

Protean Neuroimaging Presentations in an Adult with *Klebsiella Pneumoniae* Infection

Chih-Hsiang Lin¹, Chen-Hsien Lu¹, Chun-Chung Lui²,
Chi-Ren Huang,¹ Yao-Chung Chuang¹, Wen-Neng Chang¹

Abstract-

Purpose: To report on the findings of a series of cranial computed tomography (CT) and magnetic resonance (MR) imaging studies of a 57-years-old woman with *Klebsiella* (K.) *pneumoniae* infection.

Case report: The patient had fever, consciousness disturbance and left hemiplegia as the initial presentations of K. *pneumoniae* infection. Initial blood culture grew K. *pneumoniae*, and a delayed purulent cerebrospinal fluid profile was found later. The serial neuroimaging studies showed cerebral hemorrhage, cerebritis and subsequent multiple abscess formations. In the meanwhile hepatic and pulmonary abscess were also discovered by imaging studies. With a 77- days intravenous ceftriaxone treatment (4 gm/day), the abscess formations of brain, lung and liver were all resolved.

Conclusion: This study showed the protean neuroimage features of a woman with K. *pneumoniae* infection and the confirmation of multiple brain abscesses was made by follow-up neuroimaging studies. These sequential neuroimage findings in one patient are uncommon but deserved special clinical note by the first-line, primary-care physicians including neurologists.

Key Words: bacteremia, brain abscess, cerebral hemorrhage, cerebritis, K. *pneumoniae* infection

Acta Neurol Taiwan 2010;19:199-203

INTRODUCTION

A distinct syndrome of *Klebsiella* (K.) *pneumoniae* infection consisting of community-acquired liver abscess, diabetes mellitus (DM) and multiple septic metastatic lesions has been disclosed in Taiwan^(1,2). In Taiwan, several epidemiologic studies of adult bacterial meningitis (ABM) have also revealed that K. *pneumoniae* is the most common implicated pathogen of commu-

nity-acquired infection^(2,3). In adult K. *pneumoniae* central nervous system (CNS) infection, meningitis and brain abscess are the two common presentations^(3,4); despite there is a hemodynamic change in the early phase of bacterial meningitis⁽⁵⁾, cerebral vascular events are not. In this study, we demonstrated a series of neuroimaging study in an adult case of K. *pneumoniae* infection presented with concomitant meningitis, cerebral hemorrhage, and cerebritis with subsequent multi-

From the Departments of ¹Neurology and ²Neuroradiology, Chang Gung Memorial Hospital-Kaohsiung Medical Center, Chang Gung University College of Medicine, Kaohsiung, Taiwan.

Received July 27, 2009. Revised September 4, 2009.

Accepted November 2, 2009.

Correspondence to: Wen-Neng Chang, MD, Department of Neurology, Chang Gung Memorial Hospital, No. 123, Ta-Pei Road, Niao-Sung Hsiang, Kaohsiung Hsien, Taiwan.

E-mail: cwenneng@ms19.hinet.net

ple brain abscess formations.

CASE REPORT

On June 3rd, 2008, a 57-year-old woman, presented to the emergency department (ED) of Chang Gung Memorial Hospital-Kaohsiung with a chief complaint of fever, progressive weakness of left limbs and drowsy state for two days. She had no recent history of head injury and her past history was unremarkable except the presence of hypertension and hyperlipidemia for many years. At ED, she was found to be in an acute-ill looking



Figure 1. Brain computed tomographic study reveals a hyperdense lesion at the left caudate nucleus (arrow)

