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ORIGINAL RESEARCH

Clinical Characteristics and Risk Factors for Blood Culture-Positive Klebsiella pneumoniae Liver Abscess: A Retrospective Study

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Background: Positive blood cultures for Klebsiella pneumoniae liver abscess (KPLA) are associated with an increased risk of extrahepatic organ infections and severe complications such as septicemia and septic shock, leading to higher mortality rates. This study aimed to investigate the clinical characteristics of patients with blood culture-positive KPLA and identify potential predictive indicators.

Methods: We performed a retrospective analysis of clinical data from 263 KPLA patients diagnosed at our hospital between January 2019 and December 2023. The objective was to compare clinical characteristics between patients with positive and negative blood cultures and explore factors influencing blood culture positivity. Patients were divided into a blood culture-positive group (study group) and a blood culture-negative group (control group). We compared baseline characteristics, laboratory parameters, ultrasound findings, and complications. Logistic regression identified risk factors, and receiver operating characteristic (ROC) curves assessed the predictive value of inflammatory markers.

Results: The study group exhibited higher ICU admission rates, longer hospital stays, and elevated qSOFA scores (≥2, 15.1 vs 2.6, P=0.003) along with a greater prevalence of diabetes and biliary diseases. Key laboratory values, including glucose, creatinine, procalcitonin (PCT), and C-reactive protein (CRP), were significantly higher, while albumin and platelet levels were lower ($P < 0.05$). Complications such as pleural effusion (35.1 vs 12.8, P<0.001), ascites (15.1 vs 2.6, P=0.003), pulmonary infections (27.6 vs 7.7, P<0.001), and extrahepatic abscesses (15.7 vs 5.1, P=0.018) were notably more common. Diabetes was identified as an independent risk factor for blood culture-positive KPLA. Among inflammatory markers, PCT showed the highest predictive value for blood culture positivity (AUC=0.683; cutoff=4.97 ng/mL; sensitivity=70.3%; specificity=62.8%).

Conclusion: Patients with underlying diabetes mellitus are more prone to developing blood culture-positive KPLA. PCT demonstrates better predictive performance for blood culture-positive KPLA, and patients with PCT levels ≥4.97 ng/mL have a higher likelihood of positive blood culture results.

Keywords: blood culture positivity, Klebsiella pneumoniae, hepatic abscess, clinical features, risk factors

Liver abscesses (LA) can be classified as bacterial, protozoan (amoebic), or fungal. Bacterial liver abscesses (BLA) are most commonly caused by Escherichia coli, Klebsiella spp, Streptococcus anginosus group, Staphylococcus aureus, and anaerobes. Amebic liver abscesses (ALA) are primarily associated with Entamoeba histolytica, which is linked to extra-intestinal amebiasis. Fungal infections are a relatively rare cause of liver abscesses.[1] Klebsiella pneumoniae (KP) has recently emerged as the predominant pathogen responsible for BLA in Wenzhou, Zhejiang, China.[2,3] Bloodstream infections (BSI) are a common complication among BLA patients, significantly impacting disease progression and prognosis.[4] The dissemination of bacteria through the bloodstream not only increases the risk of infections in extra-hepatic organs but may also lead to severe complications such as septicemia and septic shock, further complicating the condition and significantly elevating mortality rates.[5] Sepsis is a life-threatening organ dysfunction resulting from a

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dysregulated host response to infection. It fundamentally represents an uncontrolled systemic inflammatory response triggered by infection, leading to multiple organ failure and potentially death. The impact of sepsis is not only reflected in its high mortality rate but also in the extensive damage it inflicts on various organ systems and the long-term sequelae that may follow. Sepsis is a complex condition characterized by diverse pathogens, making early identification challenging. Treatment primarily relies on empirical medication, and the therapeutic efficacy remains to be improved. Additionally, substantial individual variability among patients—such as age, underlying health conditions, organ function status, site of infection, and immune status also significantly affects the effectiveness of anti-infective treatments.

