Critical Care

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Prognosis of liver abscess in the intensive care unit (POLAIR), a multicentre observational study

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Abstract

Background Liver abscess (LA) is a rare but potentially serious condition with a high mortality rate. Current epidemiological data of LA patients requiring intensive care unit (ICU) admission are limited.

Methods This multicentre retrospective study included adults admitted to 24 ICUs in France between January 2010 and December 2020. Risk factors for mortality were identified by multivariate analysis. A propensity score was used to adjust for confounders related to the presence of portal vein thrombosis.

Results 335 patients were enrolled. The median age was 66 years [53–73] and 68% were male. Commons comorbidities included diabetes (29.9%) and cancer or haematological disease. Septic shock was the main reason for admission (58%). The median SAPS2 score at ICU admission was 42 [31–53] and the SOFA score was 6 [3–9]. The putative origin of LA was biliary (31%), while 40% were cryptogenic. Most patients (60%) had a solitary LA, involving the right lobe (38.8%), with a median diameter of 67 mm [47–91]. Associated portal vein thrombosis (PVT) was present in 13.4% of cases. Microbiological documentation was obtained in 82% of patients, showing gram-negative bacilli (59.7%), mainly *Escherichia coli* (19.6%) and *Klebsiella* spp. (19.1%), and gram-positive cocci (29.6%), mainly *Streptococcus* spp. (17.1%). Drainage was performed in 62% of cases, 40% within 48 h. The median duration of antibiotic therapy was 35 days [21–42]. During hospitalisation, 62% of patients required vasopressors and 29% required mechanical ventilation. In-ICU mortality was 11.6%. Multivariate analysis showed that organ dysfunction illustrated by SOFA score (HR 3.45 [1.95–6.09], $p<0.001$) and PVT (HR 3.14 [1.54–6.39], $p=0.001$) were significant risk factors for mortality. Drainage was not associated with improved short-term survival (HR 1.22 [0.65–2.72], $p=0.52$). In the population matched for PVT confounders, a higher sofa score was the only factor associated with mortality (HR 3.11 [1.76–5.49] IC95%, $p=0.001$).

Conclusions This multicentre study illustrates the severity of LA in French intensive care units and identifies organ dysfunction (SOFA score) and portal vein thrombosis as major risk factors for mortality. Prospective studies are needed to improve management strategies, as the survival benefit of drainage is unclear.

Keywords Liver abscess, Prognosis, Mortality, Portal vein thrombosis, Microbiology, Intensive care

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Background

Liver abscess (LA), defined as a pus collection in the liver, is a rare but potentially severe condition. The incidence of LA in Western countries is approximately 2 per 100,000 per year, which contrasts with higher rates reported in Asia, where it can reach 86 per 100,000 [1–7] and mortality rates vary from 6 to 14% [8–10].

The risk factors associated with LA are well documented and include diabetes, alcohol consumption, chronic liver disease and immunosuppression, with a higher prevalence in male patient [11–14]. While biliary tract infection is the most common presumed mechanism of LA formation, other origins have also been reported, such as arterial or portal dissemination from an extra-digestive or digestive infectious site, or infection of pre-existing lesions of the liver. A significant number of cases still remain cryptogenic [6, 7, 15].

The literature suggests that 10–20% of patients with LA require admission to an intensive care unit (ICU) due to severe complications of the infection or co-morbidities decompensation [16, 17]. Mortality rates in LA patients requiring ICU admission can reach 28% [17].

Current epidemiological data on LA in France, particularly in patients requiring ICU admission, remain limited. As severe forms of LA may represent a significant challenge due to their complex pathophysiology and high mortality rate, there is a need for improvement in our understanding of this rare disease, a preliminary step to better management strategies and patient prognosis. The primary objective of this study was to describe the clinical characteristics and outcomes of patients admitted to the ICU with liver abscess. The primary endpoint was ICU mortality. Secondary endpoints included the effect of drainage procedures, microbiological documentation, and the prognostic significance of portal vein thrombosis.

Methods

Study design and population

This study is a multicentre, retrospective observational cohort study conducted in 24 French Intensive Care Units (ICUs) between January 2010 and December 2020. Adult patients (aged 18 years and older) admitted for liver abscess were identified using hospital databases, using the diagnostic codes K750, K768, A064, B670, B678, B378, B448, T814 and B675 of the International Classification of Diseases, 10th Revision, whether listed as a principal or as an associated diagnosis.

The presence of liver abscess was verified in the patients' medical charts and defined by the association of compatible clinical features such as fever and abdominal pain, along with typical imaging findings on computed tomography (CT) scan or ultrasound. Patients were excluded if their primary ICU admission diagnosis was unrelated to liver abscess, including septic shock of other origin, alternative intra-abdominal infections (pancreatitis, peritoneal abscess), non-infectious critical illness (haemorrhagic shock, acute pulmonary oedema, cardiogenic shock), or if they were admitted for postoperative monitoring without active infection. Patients were also excluded if they were under 18 years of age or had missing data that precluded analysis.

Sepsis and septic shock were defined according to the Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3) [18]. The final analysis included only patients who met these definitions and had a confirmed liver abscess as the primary source of infection. A detailed flowchart illustrating patient selection and exclusion criteria is provided in Supplementary Fig. 1.

