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碩士學位論文

化膿性肝膿瘍病患須重症照護者其臨床結果和預後因子分析

Clinical outcome and prognostic factors of patients with pyogenic liver abscess requiring intensive care

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摘要

研究目的: 即使隨著醫療上對於診斷和治療的進步,化膿性肝膿瘍依然是個具有生命威脅性的疾病。本研究是去評估化膿性肝膿瘍病患須重症照護者,其臨床結果和預後因子的分析。

研究方法: 從 2001 年 1 月至 2005 年 12 月於 1700 床的大學教學醫院,以回溯性地病例分析化膿性肝膿瘍病患須住加護病房者的資料。其間共有 436 位成人病患(≧18 歲)被診斷為化膿性肝膿瘍,而其中有 72 位病患須住加護病房接受重症照護。

研究結果: 72 位病患中的 20 位於加護病房死亡,因此其加護病房死亡率為 28 %。病患最常見的潛伏疾病為糖尿病 (51%),最常見的致病菌種為克雷伯士氏肺炎桿菌 (74%)。和生存者比較,死亡者有較高的急性生理和慢性健康評估(APACHE) II 數值 (22.2±9 vs. 13.7±6, p<0.001), 較高的血中肌酸酐濃度 (2.9±2 vs. 1.9 ±2 mg/dl, p=0.02), 較常的凝血原時間 (21±5 vs. 16±5 s, p=0.01)於第一天的加護病房住院。除此之外,和死亡相關的因子包括不適當的抗生素治療 (p=0.026), 敗血性休克 (p=0.002), 急性呼吸衰竭 (p<0.001) 和急性腎衰竭 (p=0.043)於第一天的加護病房住院。經由多重因子邏輯回歸分析,可獨立的與死亡相關的因子是於第一天的加護病房住院出現急性呼吸衰竭 (p=0.003, relative risk = 18.7) 和 APACHE II 數值大於 16 (p=0.026, relative risk

= 7.43)。

研究結論：化膿性肝膿瘍病患須住加護病房者，其一些因子像是肝膿瘍的大小、致病菌種、併發症和大部分的實驗室數據都和死亡沒有相關。只有在第一天的加護病房住院出現急性呼吸衰竭和 APACHE II 數值大於16為明顯有意義的癒後因子。

Abstract

Objective: Despite improvements in diagnosis and treatment, pyogenic liver abscess (PLA) remains a life-threatening disease. This study is to evaluate clinical outcome and prognostic factors in PLA patients admitted to intensive care unit (ICU).

Design: Retrospective study.

Setting: Medical and surgical ICU in a 1700-bed university-based hospital.

Patients: Four hundred and thirty-six adult patients (≧18 ys) with the diagnosis of PLA were reviewed, and a total of 72 PLA patients requiring intensive care were enrolled.

Measurements and Main Results: Twenty of 72 enrolled patients died, yielding an ICU mortality rate of 28 %. The most common underlying disease was diabetes mellitus (51%), and the most common microorganism was Klebsiella pneumoniae (74%). Compared with survivors, nonsurvivors had higher Acute Physiology and Chronic Health Evaluation (APACHE) II score (22.2±9 vs. 13.7±6, p<0.001), higher serum creatinine (2.9±2 vs. 1.9±2 mg/dl, p=0.02), and longer prothrombin time (21±5 vs. 16±5 s, p=0.01) on the first day of ICU admission. In addition, factors associated with mortality included inadequate antibiotics treatment (p=0.026), septic shock (p=0.002), acute respiratory failure (p<0.001) and acute renal failure (p=0.043) on the

first day of ICU admission. On multivariate logistic regression analysis, factors that independently correlated with mortality were the presence of acute respiratory failure (p=0.003, relative risk = 18.7) and APACHE II score > 16 (p=0.026, relative risk = 7.43).

