Emphysematous Liver Abscesses Complicated by Septic Pulmonary Emboli in Patients with Diabetes: Two Cases

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Abstract

An emphysematous liver abscess is a fatal condition that often occurs in patients with uncontrolled diabetes mellitus. I herein describe two cases of Klebsiella pneumoniae-induced emphysematous liver abscesses complicated by septic pulmonary emboli in patients with poorly controlled diabetes mellitus. Both patients showed hemoglobin A1c levels of more than 10% and did not present with any abdominal symptoms on admission. However, they were diagnosed and successfully treated with percutaneous transhepatic abscess drainage and antibiotics. This fatal disease should be taken into consideration in patients with uncontrolled diabetes mellitus who suffer from prolonged fevers and uncharacteristic general malaise.

Key words: emphysematous liver abscess, gas-forming liver abscesses, septic pulmonary emboli, Klebsiella pneumoniae, string test, diabetes mellitus

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Introduction

Emphysematous liver abscesses are characterized by changes occurring inside the abscess or by the margin due to gas formation. According to previous reports, emphysematous liver abscesses often occur in patients with uncontrolled diabetes mellitus (DM) and cause complications in many cases (1, 2). The death rate has been reported to be approximately 30% (1, 3), which is higher than that of non-gas forming liver abscesses (4, 5). I herein describe two cases of emphysematous liver abscesses complicated by septic pulmonary emboli in patients with poorly controlled DM.

Case Reports

Case 1

A 58-year-old man presented to another hospital complaining of a 10-day history of general malaise. He had been diagnosed with DM approximately 20 years previously but had never received treatment. Systemic computed tomography (CT) showed a low-density area with an emphysematous change in the right lobe of the liver suggestive of a gas-forming liver abscess. The patient was subsequently transferred to our hospital for further investigation and treatment.

On arrival, the patient’s vital signs were as follows: heart rate, 112 beats/min; blood pressure, 88/51 mmHg; oxygen saturation on room air, 98%; respiratory rate, 28 breaths/min; and body temperature, 38.5°C. A physical examination revealed nothing remarkable. The patient’s laboratory tests revealed the following data: white blood cells (WBC), 31,000/mm³; C-reactive protein (CRP), 14.1 mg/dL; procalcitonin (PCT), >10 ng/mL; aspartate aminotransferase (AST), 164 IU/L; alanine aminotransferase (ALT), 145 IU/L; platelets (Plt), 1.1×10⁴ mm³; prothrombin time/interna- tional normalized ratio (PT-INR), 1.7; fibrin degradation product (FDP), 22.8 μg/mL; arterial lactate level, 3.0 mmol/L; serum glucose level, 417 mg/dL; and hemoglobin A1c (HbA1c) level, 11.4% (Table 1). Contrast-enhanced abdominal CT revealed a gas-producing multilocular abscess in the posterior segment of the right lobe (Figure A). Emphysematous cystitis was also found at the same time. Chest CT showed a pleural effusion and a wedge-shaped ground glass opacity (GGO) in the peripheral area of the left lower lobe.
glutamic acid decarboxylase (GAD) antibodies resulted in the patient being diagnosed with slowly progressive insulin-dependent diabetes mellitus (SPIDDM).

The antibiotic therapy was eventually changed to oral cefcape pivoxil (100 mg three times a day), and the patient was discharged on day 23. The antibiotic treatment was continued for 30 days, and no recurrence has been reported.

**Case 2**

A 61-year-old woman with a medical history of insulin-dependent type II DM complained of a week-long history of fever, chills and a slight headache. Her vital signs were as follows: heart rate, 95 beats/min; blood pressure, 125/62 mmHg; oxygen saturation on room air, 95%; body temperature, 38.9°C. The patient was conscious, and except for the headache, no other findings were detected on a physical examination.

A laboratory examination revealed the following data: WBC, 16,300/mm³; CRP, 37.8 mg/dL; PCT, >10 ng/mL; AST, 116 IU/L; ALT, 142 IU/L; Plt, 14.4 x 10⁴/mm³; PT-INR, 1.06; FDP, 37.3 μg/mL; arterial lactate level, 3.2 mmol/L; serum glucose level, 402 mg/dL; HbA1c level, 10.5%; and glycoalbumin 36.9% (Table 2). A cerebrospinal fluid (CSF) examination was performed to rule out the presence of any central nervous system infections. The CSF was cloudy. The antibiotic treatment was continued for 30 days, and no recurrence has been reported.