BSI caused by LA are a specific clinical condition. Currently, there is a lack of sufficient predictive indicators for the occurrence of bloodstream infections associated with Klebsiella pneumoniae liver abscess (KPLA). Although predictive models for bloodstream infections in KPLA have been developed, their accuracy requires further enhancement. We aim to predict bloodstream infections in KPLA by identifying independent risk factors for blood culture positivity and evaluating inflammatory markers. Invasive Klebsiella Syndrome (IKS) is a severe multi-site infection typically caused by hypervirulent Klebsiella pneumoniae, which can lead to multi-organ infections. Complications associated with KPLA include liver abscess, lung infections, endophthalmitis, meningitis, splenic abscesses and bloodstream infections. Therefore, it is critically important to actively prevent and control the occurrence of bloodstream infections in patients with KPLA. This study selected 263 KPLA patients diagnosed and treated at our hospital from January 2019 to December 2023, aiming to explore the clinical characteristics, incidence of bloodstream infections, and associated risk factors in KPLA patients. The findings of this research are reported in detail below, providing a scientific basis for clinical prevention and treatment strategies.

Materials and Methods

Among patients with liver abscess hospitalized and treated in the Emergency Department, Hepatobiliary Surgery Department, and Infectious Diseases Department of our hospital, we identified 532 cases of KPLA diagnosed and treated between January 2019 and December 2023. After a rigorous review of data completeness, cases with incomplete data, prior antibiotic treatment, or mixed infections were excluded. Ultimately, 263 patients were included in this study, comprising 182 males and 81 females. Based on the results of blood cultures and drainage fluid bacterial cultures, 186 patients with positive blood cultures were categorized as the study group, while 77 patients with negative blood cultures but positive drainage fluid cultures were categorized as the control group. All patients received standard antibiotic therapy, initially using third-generation cephalosporins for empirical infection treatment. After the blood culture results were reported, appropriate antibiotics were selected based on the sensitivity profile. The duration of therapy was determined by the reduction in the size of the patient's abscess. In addition, ultrasound-guided abscess drainage was performed as needed, along with other necessary symptomatic and supportive treatments. The inclusion criteria for this study were as follows: (1) patients exhibiting typical symptoms such as fever and abdominal pain, with a definitive diagnosis of liver abscess confirmed by imaging studies; (2) patients in the study group who tested positive for Klebsiella pneumoniae in blood cultures; (3) The bacterial culture results of abscess fluid in the control group were confirmed to be positive for Klebsiella pneumoniae but blood culture negative. The exclusion criteria included: (1) patients with bacterial culture results indicating infections by special pathogens such as fungi or Mycobacterium tuberculosis; (2) patients with mixed bacterial infections; (3) The patient's clinical treatment data is incomplete. A detailed flowchart is illustrated in Figure 1. This study is a retrospective study, and all patients' personal information has been anonymized. This study complies with the Declaration of Helsinki. This study was approved by the Ethics Committee of the First Affiliated Hospital of Wenzhou Medical University (Ethics Approval Number: KY2024-R254). The study was conducted after obtaining approval from the Ethics Committee for a waiver of written informed consent.

Methods

We systematically collected and organized a series of key information regarding the patients through the hospital's electronic medical record system. This information encompassed the patients' demographic data, including general information; hematological test results, comprising complete blood counts and biochemical parameters; inflammatory markers, specifically the results of C-reactive protein (CRP) and procalcitonin (PCT) assays; bacterial culture results;