appearance and her consciousness level was E4V5M6. She had left hemiplegia and positive Babinski's sign, and she also had tonic deviation of eyeballs to right side. Her blood pressure was 148/84 mmHg and body temperature, 39.4°C. Peripheral blood study revealed a white blood cell (WBC) count of $7.2 \times 10^3/\text{ml}$ (normal = 3.5-11.0), with 67.0% neutrophil, platelet count $34 \times 10^3/\text{ml}$ (normal = 150-400), glucose 199 mg/dL (normal = 70-105), aspartate aminotransferase 112 U/L (normal = 0-37), alanine aminotransferase 81 U/L (normal = 0-40), direct bilirubin 0.78 mg/dL (normal = 0-0.4), total bilirubin 1.7 mg/dL (normal = 0.2-1.4), albumin 3.0 U/L (normal = 135-214), alkaline phosphatase 83 U/L (normal = 28-94), C-reactive protein 429.2 mg/L (normal = <5), creatinine 0.7 mg/dL (normal = 0.4-1.4), and blood urea nitrogen 14 mg/dL (normal = 7-20). Glycosylated hemoglobin (HbA1c) was 6.8%. Arterial blood gas profile was normal. Initial cranial computed tomography (CT) study was performed on June 3rd and showed small left caudate hemorrhage (Figure 1). Brain magnetic resonance (MR) imaging study (Figure 2) of the same day revealed 1) hyperintensities at the right internal capsule and left caudate nucleus on diffusion-weighted (DW) imaging; 2) lesions with hypointensities on apparent diffusion coefficients (ADC) map, which were corresponding to the areas with hyperintensity shown on DW imaging; and 3) gradient echo sequence revealed areas with hemorrhage at the left caudate nucleus and right internal

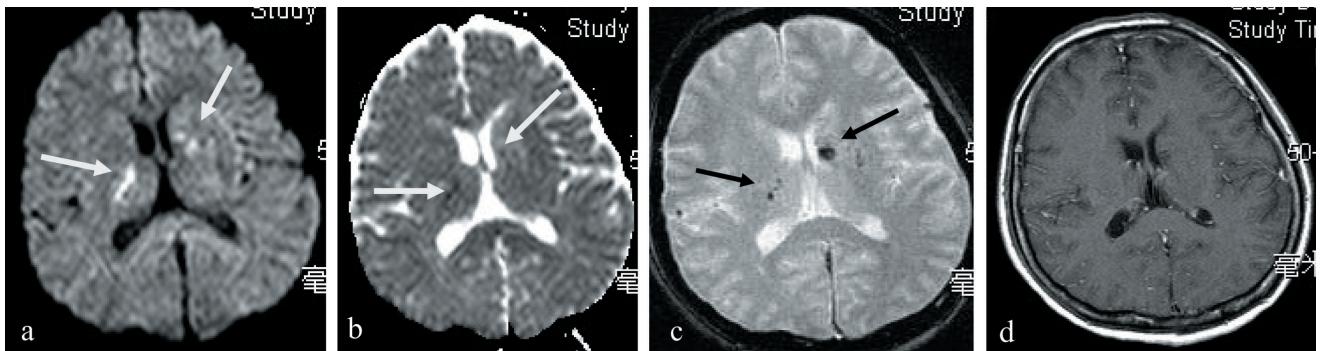


Figure 2. Findings of brain magnetic resonance imaging study (June 3rd, 2008). (a) Diffusion-weighted image shows hyperintensities at the right internal capsule (arrow) and left caudate nucleus (arrow); (b) Apparent diffusion coefficient map shows hypointensities at the right internal capsule (arrow) and left caudate nucleus (arrow); (c) Gradient echo sequence reveals decreased signals at left caudate nucleus and right internal capsule (arrow); (d) Negative finding in gadolinium contrast-enhanced T1-weighted image

capsule. In this MR imaging study, neither contrast enhanced lesion nor leptomeningeal enhancement were shown. Because of the suspicion of severe infection, ceftriaxone 1 gm Q12 was administered after blood and urine cultures were performed. The dosage of ceftriaxone was increased to 2 gm Q12 hr on the next day and the blood culture grew *K. pneumoniae*. After the correction of thrombocytopenia with platelet transfusion (48 units/3 days), cerebrospinal fluid (CSF) study was performed on June 6th, and revealed a purulent feature including a white blood cell (WBC) count of 295/mm³ (neutrophil 78%), glucose ratio 0.34 (97/287), total protein 158.3 mg/dL (normal = 15-45) and lactate 97.3 mg/dL (normal = 10.8-18.9). No bacterial growth was found in this CSF culture. On June 23rd, follow-up brain