Conclusion: In patients with PLA requiring intensive care, variables including liver abscess size, pathogens, comorbidity and most laboratory data were not associated with mortality. Only the presence of acute respiratory failure and APACHE II score > 16 on the first day of ICU admission were significant prognostic factors.

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Introduction

1.1 Epidemiology of pyogenic liver abscess

The incidence of pyogenic liver abscess (PLA) is about 10 to 20 cases per 100,000 hospital admissions, or 11 cases per million persons per year [1-2]. In the past, most cases of PLA were a consequence of appendicitis complicated by pylephlebitis (portal vein inflammation) in a young patient. This presentation is less common today as a result of earlier diagnosis and effective antibiotic therapy. Most cases now are cryptogenic or occur in older men, with a peak incidence in the fifth and sixth decades of life, mirrors the prevalence in the population of biliary disease [3]. Infections of the biliary tract (e.g., cholangitis, cholecystitis) are the most common identifiable source of liver abscess. Infection may spread to the liver from the bile duct, along a penetrating vessel, or from an adjacent septic focus (including pylephlebitis). PLA may arise as a late complication of endoscopic sphincterotomy for bile duct stones or within 3 to 6 weeks of a surgical biliary–intestinal anastomosis [3]. PLA may complicate recurrent pyogenic cholangitis, which is found predominantly in East and Southeast Asia and is characterized by recurring episodes of cholangitis, intrahepatic stone formation, and, in many cases, biliary parasitic

infections. Less commonly, liver abscess is a complication of bacteremia arising from underlying abdominal disease, such as diverticulitis, perforated or penetrating peptic ulcer, gastrointestinal malignancy, inflammatory bowel disease, or peritonitis, or rarely from bacterial endocarditis or penetration of a foreign body through the wall of the colon. The risk of liver abscess and associated mortality rate may be increased in patients with cirrhosis [4]. Occasionally, a PLA may be the presentation of a hepatocellular or gallbladder carcinoma or a complication of chemoembolization or percutaneous ablation of a hepatic neoplasm [5].

1.2 Microbiology of pyogenic liver abscess

Most PLA are polymicrobial [6]. However, it is difficult to culture most microorganisms. Even in the preantibiotic era, a high rate of sterile cultures was seen, probably reflecting inadequate culture techniques. Despite these difficulties, abscess cultures are positive in 80% to 90% of cases. In terms of specific pathogens, the most frequently isolated organisms are *Escherichia coli* and *Klebsiella*. Enterococci and viridans streptococci are also common, primarily in polymicrobial abscesses. *Staphylococcus aureus*, by contrast, is more commonly associated with monomicrobial abscesses. The most commonly identified anaerobic species are

Bacteroides fragilis and *Fusobacterium necrophorum*. In rare pathogens of PLA, there were *Salmonella typhi*, *Clostridium*, *Actinomyces* species,*Yersinia enterocolitica*, *Pasteurella multocida*, *Haemophilus parainfluenzae*, and *Listeria* species. PAL caused by *Staphylococcus aureus* infection are most common in children and patients with septicemia or other conditions associated with impaired host resistance, including chronic granulomatous disease [7].

1.3 Prognostic factors for pyogenic liver abscess

Despite the advances of diagnostic modalities and the improvement of clinical care techniques, pyogenic liver abscess (PLA) is still a critical illness with high morbidity and mortality. Its clinical incidence ranges from 0.008 to 2.2 % in hospitalized patients, with a mortality of 6-14 % [8-11]. Concerning risks factors for mortality, there was still no general consensus; however, sepsis, shock, biliary origin, multiple abscesses, low hemoglobin level, and high concentration of blood urea nitrogen were ever reported as independent predictors [12-13].