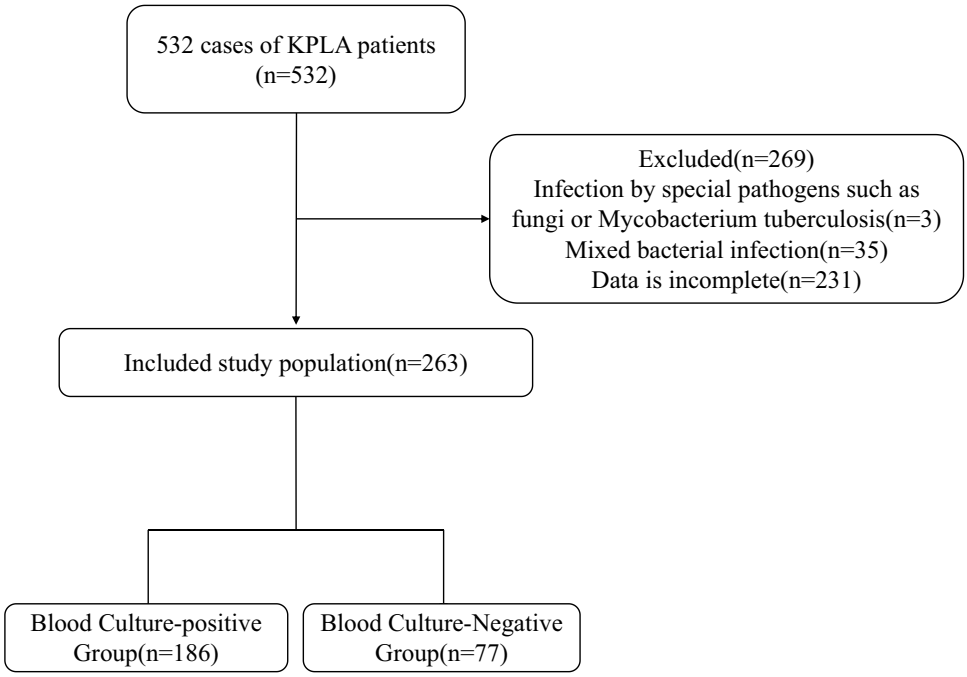

Figure 1 Flowchart of patient enrollment.

imaging data; patients' symptoms and signs, The qSOFA (Quick Sequential Organ Failure Assessment) score upon admission (1 point for altered mental status; 1 point for systolic blood pressure ≤100 mmHg; 1 point for respiratory rate ≥22 breaths per minute), comorbid conditions, and baseline disease information.

Statistical Analysis

This study employed SPSS 29 statistical software for comprehensive data analysis and processing. For continuous variables, data following a normal distribution were presented as mean ± standard deviation ($\bar{x} \pm s$) and compared using the *t*-test to assess differences. For data not following a normal distribution, the results were expressed as median and interquartile range M (Q25, Q75), and differences were evaluated using the Mann–Whitney *U*-test; categorical data were expressed as percentages (%) and analyzed using the χ^2 (chi-squared) test to evaluate significance. The core of the research focuses on comparing the clinical characteristics of patients with KPLA who tested positive versus those who tested negative in blood cultures. Based on this comparison, we conducted an in-depth analysis of the factors associated with KPLA in patients with positive blood cultures. Additionally, we utilized a logistic regression model to identify independent risk factors that contribute to the occurrence of KPLA with positive blood cultures. A p-value of less than 0.05 was considered statistically significant. To more intuitively evaluate the predictive performance of various inflammatory markers, receiver operating characteristic (ROC) curves were plotted. Additionally, a combined parameter (PC) was calculated using the formula: PC = 0.326 + PCT × 0.015 + CRP × 0.001. A comprehensive assessment of the predictive value of each marker was conducted.

Results

About 70.34% of the total patient population had positive blood culture results. The durations of ICU stay and hospitalization, qSOFA score (≥2), and the presence of underlying conditions such as diabetes and biliary system diseases were significantly higher in the study group compared to the control group (P<0.05) (Table 1).

The levels of glucose, creatinine, PCT, and CRP were significantly higher in the study group compared to the control group, while albumin and platelet levels were significantly lower (P<0.05) (Table 2).

The incidences of pleural effusion, ascites, pulmonary infection, and extrahepatic abscess were significantly higher in the study group compared to the control group (P<0.05) (Table 3). There was a statistically significant difference between

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Table 1 General Characteristics and ICU Admission Status of Two Groups of KPLA Patients

Item		Blood Culture-Negative Group n=77	Blood Culture-Positive Group n=186	t/χ^2	P
Gender	Male	55(70.5)	127(68.6)	0.089	0.765
	Female	23(29.5)	58(31.4)		
ICU Admission		9(11.5)	55(29.7)	9.861	0.002
Length of Hospital Stay (days)		12.91(8.35,18.2)	15.88(11.74,21.87)	−3.169	0.002
Age (years)		57.09±14.89	60.22±14.57	−1.582	0.115
Maximum Temperature After Admission (≥39°C)		41(52.6)	115(62.2)	2.095	0.148
qSOFA Score (≥2)		2(2.6)	28(15.1)	8.580	0.003
Diabetes Mellitus		38(48.7)	127(68.6)	9.323	0.002
Biliary System Diseases		12(15.4)	54(29.2)	5.562	0.018
Malignant Tumors		6(7.7)	10(5.4)	0.502	0.479
Liver Diseases		9(11.5)	27(14.6)	0.434	0.510
Hypertension		19(24.4)	52(28.1)	0.391	0.532
Outcome (Mortality Rate)		0(0)	8(4.3)	3.479	0.062

