

# A Case of Ventriculitis Associated with Renal Abscess Caused by Serotype K1 *Klebsiella pneumoniae*

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Recently, serotype K1 *Klebsiella pneumoniae* has been a major agent of an invasive syndrome characterized by liver abscess and its metastatic infection. Extrahepatic infection and its characteristics in patients with renal abscess caused by *K. pneumoniae* are poorly understood, and few cases of central nervous system infection have been reported. This is a report of 80-year-old woman with uncontrolled type 2 diabetes mellitus with renal abscess caused by serotype K1 *K. pneumoniae*, complicated with ventriculitis despite of appropriate use of antibiotics. Physicians need to be aware of possibility of metastatic infection in patients with serotype K1 *K. pneumoniae* infection, if they develop neurologic symptom and focus of infection is still present.

**Key Words:** *Klebsiella pneumoniae*; Abscess, Kidney; Cerebral ventriculitis; Central nervous system infection

## Introduction

*Klebsiella pneumoniae*, a member of the Enterobacteriaceae family, has been implicated as a major cause of pneumonia since the 19th century and is also an established cause of urinary tract infection, hepatobiliary infections, and osteomyelitis, mainly in alcoholics and diabetics [1]. Since the 1980s, a new distinctive invasive syndrome has been reported in Taiwan, which is characterized by community-acquired liver abscess and metastatic spread to distant sites in patients without underlying hepatobiliary disease [1]. Lung abscess, prostate abscess, soft tissue abscess, endophthalmitis/uveitis, and central nervous system (CNS) infection could occur as metastatic complications [2, 3].

Compared to those on liver abscess, there are only a few reports on metastatic infection and virulence factor in perinephric or renal abscess caused by *K. pneumoniae*, in the medical literature. In particular, there are no reports on CNS infections such as ventriculitis in patients with *K. pneumoniae* renal abscess. Here, we report, to our knowledge, the first case of renal abscess caused by serotype K1 *K. pneumoniae* that spread to the CNS and presented as ventriculitis.

## Case Report

An 80-year-old woman presented with decreased mentality,

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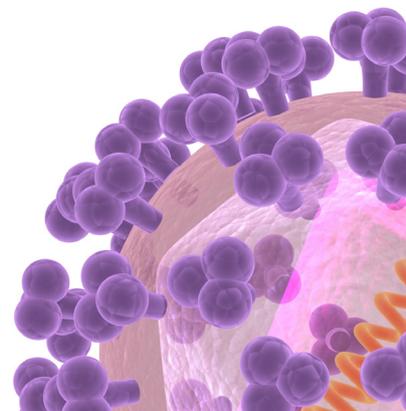
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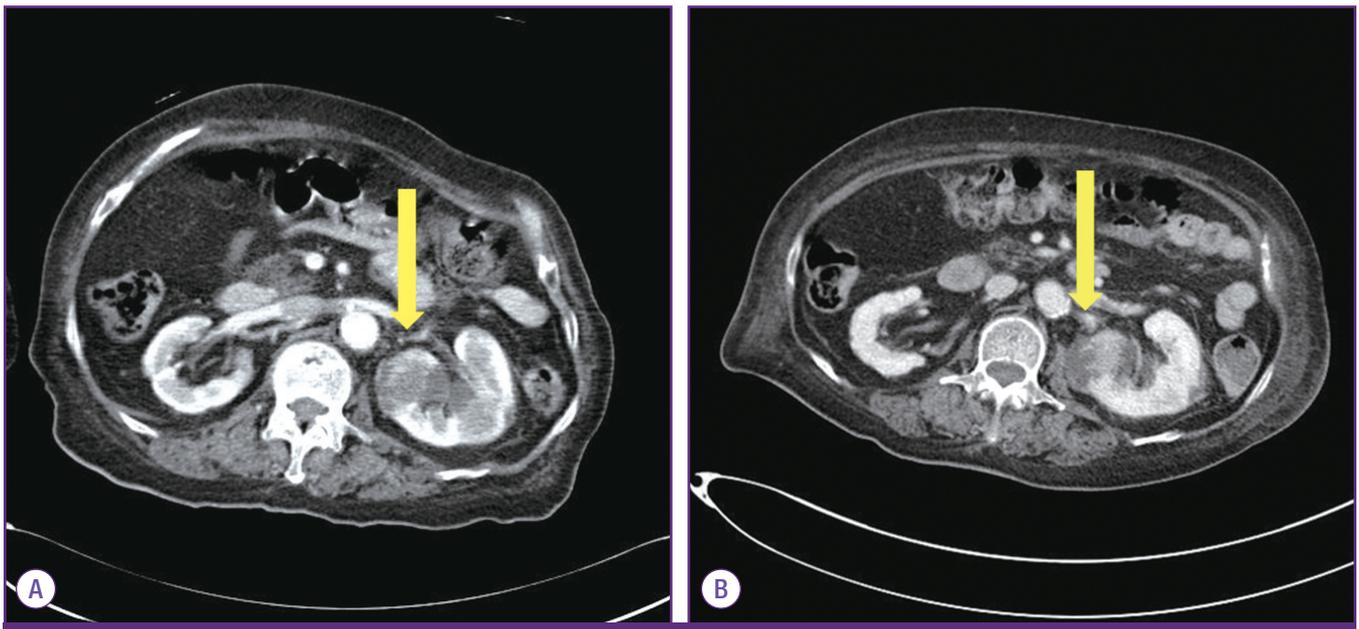
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**Figure 1.** (A) Computed tomography scan showed multiple ill-defined nodular hypodense lesions in the left kidney (arrow, yellow), suggesting multiple abscess formation. (B) Follow up CT scan showed large abscess in the upper pole of left kidney (arrow, yellow), which has increased in size and outbulged, as compared to the findings of the previous scan.