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### Table 1. Laboratory Examination of Case 1

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value (Unit)</th>
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<tbody>
<tr>
<td>WBC (10⁹/mm³)</td>
<td>31,000</td>
</tr>
<tr>
<td>Neutrophils (%)</td>
<td>98.3</td>
</tr>
<tr>
<td>Lymphocytes (%)</td>
<td>1.3</td>
</tr>
<tr>
<td>Monocytes (%)</td>
<td>0.3</td>
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<tr>
<td>Eosinophils (%)</td>
<td>0.1</td>
</tr>
<tr>
<td>Basophils (%)</td>
<td>0</td>
</tr>
<tr>
<td>Hemoglobin (g/dL)</td>
<td>12.8</td>
</tr>
<tr>
<td>Platelets (10⁹/mm³)</td>
<td>1.1 x 10⁹</td>
</tr>
<tr>
<td>LDH (IU/L)</td>
<td>350</td>
</tr>
<tr>
<td>AST (IU/L)</td>
<td>164</td>
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<tr>
<td>ALT (IU/L)</td>
<td>145</td>
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<tr>
<td>ALP (IU/L)</td>
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</tr>
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<td>γGTP (IU/L)</td>
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</tr>
<tr>
<td>ChE (IU/L)</td>
<td>78</td>
</tr>
<tr>
<td>T-bil (mg/dL)</td>
<td>1.5</td>
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<tr>
<td>BUN (mg/dL)</td>
<td>27.9</td>
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<td>HbA1c (%)</td>
<td>1.8</td>
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</table>

**Table 2. Laboratory Examination of Case 2**

<table>
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<th>Parameter</th>
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<tbody>
<tr>
<td>WBC (10⁹/mm³)</td>
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<tr>
<td>Neutrophils (%)</td>
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<tr>
<td>Lymphocytes (%)</td>
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<td>Monocytes (%)</td>
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<tr>
<td>Eosinophils (%)</td>
<td>0</td>
</tr>
<tr>
<td>Basophils (%)</td>
<td>0.3</td>
</tr>
<tr>
<td>Hemoglobin (g/dL)</td>
<td>12.3</td>
</tr>
<tr>
<td>Platelet (10⁹/mm³)</td>
<td>14.4 x 10⁹</td>
</tr>
</tbody>
</table>

LDH: lactate dehydrogenase; AST: aspartate aminotransferase; ALT: alanine aminotransferase; ALP: alkaline phosphatase; γGTP: γ-glutamyltransferase; ChE: cholinesterase; T-bil: total bilirubin; BUN: blood urea nitrogen; Cre: creatinine; TP: total protein; Alb: albumin; CRP: C-reactive protein; PCT: procalcitonin; HbA1C: hemoglobin A1C; PT-INR: prothrombin time/international normalized ratio; APTT: activated partial thromboplastin time; FDP: fibrin degradation product; RBC: red blood cells; HFF: high power field; WBC: white blood cells; Glucose: 402 mg/dL; HbA1c: 10.5%.

**Suggestive of septic emboli (Figure E).**

The patient was admitted to the intensive care unit (ICU) with diagnoses of severe sepsis, Disseminated intravascular coagulation (DIC) and septic pulmonary emboli caused by the emphysematous liver abscess. The Acute Physiology and Chronic Health Evaluation II (APACHE II) score was 19. Percutaneous transhepatic abscess drainage (PTAD) was performed at the bedside, and approximately 100 mL of the abscess was successfully aspirated. A Gram stain of the abscess showed many inflammatory cells and Gram-negative rods, and meropenem (1 g every 12 hours) was administered. *Klebsiella pneumoniae* was isolated from both the blood culture and the PTAD aspiration specimen. A string test using the colony of the organism was negative. After analyzing the results of antibiotic susceptibility tests, the antibiotic therapy was changed to cefmetazole (2 g every eight hours) on day 6 (Table 3). The PTAD tube was removed on day 16.

Glucose control was first accomplished using a continuous insulin infusion then through the use of intermittent therapy. During hospitalization, the detection of anti-
231 mg/dL, and the glucose level was 185 mg/dL. Gram staining revealed Gram-negative, rod-shaped bacteria, which were phagocytized by inflammatory cells. The patient was admitted to the ICU with a diagnosis of severe sepsis caused by meningitis, and meropenem (1 g every eight hours) and linezolid (600 mg every 12 hours) were empirically administered. The patient’s APACHE II score was calculated to be 14.

On day 2, Gram-negative rods were isolated from two sets of blood cultures. Both blood and CSF cultures yielded string tests positive for *K. pneumoniae*. On the basis of the results of antibiotic susceptibility testing, the antibiotics were changed to ceftriaxone (2 g every 12 hours) (Table 3).