Chou FF et al. reported that presence of sepsis and multiple organ failure were significant factors in predicting mortality. Local findings, such as rupture of the abscesses, multiple abscesses, and gas-forming abscesses, were not independent

factors [14]. Lee KT large abscess, diabetes mellitus and sepsis were significantly associated with hospital mortality. On multivariate logistic regression analysis, the presence of sepsis ($p = 0.0031$) was found to be an independent risk factor [12]. Alvarez Perez et al. found that prognostic variables for a complicated clinical course were the presence of shock, low hemoglobin level, elevated prothrombin time, and polymicrobial infection. Shock, distress, low hemoglobin level, increased creatinine, and positive blood culture were significant predictors of a complicated-related clinical course. Concerning mortality, a biliary origin, shock, multiple abscesses, low hemoglobin level, and high concentration of blood urea nitrogen were independent predictors [13]. Hsieh CB et al. reported that the Acute Physiology and Chronic Health Evaluation (APACHE) II score and the primary liver cancer history predict the in-hospital mortality of the PLA patient [15].

1.4 Pyogenic liver abscess and intensive care

Certainly, there were a variety of critical conditions of PLA patients requiring intensive care, including septic shock, acute respiratory distress syndrome (ARDS), disseminated intravascular coagulation (DIC), and abscess rupture [12-13]. However, there were no reported clinical data regarding the incidence of PLA requiring

treatment in an intensive care unit (ICU), the common PLA-related complications in ICU, and prognostic factors associated with PLA requiring intensive care.

1.5 The purpose of this study

In this study, we had the careful review of PLA patients admitted to ICU. The aim is to describe the characteristics of PLA patients requiring ICU care, to determine the clinical outcome in ICU admission, and to find the predictive factors for mortality.

Materials and Methods

2.1 Enrolled Patients

Adult patients (≧18 years) with PLA that were admitted to the medical and surgical ICU of a university-affiliated, 1,700-bed tertiary medical center in Taiwan, from January 2001 to December 2005, were retrospectively reviewed and analyzed. PLA was diagnosed if at least one of the following conditions was met: (1) liver abscess was found at surgery; (2) pus material was drained from image-guided percutaneous puncture; and (3) either abdominal ultrasound or computed tomography showed intrahepatic cavities, together with recovery of appropriate microorganisms from accompanying blood cultures and resolution of the lesion after antibiotic treatment. The patients with the following diagnoses were excluded: fungal abscess, parasite abscess, mycobacterium abscess and amebic abscess. Criteria for ICU admission utilized at this hospital were according to recommendations by the American College of Critical Care Medicine and Society of Critical Care Medicine [16]**.** During the five-year interval, there were 436 PLA patients admitted in our hospital. Of these, 72 critically-ill and septic patients (17 %) were enrolled in our series for further analysis. The enrolled 72 patients included 46 men (64 %) and 26

women (36 %), with the age ranged from 21 to 91 years (mean = 58.3 years). This study was approved by the Institutional Review Board of our hospital.

2. 2 Data Collection

We analyzed the following clinical and laboratory parameters: age, sex, body mass index, clinical features, Glasgow Coma Scale (GCS), underlying diseases, causes of admission, Acute Physiology and Chronic Health Evaluation (APACHE) II score [17], complete blood counts, biochemistry data, roentgenographic investigations including number and size of PLA, bacteriology, occurrence of complications, and duration of ICU stay and outcome. In terms of microorganism exams, all samples from blood and abscess cavity cultures were isolated and identified by standard aerobic and anaerobic diagnostic techniques. Clinically, all patients were treated by intravenous antibiotics after two sets of blood cultures. Before sensitive tests for bacteria were available, parenteral third-generation cephalosporin plus metronidazole were usually given empirically for critically-ill patients for 4 to 6 weeks. Unless there were contraindications, such as bleeding tendency, lack of cooperation or too small abscess size, all patients underwent percutaneous transhepatic drainage, using a 14 Fr pigtail catheter by the modified Seldinger technique. After the drainage, the abscess

was monitored with bedside ultrasound or computed tomography. Patients who failed to percutaneous drainage or who had complications of a biliary stone, rupture of abscess with peritonitis were indicated for surgical intervention.

