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Case report

Multiple brain abscesses presented with monoparesis in a patient with lung abscess mimicking lung cancer

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ABSTRACT

Multiple brain abscesses associated with the lung mass require differential diagnosis from cancerous diseases. Here, we report a rare case of multiple brain abscesses originating from a lung abscess. A 65-year-old man presented with a 2-day history of motor weakness during antibiotic treatment for pneumonia. Brain magnetic resonance imaging (MRI) revealed multiple enhanced lesions of various sizes in the whole brain. Diffusion-weighted MRI showed high signal intensity in several lesions, and magnetic resonance (MR) spectroscopy showed reduced N-acetyl-aspartate (NAA) and high lactate-lipid complex levels. Positron emission tomography/computed tomography revealed a hypermetabolic mass-like lesion (size: 5 × 3 cm) in the right lower lobe. The patient was diagnosed with organizing pneumonia by bronchoscopy and was successfully treated with empirical antibiotics for multiple brain abscesses and lung abscesses. If new neurological deficits occur during the treatment of inflammatory diseases such as pneumonia, the possibility of brain abscesses and cancerous conditions should be considered. Appropriate diagnosis and antibiotic treatment should be performed to ensure favorable outcomes.

Introduction

Brain abscess is a rare but potentially life-threatening neuroinfectious disease [1,2]. The mortality rate of brain abscess is 20%, although a decreasing tendency has been reported in the past decades [1]. Hence, appropriate diagnosis and early treatments such as surgery and antibiotic treatment should be performed. Brain abscess has been associated with various risk factors such as contiguous infections (e.g., middle ear and paranasal sinus infection), hematogenous dissemination from distant focus (e.g., pulmonary infection and infective endocarditis), and other trauma [1,2]. Although hematogenous spread from pulmonary infection is a well-known pathogenesis, it is difficult to differentiate lung abscess with newly developed multiple brain lesions from cancerous lesions without histopathological examination [3].

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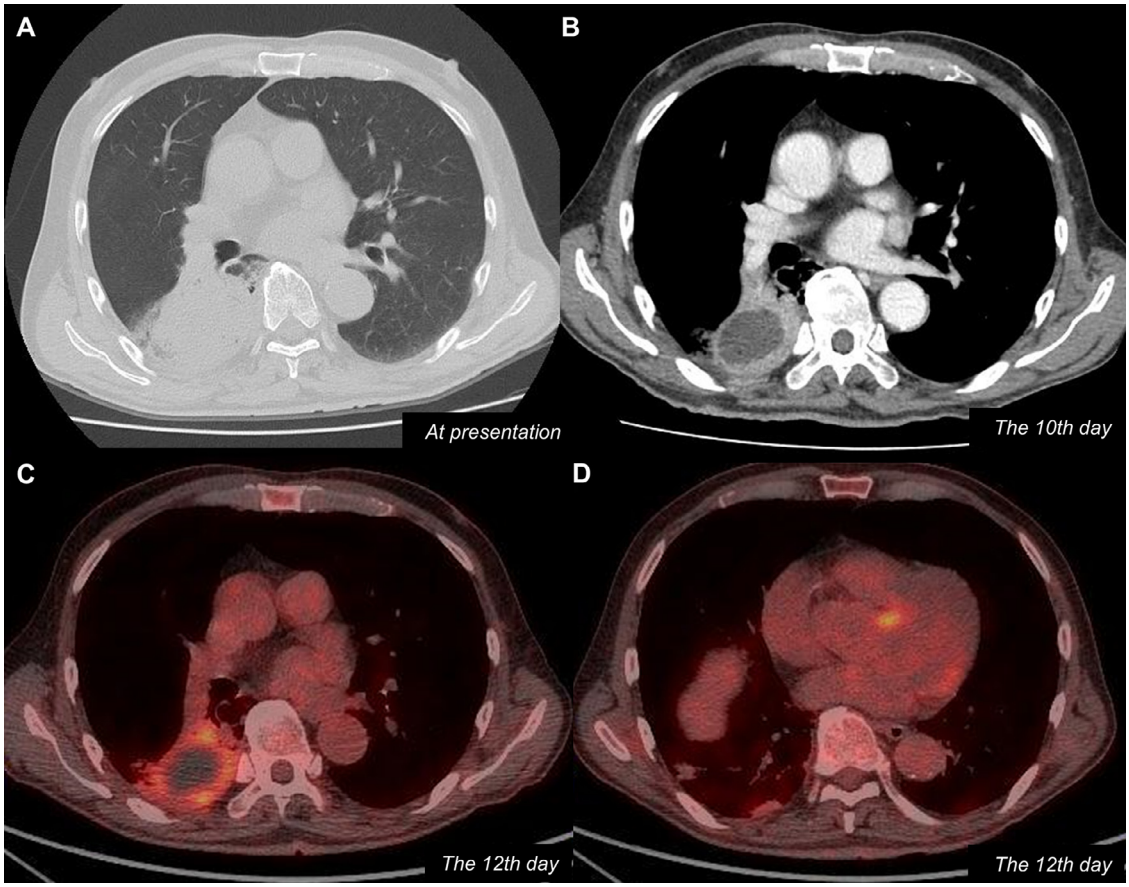