The patient’s serum glucose level was controlled through the use of a continuous insulin infusion after admission, as in Case 1.

Although a follow-up CSF examination showed improvements (Table 4), the patient’s consciousness gradually deteriorated and the high inflammatory state persisted. Therefore, a systemic CT scan was performed on day 4 that showed a gas-producing abscess in the liver (Figure B) and many bilateral sporadic wedge-shaped GGOs, indicating the presence of septic pulmonary emboli originating from the liver abscess (Figure F). PTAD was performed on the gas-
producing abscess, and approximately 60 mL of the abscess was aspirated. The patient subsequently exhibited a good clinical course, and a follow-up CT examination revealed improvements in the condition of the septic emboli. Fundoscopy was not performed; however, the patient had no eye manifestations, and the presence of a brain abscess was ruled out using magnetic resonance imaging of the head.

**Discussion**

Primary liver abscesses caused by *K. pneumoniae* are characterized by the absence of any gastrointestinal disorders that may be the source of the liver abscess (6). This kind of disease has been widely reported in Southeast Asia, especially in Taiwan, and is known to cause septic pulmonary emboli, meningitis and endophthalmitis (7). Based on the patients’ clinical courses, these two cases can be categorized as this type of liver abscess.

Emphysematous liver abscesses, also known as gas-forming liver abscesses, constitute the other categorization of these cases. Emphysematous liver abscess is a rare disease that was first reported by Smith in 1944 (8) and accounts for 6.6-24% of all cases of liver abscess (2, 9-11). Previous reports have indicated that 76-85.5% of emphysematous liver abscesses occur in patients with uncontrolled DM (1, 2), and the common pathogens are *K. pneumoniae* and *Escherichia coli* (12, 13). Chang et al. reported that *K. pneumoniae* accounts for 82% of emphysematous liver abscesses (2). It is assumed that these facultative anaerobes can grow in anoxic environments by degrading glucose, especially under hyperglycemic conditions. During this process, carbon dioxide is produced and emphysematous liver abscesses are formed. Therefore, this condition is considered to be common in patients with especially poorly controlled DM.

The death rate is estimated to be 27.7-30.4% in cases of emphysematous liver abscess (1, 3), which is higher than that observed in cases of non-gas-forming liver abscesses (2-12%) (4, 5). This difference can be explained by the fact that patients with DM tend to contract emphysematous liver abscesses.

Another point of interest is the high frequency of complications. Both of our patients had DM, and the causative organism was same, *K. pneumonia*, in each case. In that sense, these two cases were relatively common. However, the complication of septic pulmonary emboli is worth noting. Chang et al. reported that 92% of emphysematous liver abscess cases involve complications, the most common being respiratory-related complications (61%) (2). Yang et al. reported that hepatocellular injury (ALT >100 IU/L) is seen in 57% of gas-forming and 19% of non-gas-forming liver abscesses (2). It is assumed that these facultative anaerobes can grow in anoxic environments by degrading glucose, especially under hyperglycemic conditions. During this process, carbon dioxide is produced and emphysematous liver abscesses are formed. Therefore, this condition is considered to be common in patients with especially poorly controlled DM.

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fore, performing appropriate drainage in the early stage of a patient’s clinical course is important.

The virulence factors of *K. pneumoniae* are reported to be rpmA (regulator of mucoid phenotype gene A), magA (mucoid-associated gene A), capsular serotype, lipopolysaccharide, hypermucoviscosity phenotype and so on (18-24). Strains with the hypermucoviscosity phenotype show extremely high viscosity, as demonstrated on string tests of colonies cultured in the laboratory. A positive string test is defined by the formation of viscous strings >5 mm long when a loop is used to stretch the colony on an agar plate (25).

A hypermucoviscosity strain often possesses rpmA (24), which is reported to be one of the risk factors for bloodstream infection caused by *K. pneumoniae* liver abscesses (6). In Case 2, although genetic testing was not performed, the string test was positive, and meningitis, a relatively common complication of primary liver abscesses caused by *K. pneumoniae*, was found. This fact may suggest that this simplified method of predicting the occurrence of complications should be utilized in daily practice. Genetic testing is expensive and cannot be performed everywhere. In contrast, string tests are an easy, inexpensive and available method.

Although abdominal tenderness usually occurs in patients with liver abscesses (4), the patients described in the present cases did not complain of any abdominal symptoms on admission. Instead, the chief complaints were general malaise with liver abscesses (4), the patients described in the present method.

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The authors state that they have no Conflict of Interest (COI).

**References**