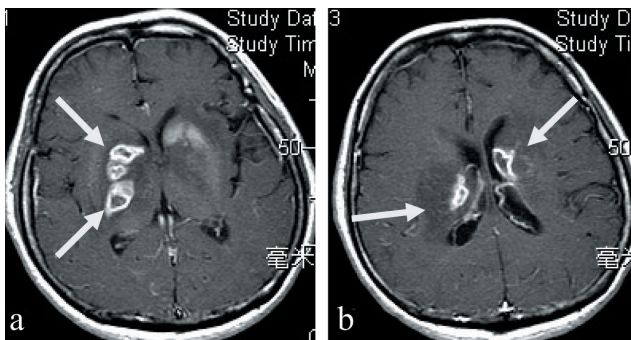


Figure 3. Gadolinium contrast-enhanced T1-weighted images show multiple lesions with rimmed-enhancement at the areas of bilateral basal ganglia (arrow)

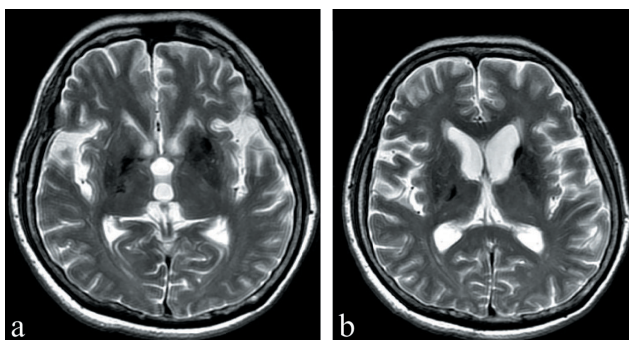


Figure 4. T2-weighted images of brain magnetic resonance imaging study. Figure 4a (July 23th, 2008) and Figure 4b (February 12th, 2009) show progressive resolution of previous lesions.

MR imaging study was performed. In this study, multiple lesions with rimmed-enhancement in the areas of bilateral basal ganglia were found (Figure 3). Under antibiotic treatment, follow-up brain MR imaging study, performed on July 23rd, revealed progressive resolution of the previous enhanced lesions (Figure 4a).

Besides the findings of neuroimaging study, right lung abscess was later detected by chest x-ray (June 6th), chest echography (June 11th) and chest CT (June 18th). In the meanwhile, liver echo study (June 7th) also revealed a mixed echoic liver mass 5×6 cm over segments 5 to 8.

During the therapeutic course, he received intravenous ceftriaxone treatment for 77 days without drainage for the abscesses of the brain, lung and liver. She was discharged on September 2nd, 2008 and the neurologic sequelae included left hemiplegia and decreased mental state. The muscle power of the left limbs was graded as 0/5 by MRC grade and she was still able to communicate with others by verbal. On February 12th, 2009, follow-up brain MRI showed a resolution of previous lesion but tissue loss at the left caudate nucleus and right internal capsule were noted (Figure 4b).

DISCUSSION

From the laboratory data and clinical presentations, this patient has *K. pneumoniae* bacteremia-related medical and neurological complications. The medical complications included liver and pulmonary abscesses, and severe thrombocytopenia. The neurologic complications included cerebral hemorrhage, meningitis and cerebritis with subsequent abscess formations. All these medical and neurologic complications are not uncommon in *K. pneumoniae* infection^(1,2,9) but these sequential neurologic events demonstrated by a serial of neuroimaging study is rarely reported in one individual in the literature. The diagnosis of meningitis of this case was delayed by the presence of severe thrombocytopenia which can be seen in severe infections including meningitis⁽³⁾. Because of the need of correction of severe thrombocytopenia, the CSF study was performed after a three days' antibiotic application. Although this delay may markedly decrease

the diagnostic yield of Gram's stain and culture⁽¹⁰⁾, the presence of meningitis of this case can be confirmed by the purulent CSF profile^(3,6).