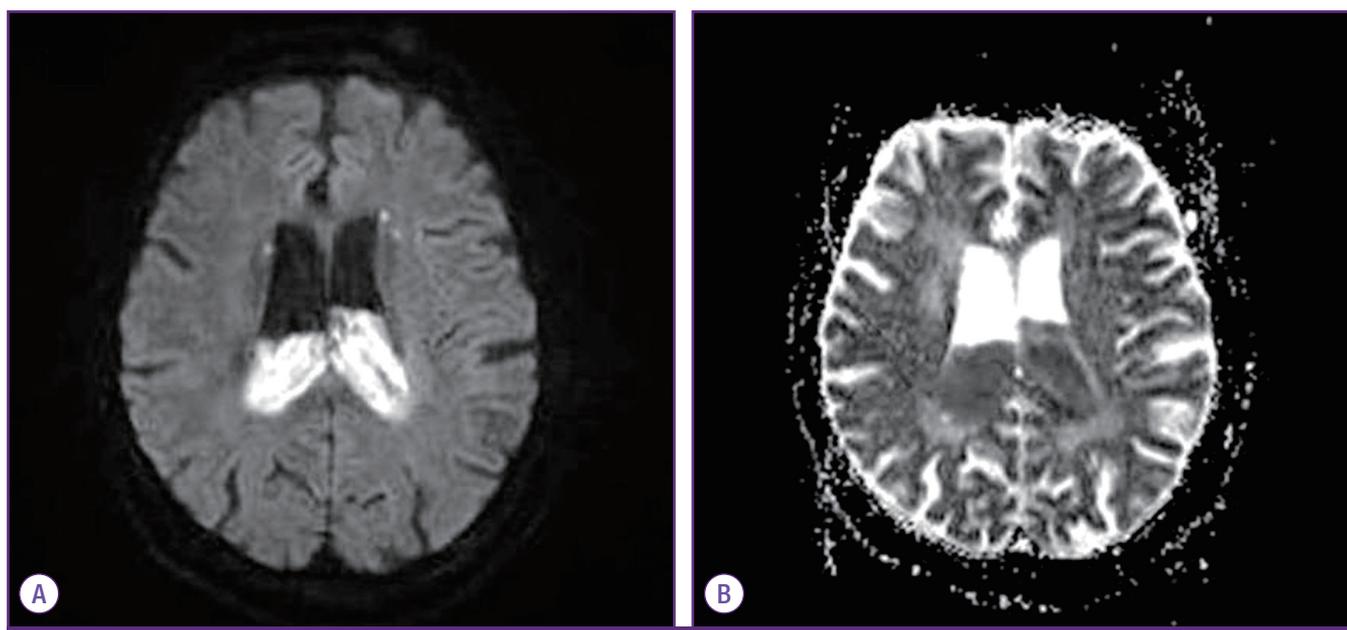
a 3-day history of polyuria, general weakness, and poor oral intake. She had been diagnosed with type 2 diabetes mellitus more than 30 years before and was treated with an oral hypoglycemic agent.