Table 2 Laboratory Parameters of Two Groups of KPLA Patients

Item	Blood Culture-Negative Group n=77	Blood Culture-Positive Group n=186	t/Z	P
White Blood Cell Count (×10^9/L)	12.27(9.50,15.63)	12.96(9.41,17.90)	−0.913	0.361
Glucose (mmol/L)	8.6(7.15,15.25)	11.3(7.4,18.83)	−2.423	0.015
Total Bilirubin (umol/L)	14(9.5,21.5)	17(11,29)	−1.833	0.067
Albumin (g/L)	30.62±5.77	28.49±5.02	3.007	0.003
Hemoglobin (g/L)	125(112.5,135.5)	125(108.8,140)	−0.245	0.806
Neutrophil Count (×10^9/L)	10.23(7.28,13.72)	11.56(8.37,15.80)	1.489	0.136
Alanine Aminotransferase (U/L)	61(38,99)	68(37,117.5)	−0.659	0.51
Creatinine (umol/L)	70(53.5,93.5)	82(62,111)	−2.411	0.016
Sodium (mmol/L)	135(132,137)	135(129.8,137.3)	−0.672	0.502
Platelet Count (×10^9/L)	219(142,313.5)	145.5(96.8,228.5)	−4.341	<0.001
C-Reactive Protein (mg/L)	163.5(121.5,222.2)	186.7(124.6,276.9)	−2.064	0.039
Procalcitonin (ng/mL)	2.4(0.64,18.65)	14.65(3.9,63.03)	−4.692	<0.001
ESBL(+)	0(0)	4(2.2)	0.022	0.882

the study group and the control group in the proportion of liver abscesses with a size ≤5 cm or the proportion of cases with ≥2 abscesses (P<0.05) (Table 4).

Using blood culture results as the dependent variable (positive = 1, negative = 0), a logistic regression analysis was conducted incorporating 16 variables that demonstrated statistical significance between the two groups. These variables included ICU admission status (yes), length of hospitalization, presence of biliary system diseases (yes), diabetes (yes), pleural effusion (yes), ascites (yes), pulmonary infection (yes), extrahepatic abscess (yes), albumin levels, serum creatinine, PCT, CRP, platelet level, qSOFA score ≥2, liver abscess size ≤5 cm, and the presence of ≥2 abscesses. The results indicated that the presence of underlying diabetes was identified as an independent risk factor for positive blood cultures in KPLA cases (Table 5).

The ROC curves were constructed for PCT, CRP, and the PCT and CRP (PC). The results indicated that the area under the curve (AUC) for PCT was 0.683, with a 95% CI of 0.610–0.756. The cutoff value was 4.97, with a sensitivity of 0.703 and a specificity of 0.628. For CRP, the AUC was 0.581, 95% CI (0.507–0.654), with a cutoff value of 173.90, sensitivity of 0.595, and specificity of 0.628. The PCT and CRP (PC) showed an AUC of 0.673, 95% CI (0.602–0.745), with a cutoff

Table 3 Complication Profiles in Two Groups of KPLA Patients

Item	Blood Culture-Negative Group n=77	Blood Culture-positive Group n=186	t/χ^2	P
Pleural Effusion	10(12.8)	65(35.1)	13.402	<0.001
Ascites	2(2.6)	28(15.1)	8.580	0.003
Pulmonary Infection	6(7.7)	51(27.6)	12.767	<0.001
Endophthalmitis	1(1.3)	4(2.2)	0.233	0.629
Extrahepatic Abscess	4(5.1)	29(15.7)	5.536	0.018

Table 4 The Conditions of KPLA Abscesses in Two Groups

Item		Blood Culture-Negative Group n=77	Blood Culture-positive Group n=186	t/χ^2	P
Liver Abscess ≤ 5 cm		16(20.5)	65(35.1)	5.504	0.019
5 cm < Liver Abscess < 10 cm		53(68.0)	103(55.7)	5.034	0.025
Liver Abscess ≥ 10 cm		9(11.5)	17(9.2)	0.340	0.560
Number of Abscesses ≥ 2		9(11.5)	45(24.3)	5.497	0.019
Abscess Location	Right Liver	47(60.3)	125(67.6)	1.370	0.504
	Left Liver	26(33.3)	49(26.5)		
	Both Left and Right Liver	5(6.4)	11(5.9)		