Fig. 1 – A. Initial chest computed tomography (CT) image showing a mass-like lesion (size: 5 x 3 cm), indicating lobar pneumonia in the right lower lobe. B. Follow-up chest CT image at 10 days after presentation showing a slightly decreased mass lesion with rim enhancement. C and D. PET/CT image at 12 days after presentation showing a round-shaped hypermetabolic mass with central low attenuation area.

Here, we present a rare case of multiple brain abscesses related to lung abscess that was diagnosed and successfully treated with antibiotic treatment.

Case report

A 65-year-old man presented to the emergency department of a regional hospital with a 2-day history of motor weakness in the left upper extremity during the coronavirus disease (COVID-19) pandemic. He tested negative for COVID-19. He had hypertension and diabetes mellitus. Neurological examination revealed motor weakness in the left upper extremity (grade 4). Ten days ago, he was admitted to a regional hospital for the treatment of pneumonia. Initial chest computed tomography (CT) showed a mass-like lesion (size: approximately 5 cm) in the right lower lobe (RLL) (Fig. 1A). Laboratory analyses revealed an increase in the level of inflammatory markers: leukocytosis, 15.2 $\times$ $10^3/\mu L$; C-reactive protein, 8.7 mg/L (normal range, $\leq$ 0.5 mg/dL); and erythrocyte sedimentation rate, 101 mm/hour. Gram-positive cocci, *Viridans streptococci* (suspicious of normal flora), were identified on gram staining of sputum. No bacteria responsible for pneumonia were found in sputum and blood culture. Mycoplasma polymerase chain reaction and acid-fast bacilli staining results were found to be negative. The patient was treated with empirical antibiotics such as the third-generation cephalosporins. During antibiotic treatment, the fever subsided. However, after 8 days of antibiotic treatment, the patient complained of gradual motor weakness in the left upper extremity and underwent magnetic resonance imaging (MRI) at the regional hospital (Fig. 2A-E). MRI revealed multiple enhanced lesions of extremely small to small size in the whole brain (Fig. 2A-C). T2-weighted MRI revealed severe perilesional edema (Fig. 2D). Diffusion-weighted imaging (DWI) MRI showed restricted diffusion with characteristic hyperintensity (Fig. 2E). Additionally, follow-up contrast-enhanced CT of the chest showed a rim-enhanced mass lesion (size: 5 $\times$ 3 cm) in the RLL (Fig. 1B). The patient was referred to our institution for the differential diagnosis of cancerous lesions of the lung and brain.

A systemic work-up was performed for differential diagnosis. Positron emission tomography (PET)/CT at 12 days after presentation revealed a round hypermetabolic mass with central low attenuation that was suspicious for both lung abscess and lung cancer (Fig. 1C and D). Thereafter, diagnostic bronchoscopy was performed. Cytological examination of the bronchial lavage fluid revealed no malignant cells.