At the current hospital admission, the patient's temperature was 38.0°C. Her blood pressure was 143/92 mmHg, heart rate was 123/min, respiratory rate was 28/min, and oxygen saturation was 99% in room air. She was dehydrated, and the rest of the physical examination findings were unremarkable. No definite abnormality was detected through neurologic examination. Her laboratory values were notable as follows: white blood cell (WBC) count of 16,540 cells/mm<sup>3</sup>, segmented neutrophil concentration of 88.4%, bicarbonate level of 17.3 mmol/L, C-reactive protein (CRP) level of over 34.1 mg/dL, glucose level of 648 mg/dL, hemoglobin A1c concentration of 8.4%, sodium level of 151 mEq/L, osmolality of 357 mOsm/Kg, and creatinine level of 1.19 mg/dL. Routine urinalysis showed WBC 30–49/HPF and some bacteria. Computer tomography (CT) scan of the abdomen showed multiple ill-defined nodular hypodense lesions in the left kidney that suggest acute pyelonephritis of the left kidney with multiple abscess formation (Fig. 1). No definite abnormality was observed on brain CT.

The patient was admitted to the hospital and treated with intravenous hydration and insulin and started treatment empirically on piperacillin/tazobactam (4.5 g q8hr, IV). We attempted percutaneous drainage of renal abscess, but did not

succeed because of inadequate liquefaction. Cultures from peripheral blood and urine revealed *K. pneumoniae*, which was susceptible to most antibiotics including amikacin, cephalosporins, and ciprofloxacin. The string test was positive, showing a hypermucoviscosity phenotype. The patient was afebrile and in a stable condition on day 3 of hospitalization.

On day 6 of hospitalization, the patient developed a fever, her mental state deteriorated, and she developed stupor. At that time, her WBC count and CRP level decreased to 13,860 cells/mm<sup>3</sup> and 5.99 mg/dL. The patient showed seizure-like activity, and neurologic examination revealed objective changes with positive pyramidal and Babinski signs. Magnetic resonance imaging (MRI) of the brain showed elevated signals in the lateral ventricles, Sylvian fissure, suprasellar, interpeduncular cistern, and posterior fossa, suggestive of ventriculitis (Fig. 2). Cerebrospinal fluid (CSF) showed a very turbid and milky appearance, and the WBC count was 7,200/mm<sup>3</sup> segmented neutrophil concentration was 44%, protein level was 359.3 mg/dL, glucose level <10 mg/dL. The antibiotic regimen was changed from piperacillin/tazobactam to ceftriaxone (2 g q12hr, IV) and vancomycin (1 g q12hr, IV), and emergency extraventricular drainage (EVD) was performed. Although the blood culture at that time showed negative result, the CSF culture revealed *K. pneumoniae*. We continued ceftriaxone alone. *K. pneumoniae* isolated from the CSF was found to be of hypermucoviscosity phenotype and was shown



**Figure 2.** MR diffusion weighted image (A) showed high signal intensity in both lateral ventricle, and low apparent diffusion coefficient (B) values, suggesting abscess formation in both lateral ventricles.

same antibiotic susceptibility as those drawn from first blood culture. Abdomen CT scan was performed, and abscess of left kidney increased in size and protruded (Fig. 1), and other disseminated infection was not found. Percutaneous drainage for renal abscess was performed. Two weeks after admission, the EVD catheter and pig tail catheter of the left renal abscess were removed. The patient's general condition and laboratory data remained favorable. After 28 days of intravenous antibiotics, the patient was discharged to the long-term care facility with oral cefditoren (600 mg/day) of two weeks, showing improvement of neurologic state slowly, and after 1 month, could express in words.

We evaluated the serotyping and virulence genes of *K. pneumoniae* from blood and CSF including serotype K1, *rmpA*. For serotyping, we use PCR detection of serotype K1 specific alleles at the *wzx* loci, with the following primers, as previously described [4]. Consequently, serotype K1-specific alleles at the *wzx* were positive in the strains of the blood and CSF, indicating that the serotype of this *K. pneumoniae* was K1. The presence of genes encoding virulence factors was determined by polymerase chain reaction using primers documented previously [5] and *rmpA* gene was confirmed in the microorganism from CSF and blood. We didn't analyze the presence of *magA* gene which was known as one of factor associated virulence.