The intracerebral hemorrhage of this case was demonstrated in the initial brain CT study. This hemorrhagic focus was also detected by the gradient echo sequence, a more sensitive sequence than traditional neuroimaging, of brain MR imaging study in which additional small hemorrhagic foci in the right internal capsule were also noted. Intracerebral hemorrhage is an uncommon vascular event of adult bacteremia and meningitis^(6,11,12). Vasospasm and vasculitis are reported to be the major pathophysiologic factors responsible for the vascular event in bacteremia and meningitis^(5,6,11-15), and may result in high incidence of neurologic sequelae of the survivors. The cause of this patient's intracerebral hemorrhage may be multiple factors related; besides the above mentioned possibilities, thrombocytopenia may also have played an important role for the vascular event⁽¹⁶⁾.

The low-density lesions at the areas of right internal capsule and left periventricular area, as shown in brain CT study, were corresponding to the brain MR image findings which showed hyperintensity on DW image and hypodensity on ADC map. Many brain lesions can be responsible for this MR image features including acute cerebral infarction, pyogenic infections such as cerebritis and abscess, brain tumor and traumatic axonal injury⁽¹⁷⁻¹⁹⁾. The absence of enhancement of the above-mentioned lesions in the first MR imaging study has lessened but could not exclude the possibility of abscess and brain tumor totally. But the possibility of brain tumor was eliminated further by the marked resolution of the above-mentioned brain lesions after antibiotic treatment only. However, multiple lesions with rimmed-enhancement in the above-mentioned locations of lesions were noted in the second brain MR imaging study, i.e. about 19 days after the first brain MR imaging study, a time-duration that is adequate for the maturation of a brain abscess. Without neurosurgical intervention, these enhanced brain lesions resolved after on intravenous ceftriaxone treatment for 77 days. Based on all these sequential MR image changes and the result of therapeutic

course, at this moment, we may speculate that those areas with hyperintensity on DW image and hypodensity on ADC map were actually the areas of cerebritis and evolved to abscess formation gradually despite there was an appropriate antibiotic treatment. All these image findings and time-tempo of lesion evolution fulfilled the image characteristics of brain abscess^(19, 20). Because of the presence of these protean neuroimaging features, this patient survived with severe neurologic sequelae. Clinically, *K. pneumoniae*-related brain abscess can locate at all parts of the brain⁽⁴⁾, but deep-seated location, such as shown in this case, is not common⁽⁴⁾. The reported neuroimaging manifestations of *K. pneumoniae* infections are many⁽²¹⁻²⁴⁾, besides vascular events (infarction and hemorrhage), gas-forming abscesses are characteristics.

In conclusion, this *K. pneumoniae*-infected patient had protean neuroimaging features and the confirmation of these neuroimaging features was made by the combination of a series of neuroimaging studies and the result of therapeutic course. These sequential neuroimaging findings in one patient are uncommon but deserved special clinical note by the first-line, primary-care physicians including neurologists.

REFERENCES

1. Ko WC, Paterson DL, Sagnimeni AJ, Hansen DS, Von Gottberg A, Mohapatra S, Casellas JM, Goossens H, Mulazimoglu L, Trenholme G, Klugman KP, McCormack JG, Yu VL. Community-acquired *Klebsiella pneumoniae* bacteremia: global differences in clinical patterns. *Emerg Infect Dis* 2002;8:160-166.
2. Lee SS, Chen YS, Tsai HC, Wann SR, Lin HH, Huang CK, Liu YC. Predictors of septic metastatic infection and mortality among patients with *Klebsiella pneumoniae* liver abscess. *Clin Infect Dis* 2008;47:642-650.
3. Chang WN, Lu CH, Huang CR, Tsai NW, Chuang YC, Chang CC, Chen SF, Chien CC. Changing epidemiology of adult bacterial meningitis in southern Taiwan: a hospital-based study. *Infection* 2008;16:15-22.
4. Liliang PC, Lin YC, Su TM, Rau CS, Lu CH, Chang WN, Lee TC, Chen HJ. *Klebsiella* brain abscess in adults.