Clinical, biological and radiological data

Data collected included patient age, sex, comorbidities (e.g. cardiovascular disease, chronic respiratory disease, chronic liver disease, diabetes mellitus, immunodeficiency, cancer, chronic renal failure). Comorbidities were classified according to the Charlson Comorbidity Index (CCI) [19], allowing standardised risk stratification of underlying diseases. Clinical symptoms and biological characteristics on admission, as well as radiological and microbiological findings, were also recorded. Severity was assessed using the Simplified Acute Physiology Score (SAPS II) and SOFA [20, 21]. Liver abscess characteristics collected included: number of abscesses, location within the liver, size and presumed mechanism of infection (whether arterial, biliary, portal, associated with underlying liver lesions or cryptogenic).

In addition, specific data recorded during the ICU stay included: incidence of shock, administration of catecholamines, presence of respiratory distress syndrome, need for mechanical ventilation, incidence of renal failure, need for renal replacement therapy, and length of ICU stay and overall hospital stay. In-hospital mortality was also recorded as part of the study data. The patients were followed until they were discharged from hospital or died.

Microbiological data

Therapeutic interventions and results of microbiological workup were recorded, including blood cultures, needle aspiration or drainage procedures, the interval between needle aspiration and admission, microbiological documentation (both in blood samples and from needle aspirations), number and types of pathogens documented, the class of antibiotic therapy administered, the duration of antibiotic treatment, and any adjunctive antifungal agents used. Due to the small number of cases, surgical drainage was not included in

the primary analysis. However, all microbiological documentation, regardless of the drainage method used, were included in the microbiological analysis. Specific data on microbiological findings from surgical drainage were not systematically recorded as a separate category.

Statistical analysis

Results were expressed as median and 25th and 75th quartiles [Q1–Q3] for quantitative data and as numbers and percentages for categorical data. Quantitative variables were compared using the Wilcoxon test, and qualitative variables were compared using the chi-square test with Yate's continuity correction if needed. Given the retrospective nature of this study, no power calculation was performed. However, we confirmed the robustness of our findings by validating the results of the multivariate analysis through a propensity score analysis. Survival analysis was performed using multivariate Cox models including clinically relevant variables. The multivariate analysis included all variables associated with mortality in the univariate analysis without interaction. Median age was forced in this multivariate analysis because it is usually associated with mortality. All needle aspiration or drainage procedures were recorded regardless of timing. However, for all analyses, needle aspiration or drainage procedures were included if they were performed between the day before admission and 48 h after admission to the ICU to reduce immortal time bias. In other words, if a patient had a drainage or needle aspiration procedure after 48 h of ICU admission, they were analysed in the "no invasive procedure group". As portal thrombosis was associated with higher mortality, this variable was explored with a propensity score in order to adjust confounding factors. First, a directed acyclic graph was built with variables considered by the authors to be cofounder or collider bias for portal vein thrombosis (age, chronic alcohol use and cirrhosis). Then we computed the propensity score using logistic regression based on these characteristics with a 1:1 matching algorithm without replacement and a caliper of 0.2. The matched population was then used for a logistic regression including two variables considered to be potential confounders of mortality factors (SOFA and needle aspiration). Kaplan–Meier curves were used to describe survival at the last news. Missing data were not imputed. All analyses were performed with R software, version 3.6.2. (R Foundation for Statistical Computing, Vienna, Austria; https://www.R-project.org/).

Ethics approval

This study received ethical approval from the Ethics Committee of the Société de Réanimation de Langue Française (SRLF): reference CE SRLF 21–87. The patient cohort was registered with the Commition Nationale de l'Information et des Libertés (CNIL) under the MR004 framework, registration number 2224428. The methodological quality of the study was assessed according to the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines (Additional file 3).

Results

Patient characteristics at the ICU admission

Between January 2010 and December 2020, a total of 335 patients were enrolled in 24 intensive care units (ICUs) in France, with a median number of patients per centre of 11.5 [7–20.5]. The flow chart of the study is presented in Supplementary Fig. 1 and demographic and baseline characteristics of the patients in Table 1.

The cohort had a median age of 66 years [55–73] with a predominance of male patients (68%). Common comorbidities included diabetes, cancer and haematological malignancies. Chronic liver disease was noted in 60 patients (17.9%), and about one third had a history of tobacco or alcohol use. The reasons for ICU admission were septic shock (58%) and sepsis (42%).

On admission, median SAPS2 was 42 [31–53] and SOFA score was 6 [3–9]. A high proportion of patients displayed lactic acidosis, coagulopathy, hepatic cytolysis, cholestasis, and renal impairment. Common clinical manifestations included fever (78.8%), abdominal pain (48.1%) and jaundice (observed in 54 patients). Organ support therapies were frequently required, with 62.4% of the patients receiving vasopressor infusions, 29.6% receiving mechanical ventilation and 13.1% requiring renal replacement therapy.

During their stay in the ICU, 21.8% of patients developed a new septic shock, 18.2% developed renal failure and 16.1% developed respiratory failure.