Concerning complications, sepsis and septic shock were defined in accordance with the criteria of International Sepsis Definitions Conference [18]**.** Respiratory failure was defined as patients who required mechanical ventilation support by clinical physician judgments and disease progress. Acute respiratory distress syndrome (ARDS) was defined in accordance with to the Year in Review in Intensive Care Medicine. 2005. [19]**.** The criteria for Acute renal failure (ARF) were oliguria defined as urine output of less than 200 mL in 12 hours and/or marked azotemia defined as a blood urea nitrogen level higher than 84 mg/dL (>30 mmol/L) [20]. Septic metastatic infection was defined as other sites infection concomitant with PLA, including endophthalmitis, pulmonary abscess, meningitis, prostate abscess, pyogenic arthritis, and psoas abscess [21]. The criteria of Disseminated Intravascular Coagulation (DIC) were according to the guideline of the International Society on Thrombosis and Haemostasis (ISTH) [22].

2.3 Statistical Analysis

The data were compiled and analyzed by using a commercial statistical software (SPSS for Windows, version 10.0, Chicago, IL, USA). All continuous data are expressed as means ± standard deviation (SD) and compared using a two-tailed Student *t* test. Categorical variables are reported as a percentage and compared using chi-square or Fisher exact test, when appropriate. A multivariate stepwise logistic regression analysis is used to identify independently significant factors in predicting in-hospital mortality. A $p<0.05$ was considered statistically significant.

Results

3.1 Comorbidity and Clinical Symptoms

Among the enrolled 72 patients admitted to ICU, concomitant underlying diseases were frequently found at the time of admission and the most common was diabetes mellitus (n=37, 51%) followed by alcoholism (n=17, 24%), biliary stone (n=11, 15%), uremia (n=7, 10%), malignancy (n=5, 7%) and liver cirrhosis (n=2, 3%). The most common clinical features were fever with chills (n=46, 64%) and abdominal pain (n=12, 17%), besides, the other presenting symptoms included general malaise (n=5, 7%), nausea or vomiting (n=6, 8%), altered mental status (n= 4, 6%), jaundice (n=2, 3%) and diarrhea (n=1, 1 %) [Table 1]. The duration of symptom before admission ranged from 1 to 10 days with a mean of 4.3±5.0 days.

Further comparing the general characteristics between the survivors (n=52) and nonsurvivors (n=20), we found that there were no differences in gender, age, body mass index, duration of symptoms before admission, presenting symptoms and underlying diseases. Only Glasgow Coma Scale (GCS) and APACH II score of the first day ICU admission had statistical significance between the two groups ($p<0.05$),

as shown in Table 1 in detail.

3.2 Abscess Size, Bacteriology and Treatment

The size of abscess measured by computed tomography of abdomen ranged from 1 to 12 cm in diameter, with a mean of 5.2±3 cm. The majority of abscess was solitary, which was found in 49 of 72 patients (68.1%). Further analysis of bacteriology, aspirated pus cultures were obtained in 61 patients with a positive culture rate of 85.2% (52/61), and positive rate of blood culture was 70.8 % (51/72). Moreover, polymicrobial infections were found in 13.9 % of the positive cultures. *Klebsiella pneumoniae* (74 %) was the most common organism isolated either from blood culture or pus culture, followed by *Escherichia coli* (18 %), *Streptococcus spp.* (7 %), and *Enterococcus spp.* (5 %). In addition, only four patients were infected by anaerobes, including Bacteroide fragilis (n=2) and Fusobacterium (n=2).

