



ORIGINAL ARTICLE

Clinical characteristics and economic consequence of *Klebsiella pneumoniae* liver abscess in Taiwan



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KEYWORDS

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Background: *Klebsiella pneumoniae* liver abscess (KPLA) has emerged as an endemic disease in Taiwan, and its prevalence has been increasing in east Asian countries in the past three decades. The utilization of healthcare resources associated with KPLA is assumed to be substantial, and may be of future concern. This study investigated the clinical characteristics and economic burden of KPLA in Taiwan in 2011 and 2012.

Methods: Adult patients with KPLA were identified retrospectively in a tertiary medical center in Taiwan from January 2011 to December 2012. The clinical characteristics, total and daily hospitalization expenditure, and the risk factors for the costs of KPLA were analyzed.

Results: Among patients with KPLA, the median cost was \$5290.80 in US dollars, and the mean cost was \$6337.50 ± \$4363.40. Length of hospital stay was the only independent risk factor for the high total hospitalization expenditure. The duration of antibiotic use was nearly the same as the length of hospital stay. The prolonged stay in the general ward (≥21 days) also contributed to the high total cost of hospitalization. The independent risk factors for the high average daily cost of hospitalization were a higher Charlson Comorbidity Index and the requirement of intensive care on admission.

Conclusion: The current study is the first to demonstrate the high economic burden resulting from KPLA in a medical center in Taiwan. Standardizing the treatment protocol for KPLA

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inpatients and introducing an outpatient parenteral antimicrobial therapy center to reduce the length of stay may reduce costs, whereas development of a vaccine may be necessary to tackle endemic KPLA in the future.

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Introduction

Pyogenic liver abscess is a common disease in Taiwan,¹ and the annual incidence of 11.99–17.59 per 100,000 population² is substantially higher than in Western countries, such as Denmark,³ Canada,⁴ and the United States⁵ with annual incidences of 1.0, 2.3, and 2.7–4.1 per 100,000 population, respectively. In the past three decades, *Klebsiella pneumoniae* has emerged as the main cause of pyogenic liver abscess in Taiwan and other East Asian countries, especially Korea and Singapore,^{2,6–15} whereas *Streptococcus* species and *Escherichia coli* are the predominant cause of pyogenic liver abscess in Western countries.^{4,5} The increasing prevalence of *K. pneumoniae* liver abscess (KPLA), and the associated distinctive invasive syndrome complicated by endophthalmitis, central nervous system infection, and septic metastatic lesions in other organs have contributed to the endemic features of the disease in Taiwan.^{1,2,6–9,11,12,16–21}

The clinical and microbiological characteristics of KPLA in Taiwan have been widely studied in the past three decades.^{2,6,7,9,11–14,18–26} The mortality rate of KPLA seemed to be decreasing in recent years in Taiwan because of increased physician awareness.^{2,22} However, concerns remain over the metastatic complications of KPLA,^{9,12,17–20,22} the long hospital stay,^{2,6,9,13,14} and the associated illness requiring critical care.²⁴ In addition, some patients experience major disability and poor long-term prognosis because of ocular or neurological complications arising from KPLA.¹⁷ As a result of the endemic features of KPLA in Taiwan, the associated utilization of healthcare resources is assumed to be substantial, but the economic burden of KPLA in Taiwan has never been determined.

In the current study, we aimed to investigate the clinical characteristics of KPLA and the associated economic consequence in a medical center in northern Taiwan in 2011 and 2012.

Methods

Study population

This retrospective cohort analysis was conducted at a 2900-bed tertiary medical center, Taipei Veterans General Hospital, from January 2011 to December 2012. In patients enrolled in this study, the diagnosis of KPLA was made by the presence of liver abscesses on abdominal ultrasonography or computed tomography, plus identification of the infectious organism isolated from liver pus or blood as *K. pneumoniae*. Patients younger than 20 years were excluded from the study. The study was approved by the

Institution Review Board of Taipei Veterans General Hospital.

Data collection

Patient medical records were reviewed by clinicians, and microbiological results of the liver abscess or blood were acquired from the Department of Microbiology in our hospital. Data on age, sex, underlying diseases, Charlson Comorbidity Index, clinical presentations, laboratory findings, Acute Physiology and Chronic Health Evaluation (APACHE) II scores within 48 hours after admission, origin and nature of the liver abscesses, radiological images, and patient management were collected. The unavailable parameters of APACHE II score were considered as within normal limits if there was no strong indication to measure within 48 hours after admission. The outcome measurements were: the requirement of intensive care on admission; the length of hospitalization; total expenditure related to KPLA, including emergency department costs; average daily hospital expenditure; and in-hospital mortality. A liver abscess of cryptogenic origin was defined as one in which no obvious extrahepatic source of infection could be identified and there was no underlying hepatobiliary disease.²¹ A liver abscess of biliary tract origin was defined when clinical features of cholecystitis/cholangitis or extrahepatic biliary ductal abnormalities on radiographic images were identified.²¹ Septic metastatic infection was defined as a distant site of infection with the same pathogen (*K. pneumoniae*) as in the pyogenic liver abscess. Definitive antibiotic therapy was defined as initial and continuous administration of antibiotics after susceptibility testing of cultures was available.²⁷ If the patient received various antibiotics after the culture results were available, the antibiotic with the longest duration of administration was considered as the definitive therapy. According to the policy of the Department of Infection Control in our hospital, amoxicillin-clavulanate, ampicillin-sulbactam, and first- or second- generation cephalosporins were defined as first-line antibiotics. Cephamycins, third- or fourth-generation cephalosporins, fluoroquinolones, tigecycline, piperacillin-tazobactam, colistin, and all carbapenems were defined as second-line antibiotics. The prolonged hospitalization was defined as hospital stays ≥ 21 days. The prolonged stay in the general ward was defined as being hospitalized in the general ward ≥ 21 days.

Cost data analysis

The total hospitalization expenditure of each episode of KPLA was assessed from the hospital's perspective as

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