Cryptogenic Liver Abscess Caused by a K1 Serotype Klebsiella pneumoniae Isolate

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Abstract

Hypervirulent Klebsiella pneumoniae (hvKp) is a common cause of pyogenic liver abscesses in Asia but is quite uncommon in North America. Among the cases described in North America, only occasional reports have described molecular strain typing to confirm the K1 strain as the causative agent. We report a 56-year-old Hispanic female with no previous intra-abdominal pathology and no recent travel, who presented with subacute abdominal pain and developed bacteremia and monomicrobial pyogenic liver abscess due to a community-acquired K1 serotype K. pneumoniae isolate. In this case, the infection was recognized early, so the patient was successfully treated with percutaneous drainage and prolonged antibiotic therapy. HvKp can cause severe invasive disease with high morbidity and mortality, and the recent emergence of multidrug resistance in these strains poses a serious threat to public health. In addition, the isolation of a K1 K. pneumoniae strain from a cryptogenic liver abscess in a Hispanic patient with no epidemiologic risk factors raises concern for a wider spread of the hypervirulent strain beyond Asian populations. Therefore, a high index of suspicion for hvKp infection in the Hispanic population can be crucial as the hypervirulent strain is likely to cause severe metastatic infection with significant morbidity and mortality.

Keywords: Hypervirulent Klebsiella pneumoniae, K1, Klebsiella pneumoniae, liver abscess

Introduction

Pyogenic liver abscesses are often polymicrobial, with Escherichia coli, Klebsiella pneumoniae, and Streptococcus spp. being the most common pathogens involved.[1] Most pyogenic liver abscesses develop in the setting of biliary infection through the direct spread, or in cases of intra-abdominal infection such as appendicitis and peritonitis from hematogenous dissemination through the portal circulation. In some cases, however, no source is ever identified.[1]

A distinct clinical syndrome of primary monomicrobial pyogenic liver abscess caused by community-acquired K. pneumoniae in patients with no underlying intra-abdominal pathology was first identified in the 1990s in Taiwan. Community-acquired K. pneumoniae has since become the most common cause of pyogenic liver abscess in East Asia.[2] Sporadic cases have also recently been reported in Australia, Europe, and North America, in individuals who were diabetic but had no underlying hepatobiliary disease, colorectal disease, or a history of intra-abdominal surgery or trauma.[3-7] These infections can also be associated with unusual septic metastatic localizations such as endophthalmitis and meningitis.[8]

Case Report

A 56-year-old female with coronary artery disease, hypertension, diabetes mellitus Type II, and hyperthyroidism presented with left pelvic pain. The patient reported 6 months of burning urinary sensation. She had completed multiple courses of oral antibiotics for presumed urinary tract infection (UTI). The patient immigrated to the United States from El Salvador 7 years ago, but she denied recent travel or hospitalizations in the past 2 years. Her occupation in the US involved taking care of children and the elderly.

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On initial presentation, the patient was afebrile and hemodynamically stable. Her physical examination was notable for left costovertebral angle tenderness. She was prescribed an empiric course of oral ciprofloxacin for suspected UTI and discharged.

She presented again the next day with progressive right-sided abdominal pain accompanied by fever, chills, and nonbloody, nonbilious emesis. Physical examination revealed right upper quadrant tenderness. She was febrile and hypotensive, therefore, empiric vancomycin, cefepime, and metronidazole were started for acute sepsis with shock after blood cultures were obtained. Laboratory workup was notable for aspartate aminotransferase 53 IU/L, alanine aminotransferase 63 IU/L, alkaline phosphatase 124 IU/L, lactic acid 2.7 mmol/L, white blood cell 2.04 K/µL, 18% bands, and procalcitonin 43.15 ng/mL. alpha-fetoprotein, cancer antigen (CA) 19-9, carcinoembryonic antigen, and CA 125 were negative.

Abdominal computed tomography (CT) revealed a 3.8-cm ill-defined hypodense heterogeneous lesion in the right hepatic lobe. Her abdominal magnetic resonance imaging showed a 4.7-cm liver abscess. The primary infectious source was a pyogenic liver abscess. She underwent an aspiration of the abscess and microbiological analysis of the fluid. The empiric antimicrobial regimen aimed to cover streptococci, enteric Gram-negative bacilli, and anaerobes. In this patient, with no evident predisposition to pyogenic liver abscess (such as biliary disease or intra-abdominal surgery) and with appropriate epidemiologic risk factors such as immigration or travel from Asia, Central or South America, and Africa, the serology testing for Entamoeba histolytica was performed, and this organism was covered empirically with metronidazole. An alternative empiric regimen with similar coverage would be piperacillin-tazobactam with metronidazole. Blood cultures on admission grew *K. pneumoniae* on day 3. Subsequent infectious studies, including serum Strongyloides IgG, *E. histolytica* IgM/IgG, and stool for ova/parasites, were negative. The liver abscess was drained by interventional radiology. The abscess fluid cultures eventually both grew *K. pneumoniae* that was susceptible to all antibiotics except ampicillin [Figure 2]. Vancomycin and metronidazole were stopped. Cefepime was deescalated to ceftriaxone. Fortunately, our patient did not have evidence of any metastatic infection.