In our series, therapeutic options for PLA included percutaneous drainage combined with antibiotics, surgery, and antibiotics only. Seven patients were treated with antibiotics alone and sixty-one (84%) patients initially received antibiotics treatment combined with percutaneous drainage, however, two patients subsequently failed and therefore underwent surgical intervention. Laparotomy was performed in 6

patients, including peritonitis caused by ruptured abscess (n=3), failure of percutaneous drainage (n=2), and abscess with hepatolithiasis (n=1). Further analysis of the above variables, we found that there was no statistical significance between the two groups. Table 2 showed the bacteriology and treatment in detail.

3.3 Complication, Mortality and Prognostic Factors

Among the enrolled 72 patients with PLA admitted to ICU, twenty patients died, yielding an ICU mortality rate of 28%, and an overall mortality rate of PLA about 4.6%. Almost all deaths were PLA related, except one patient died of acute myocardial infarction while treating abscess. Seventeen (85%) patients were died of septic shock and the remaining two (10%) patients were died of ARDS. Laboratory data of survivors and nonsurvivors on the first day of ICU admission both demonstrated leukocytosis, anemia, abnormal liver and renal function tests, markedly elevated C-reactive protein, hypoalbuminemia, and prolonged prothrombin time (PT). However, only serum creatinine concentration (1.9±2 vs. 2.9±2, $p<0.05$) and PT (16±5 vs. 21±5, $p<0.05$) were statistically significant between the two groups [Table 3].

The most common clinical course related complications of ICU admission were septic shock (n=40, 56 %), followed by acute renal failure (n=33, 46 %), DIC (n=26,

36 %) and acute respiratory failure (n=23, 21 %). Particularly, eight (11 %) patients developed metastatic infections, including endophthalmitis (n=4), meningitis (n=2), pulmonary septic emboli (n=1), and septic arthritis (n=1). The length of ICU stay ranged from 1 to 31 days (mean = 10±10 days) and total hospital stay ranged from 1 to 125 days (mean = 31±38 days). Further comparing these variables, as shown in Table 4, the existence of septic shock, acute renal failure, or respiratory failure were significantly lower in survivors than in nonsurvivors (p<0.05). Significant factors were also analyzed again by multiple logistic regression analysis [Table 5], and the results revealed that the presence of acute respiratory failure on the first ICU admission day and APACHE II score > 16 were the best independent predictors of prognosis. Especially, in patients with PLA requiring critical care, occurrence of acute renal failure in combination with acute respiratory failure reached mortality rate of 81 %. Occurrence of acute respiratory failure with APACHE II score > 16 reached mortality rate of 92 %.

Discussion

To our knowledge, this is the first retrospective study focusing on outcomes and predictors of mortality in patients with PLA requiring intensive care. Our study showed that 17 % of all PLA (72/436) were critically ill patients requiring intensive care and that yielded a mortality rate of 28 %. Moreover, the most common underlying disease was diabetes mellitus, and the most common isolated microorganism was *Klebsiella pneumoniae.* The occurrences of higher APACHE II score (>16) and presence of acute respiratory failure on the first day of ICU admission significantly increased the likelihood of mortality.

Although the general condition of enrolled patients was relatively critical in this series, the clinical features, age and gender distribution of PLA patients were similar to that of previous reports [12, 23-24]. The major presenting symptoms were fever, chills and abdominal pain, however, a few patients presented with only altered mental status, dizziness or general malaise. As reported by previous literature [12, 25-26], diabetes mellitus was also the most common underlying disease in our series, followed by alcoholism, biliary tract disease and malignancy. Surprisingly, rare study reported that alcoholism was one of the most common concomitant medical problems

in PLA [27].

