

## Case Report

# A Case of *Klebsiella pneumoniae* infection

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### Abstract

**Introduction:** In recent years, hypervirulent *Klebsiella pneumoniae* (hvKp) has attracted increasing attention. It usually causes liver abscesses, which spread through the bloodstream to other parts such as the eyes, brain, lungs. 5.5% of all paroxysmal sympathetic hyperactivity syndrome are associated with infection, hydrocephalus, brain tumors, and some unknown causes. Younger patients with focal lesions of the brain parenchyma are at higher risk of paroxysmal sympathetic hyperactivity (PSH).

**Case presentation:** This case report details the clinical features of *Klebsiella pneumoniae* diagnosed in a healthy individual. In addition to liver abscesses, bacteremia, and hyperglycemia, there are also brain abscesses, hernias, and postoperative paroxysmal sympathetic hyperactivity, an unexpected association between diseases or symptoms. The patient stabilized after comprehensive treatment, including early drainage of abscesses, rapid pathogen diagnosis, and timely and appropriate antibiotics. At a two-month follow-up, no signs of infection recurrence were noted, and the patient regained neurological function and could participate in regular physical activity.

**Discussion:** Symptoms of *Klebsiella pneumoniae* infection usually appear gradually, and misdiagnosis is common. When young patients suddenly develop high fever and abscess at a particular site, *Klebsiella pneumoniae* infection should be considered routine. Paroxysmal sympathetic hyperactivity syndrome caused by infection is rare, but a clinical score (PSH assessment measure, PSH-AM score) should be performed when clinical features appear. Early diagnosis and treatment can improve the prognosis.

**Key words:** *Klebsiella pneumoniae*; invasive liver abscess syndrome; central nervous system infection; paroxysmal sympathetic hyperactivity.

*J Infect Dev Ctries* 2024; 18(6):972-977. doi:10.3855/jidc.18686

(Received 05 June 2023 – Accepted 31 July 2023)

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### Introduction

*Klebsiella pneumoniae* (*K. pneumoniae*) is a Gram-negative, gas-producing *Enterobacterium* that is widely present in nature and belongs to the normal flora of the human mouth and intestine [1]. *K. pneumoniae* infection occurs mainly in patients with compromised host defenses and is usually hospital-acquired. Hypervirulent *K. pneumoniae* (hvKp), first identified in Taiwan in 1986, belongs to part of the *Enterobacteriaceae* family and is increasingly seen worldwide [2], that is the leading cause of community-acquired suppurative liver abscesses, which are often life-threatening and associated with a wide range of clinical symptoms [3].

In 2012, Fang *et al.* [4] proposed a case definition of invasive liver abscess syndrome: *K. pneumoniae* liver abscess with extrahepatic complications, especially involving the central nervous system or endophthalmitis. Invasive *K. pneumoniae* liver abscess syndrome presents primarily as a single pathogen liver abscess, usually community-acquired.

Although the exact pathogenesis of hvKp remains unclear, many studies have shown that hvKp initially colonizes the gastrointestinal tract and preferentially infects other organs, primarily the liver [5]. Therefore, purulent liver abscess formation is the main symptom of *K. pneumoniae* infection, mostly in diabetic patients [6]. Invasive liver abscess syndrome with metastatic infection caused by *K. pneumoniae* is associated with high morbidity and mortality [7,8]. In these distal metastatic infections, brain abscesses caused by hvKp are considered to be secondary to blood-borne transmission from prior bacteremia, which can lead to brain herniation and is a life-threatening disease. PSH is a relatively common but not yet recognized complication of acute diffuse or multifocal brain disease. Infectious factors related to PSH accounts for less than 5.5%. PSH may lead to unnecessary testing and sometimes inappropriate treatment. Adjustment of supportive care and appropriate medical intervention can often greatly alleviate the condition [9,10].