We further characterized the isolated Klebsiella strain by wzi sequencing, which indicated that this strain expressed a wzi-1 (K1) capsular serotype. This was confirmed with an enzyme-linked immunosorbent assay using 4C5, an IgG specific for the K1 capsular polysaccharide (CPS). Since the patient had no underlying hepatobiliary disease, no history of intra-abdominal surgery or trauma, and no recent travel, she was diagnosed with *K. pneumoniae* primary liver abscess (KLA). Most KLA cases are community-acquired. Community-acquired *Klebsiella* strains are typically resistant to first-generation cephalosporins and ampicillin but rarely produce extended-spectrum beta-lactamases (ESBL). The preferred agent, therefore, is a third-generation cephalosporin or an extended-spectrum beta-lactam such as piperacillin-tazobactam. In this case, based on the final susceptibility results, she was treated with a prolonged course of ceftriaxone for 6 weeks. At 6-week follow-up, repeated abdominal CT scan confirmed interval decrease in size of the liver abscess.

**Discussion**

We report a case of monomicrobial pyogenic liver abscess due to a community-acquired hypervirulent *K. pneumoniae* (hvKp) strain of the K1 serotype in a Hispanic patient. hvKp is a common cause of pyogenic liver abscesses in Asia but quite...
uncommon in North America. Among the cases described in North America, only occasional reports have described molecular strain typing to confirm the K1 strain as the causative agent. The isolation of a K1 K. pneumoniae strain from a cryptogenic liver abscess in a Hispanic patient with no epidemiologic risk factors raises a possibility for a wider spread of the hypervirulent strain beyond the Asian population.

Community-acquired hvKp strains express an increased number of virulence factors compared to other K. pneumoniae isolates. These include siderophore systems for iron acquisition such as aerobactin, a hypermucoviscosity phenotype, and regulator of mucoid phenotype A (rmpA and rmpA2) genes which regulate capsule synthesis. The prevailing CPS in hvKp strains is the K1 serotype, followed by K2 and non-K1/K2 serotypes whereas nosocomial K. pneumoniae isolates express a variety of other capsule types. The K1 capsular serotype, in particular, is associated with invasive community-acquired syndrome of liver abscesses, meningitis, and endophthalmitis in Asian countries.

Among the cases of KLA described in North America, only occasional reports have confirmed the K1 strain as the causative agent. This report describes an unusual case of a cryptogenic primary liver abscess in a Hispanic patient in New York, confirmed to be caused by hvKp of the K1 capsular, raising concern for an emergence of the hypervirulent strain beyond Asian populations.

Until recently, hvKp strains rarely produced ESBL, so if recognized early, infections caused by hvKp can be successfully treated despite their invasiveness, as demonstrated in this case. Of great concern is the emerging antibiotic resistance in hvKp strains, which has been reported in China, due to the acquisition of carbapenemase-producing plasmids such as blaKPC and blaKPC-3. The standard carbapenem-resistant strains, which belong to the clonal group 258, are less virulent and do not commonly cause invasive disease in health people. In contrast, hvKp strains usually belong to the ST23 clonal group and cause severe infection with high mortality and morbidity even in healthy adults. Emergence of multidrug resistance in this hypervirulent strain poses unprecedented threats to public health and needs to be monitored carefully.

In conclusion, a high index of suspicion for hvKp infection in the Hispanic population can be crucial as the hypervirulent strain is likely to cause severe metastatic infection with significant morbidity and mortality.

Declaration of patient consent
The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given her consent for her images and other clinical information to be reported in the journal. The patient understands that name and initials will not be published, and due efforts will be made to conceal the identity, but anonymity cannot be guaranteed.

Research quality and ethics statement
The authors followed applicable EQUATOR Network (https://www.equator-network.org/) guidelines, notably the CARE guideline, during the conduct of this report.

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Conflicts of interest
There are no conflicts of interest.

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