Abscess characteristics

The primary imaging modality used for diagnosis was abdominal CT scan, typically performed on the day of admission (day 0 [− 1–0]). The putative origin of LA was most commonly biliary (31.6%). Other sources included pre-existing lesions (11.9%), portal (10.7%) and arterial (5.7%), while 40% were cryptogenic with no identifiable source.

Portal vein thrombosis (PVT) was present in 45 patients, accounting for 13.4% of cases. The most common causes of abscesses in patients with portal

Table 1 Demographics, abscess characteristics and therapy in 335 patients with liver abscess

Parameters	Total n = 335 n (%) or Med. [IQR]	Survivor n = 296 n (%) or Med. [IQR]	Deceased n = 39 n (%) or Med. [IQR]	*p* value*
Age, years	66 [55–73]	66 [55–73]	68 [60–75.5]	0.300
Male gender	228 (68.1)	201 (67.9)	27 (69.2)	1.000
SAPS2	42 [31.75–53.25]	39 [31–52]	54 [49–66]	**0.001**
SOFA at ICU admission	6 [3–9]	5 [3–8]	12 [8–15]	**< 0.001**
BMI	24.28 [22.19–28.65]	24.35 [22.38–28.71]	23.67 [21.58–27.11]	0.608
Comorbidities				
CCI	1 [0–3]	1 [0–3]	2 [1–4]	0.081
Diabetes	100 (29.9)	81 (27.4)	19 (48.7)	**0.011**
Chronic liver disease	60 (17.9)	56 (18.9)	4 (10.3)	0.270
Cancer and hematologic malignancies	98 (29.3)	83 (28)	15 (38.4)	0.061
Cirrhosis CHILD PUGH B or C	12 (3.6)	9 (3)	3 (7.7)	0.312
Chronic kidney disease	21 (6.3)	19 (6.4)	2 (5.1)	1.000
Tobacco use	102 (30.4)	94 (31.8)	8 (20.5)	0.211
Alcohol consumption	100 (29.9)	89 (30.1)	11 (28.2)	0.957
Time from diagnosis to admission, days	0 [− 1–0]	0 [− 1 − 0]	0 [− 3–0]	0.350
Single abscess	204 (60.9)	160 (60.8)	24 (61.5)	0.476
Multiple abscess	126 (37.6)	112 (37.8)	14 (35.9)	0.952
Localisation				
Left lobe involvement only	61 (18.2)	54 (18.2)	7 (17.9)	1.000
Right lobe involvement only	130 (38.8)	116 (39.2)	14 (35.9)	0.824
Bi-lobar involvement	31 (9.3)	28 (9.5)	3 (7.7)	0.948
Abscess greater size, mm	67 [47–91]	65 [47–90.75]	70 [50–105]	0.753
Presumed origin of abscess				
Arterial	19 (5.7)	17 (5.7)	2 (5.1)	1.000
Portal	36 (10.7)	35 (11.8)	1 (2.6)	0.139
Local	40 (11.9)	36 (11.8)	4 (10.3)	0.934
Biliary	106 (31.6)	90 (31.4)	13 (33.3)	0.953
Cryptogenic	134 (40.0)	115 (38.8)	19 (48.7)	0.296
Associated portal vein thrombosis	45 (13.4)	31 (10.5)	14 (35.9)	< **0.001**
Procedures				
Drainage/percutaneous needle aspiration	208 (62.1)	191 (64.5)	17 (43.6)	**0.018**
Surgical drainage	12 (3.6)	10 (3.4)	2 (5.1)	0.638
Time from admission to drainage, days	1 [0–2]	1 [0–2]	0 [0–1]	0.131
Time from diagnosis to drainage, days	2 [1–5]	2 [1–5]	2 [0–5.5]	0.856
Antibiotics	335 (100)	296 (100)	39 (100)	
Duration of antibiotic treatment, days	35 [21–42]	42 [21–42]	4.5 [2–10.75]	**< 0.001**
Antifungal	27 (8.1)	20 (6.8)	7 (17.9)	**0.036**
Organ support therapy during ICU stay				
Vasopresssor infusion	209 (62.4)	171 (57)	38 (97.4)	**< 0.001**
Vasopresssor infusion duration, days	1 [0–3]	1 [0–2]	3 [1.75–5]	**< 0.001**
Invasive mechanical ventilation	99 (29.6)	66 (22.3)	33 (84.6)	**< 0.001**
Invasive mechanical ventilation duration, days	0 [0–1]	0 [0–0]	2 [1–4]	**< 0.001**
Oxygen therapy	214 (63.9)	180 (60.8)	34 (87.2)	**0.002**
Renal replacement therapy	44 (13.1)	27 (9.1)	17 (43.6)	**< 0.001**
Red blood cell transfusion	61 (18.2)	47 (15.9)	14 (35.9)	**0.005**
Death in ICU	39 (11.6)			
Death in hospital	24 (7.2)			
Length of stay in ICU, days	5 [3–9]	5 [3–9]	3 [2–8.5]	0.121
Length of stay in hospital, days	22 [15–39]			

Table 1 (continued)

SAPS2 simplified acute physiology score, *CCI* charlson comorbidity index, *SOFA* Sepsis-related organ failure

**p* for univariate analysis. Bold values indicates p < 0.05

vein thrombosis were cryptogenic (38%) and biliary (33%) (Additional file 1).