Table 5 Logistic Regression Analysis of Factors Influencing Blood Culture Positivity in Patients with KPLA

Item	B	Wald	P	OR Value	95% Confidence Interval	
					Lower Limit	Upper Limit
Length of Hospital Stay (days)	0.032	2.166	0.141	1.032	0.989	1.077
Admission to ICU (Yes)	0.444	0.808	0.369	1.558	0.592	4.099
Diabetes (Yes)	−0.728	4.65	0.031	0.483	0.249	0.936
Gallbladder Disease (Yes)	−0.643	2.572	0.109	0.526	0.24	1.153
Pleural Effusion (Yes)	−0.821	3.335	0.068	0.44	0.182	1.062
Ascites (Yes)	−0.876	1.067	0.302	0.416	0.079	2.196
Pulmonary Infection (Yes)	−0.471	0.794	0.373	0.625	0.222	1.759
Extrahepatic Abscess (Yes)	−0.703	1.118	0.29	0.495	0.134	1.823
Albumin (g/L)	−0.024	0.584	0.445	0.976	0.917	1.039
Creatinine (umol/L)	0.003	0.476	0.49	1.003	0.995	1.011
Procalcitonin (ng/mL)	0.006	0.815	0.367	1.006	0.993	1.018
Platelet Count (×10^9/L)	−0.002	2.978	0.084	0.998	0.995	1
C-Reactive Protein (mg/L)	0.001	0.133	0.716	1.001	0.997	1.005
Abscess Size ≤ 5 cm	0.6	2.434	0.119	1.821	0.858	3.868
Number of Abscesses ≥ 2	0.583	1.62	0.203	1.791	0.73	4.392
qSOFA Score ≥ 2	0.837	1.007	0.316	2.308	0.451	11.827

value of 0.68, sensitivity of 0.686, and specificity of 0.654. The predictive efficacy of PCT for positive blood cultures in KPLA was slightly superior to that of CRP and the combined indicator (Tables 6 and 7, Figure 2). Patients with KPLA and PCT levels ≥4.97 ng/mL were more likely to have positive blood cultures (Tables 6 and 7, Figure 2). Using stratified interaction analysis to validate the effectiveness of PCT in different population subgroups, the P for interaction values were all>0.05, indicating that there is no difference in the predictive ability of PCT among different subgroups.(Table 8)

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Table 6 ROC Analysis of Inflammatory Markers Affecting Blood Culture Positivity in Patients with KPLA

Indicator Name	Area	95% Confidence Interval		Cutoff Value	Youden Index	Sensitivity	Specificity
		Lower	Upper				
C-reactive Protein	0.581	0.507	0.654	173.90	0.223	0.595	0.628
Procalcitonin	0.683	0.61	0.756	4.97	0.331	0.703	0.628
CRP and PCT (CP)	0.673	0.602	0.745	0.68	0.340	0.686	0.654

Table 7 Comparison Table of ROC Curves for Inflammatory Markers Influencing Blood Culture Positivity in Patients with KPLA

Comparison	z	P-value
C-reactive Protein vs Procalcitonin	−2.433	0.015
C-reactive Protein vs CRP and PCT (CP)	−2.068	0.039
Procalcitonin vs CRP and PCT (CP)	2.463	0.014

Discussion

In recent decades, there has been a continuous rise in the incidence of PLA, attributed to the increasing prevalence of diabetes, tumors, and immunological diseases, alongside an extension of human lifespan. In China, which is a region with a high incidence of PLA, the growth of its occurrence has been particularly noteworthy.[6–8] Recent domestic studies have indicated that a major pathogen responsible for bacterial liver abscesses is Klebsiella pneumoniae,[9,10] highlighting the significant role of Klebsiella pneumoniae in cases of liver abscesses in China. Additionally, the results of pathogen detection in our hospital over recent years have predominantly pointed towards this organism.