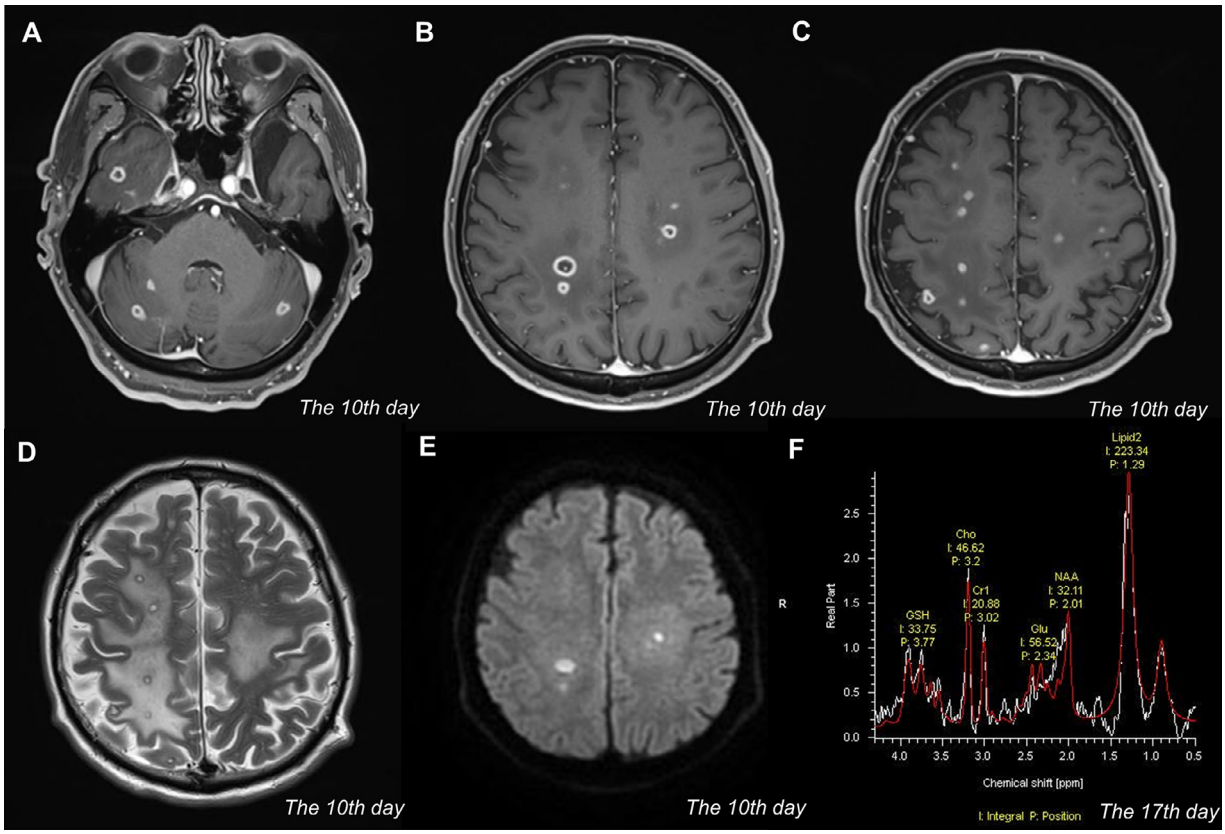

Fig. 2 – Initial magnetic resonance (MR) imaging at 10 days after presentation (A-E). A-C. **T1-weighted contrast-enhanced MR image showing multiple enhanced lesions of variable size in the whole brain.** D. **T2-weighted MR image showing perilesional edema.** E. **Diffusion-weighed MR image showing several hypersignal intensity lesions.** F. **Additional MR spectroscopy at 17 days after initial presentation showing decreased NAA and high lactate-lipid complex levels.**

Histopathological examination revealed organizing pneumonia with focally proliferating atypical pneumocytes. However, we were unable to detect any bacterium in the sputum, blood, and bronchial lavage fluid that was responsible for abscess. Additional MR spectroscopy at 17 days after presentation performed for the differential diagnosis of brain lesions revealed that the levels of choline and lactate-lipid complex were high and that of NAA was low (Fig. 2F). Cerebrospinal fluid analysis revealed the following: white blood cell count, 19/μL (94%, lymphocyte); glucose concentration, 126 mg/dL; and protein concentration, 43.86 mg/dL. Gram staining showed no organisms.