To our knowledge, this is the first clinical case of severe hvKp infection with PSH reported and the first

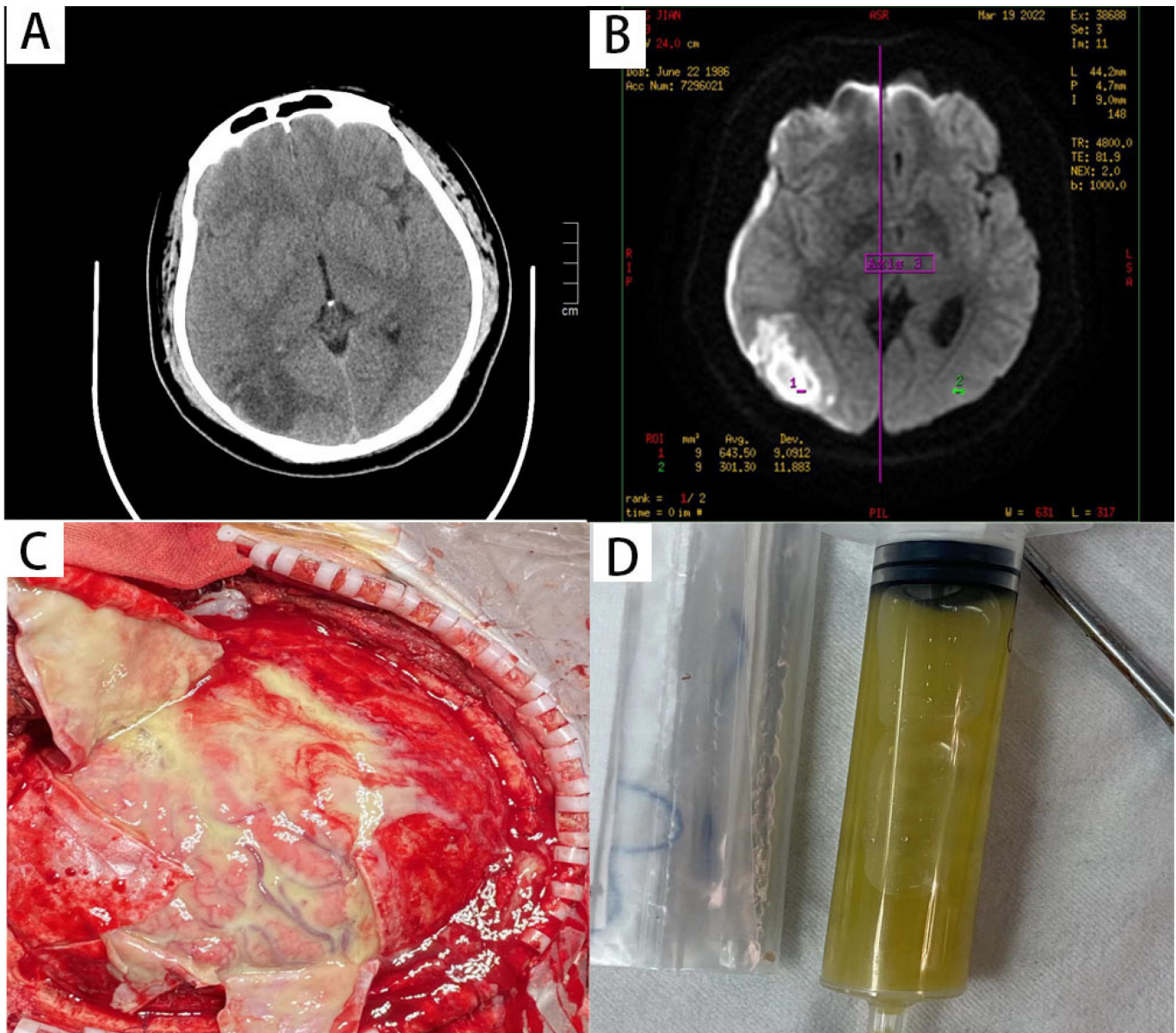
clinical case of PSH caused by an infection in adult patients.

### Case report

A 35-year-old male was admitted to the emergency ward of our hospital, complaining of headache with a fever for six days and three days of gibberish without any symptoms prior to the headache. Since the onset of headache, his temperature was 39.9 °C. The patient visited the local hospital and received symptomatic treatments. He gradually deteriorated and started gibberish speech. The family member complained of no

history of diabetes. On admission, the physical examination of the face, chest, and abdomen was unremarkable. Cervical resistance was positive, and the left limb muscle strength grade IV and the right limb muscle strength grade V were noted. His temperature, heart rate, and blood pressure on admission were recorded as 36.2 °C, 79 beats per minute, and 130/80 mmHg, respectively. Laboratory investigations were as follows: peripheral blood white blood cell count,  $9.49 \times 10^9/L$ ; high sensitivity C-reactive protein, 231.39 mg/L; procalcitonin, 0.96 ng/mL; ESR, 75 mm/hour; lactic acid, 1.51 mmol/L; intravenous blood glucose, 13