The etiology of liver abscesses is complex and multifaceted, with intricate connections to the systemic circulatory system, the portal venous system, and retrograde infections of the biliary tract. Liver abscesses can be classified as bacterial, protozoan (amoebic), or fungal. Bacterial liver abscesses (BLA) are most commonly caused by Escherichia coli, Klebsiella spp, Streptococcus anginosus group, Staphylococcus aureus, and anaerobes. Hypervirulent strains of K. pneumoniae are also associated with liver abscess, while other manifestations include pneumonia, endophthalmitis, meningitis and necrotizing fasciitis.[11] Cases of liver abscesses with unclear sources of infection and transmission pathways pose additional challenges for clinical diagnosis and treatment.[12] Fortunately, advancements in clinical imaging diagnostic techniques, improvements in treatment modalities, and the widespread use of antimicrobial agents have significantly reduced the incidence of complications and mortality rates among patients with liver abscesses (PLA).[13] However, in patients with bloodstream infections related to liver abscesses, the release of large amounts of toxins during pathogen proliferation can trigger intense immune responses and systemic inflammatory responses, leading to local tissue damage and systemic dysfunction. This excessive immune response, while beneficial for the clearance of pathogens, may also trigger a cytokine storm, resulting in systemic multi-organ damage and potentially leading to severe complications such as sepsis or septic shock. Furthermore, the immune system may exhibit an exaggerated response while combating pathogens, which can exacerbate systemic symptoms and complicate treatment efforts.

This study reveals that the population of patients with KPLA primarily consists of middle-aged and elderly males, often accompanied by underlying health conditions such as diabetes, biliary diseases, liver disease, hypertension, and malignancies. This finding aligns with descriptions in previous literature.[14,15] However, when exploring whether these underlying conditions increase the risk of bloodstream infections, We found that factors such as hypertension and malignancies did not demonstrate statistically significant differences ($P > 0.05$). However, patients with underlying biliary system diseases or diabetes were more prone to bloodstream infections. This finding differs from the results of previous research conducted by Li et al.[16] This study found that patients with underlying biliary system diseases or diabetes, particularly those with chronically elevated blood