- Infection 2001;29:81-86.
5. Lu CH, Chang HW, Lui CC, Huang CR, Chang WN. Cerebral hemodynamics in acute bacterial meningitis in adults. *QJM* 2006;99:863-869.
 6. Durand ML, Calderwood SB, Weber DJ, Miller SI, Southwick FS, Caviness VS Jr, Swartz MN. Acute bacterial meningitis in adults: a review of 493 episodes. *New Engl J Med* 1993;328:21-28.
 7. van de Beek D, de Gans J, Spanjaard L, Weisfelt M, Reitsma JB, Vermeulen M. Clinical features and prognostic factors in adults with bacterial meningitis. *N Eng J Med* 2004;351:1849-1859.
 8. Pfister HW, Borasio GD, Dirnagl U, Bauer M, Einhäupl KM. Cerebrovascular complications of bacterial meningitis in adults. *Neurology* 1992;1497-1504.
 9. Lu CH, Chang WN, Chang HW. *Klebsiella pneumoniae* meningitis in adults: clinical features, prognostic factors and therapeutic outcomes. *J Clin Neurosci* 2002;9:533-538.
 10. Ziai WC, Lewin JJ 3rd. Update in the diagnosis and management of central nervous system infections. *Neurol Clin North Am* 2008;26:427-468.
 11. Syrjanen, J. Central nervous system complications in patients with bacteremia. *Scand J Infect Dis* 1989;21:285-296.
 12. Kastenbauer S, Pfister HW. Pneumococcal meningitis in adults: spectrum of complications and prognostic factors in a series of 87 cases. *Brain* 2003;126:1015-1025.
 13. Igarashi M, Gilmartin RC, Gerald B, Wilburn F, Jabbour JT. Cerebral arteritis and bacterial meningitis. *Arch Neurol* 1984;41:531-535.
 14. Seymour JJ, Ferrera PC. Coincident meningitis and intracerebral hemorrhage in an unresponsive adult. *Am J Emerg Med* 1998;16:576-578
 15. Quinones-Hinojosa A, Gulati M, Singh V, Lawton MT. Spontaneous intracerebral hemorrhage due to coagulation disorders. *Neurosurg Focus* 2003;15:E3.
 16. Castillo M, Mukherji SK. Diffusion-weighted imaging in the evaluation of intracranial lesions. *Semin Ultrasound CT MRI* 2000;21:405-416.
 17. Schaefer PW, Grant PE, Gonzalez RG. Diffusion-weighted MR imaging of the brain. *Radiology* 2000;217:331-345.
 18. Chang SC, Lai PH, Chen WL, Weng HH, Ho JT, Wang JS, Chang CY, Pan HB, Yang CF. Diffusion-weighted MRI features of brain abscess and cystic or necrotic brain tumors: comparison with conventional MRI. *Clin Imaging* 2002; 26:227-236.
 19. Lai PH, Hsu SS, Lo YK, Ding SW. Role of diffusion-weighted imaging and proton MR spectroscopy in distinguishing between pyogenic brain abscess and necrotic brain tumor. *Acta Neurol Taiwan* 2004;13:107-113.
 20. Wipfler P, Pilz G, Lesicky O, Golaszewski SM, Ladurner G, Kraus J. *Klebsiella* meningoencephalitis presenting like embolic ischemic stroke. *J Neurol* 2008;55:1983-1984.
 21. Tada M, Toyoshima Y, Honda H, Kojima N, Yamamoto T, Nishikura K, Takahashi H. Multiple gas-forming brain Microabscesses Due to *Klebsiella pneumoniae*. *Arch Neurol* 2006;63:608-609.
 22. Liliang PC, Hung KS, Cheng CH, Chen HJ, Ohta I, Lui CC. Rapid gas-forming brain abscess due to *Klebsiella pneumoniae*. Case illustration. *J Neurosurg* 1999;91:1060.
 23. Marcolini J, Nguyen M, Ericsson C. *Klebsiella pneumoniae* Brain Abscess in a Taiwanese Adult. *J Infect* 2002;44:205-210.