Based on the aforementioned findings, we concluded that the patient had brain abscess related to lung abscess and started treatment for lung and brain abscesses. Although empirical antibiotics were administered at the regional hospital, brain abscess with a neurological deficit developed. Subsequently, vancomycin was added to the treatment regimen. Thus, the patient was treated with intravenous empirical antibiotics—the third-generation cephalosporin, ampicillin or sulbactam, and vancomycin. The motor weakness gradually improved. After 6 weeks, follow-up chest CT revealed that lesions in the RLL had nearly disappeared and brain MRI revealed that several brain lesions had reduced in size (Fig. 3A-C). Based on the clinical and radiological improvements, we decided to stop the antibiotic treatment. Eventually, after 6 weeks, the patient was discharged without any neurological deficits. Follow-up MRI at 6 months showed no enhanced lesions in the brain (Fig. 3D-F).

Discussion

MRI is a standard radiological tool used for the diagnosis of brain abscess. A hyperintense signal on DWI typically differentiates brain abscesses from necrotic tumors [4]. In a prospective study by Reddy et al., the sensitivity and specificity of DWI for differentiating brain abscesses from other cystic mass lesions were 96% (positive predictive value, 98%; negative predictive value, 92%) [4]. On the other hand, Hartmann et al. analyzed DWI MRI data of 17 patients with ring-enhanced lesions and suggested that diffusion restriction is not pathognomonic for brain abscess [5]. Moreover, hypointense signals on DWI have been reported in patients with *Staphylococcus aureus* brain abscesses [6]. Therefore, it is difficult to diagnose intracranial cystic lesions. MR spectroscopy presents diagnostic information regarding brain abscess [7]. A combination of MR spectroscopy and DWI may facilitate the differential diagnosis of brain abscesses and other cystic le-