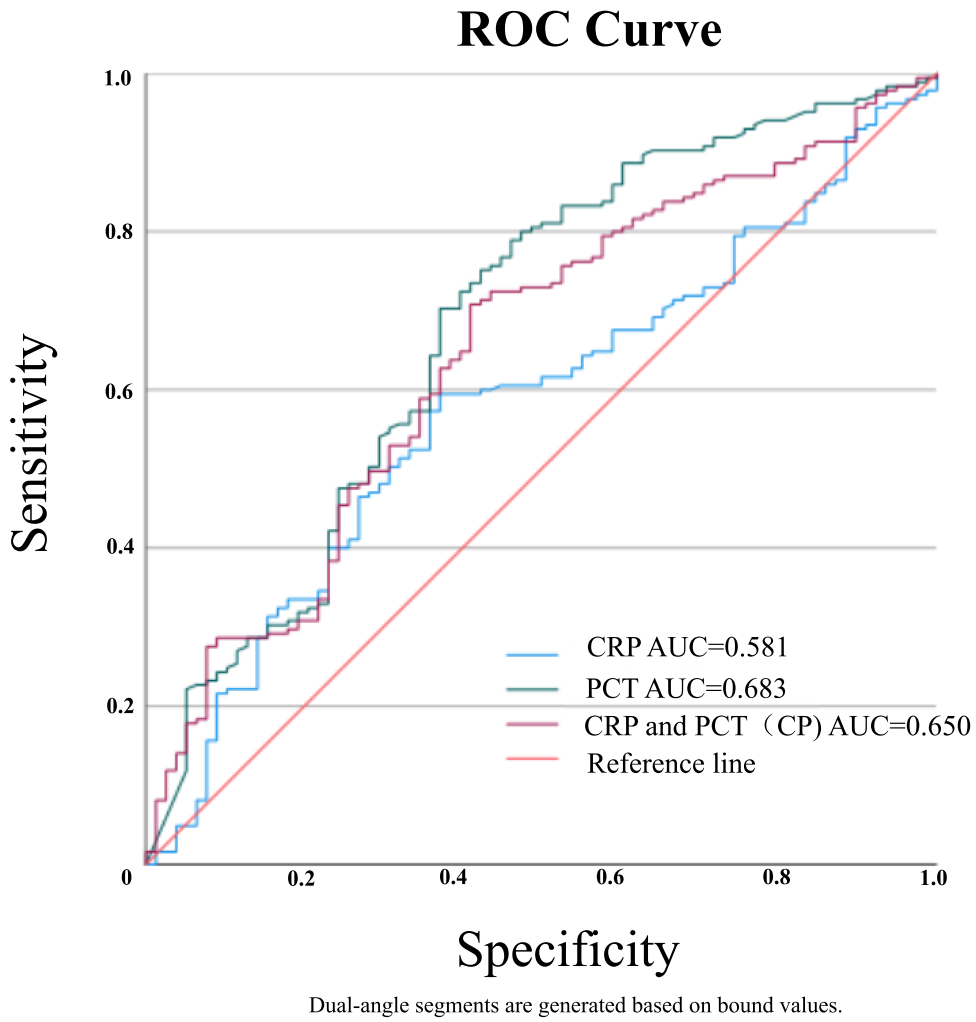

Figure 2 ROC curve of the influencing factors for blood culture-positive KPLA.

glucose levels who were asymptomatic and untreated, had a higher risk of developing bacterial liver abscesses with bloodstream infections. In individuals with unstable blood glucose levels, prolonged hyperglycemia can weaken the phagocytic ability of white blood cells, reduce immune function, and create a high-glucose environment within the body that serves as a favorable condition for bacterial growth. Moreover, the continuous mutation of bacteria and the increasing virulence of their invasive capabilities, combined with the vascular and neurological complications caused by long-term diabetes, further exacerbate the risk. These factors collectively create highly favorable conditions for pathogenic bacteria to enter the bloodstream and proliferate extensively. Moreover, the continuous mutation of bacteria and the increasing virulence of their

Table 8 Statistical Interactions Between PCT and Baseline Characteristics

X = PCT	Number	Outcome	P interaction
SEX			
0	81	1.013 (0.996, 1.031) 0.1419	0.7283
1	182	1.017 (1.006, 1.029) 0.0035	
AGE			
<=70	208	1.016 (1.006, 1.027) 0.0023	0.6880
>70	55	1.011 (0.988, 1.035) 0.3602	

(*Continued*)

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Table 8 (Continued).

X = PCT	Number	Outcome	P interaction
Diabetes Mellitus			
0	98	1.012 (0.999, 1.024) 0.0639	0.2850
1	165	1.023 (1.006, 1.039) 0.0061	
Biliary System Diseases			
0	197	1.017 (1.006, 1.028) 0.0023	0.7305
1	66	1.012 (0.991, 1.035) 0.2651	
Liver Abscess (>10=1, 5–10=2, <5=3)			
1	26	1.011 (0.980, 1.043) 0.4959	
2	156	1.015 (1.004, 1.026) 0.0084	0.7274
3	81	1.025 (0.999, 1.052) 0.0626	
qSOFA≥2			
0	233	1.014 (1.004, 1.024) 0.0064	0.9220
1	30	1.012 (0.973, 1.053) 0.5500	
CRP (calculated based on cutoff value)			
<=173.9	124	1.008 (0.992, 1.025) 0.3420	0.5389
>173.9	139	1.015 (1.002, 1.028) 0.0265	

Notes: Table data: β (95% CI) P-value / OR (95% CI) P-value. Outcome variable: OUTCOME. Exposure variable: PCT. Adjusted variable: None.

invasive capabilities, combined with the vascular and neurological complications caused by long-term diabetes, further exacerbate the risk. These factors collectively create highly favorable conditions for pathogenic bacteria to enter the bloodstream and proliferate extensively.[17–19]

This study also indicates significant differences in various aspects among patients with bloodstream-culture-positive KPLA. KPLA does not present with bacteremia, which may be associated with localized infections and the host's immune status. Compared to the control group, patients in the study group exhibited a significantly higher proportion of ICU admissions, longer hospitalization duration, elevated serum creatinine levels, as well as increased levels of PCT and CRP. Additionally, the incidence of complications such as pleural effusion, pulmonary infection, ascites, and extrahepatic abscesses was notably higher. Conversely, their albumin levels and platelet counts were significantly lower. These differences suggest that patients with concomitant bloodstream infections experience significant bacterial proliferation within the vascular system and various tissues, leading to the release of toxins that exacerbate systemic inflammatory responses. This results in markedly elevated inflammatory markers, placing the body in a hypermetabolic state, which subsequently increases protein consumption and can lead to severe hypoalbuminemia. Hypoalbuminemia leads to a reduction in plasma colloid osmotic pressure, which facilitates the leakage of fluid components from the bloodstream into the interstitial spaces outside the blood vessels. This condition increases the likelihood of developing pleural and peritoneal effusions. Moreover, inflammatory mediators may adversely affect renal function and fluid balance, contributing to elevated creatinine levels. Additionally, inflammatory mediators such as cytokines and chemokines can inhibit platelet production in the bone marrow while simultaneously increasing platelet consumption and destruction, resulting in a decrease in platelet count.