Consistent with previous investigations [12-13, 25-27], *Klebsiella pneumoniae* was the most commonly isolated microorganism (74%) in this study. The unique characteristic of *Klebsiella pneumoniae* liver abscess was its potential for septic metastatic infection, which may present as endophthalmitis, pulmonary septic emboli, meningitis, or septic arthritis [21, 28]. In our series, two patients presented as fever, headache, and altered mental status without gastrointestinal symptoms were initially diagnosed as bacterial meningitis. However, blood cultures yielded *Klebsiella pneumoniae* three days later after admission, and then liver abscess was found by bedside ultrasound. Therefore, it is crucial to employ a diagnostic work-up for metastatic complications in PLA, especially in patients concomitant with diabetes mellitus [27] or bacterial culture yielding *Klebsiella pneumonia*. Interestingly, *Klebsiella pneumonia* liver abscess is a prominent pathogen in Taiwan and many studies had been reported its special characteristics. Wang JH et al. found that *Klebsiella pneumonia* related PLA had higher incidences of diabetes or glucose intolerance (75% vs. 4.5%) and metastatic infections (11.9% vs. 0) and lower rates of intra-abdominal abnormalities (0.6% vs. 95.5%), mortality (11.3% vs. 41%), and relapse (4.4% vs. 41%) compared with non- *Klebsiella pneumonia* group [29]. To investigate the frequency of hypermucoviscosity in bacteraemic isolates of *Klebsiella*

pneumonia, and to determine the significance of any association between HV and various clinical manifestations, Lee HC et al. found that the hypermucoviscosity phenotype of *Klebsiella pneumonia* bacteraemic isolates was associated with the development of a distinctive invasive syndrome [30]. To identify risk factors for spontaneous rupture of liver abscess caused by *Klebsiella pneumoniae*, one study reported that patients with spontaneous rupture of liver abscess were found to have significantly higher proportions of diabetic mellitus (100% versus 62.1%, P = 0.003), larger abscess size (mean of maximal diameter 7.8 versus 6.1 cm, P = 0.043), gas formation in abscess (87.5% versus 23.5%, P < 0.001), and left hepatic lobe involvement (50.0% versus 16.5%, P = 0.018). K. pneumoniae serotypes K1 and K2 were the predominant microorganisms isolated in both patients with non-rupture of liver abscess and spontaneous rupture of liver abscess. Pulsed-field gel electrophoresis-generated fingerprinting of *Klebsiella pneumoniae* isolates from patients with spontaneous rupture of liver abscess revealed that these pathogens were non-genetically related [31].

Reviewing the literature, the most common risk factors for PLA were malignancy, immunosuppression, diabetes, and previous biliary surgery or interventional endoscopy. Particularly in East Asia, diabetes mellitus is an important risk factor, but formal evidence is limited. Therefore Thomsen RW et al. conducted a case-control

study with participants drawn from the entire population of Denmark, which showed that Diabetes is a strong, potentially modifiable risk factor for PLA. PLA is associated with a similarly poor prognosis for patients with diabetes and for other patients [32]. In another study, Kaplan GG et al. reported that liver transplantation patients, diabetics, and patients with a history of malignancy were associated with significantly higher risk for developing a PLA [33]. Metastatic infection was also a special demonstration of PLA and most common metastatic infection organs included brain, lung, spleen, and eye. To identify the risk factors for developing extra-hepatic metastases from PLA, Chen SC et al. suggest that diabetes mellitus and alcoholism are significant risk factors for developing metastatic infections from pyogenic liver abscesses [27]. In the aspect of PLA associated septic endophthalmitis, one study concluded that physicians should be alert to the development of endogenous *Klebsiella pneumoniae* endophthalmitis when patients with diabetes along with *Klebsiella pneumoniae* –induced PLA complain of ocular symptoms. In the majority of patients with endogenous *Klebsiella pneumoniae* endophthalmitis associated with PLA, visual outcome is generally poor despite aggressive antibiotic therapy. Early diagnosis and prompt intervention with intravitreal antibiotics within 48 hours may salvage useful vision in some patients with endogenous *Klebsiella pneumoniae* endophthalmitis [34].

Recently the introduction and refinement of percutaneous drainage techniques have dramatically improved the treatment success rate [10, 12], however, it seemed not to influence the outcome of critically ill patients with PLA in our study. Probably most patients in our series were in severe sepsis, so that the treatment should not only focus on a local inflammation or infection but should also regulate a systemic complex immunologic reaction [35].