Of the total cohort, 204 patients (60.9%) presented with a solitary LA, while the rest had multiple abscesses. The LA involved the right part of the liver in 58.5% of cases, the left in 27.4% and both in 13.9% of cases (Fig. 1). Larger abscess diameter was 67 mm [47–91].

Microbiological characteristics

Blood cultures were obtained for all patients of the study. Interventional procedures consisted in needle aspiration or drainage in 208 patients (62.1%) and surgical drainage in 12 patients (3.6%). Early intervention, defined as needle aspiration or drainage performed between the day before admission and 48 h after ICU admission, was performed in 135 patients (40%). The median time between admission and the procedure for all patients was 1 day [0–2].

In the study, 82% of LAs were microbiologically documented by either blood or needle aspiration cultures. A predominance of gram-negative bacilli was observed, accounting for 59.7% of isolates. Gram-positive cocci were also prominent, accounting for 29.6% of microbial isolates. In addition, other types of pathogens were identified in 11.9% of cases. Microbiological data are summarised in Table 2.

A positive blood culture was reported in 69.5% of patients and a positive needle aspiration culture in 33.4% of patients (corresponding to 53% of patients who received a needle aspiration). When blood culture and needle aspiration culture were both positive (23% of cases), 48 patients had the same documentation and 35 patients had different documentations. Detailed microbiological data for the different types of documentations in blood culture and needle aspiration is shown in Supplementary Fig. 2.

Multiple pathogens were identified in 104 (31%) patients (Supplementary Fig. 3). The most commonly identified bacteria were *Escherichia coli* (20%), *Klebsiella spp*. (19%), *Streptococcus spp.* (17%), *Enterococcus spp.* (10%) (Supplementary Fig. 4).

As illustrated in supplementary Fig. 5, 35 patients had both a positive blood and needle aspiration culture with different microbiological documentations and they were more pathogens identified in liver abscess culture (35 patients with different numbers of pathogens between samples; 56 pathogens in blood vs 75 pathogens in pus). The concordance between blood cultures and analysis of abscess pus was only 23% (48/208).

All patients received antibiotic treatment and the median duration of antibiotherapy was 35 days [21–42]. Antibiotic therapy was recorded on the first

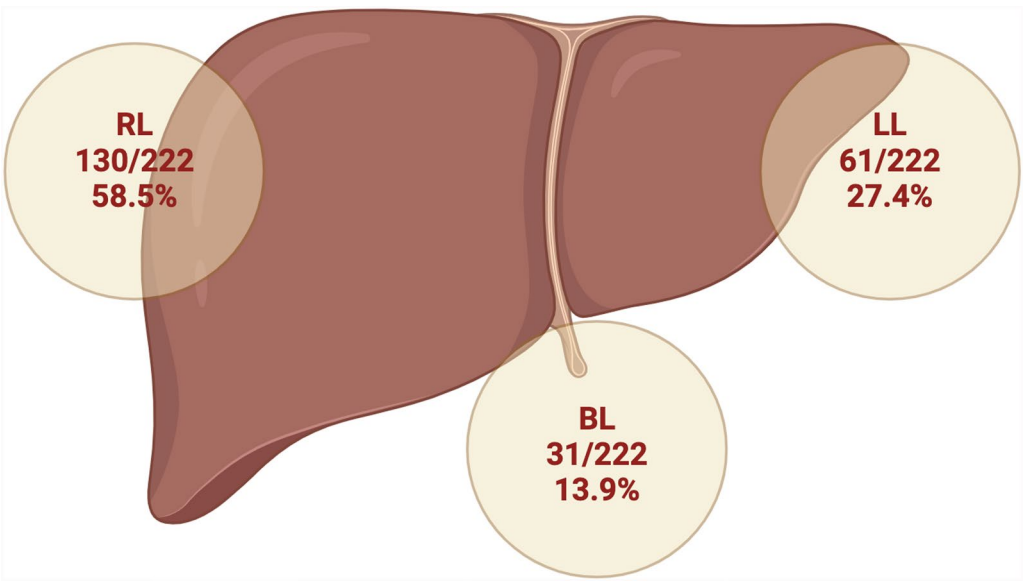

Fig. 1 liver abscess radiological localisation. Legend: RL, Right Lobe involvement only; LL, Left Lobe involvement only; BL, Bi-lobar involvement