It is noteworthy that when patients with KPLA experience bloodstream infections, the lungs are among the most common sites of extrahepatic infection, in addition to liver abscesses.[20] This study demonstrates that pulmonary infection is the most prevalent complication in bloodstream-culture-positive KPLA patients, which aligns with findings from studies by Lee et al and Tian et al[21–23] Furthermore, both univariate and multivariate logistic regression analyses indicate that patients with KPLA who develop pulmonary infections are more likely to yield positive blood culture results. This may be attributed to the dissemination of bacteria or inflammatory mediators through the bloodstream during liver abscess-related bloodstream infections. Given that the lungs occupy a critical position within the circulatory system, bacteria can spread to the lungs via the hepatic venous route into the inferior vena cava, as well as through the arterial pathway, thereby precipitating pulmonary infections. Additionally, the lungs, as a central component of the respiratory system and in direct contact with the external environment, are more susceptible to invasion by bacteria or viruses.

The results of this study indicate that liver abscesses were predominantly located in the right lobe. In the study group, the proportion of abscesses with a diameter ≤5 cm and cases with ≥2 abscesses was higher, which is consistent with findings from previous studies.[24] A possible explanation is that smaller abscesses typically accumulate pus at a slower rate, allowing bacteria sufficient time to escape from the pus, thereby further infecting surrounding tissues or spreading to other sites via the bloodstream. In contrast, larger abscesses, despite accumulating more pus, may create higher internal pressure, making it more difficult for bacteria to penetrate the abscess wall and invade the surrounding tissues; On the other hand, smaller abscesses may elicit a relatively weaker immune response, which may be insufficient to effectively eliminate bacteria. This could result in increased erosion and damage to surrounding tissues, providing greater opportunities for bacteria to enter the vasculature or lymphatic system, thereby increasing the likelihood of infection spreading to other sites. In contrast, larger abscesses may provoke a more robust immune response, which could contribute to better local infection control.

Procalcitonin (PCT) is an important biological marker for assessing the intensity of systemic inflammatory responses. Its levels significantly rise during systemic or central nervous system inflammatory reactions and are closely associated with the degree of infection, as well as its progression or resolution.[25] Studies conducted by Wang et al have demonstrated that patients with bacterial liver abscess complicated by septic shock exhibit higher levels of PCT.[26,27] In this study, the PCT levels in the study group were significantly higher than those in the control group. By constructing a ROC curve, the AUC for PCT was 0.683, with a 95% CI of 0.61–0.756. The cutoff value was determined to be 4.97, with a sensitivity of 0.703 and a specificity of 0.628; It has significant predictive value for the risk of developing bloodstream infections in patients with KPLA. Therefore, in clinical practice, if a patient's PCT level rises to ≥4.97, the possibility of concurrent sepsis should be highly suspected. Such patients should be closely monitored, and early intervention should be implemented to ensure effective clinical treatment and improve prognosis.

Conclusion

In summary, patients with bloodstream-culture-positive KPLA exhibit significant differences across various clinical indicators and complications. Compared to CRP, PCT is more effective in reflecting whether a patient has developed bloodstream infection. KPLA patients with elevated PCT levels of ≥4.97 are more likely to present with positive blood culture results. It is recommended that PCT should become a routine screening biomarker for cases suspected of KPLA in clinical practice. However, it is important to note that this study is categorized as a retrospective analysis, and the number of cases involved is relatively limited. Therefore, the specific threshold for elevated PCT levels requires further validation. In future prospective studies, these findings can be validated through larger cohorts and the verification of biomarkers.

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Disclosure

The authors report no conflicts of interest in this work.

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