nearest distance from brain abscess to the ventricle or cortex. In patients with multiple abscesses, all parameters were measured from the largest brain abscess.

2.4. Outcome measurements

Hospital outcomes were evaluated at hospital discharge or death by the Glasgow Outcome Scale where 1 = death, 2 = vegeta tive stage, 3 = need frequent help, 4 = does not need frequent help and able to be alone at home, 5 = not able to work, 6 = able to work but at a reduced capacity, 7 = participates at least half as often as before in regular social activities, and 8 = able to work to previous capacity. The cause of death was classified into brain abscess related death and non-brain abscess related death.

2.5. Data analysis

Discrete data were analyzed by descriptive methods and the χ^2 test. Continuous data were analyzed by mean, median, independent *t*-test, and Mann Whitney *U* test. The predictors of hospital mortality with $p < 0.2$ determined by univariate χ^2 test were entered into a multivariate logistic regression model to identify the independent predictors of death outcome. The factors with a p-value <0.05 in multivariate analyses were considered statistically significant. The study protocol was approved by the ethical committee of the faculty.

3. Results

Among the 87 patients identified by ICD 10 code G060 and A178, 6 patients were excluded due to the diagnosis of epidural and subdural empyema. Therefore, 81 patients were eligible for this study. Forty-seven patients were male (58.0%) and 34 patients were female (42.0%) with an overall mean age (±SD) of 47.68 (±16.92) years old. The median time of symptoms duration prior to the diagnosis establishment was 10 days.

3.1. Risk factors and potential primary source of infection

The most common risk factor found in 34 patients (42.0%) was an immunocompromised state: 13 patients (16.0%) with diabetes mellitus, 10 patients (12.3%) with HIV infection, 6 patients (7.4%) with current steroid use, 3 patients (3.7%) with liver cirrhosis, and 2 patients (2.5%) with febrile neutropenia. Potential primary sources of infection were classified into 3 categories. First, infection spreading from a contiguous paracranial site into an adjacent brain area occurred in 20 patients (24.7%): 8 patients (9.9%) with otitis media and mastoiditis, 8 patients (9.9%) with paranasal sinusitis, and 4 patients (4.9%) with dental root abscess. Second, hematogenous spreading was considered in 9 patients (11.1%): 7 patients (8.6%) with cyanotic heart disease, 1 patient (1.2%) with respiratory infection, and 1 patient (1.2%) with pulmonary arteriovenous malformation. Third, direct penetration head injury and surgical site infection were found in only 2 patients (2.5%) and 1 patient (1.2%), respectively.

3.2. Clinical presentations

All patients had multiple symptoms and signs. The common clinical presentations were headache (61.7%), fever (50.6%), hemiplegia (34.6%), nausea and vomiting (33.3%), confusion (24.7%), and seizure (17.3%). Only 4 patients (4.9%) had evidence of focal onset seizure. Neck stiffness was found in 8 patients (9.9%). Some patients developed signs and symptoms which indicated either cortical or superficial subcortical lesion such as aphasia (4.9%) or monoplegia (3.7%). Only 3 patients (3.7%) presented with behavioral change and neuropsychiatric symptoms. Visual field defect was found in only 1 patient (1.2%) which was the same as sensory impairment. Impaired consciousness (Glasgow coma scale scores 3–13) and systemic inflammatory response syndrome with sepsis were found in 17.3% and 37%, consecutively.

3.3. Investigations

Forty-one patients (50.6%) had leukocytosis with white blood cell (WBC) count more than 10,000 cells/μL. All patients underwent at least 1 method of neuroimaging. Brain CT and MRI were performed in 67 patients (82.7%) and 57 patients (70.4%), respectively. Forty-three patients were investigated by both methods. Forty-six patients (56.8%) had a single abscess while the other 35 patients (43.2%) had multiple abscesses. The median (IQR) diameter and volume of the abscesses were 29 mm. (range 3–88) and 8 mm^3 (range 1–227), consecutively. The median distance between abscess wall and the nearest potential ruptured site was 5 mm. (range 1–58). Intraventricular rupture of a brain abscess occurred in only 1 patient (1.2%).

Most abscesses (71.6%) were located in the supratentorial region. Frontal lobe was the most common site in 34 patients (42.0%), whereas the other sites were temporal lobe (28.4%), parietal lobe (27.2%), and occipital lobe (24.7%). In the infratentorial region, cerebellar abscess was found in 20 patients (24.7%) while brainstem abscess was found in 3 patients (3.7%). The most com-

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