## Discussion

Perinephric and renal abscesses are rare among the various existing intra-abdominal abscesses. More than three-quarters of the cases arise from a urinary tract infection (UTI) and known risk factors are urinary flow obstruction, renal stones, other structural abnormalities of the urinary tract, prior surgery, trauma, and diabetes mellitus [6]. Our patient had diabetes mellitus controlled by administration of an oral hypoglycemic agent for 30 years, and she presented with a hyperosmolar hyperglycemic state at admission. Patients with diabetes have greater frequency, severity, and complication of infection. For reasons that are not fully understood, there are abnormalities of cell-mediated immunity and phagocytosis in the presence of hyperglycemia, with diminished vascularization [6]. Neutrophils are an essential part of the innate immunity against bacterial infection. Impaired neutrophil activity in type 2 diabetes mellitus is partly responsible for the increased susceptibility to infection [7].

*K. pneumoniae* is one of the major causes of community-acquired liver abscess in Southeast Asia, and capable of causing UTI in both healthy people and in-hospital patient [8]. Since the 1980s, a few case reports of secondary CNS infection due to liver abscess have been published. In Korea, there have been a few reports of disseminated infection due to *K. pneumoniae*. Jung et al. [9] reported a case of endogenous endophthalmitis and septic pulmonary embolism in *K. pneumoni-*

*ae* renal abscess, and this report also have summarized cases of *K. pneumoniae* infection with multiple foci, involving endophthalmitis, renal, liver or prostate infection and CNS infection with concomitant liver abscess or spondylitis. However, no cases of metastatic CNS infection with *K. pneumoniae* renal abscess have been reported. *K. pneumoniae* CNS infection is a life-threatening disease and the case fatality rate of *K. pneumoniae* meningitis remains high at 30-40%, with severe neurological sequelae, especially serotype K1 isolates is found in this patients [10]. Ventriculitis is inflammation in the ventricular system of the CNS and occurs as a complication of meningitis, which is a result of severe meningitis affecting the basal cisterns or rupture of a cerebral abscess into a ventricle. Although antimicrobial treatment with surgical intervention is known to the mainstay of treatment [11], prognosis is poor in most of cases. Generally, the presence of inflammation in the setting of bacterial meningitis enhances the ability of a given antimicrobial to penetrate the blood-brain barrier. However, this phenomenon may be less observed in case of ventriculitis, in which the ventricles can do as a persistent source of infection, as a potential blockade of CSF outflow tracts [12]. We used proper antibiotics continuously, and performed prompt external ventricular drainage. Early invasive treatment in our patient resulted to favorable outcome. In cases with *K. pneumoniae* CNS infection, concomitant septic metastatic infection involving liver, eyes is commonly found [13]. However in our patient, other metastatic septic site was not shown.

Serotype K1 *K. pneumoniae* is known as one of the subtypes associated with manifestations of distinct invasive syndrome in the presence of liver abscess. Capsular serotype K1 has been generally considered to be the predominant virulent strain of *K. pneumoniae* capable of producing a capsular polysaccharide-presenting hypermucoviscosity, which is more resistant to phagocytosis [14-16]. A recent report has documented that serotype K1 *K. pneumoniae* is also capable of causing ocular or CNS complications from pyogenic liver abscess [17]. Other factors associated with the invasive syndrome are hypermucoviscous phenotype, presence of virulence-associated genes such as *rmpA* and *maga*; *maga* is a part of the gene cluster for serotype K1 capsular formation [14-16], and *rmpA* is a regulatory gene responsible for the hypermucoviscous phenotype [1]. Yu et al. [18] had reported previously that the presence of the *rmpA* gene may contribute to expression of the hypermucoviscosity phenotype, in addition, the metastatic infection. In our case, we identified the serotype K1, hypermucoviscosity and *rmpA*, which would contribute to invasive syndrome.

Treatment of renal abscess includes drainage of pus and antibiotic therapy [6]. In this case, we immediately started proper antibiotic therapy, but we could not perform drainage of the abscess due to inadequate liquefaction of the abscess at the time of admission. Our patient developed metastatic infection presenting as ventriculitis despite the use of proper antibiotics with *in vitro* susceptibility. In our case, undrained abscess could cause metastatic CNS infection as well as virulence of serotype K1 and *rmpA* gene.

This is a report of a patient with renal abscess caused by serotype K1 *K. pneumoniae*, complicated with ventriculitis. Physicians need to be aware of possibility of metastatic infection in patients with serotype K1 *K. pneumoniae* if the patients develop neurologic symptom and focus of infection is still present.

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