Magnetic Resonance Imaging of Multiple Brain Abscesses of the Bilateral Basal Ganglia

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A 64-year-old woman developed multiple brain abscesses of the basal ganglia associated with Klebsiella pneumoniae septicemia. Magnetic resonance (MR) images showed three different stages of the brain abscesses. The images of early cerebritis of this site mimicked lacunar infarctions or dilated Virchow-Robin spaces. The differentiation of the brain abscess from lacunae and dilated Virchow-Robin spaces is discussed, together with the evolution of the brain abscesses on MR images.

Key words: Klebsiella pneumoniae, liver abscess, endophthalmitis, diabetes mellitus, meningitis, pulmonary embolization

Introduction

Brain abscesses of the basal ganglia are uncommon (1); X-ray computed tomography (CT) has made the diagnosis of these abscesses more accurate (2). Recently, magnetic resonance (MR) imaging of brain abscesses was reviewed and the high diagnostic sensitivity of MR imaging was indicated (3). However, serial MR images during the evolution of brain abscesses of the basal ganglia have not been reported. Here we report a patient with Klebsiella pneumoniae septicemia in whom different stages of brain abscesses were documented by serial MR images. This study raises some problems in the early diagnosis and determination of the stages of brain abscesses of the basal ganglia using MR images.

Case Report

A 64-year-old woman was admitted to our hospital because of drowsiness, headache and bilateral ophthalmalgia. The patient had a 10-year history of diabetes mellitus which had been managed by diet therapy alone. Two days before admission she had a headache and chilling sensation. On the next day the headache worsened and she vomited.

Physical examination revealed the woman to be acutely ill with blood pressure 138/82 mmHg, pulse 88 beats/min and regular, and body temperature 39.0°C. She was mildly drowsy but oriented. Neck stiffness and Kernig’s sign were negative. Chemosis and conjunctival hyperemia were noted in the both eyes. Ophthalmologic examination showed a decrease of visual acuity, uveitis and a few whitish spots on the retina bilaterally.

Laboratory studies disclosed the following abnormal values: white blood cell count (WBC) 11,800/mm³ with 86% neutrophils, 10% lymphocytes and 4% monocytes, glucose 223 mg/dl, Hba1c 10.8%, total bilirubin 1.0 mg/dl, alkaline phosphatase 473 U/l (normal, 30-110), urinary glucose 3+ and urinary ketones 1+. The venous blood samples, which were drawn for blood culture while the patient was febrile, yielded Klebsiella pneumoniae 6 days later.

Antibiotic therapy was initiated on hospital day 2, when hypopyon and vitreous opacity appeared and a diagnosis of bilateral endophthalmitis was made. Plain and contrast-enhanced brain CT scans showed no abnormal findings. On hospital day 3, neck stiffness appeared. T2-weighted MR images disclosed multiple small hyperintense areas in the bilateral basal ganglia, which were then thought to be lacunar infarcts or dilated Virchow-Robin spaces (Fig. 1). A lumbar puncture revealed the following: WBC 1,115/mm³ with 83% neutrophils and 17% lymphocytes, protein 165 mg/dl and glucose 52 mg/dl. A Gram’s stain, culture and cryptococcal antigen test of the cerebrospinal fluid (CSF) were negative. On hospital day 9, because of the continuing high titer of alkaline phosphatase, an ultrasonogram of the liver was performed and showed an
echolucent multinodular lesion in the right lobe, which led to a diagnosis of liver abscess. On hospital day 10, a chest roentgenogram showed multiple cotton ball-like lesions over both lung fields, consistent with the diagnosis of pulmonary

Figure 1. T2-weighted image (0.5 Tesla, TR/TE 3,000/90 msec, A) on hospital day 3 shows hyperintense areas (arrows), which were at first thought to be lacunar infarctions or Virchow-Robin spaces. Gd-DTPA-enhanced T1-weighted image (TR/TE 675/31 msec, B) shows no abnormal enhancement.

Figure 2. T2-weighted image (1.5 Tesla, TR/TE 2,500/100 msec, A) on hospital day 15 displays extensive hyperintense areas in the bilateral basal ganglia and a focus of marked hypointensity in the right lenticular nucleus (arrow). Gd-DTPA-enhanced T1-weighted image (TR/TE 600/25 msec, B) shows multiple lesions with ring-like or nodular enhancement.
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Figure 3. T2-weighted image (1.5 Tesla TR/TE 2,500/100 msec, A) on hospital day 30 shows multiple hypointense nodules (arrows) and Gd-DTPA-enhanced T1-weighted image (TR/TE 600/25, B) demonstrates nodular enhancement of the capsules (arrowheads).

embolization. On hospital day 13, a lumbar puncture disclosed improvement of the CSF findings: WBC 33/mm³ with 9% neutrophils and 91% lymphocytes, protein 97 mg/dl and glucose 48 mg/dl. Although neck stiffness had decreased, the patient remained somnolent. On hospital day 15, T2-weighted MR images showed hyperintense areas and Gd-DTPA-enhanced T1-weighted images displayed multiple ring-like or nodular enhancement in the bilateral basal ganglia, indicating multiple brain abscesses and edema (Fig. 2).

On hospital day 30, when the patient had been afebrile and alert for more than about a week, brain MR study was again performed. Gd-DTPA-enhanced T1-weighted images showed a decrease in the size and number of the lesions, while T2-weighted images revealed hypointense rings and nodules and a decrease in the area of the edema (Fig. 3). Following the antibiotic therapy for ten weeks, the patient was discharged from the hospital in good condition, except for loss of vision.