**Figure 1.** The characterization of brain abscesses.

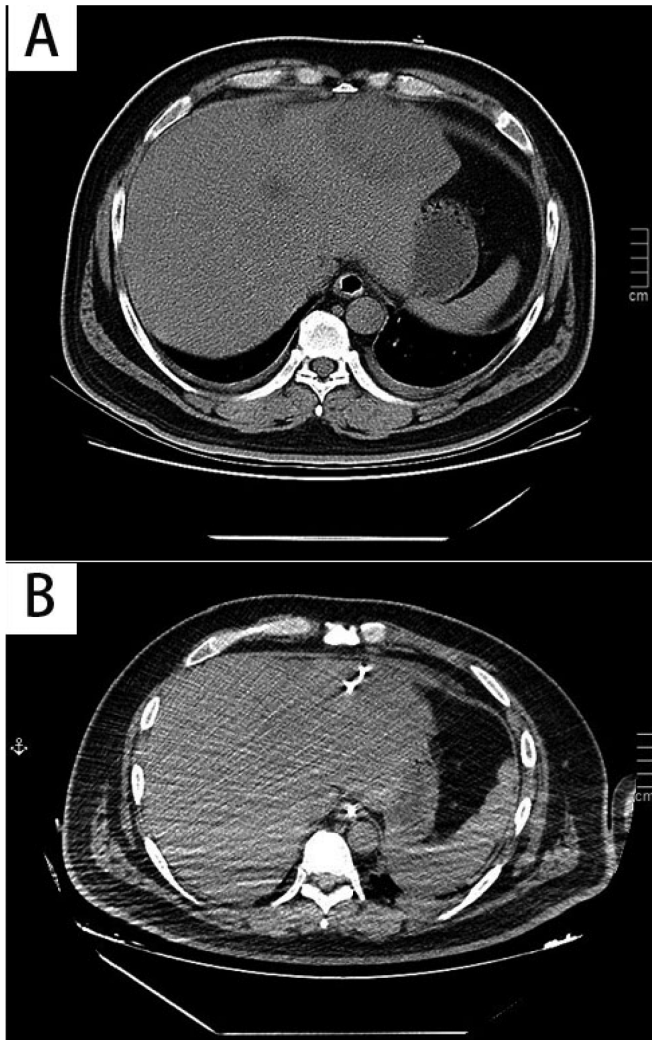


**A.** Low-density shadows with a maximum cross-sectional area of  $4.15 \times 2.71\text{cm}$  and a CT value of 18Hu by Head CT; **B.** Multiple lesions of the supratentorial right subdural, bilateral frontal- parietal lobes, right basal ganglia, temporal occipital lobe, left shift of midline structure by Head MR diffusion-weighted imaging (DWI); **C.** Large amounts of pus at the subdural; **D.** Pus was removed and bacteriologically examined.

mmol/L; HbA1c, 10.5%. Head CT findings exhibited low-density shadows with a maximum cross-sectional area of 4.15 cm × 2.71 cm and a CT value of 18 Hu that suggested marked ischemic injury in the right temporal occipital lobe, which were considered to signify foci of infection (Figure 1A). Blood cultures were collected from two sites before initiating antibiotics, and cerebrospinal fluid was collected through lumbar puncture for metagenomic Next-Generation Sequencing (NGS). Bacterial smears revealed the presence of gram-negative bacteria.

Hypervirulent *Klebsiella pneumoniae* produced brain abscesses, bacteremia, and liver abscesses, accompanied by paroxysmal sympathetic hyperactivity. The patient's condition rapidly deteriorated. Head MR diffusion-weighted imaging (DWI) revealed multiple