Table 2 Microbiological data in blood and needle aspiration culture

	Total n = 335 n (%) or Med. [IQR]	**Survivor n = 296 n (%) or Med. [IQR]**	**Deceased n = 39 n (%) or Med. [IQR]**	***p* value**
Sample performed	335 (100)	296 (100)	39 (100)	
Positive culture	275 (82.1)	244 (82.4)	31 (79.5)	0.819
Negative culture	60 (17.9)	52 (17.6)	8 (20.5)	0.819
Positive blood culture	233 (69.5)	204 (68.9)	29 (74.4)	0.610
Positive needle aspiration culture	112 (33.4)	100 (33.7)	12 (30.7)	0.845
Positive culture, blood culture only	150 (44.7)	130 (43.9)	20 (51.3)	0.485
Positive culture, needle aspiration only	29 (8.6)	25 (8.4)	4 (10.3)	0.940
Same documentation in the blood and the needle aspiration culture	48 (14.3)	42 (14.2)	6 (15.4)	1.000
Different documentation in the blood and the needle aspiration culture	35 (10.4)	33 (11.1)	2 (5.1)	0.380
Total pathogens	445	396	49	
Gram-negative bacilli	200 (59.7)	178 (60.1)	22 (56.4)	0.786
Gram-positive cocci	99 (29.6)	85 (28.7)	15 (35.9)	0.287
Echerichia coli	87 (19.6)	78 (26.4)	9 (23)	0.807
Klebsiella spp	85 (19.1)	78 (26.4)	7 (17.9)	0.348
Streptoccocus spp	76 (17.1)	68 (22.9)	8 (20.5)	0.887
Enterococcus spp	46 (10.3)	39 (13.2)	7 (17.9)	0.571
Bacteriodes spp	15 (3.4)	14 (4.7)	1 (2.6)	0.839
Enterobacter cloacae	14 (3.1)	10 (3.4)	4 (10.3)	0.111
Unidentified gram- negative bacilli	13 (2.9)	11 (3.7)	2 (5.1)	1.000
Citrobacter spp	12 (2.7)	11 (3.7)	1 (2.6)	1.000
Candida spp	10 (2.2)	9 (3.0)	1 (2.6)	1.000
Pseudomonas aeruginosa	9 (2.0)	8 (2.7)	1 (2.6)	1.000
Proteus spp	8 (1.8)	7 (2.4)	1 (2.6)	1.000
Morganella morganii	7 (1.6)	7 (2.4)	0	0.707
Clostridium spp	7 (1.6)	6 (2.1)	1 (2.6)	1.000
Fusobacterium spp	6 (1.3)	5 (2.0)	1 (2.6)	1.000
Entamoeba histolytica	6 (1.3)	6 (2.1)	0	0.798
Staphylococcus spp	5 (1.1)	5 (2.0)	0	0.908
Prevotalla spp	5 (1.1)	5 (2.0)	0	0.908
Unidentified gram-positive cocci	4 (0.9)	3 (1.0)	1 (2.6)	0.957
Hafnia alvei	4 (0.9)	3 (1.0)	1 (2.6)	0.957
Parvimonas micra	4 (0.9)	4 (1.4)	0	1.000
Actinomyces spp	3 (0.7)	3 (1.0)	0	1.000
Raoutella spp	3 (0.7)	2 (0.7)	1 (2.6)	0.785
Gemella morbillorum	2 (0.4)	1 (0.3)	1 (2.6)	0.554
Solobacterium moreii	2 (0.4)	2 (0.7)	0	1.000
Unidentified gram-positive bacilli	1 (0.2)	0	1 (2.6)	0.231
Unidentified fungi	1 (0.2)	1 (0.3)	0	1.000
Mycobacterium tuberculosis	1 (0.2)	1 (0.3)	0	1.000
Aspergillus spp	1 (0.2)	1 (0.3)	0	1.000
Bacillus cerus	1 (0.2)	1 (0.3)	0	1.000
Echinococcus	1 (0.2)	1 (0.3)	0	1.000
Eikenella corrodens	1 (0.2)	1 (0.3)	0	1.000
Veillonella parvula	1 (0.2)	1 (0.3)	0	1.000
Achromobacter spp	1 (0.2)	1 (0.3)	0	1.000
Micromonas micros	1 (0.2)	1 (0.3)	0	1.000
Yersinia pseudotuberculosis	1 (0/2)	1 (0.3)	0	1.000
Lactobacillus spp	1 (0:2)	1 (0.3)	0	1.000

**p* for univariate analysis

day of ICU admission as initial empirical treatment. Aminoglycosides, metronidazole and third-generation cephalosporins were the most commonly used antibiotics, with aminoglycosides often given in combination with beta-lactams, likely during the first 48 h, before switching to targeted therapy based on microbiological documentation. (Supplementary Fig. 5). Secondarily adapted antibiotic regimens mainly included metronidazole, third-generation cephalosporins, amoxicillin-clavulanic acid, and amoxicillin (Supplementary Fig. 6).

The median delay between diagnosis and initiation of empirical antibiotic therapy was 0 days [0–0], with 213 of 335 patients (63.6%) receiving treatment on the same day as diagnosis. When comparing survivors and non-survivors, the median delay remained at 0 days [0–0] in both groups, with no statistically significant difference ($p=0.51$). We then evaluated the effectiveness of empirical antibiotic therapy. Overall, 89% of patients (298/335) received empirical antibiotic treatment either before diagnosis or within 48 h of diagnosis. Of these 298 patients, 203 (68.1%) received an empirical regimen that was both appropriate and effective against the pathogens identified. To assess the impact of empirical antibiotic effectiveness on patient outcomes, we analysed mortality in relation to the appropriateness of the initial treatment. Of the 335 patients, 228 (68.1%) received effective initial empirical antibiotic therapy, including 204 survivors and 24 non-survivors. The remaining 107 patients (31.9%) either had ineffective empirical therapy (n = 32) or had no microbiological documentation to assess its effectiveness (n = 75). The proportion of patients receiving effective empirical antibiotic therapy was comparable between survivors and non-survivors ($p=0.455$), indicating no statistically significant association between initial empirical antibiotic effectiveness and mortality in our cohort. Finally, we analysed antibiotic de-escalation. The median time to de-escalation in the overall cohort was 2.5 days [1.75–5], with no significant difference between survivors (2 days [2, 3]) and non-survivors (2 days [1–4.25], $p=0.97$). This suggests that the timing of de-escalation did not influence mortality in our cohort.