Discussion

Liu et al first reported in 1986 seven cases of Klebsiella pneumoniae liver abscess associated with septic endophthalmitis (4). Thereafter, several cases with septic metastatic endophthalmitis associated with Klebsiella pneumoniae liver abscess have been reported (5–9). In these studies, diabetes mellitus is emphasized as the underlying disease (4, 5, 9), and it is thought that impairment of the immune system causes these infections. The case presented here seems to belong to the same disease category since she had diabetes mellitus of 10-year duration and developed liver abscess and endophthalmitis due to Klebsiella pneumoniae, but is unique in having multiple brain abscesses of the basal ganglia.

Metastatic brain abscess is a rare complication of Klebsiella pneumoniae infection. Cheng et al reported 23 cases with septic metastatic lesions associated with pyogenic liver abscess, of which 19 were caused by Klebsiella pneumoniae (10). Of the 19 patients, 12 had endophthalmitis, 7 pulmonary abscess and/or emboli, 6 brain abscess and/or purulent meningitis. Concomitant eye lesions with brain lesions were observed in 4 cases, and one case had eye, lung and brain lesions. To the best of our knowledge, that is the only study that described both endophthalmitis and brain abscess as the septic metastatic lesions associated with Klebsiella pneumoniae liver abscess. However, that study did not provide details of the patients such as the location and images of the brain abscess and the clinical courses. Since we found no serial MR studies of Klebsiella pneumoniae brain abscess, the present case may be the first demonstration of the time course changes of this disease process by MR images.

The development of brain abscesses in general is histologically divided into four stages: early cerebritis, late cerebritis, early capsule, and late capsule formation (11). Comparative studies between the pathological findings and CT appearances has enabled staging of brain abscesses in dogs (11) and in humans (12). However, MR criteria for categorizing brain abscesses have not been established.
Here, T2-weighted images on hospital day 3 showed multiple small hyperintense areas in the bilateral basal ganglia. At first we thought these areas were lacunar infarctions or dilated Virchow-Robin spaces; these are often shown as hyperintense foci around the basal ganglia on T2-weighted images (13-15), and are sometimes difficult to differentiate. Recently, several authors have raised the following differential points: lacunae occur in the upper two-thirds of the basal ganglia, are slit-like or ovoid in shape, and are larger than 5 mm in size. Dilated Virchow-Robin spaces lie in the inferior one-third of the putamen, their morphology is round or linear, and they are usually 5 mm or less (13, 14). In addition, Virchow-Robin spaces are more symmetric and bilateral than lacunae (15). When the MR images of the present patient were reviewed from these viewpoints, the hyperintense areas on T2-weighted images located in the upper two-thirds of the basal ganglia were positionally distinguished from Virchow-Robin spaces (Fig. 1, A). Moreover, in shape, size, and distribution, these areas appeared to be different from lacunar infarctions. In retrospect, these hyperintense areas represented an early phase of the brain abscesses.

Haimes et al showed that the hypointense rim on T2-weighted images, corresponding to the enhanced ring on CT, is present in mature abscesses and absent in acute cerebritis (3). However, whether or not the rim is displayed on MR images in late cerebritis and early capsule formation is uncertain. In the present patient, although the Gd-DTPA-enhanced MR images on hospital day 15 exhibited multiple lesions showing ring-like or nodular enhancement (Fig. 2B), obvious hypointense rims were not observed on T2-weighted images except a focus of marked hypointensity in the right lenticular nucleus (Fig. 2A). Since Gd-DTPA was distributed similar to CT contrast materials in experimental intracranial septic infection (16), we considered the abscesses on day 15 to be in the stage of late cerebritis or early capsule formation.

T2-weighted MR images on hospital day 30 revealed multiple hypointense nodules and a few hypointense rims (Fig. 3). We believe that these nodules and rims correspond to mature capsules. Gd-DTPA-enhanced T1-weighted images on the same day showed loss and decrease of enhancement of the abscesses, compared with the images on hospital day 15. As known in the CT studies (17), this probably shows the process of cure of the abscesses.

Central ganglionic abscesses are usually metastatic (1). Bhatia et al reviewed the CT findings of 21 patients with inflammatory lesions of the basal ganglia and thalamus: 15 were tubercular, 5 were pyogenic and 1 was fungal (2). Although fungal abscesses are rare in their study, other studies in immunocompromised patients (mostly AIDS patients) have shown that one of the most common sites of toxoplasmosis (18, 19) and cryptococcosis (20) is within the basal ganglia. The common CT finding of toxoplasmosis is a large low-density area that shows ring enhancement upon injection of contrast material, and the lesions are often multiple (18). Although the MR findings of toxoplasmosis were not described in detail, these CT findings seem similar to the MR images of the present patient. According to Tien et al (20), the MR findings of cryptococcosis show four patterns; one pattern is numerous tiny foci. These foci are hypointense on T2-weighted images and nonenhancing on postcontrast T1-weighted images; they locate relatively symmetrically in the basal ganglia and also in the midbrain (which represent dilated Virchow-Robin spaces). These MR findings of cryptococcosis resemble the images of the present case on hospital day 3. However, the negative cryptococcal antigen test of the CSF and the time course of the changes in the images make the diagnosis of cryptococcosis unlikely.

In conclusion, MR is very sensitive in detecting brain abscesses especially in the stage of early cerebritis. However, since the images of early cerebritis of the basal ganglia mimic lacunar infarctions or dilated Virchow-Robin spaces, they must be differentiated carefully; the clinical course and MR images should be followed together. In order to establish the staging of brain abscesses based on MR imaging, further studies are necessary.

References