**Figure 2.** The characterization of liver abscess by abdominal computed tomography.



**A.** Multiple lesions of the left liver lobe; **B.** Ultrasound-guided hepatic abscess puncture and drainage.

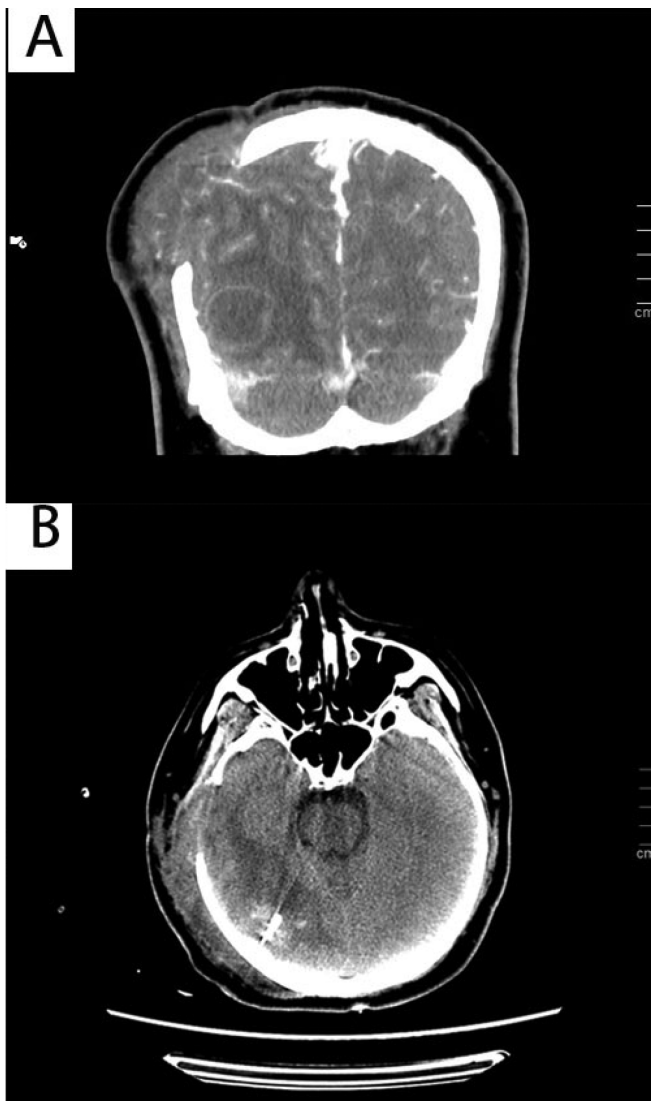
lesions of the supratentorial right subdural, bilateral frontal, parietal lobes, right basal ganglia, temporal, occipital lobe, and left shift of midline structure (Figure 1B). Physical examination revealed gradual deterioration in consciousness. Right frontotemporal top desuppression and subdural pus drainage were subsequently performed. During surgery, large amounts of pus at the subdural were observed (Figure 1C). Pus was removed and bacteriologically examined (Figure 1D). After debridement, the patient was transferred to ICU for further treatment. The patient was ventilated and insulin was administered to maintain blood glucose stability. Metagenomic NGS testing of cerebrospinal fluid revealed *Klebsiella pneumoniae*, the number of microbial nucleic acid sequences detected in the sample: 538, and 2g of Meropenem was given intravenously at 8-hour intervals. Further search for the source of the brain abscess, abdominal computed tomography showed multiple lesions of the left lobe of the liver, consistent with liver abscess manifestations, so invasive *K. pneumoniae* hepatic abscess syndrome was considered (Figure 2A). Ultrasound-guided hepatic abscess puncture and drainage was subsequently performed (Figure 2B). *K. pneumoniae* was found in blood culture and pus samples. In vitro drug susceptibility test of Meropenem was sensitive. Signs of PSH, including increased heart rate, elevated blood pressure, fever, dystonia, and rapid breathing, occurred 1 week after surgery. The PSH-AM score was 21 points, and morphine, diazepam, clonidine, propranolol, gabapentin, and bromocriptine were administered to control sympathetic nerve excitement symptoms. Enhanced CT examination showed that the right parietotemporal occipital lobe and left frontal lobe low-density shadow expanded compared with the previous range, and the inner ring enhancement changes were visible in the right occipital lobe (Figure 3A). The right occipital lesion was more significant, and infection (brain abscess) was considered. The patient's condition stabilized after intensive treatment, and he recovered after several punctures and drainage (Figure 3B). The patient and his family returned to the local hospital for further treatment. At two months of follow-up, no infectious recurrence affecting any previously infected organs was noted, and the bone flap was returned. His neurological function recovered, modified Rankin Scale (mRS) 0 points, and he could participate in regular physical activity.