Factors associated with mortality

Among the 335 patients admitted to the ICU with LA, 39 patients died, resulting in a mortality rate of 11.6%. The length of ICU stay was 5 days [3–9] and follow-up was 223 days [10–2179]. Tables 1 and 3 detail the clinical and biological presentation of survivors and non-survivors, along with therapeutic interventions.

Factors associated with ICU mortality in univariate analysis were higher SAPS2 score and SOFA score at ICU admission (39 [31–52] vs 54 [49–66] and 5 [3–8] vs12 [8–15] respectively, $p<0.05$), and the presence of portal vein thrombosis (10.5% vs 35.9% $p<0.05$). Biological alterations suggestive of liver dysfunction and sepsis were more severe in decedents (higher hepatic cytolysis, bilirubin and arterial lactate rates, and lower platelet, factor V and prothrombin times). Drainage or percutaneous needle aspiration was associated with survival (64.5% vs 43.6%, $p<0.001$), regardless of the delay of the procedure. In addition, organ support therapies were more frequently required in non-survivors (vasopressor infusion for 57% vs 97.4% patients and mechanical ventilation for 22.3% vs 43.6% patients, $p<0.05$).

In multivariate analysis, factors associated with mortality were organ dysfunctions as assessed by higher SOFA score (HR 3.45 [1.95–6.09] IC95%, $p<0.001$) and the presence of portal vein thrombosis (HR 3.14 [1.54–6.39]IC95%, $p=0.001$). Survival according to the presence of portal thrombosis is illustrated in Fig. 2. Abscess evacuation by needle aspiration or drainage (early procedure) was not associated with improved short-term survival (HR 1.22 [0.65–2.72]IC95%, $p=0.52$) (Fig. 3). The association between drainage and survival did not remain significant after adjusting for baseline severity, suggesting that the observed benefit in univariate analysis was likely confounded by initial disease severity.

In the population matched on confounders for portal thrombosis, a higher sofa score was the only factor associated with mortality (HR 3.11 [1.76–5.49] IC95%, $p=0.001$) (supplementary Fig. 7).

Discussion

This study provides a comprehensive analysis of critically ill patients with liver abscess (LA) admitted to 24 ICUs in France over a decade, representing the largest cohort of severe LA cases published to date.

We observed an ICU mortality rate of 11.6%, significantly lower than the 28% reported in 2008 [17]. This may reflect improvements in ICU management, as seen in other septic conditions [22–24].

Patient characteristics were consistent with previous studies, with diabetes, cancer and chronic liver disease being the most common comorbidities [11–14]. As expected, *Escherichia coli* and *Klebsiella spp* remained the predominant pathogens [5, 6, 16].

Higher SOFA scores were strongly associated with mortality, reinforcing the link between organ dysfunction and poor prognosis. Similarly, portal vein thrombosis (PVT) was a significant risk factor, consistent with recent reports of its impact on mortality and recurrence [1, 3]. This may be related to undiagnosed hepatic comorbidities or to hazards of anticoagulant therapy in these critically-ill patients [25–27].

Table 3 Clinical and biological data at icu admission and outcome in 335 patients with liver abscess

Parameters	Total n = 335 n (%) or Med. [IQR]	Survivor n = 296 n (%) or Med. [IQR]	Deceased n = 39 n (%) or Med. [IQR]	*p* value*
Clinical signs				
Fever, temperature > 38 °C	244 (78.8)	221 (74.7)	23 (59)	0.060
Chills	85 (25.4)	79 (26.7)	6 (15.4)	0.184
Abdominal pain	161 (48.1)	141 (47.6)	20 (51.3)	0.796
Jaundice	54 (16.1)	43 (14.5)	11 (28.2)	0.051
Biological parameters				
Leucocytes (Giga/L)	16.00 [10.42–23.95]	16.00 [10.71–23.90]	17.20 [6.83–23.80]	0.585
Hemoglobin (g/dL)	10.5 [9.1–12.1]	10.5 [9.05–12.15]	10.25 [9.17–11.62]	0.474
Platelets (Giga/L)	158 [82–267]	164 [89–270]	118 [49–217]	0.014
Alanine aminotransferase (UI/L)	85.00 [41.00–175.00]	81.50 [41.00–160.70]	142.00 [64.50–343.50]	0.027
Aspartate aminotransferase (UI/L)	99.50 [53.00–218.00]	96.00 [52.00–205.00]	145.00 [75.00–437.00]	0.016
Gamma-glutamyl transferase (UI/L)	158.00 [90.00–259.00]	157.50 [89.50–262.00]	175.00 [113.20–231.00]	0.647
Alkaline phosphatase (UI/L)	200.00 [132.00–327.00]	192.00 [126.70–306.50]	301.00 [173.00–382.50]	0.021
Total bilirubin (µmol/L)	23.50 [13.00–51.00]	22.00 [12.25–45.75]	51.50 [20.75–142.50]	0.001
Creatinine (µmol/L)	114.00 [80.50–180.25]	114.00 [79.00–175.00]	109.00 [95.50–260.00]	0.401
Factor V (%)	87 [67–112]	98.00 [77.25–126.00]	65.00 [46.00–78.00]	0.005
Prothrombin time (%)	58 [18–68]	60 [50.5–70]	47 [36.75–52.5]	< 0.001
APTT	1.21 [1.03–1.40]	1.19 [1.00–1.39]	1.35 [1.22–1.56]	0.006
Fibrinogen (g/L)	6.33 [4.89–7.42]	6.40 [5.03–7.48]	5.80 [1.56–6.49]	0.119
Arterial lactate (mmol/L)	3.60 [1.90–5.50]	3.20 [1.70.5.00]	5.00 [4.20–10.00]	< 0.001