As shown in Tables 1, 3, 4 in our series, variables on the first day of ICU admission, including high APACHE II score, high serum creatinine level, prolonged prothrombin time and low GCS score, occurrence of septic shock, acute renal failure, and acute respiratory failure were identified as significant risk factors for mortality. Based on the multivariate analysis, we only identified presence of acute respiratory failure requiring mechanical ventilation and the level of APACHE II score > 16 as the most significant risk factors for predicting mortality. The results were quite different from previous literature [12-13, 25-26], which demonstrated that septic shock was the most important risk factors. From our point of view, there were two reasons which could explain why septic shock was not the most significant risk factors but acute respiratory failure was in our study. First, even survivors of PLA in our study had a high incidence of septic shock. Second, based on the improvement of critical care in management of severe sepsis, some of acute respiratory failure in severe sepsis

patients was averted by early goal-directed resuscitation [36]. As a consequence, severe sepsis patients who did not progress to acute respiratory failure by aggressively intensive care had a significantly excellent outcome. The changes perhaps indicated that an integrated systemic and intensive management would alter the parameters of risk factors. Certainly our results and explanations need further larger series studies to confirm our results in the future [12-13, 25-27].

APACHE II score had been useful for predicting outcome of ICU admissions in many investigations [37]. However, rare studies reported that it was an independent risk factor for predicting mortality of PLA patients [38]. It was possible that most PLA patients were not in ICU setting, so the data of APACHE II was lacking. Another remarkable finding of the present study was that the overall mortality rate (4.6 %) was lower than previous reports [8-13, 39], which may reflect the improvement of intensive care before organ failure and uncontrolled sepsis.

In conclusion, the mortality rate in patients with PLA requiring intensive care was still high. *Klebsiella pneumoniae* was the most commonly isolated causative microorganism and associated septic metastatic infection might occur. Variables including liver abscess size, pathogens, comorbidity and most laboratory data were not associated with mortality. Only the presence of acute respiratory failure and APACHE II score > 16 on the first day of ICU admission were the independent

significant prognostic factors in PLA patient admitted to the ICU.

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Table 1. Clinical Features of Patients with Pyogenic Liver Abscess Admitted to the ICU

Clinical feature	Survivors (n=52)	Nonsurvivors (n=20)	*p* value
Age	55.8±16	64.6±17	0.06
Male (n [%])	34 (65)	12 (60)	0.43
Body mass index (kg/m^2)	24.6±4	25.4±3	0.51
GCS ≦ 7 (n [%])	7 (14)	7 (35)	0.03
APACHE II score	13.7±6	22.2±9	<0.001
Onset of symptoms (d)	4.7±5	3.4±3	0.33
Directly admitted to ICU	33 (64)	12 (60)	0.79
Transferred lately in ICU	19 (36)	8 (40)	0.68
Major symptoms			
Fever	32 (62)	14 (70)	0.50
Abdominal pain	9 (17)	3 (15)	0.81
Underlying disease			
Diabetes mellitus	24 (46)	13 (65)	0.15
Biliary stone	9 (17)	2 (10)	0.48
Alcoholism	11 (21)	6 (30)	0.43
Malignancy	3 (6)	2 (10)	0.53

Note: GCS= Glasgow Coma Scale

APACHE= Acute Physiology and Chronic Health Evaluation

Onset of symptoms mean the duration (days) from onset of symptoms to admission

Age, Body mass index, and APACHE II score were expressed as mean ± SD

All other data were expressed as numbers (percentages)

Table 2. Features of Liver Abscess, Bacteriology, and Treatment of Patients with Pyogenic Liver Abscess Admitted to the ICU