## Discussion

HvKp strains frequently infect younger, healthy individuals in the community, unlike (“common”) non-

hvKp strains that mainly affect immunocompromised and hospitalized patients [11]. Moreover, it can lead to infections in the other tissues, such as endophthalmitis, meningitis, brain abscesses, lung abscesses, prostate abscesses, and soft tissue infections [7,12-17]. Therefore, we should be alert to the presence of hvKp if a young patient develops an abscess in a particular site mentioned above. Epidemiology, clinical symptoms, and laboratory features are used to determine the diagnosis of hvKp infection, and then rapid diagnosis and immediate treatment should be given once the diagnosis is definite. Before antibiotic administration, we recommend that microbiological

**Figure 3.** The characterization of brain abscess by computed tomography.



**A.** The right parietotemporal occipital lobe low-density shadow expanded compared with the previous range, and the inner ring enhancement changes were made by enhanced CT examination; **B.** Brain abscess puncture and drainage.

analysis samples should be sent for early detection of pathogens. Diabetes mellitus is one of the most common underlying diseases, and higher glucose levels impair neutrophil adhesion, chemotaxis, phagocytosis, and bactericidal activity which is an independent risk factor for hvKp infection [18,19]. Head CT findings in the case revealed a brain abscess (Figure 3A). Abdomen CT showed liver abscesses (Figure 2A). The patient, in this case, had no history of diabetes. However, the perfect glycosylated hemoglobin after admission was > 9%, indicating that the patient with persistent hyperglycemia may develop diabetic nephropathy, arteriosclerosis, cataract, and other complications, which are independent risk factors for hvKp infection. It was considered that the patient had diabetes, which was ignored due to a lack of monitoring. *K. pneumoniae* liver abscess often causes septic embolism and also increases the risk of intracerebral hemorrhage [20]. PSH is a relatively common but unrecognized complication of acute diffuse or multifocal brain disease, most commonly found in young, comatose patients with severe traumatic brain injury [21]. Previous studies have shown a small number of PSH occur in patients with infection and other diseases, and only one study reported a high rate of PSH in critically ill pediatric patients with meningoencephalitis and encephalitis. The pathophysiology of PSH remains unclear. Proposed mechanisms include heightened activity of diencephalic or brainstem sympathoexcitatory regions due to direct activation or disinhibition (release phenomenon) secondary to loss of cortical and subcortical control [22,23]. In this case, imaging showed that the patient had a brain abscess, multiple lesions on the head, repeated and sudden tachycardia, hypertension, sweating, and sometimes fever and dystonia postures, which were consistent with the clinical manifestations of PSH, and the PSH-AM score was > 17 [24]. Prompt and adequate treatment includes adequate puncturing and drainage, reducing any external stimuli that may trigger seizures, reducing the likelihood of secondary complications such as dehydration, weight loss, malnutrition, and muscle contractures, and eventually, the patient recovered well in neurological function without residual sequelae. We present this rare case to draw clinicians' attention to this emerging invasive syndrome and accompanying abnormal clinical manifestations worldwide. This case illustrates that aggressive *K. pneumoniae* infection is a rapidly progressive disease that requires urgent diagnosis and treatment and that its accompanying abnormal clinical manifestations require early diagnosis and treatment to improve the prognosis.

## Conclusions

Here, we describe a severe clinical case of hvKp infection diagnosed in an otherwise healthy individual presenting with headache, fever, and impaired consciousness. Head DWI revealed multiple lesions of the head, and multiple pus subdural were visible in surgery for brain herniation. Thus, it is essential to consider the diagnosis of hvKp infection after the microbiological examination of cerebrospinal fluid revealed *K. pneumoniae*. Further search should also be made for the source of infection, with a liver abscess visible on abdominal CT and the possibility of dissemination to the lungs and other organs to avoid misdiagnosis. Postoperatively, the patient presented with an unusual clinical presentation of PSH, aggressive treatment was given, and the patient's prognosis was good. Although paroxysmal sympathetic hyperactivity syndrome caused by infection is rare, PSH was noted in this case after hvKp infection the association between hvKp infection and PSH warrants further investigation.

## Ethical Statement

This case report was approved by the ethics committee of The Second Hospital of Hebei Medical University. Written informed consent was obtained from the patient's wife, his medical power of attorney, for publication of this case report. The patient provided verbal assent.

## Authors' contributions

Xuefang Liu (Conceptualization: Lead; Data curation: Lead; Investigation: Lead; Writing – original draft: Lead); Liu Ya (Investigation: Lead; Supervision: Lead; Writing – review & editing: Lead); Yu Ning (Data curation: Supporting; Investigation: Supporting; Validation: Equal; Writing – original draft: Supporting); Huaihai Lu (Investigation: Supporting; Resources: Supporting; Supervision: Supporting); Yinlong Zhao (Formal analysis: Lead; Investigation: Supporting; Resources: Lead); Junyu zhu (Supervision: Supporting; Writing – review & editing: Supporting).

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**Conflict of interests:** No conflict of interests is declared.