APTT activated partial thromboplastin time

**p* for univariate analysis

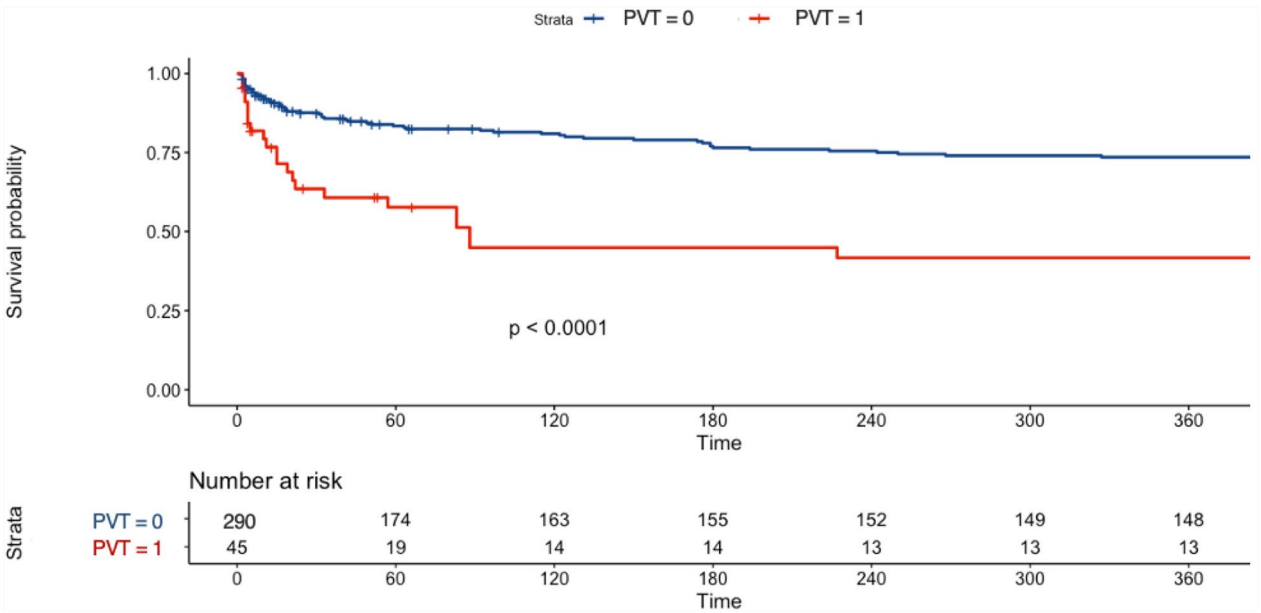

Fig. 2 Comparative survival of patients with liver abscesses according to the presence of portal vein thrombosis (pvt)