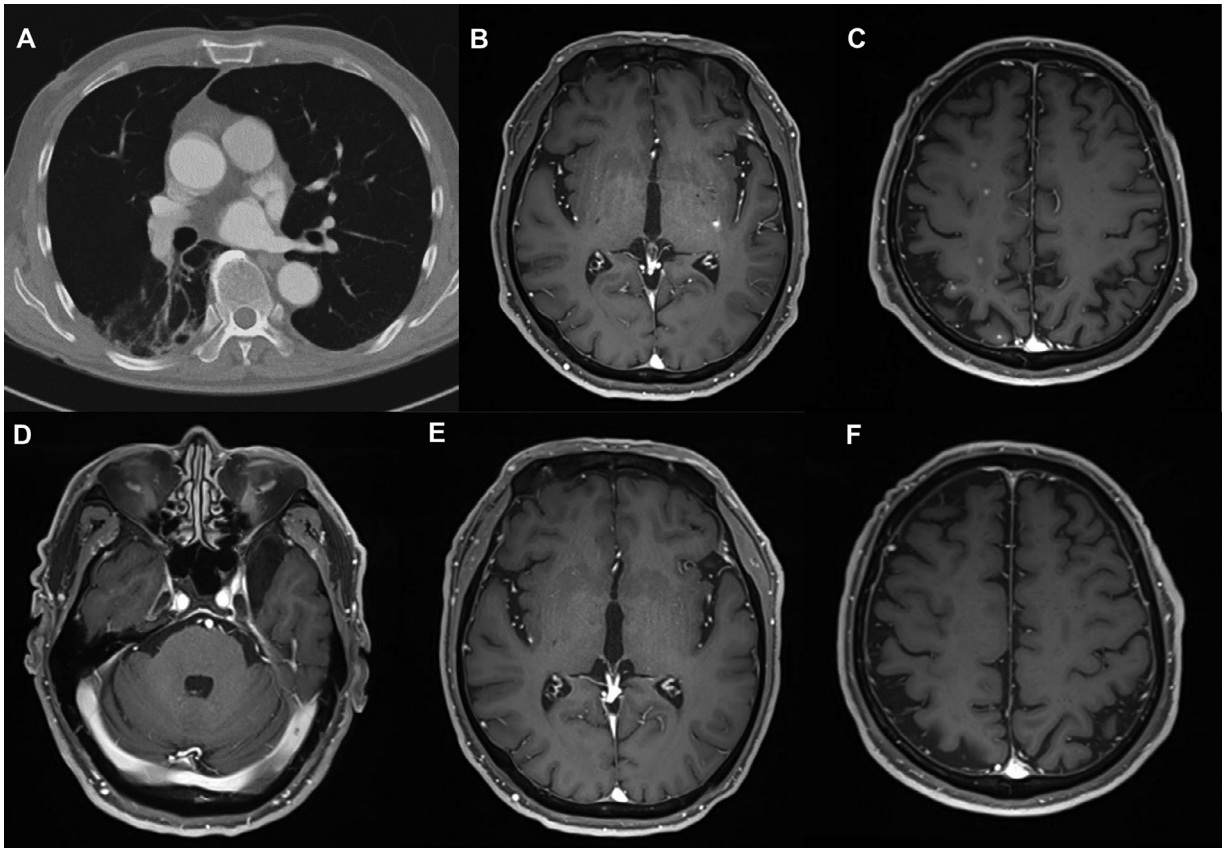

Fig. 3 – A-C. A follow-up imaging study at 6 weeks of antibiotic treatment. A. Chest CT showing decreased consolidation in the right lower lobe. B and C. Post-gadolinium contrast enhancement T1-weighted MR image showing reduced size of multiple brain lesions. D-F. A 6-month follow-up MR image showing disappearance of multiple enhanced lesions in the whole brain.

sions [7]. For example, the presence of an amino acid peak at 0.9 ppm is usually observed in brain abscesses, whereas an elevation of lipid/lactate peak is observed in anaerobic metabolism, abscess, and tumors [7]. In our case, DWI showed a hyperintense signal and MR spectroscopy showed a markedly increased lactate-lipid complex level. These findings facilitated the differentiation of brain abscesses from cancerous lesions.

Imaging findings of lung abscess on chest CT occasionally require differential diagnosis from cancerous lesions. Although FDG-PET/CT can be used to detect a variety of lung diseases, FDG-PET/CT has limitations in differentiating cancer from inflammatory diseases because of the pattern of tracer accumulation in both the diseases [8]. Therefore, histopathological examination should be performed. In our case, FDG-PET/CT results were positive and suggestive of both cancer and inflammation. The patient was diagnosed with organizing pneumonia by bronchoscopy.

Appropriate diagnosis and early treatment are necessary for treating brain abscesses. The choice of initial empirical antibiotics is generally based on various factors such as the patient's medical history, predisposing condition, and history of other infections [2]. The treatment regimen in patients with brain abscess due to hematogenous spread includes empirical antibiotics such as the third-generation cephalosporin combined with metronidazole and/or vancomycin for potential staphylococcal infection [2]. Although organism identification and in vitro susceptibility tests are essential, broad-spectrum empirical antibiotics should be used against pathogens if no other infectious agents are isolated. The duration of antibiotic treatment in patients with bacterial brain abscesses is 6–8 weeks [2,9]. In our case, the patient was diagnosed with multiple brain abscesses during antibiotic treatment for pneumonia. These initial antibiotic treatments make it difficult to identify bacteria responsible for the neurological deficits. Therefore, we decided to treat the patient with broad-spectrum antibiotics. Eventually, the patient was cured after 6 weeks of antibiotic treatment.

In conclusion, we reported a rare case of occurrence of multiple brain abscesses during antibiotic treatment for lung abscess. Thus, we suggest that appropriate diagnosis, with various imaging modalities and histological examination, and early broad-spectrum antibiotic treatment should be performed for favorable patient outcomes in such cases.

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Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgment

None.

Patient consent

The patient has consented to submit of the case to the journal and to publishing his data and radiologic images. The human Investigation Committee (IRB) of our institute approved this study.

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