Variable	Survivors (n=52)	Nonsurvivors (n=20)	p value
Abscess size (cm)	5.2±3	4.9±3	0.74
Solitary abscess	36 (69)	13 (65)	0.73
Abscess location			
Right / Left / Bil	38 / 10 / 4	15 / 3 / 2	0.89
Biliary origin	12 (23)	5 (25)	0.76
cryptogenic origin	14 (27)	6 (30)	0.61
Main pathogens			
K. pneumoniae	41 (79)	12 (60)	0.10
E. coli	8 (15)	5 (25)	0.34
Streptococcus spp.	4 (8)	1 (5)	0.69
Enterococcus spp.	2 (4)	1 (5)	0.83
Polymicrobial	8 (15)	2 (10)	0.55
Positive Blood culture	36 (69)	15 (75)	0.63
Positive Pus culture	42/49 (85)	10 /16 (63)	0.11
Treatment			
Drainage & Antibiotics	44 (85)	15 (75)	0.17
Surgery	5 (10)	1 (5)	0.09
Antibiotics only	3 (6)	4 (20)	0.13
Inadequate antibiotics	2 (4)	4 (20)	0.026

Note: data were expressed as numbers (percentages)

Table 3. Laboratory Data of Patients with Pyogenic Liver Abscess on the First Day of ICU Admission

Variable	Survivors (n=52)	Nonsurvivors (n=20)	*p* value
WBC count (10^3/per mm^3)	16.5±18	16.4±14	0.99
Hemoglobin	11.3±2	10.4±3	0.17
Platelet (10^3/per mm^3)	202±175	196±133	0.89
Alk-p (IU/l)	182±134	168±105	0.75
AST (IU/l)	127±176	562±1571	0.28
ALT (IU/l)	105±144	234±468	0.09
Total bilirubin (mg/dl)	2.5±2	2.6±2	0.89
C-reactive protein	25.8±10	23.8±9	0.61
BUN (mg/dl)	32±22	38±19	0.29
Creatinine (mg/dl)	1.9±2	2.9±2	0.02
Albumin (g/dl)	2.2±0.6	1.9±0.5	0.11
Prothrombin time (s)	16±5	21±5	0.01

Note: WBC= white blood cell Alk-p= alkaline phosphatase
AST= aspartate aminotransferase BUN=blood urea nitrogen
ALT=alanine aminotransferase
Data were expressed as mean ± standard deviation

Table 4. Complication and Outcome of Patients with Pyogenic Liver Abscess Admitted to ICU

Variable	Survivors (n=52)	Nonsurvivors (n=20)	*p* value
Complications			
Septic shock	23 (44)	17 (85)	0.002
Renal failure	20 (39)	13 (65)	0.043
Respiratory failure	11 (21)	12 (60)	<0.001
DIC	18 (35)	8 (40)	0.67
ARDS	2 (4)	2 (10)	0.31
Metastatic infection	5 (10)	3 (15)	0.52
Abscess rupture	2 (4)	1 (5)	0.48
Thoracic empyema	3 (6)	1 (5)	0.89
Admission stay			
Hospital stay, (days)	30±17	34±68	0.64
ICU stay, (days)	10±10	10±11	0.89

DIC= disseminated intravascular coagulation

ARDS= acute respiratory distress syndrome ICU= intensive care unit

Data were expressed as numbers (percentages)

Hospital stay and ICU stay were expressed as mean ± SD

Table 5. Multiple Logistic Regression Analysis of Prognostic Factors for 72 Patients with Pyogenic Liver Abscess Admitted in ICU

Factors	Comparison	Relative risk (95% CI)	*p* value
Septic Shock	yes vs. no	0.21 (0.02~2.2)	0.194
Acute Respiratory failure	yes vs. no	18.7 (2.7~125.2)	0.003
Acute Renal failure	yes vs. no	1.44 (0.27~7.69)	0.667
APACHE II	>16 vs. ≦ 16	7.43 (1.27~43.4)	0.026

Note: APACHE = Acute Physiology and Chronic Health Evaluation