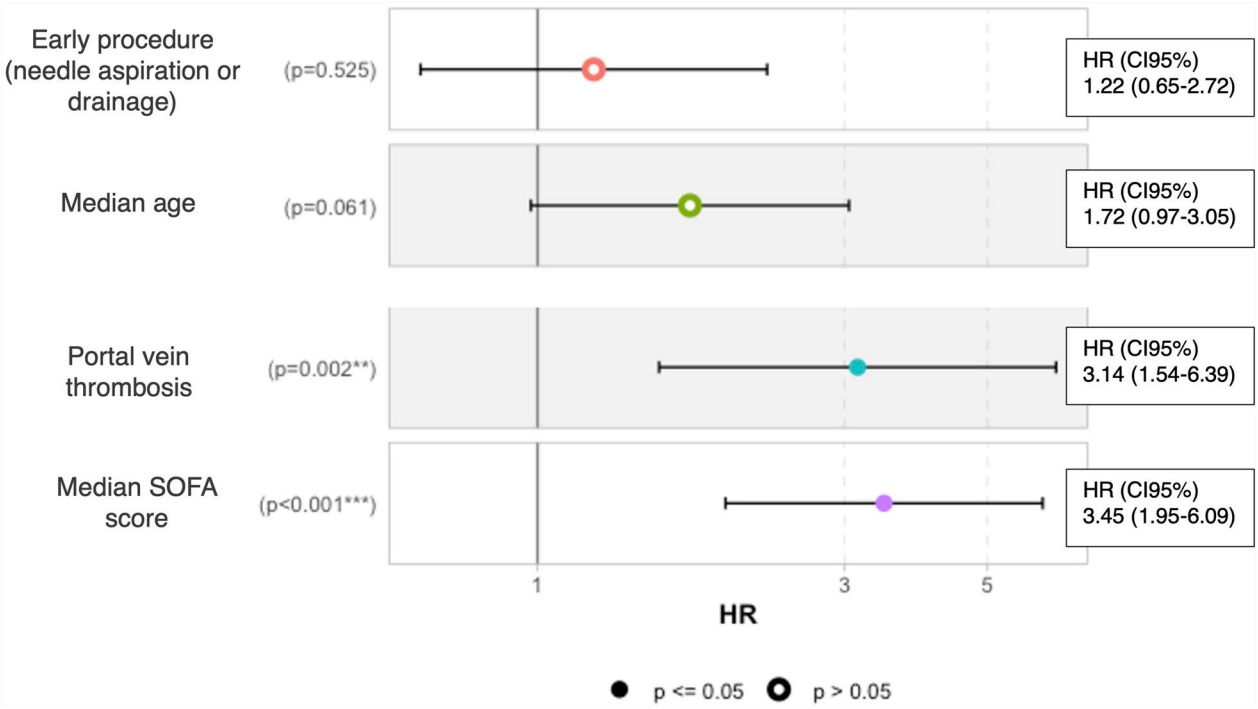

Fig. 3 Factor associated with mortality (multivariate analysis)

Microbiological documentation varied according to the method of collection. While pus cultures from abscesses were less likely to be positive, they tended to yield polymicrobial results compared with blood cultures. In this study, blood cultures appeared to be the most effective method of identifying pathogens in LA, as only 53% of patients who underwent drainage had a positive abscess culture.

It can be hypothesised that, since the median time to drainage was one day after admission, the procedure was often performed under ongoing antibiotic therapy, which may have reduced the sensitivity of pus cultures. The discrepancy between blood and abscess cultures may be due to several factors, including early administration of antibiotics, variations in bacterial load and growth conditions, and differences in specimen collection techniques. Early antibiotic exposure prior to drainage may have reduced bacterial recovery from abscess cultures. In addition, while blood cultures are obtained under strictly sterile conditions, liver abscess aspiration is technically challenging and may be affected by sampling variability, potentially affecting microbial detection rates.

In this study the concordance between blood and pus culture results was low (23%), so it may be important to retrieve both types of sample whenever possible.

These results are compatible with a recent study comparing the performance of shotgun metagenomics (SMg) with standard approaches for microbiological documentation of LA [28]. Using SMg, 43.5% (27/62) of samples were positive by both methods, but SMg found additional species in 88.9% (24/27), mostly anaerobes. Our findings reinforce the need for broad-spectrum empirical antibiotic therapy given the polymicrobial nature of LA. However, the optimal strategy for de-escalation remains uncertain, particularly whether adjustments should be based solely on blood culture results or should include pathogens identified in liver abscess samples. This is a key issue for future research.

In France, drainage is recommended for abscesses larger than 5 cm [29, 30]. In our cohort, drainage was not systematically performed in all cases of liver abscess, and several factors may explain why drainage was not performed in some of our patients. Firstly, 37.6% of patients had multiple abscesses. This makes drainage technically more difficult and sometimes ineffective. In addition, a significant proportion of patients had small abscesses (< 5 cm), which were often treated conservatively with antibiotics alone, especially in case of early clinical improvement. Anatomical factors and relative contraindications such as coagulopathy or difficult access also influenced the decision to drain. In our study, almost half (48%) of patients with multiple

abscesses and 68% of patients with small abscesses did not undergo drainage. In our work, early drainage did not significantly impact patient outcomes, even when considering only procedures performed during the first 48 h to limit immortal time bias. This was also reported by Chen et al. [17]. We also checked that a potential positive impact of drainage on survival was not masked by the negative weight of portal thrombosis by matching patients on potential confounders. This lack of effect highlights the need for careful consideration of timing and technique in invasive procedures.

We didn't compare drainage with percutaneous needle aspiration, but two meta-analyses and one randomised trial found no difference in mortality between these two procedures [31–33]. In particular, while percutaneous drainage has been suggested to improve outcomes and reduce recurrence rates [1], and while previous studies have highlighted the importance of early source control in septic shock [34], our study found no significant association between early drainage and survival after adjustment for confounders. However, residual confounding cannot be excluded and future prospective studies are needed to better define the optimal timing of invasive procedures in this population.

Despite its strengths, our study has several limitations due to its observational, retrospective design. Possible missing data and inherent selection biases could affect the generalizability of its conclusions. Nevertheless, of all the participating centres, most were general intensive care centres, and only one specialised in liver diseases, representing 28 patients in this cohort, which may reduce some concerns about selection bias. In addition, as a single-country study conducted in France, extrapolation to other health care settings may be limited.

Conclusion

This multicentre study represents the largest ICU cohort of patients with liver abscess (LA) to date, and illustrates the severity of liver abscess (LA) and its management challenges in French ICUs. We identified organ dysfunctions (SOFA score) and portal vein thrombosis as important predictors of mortality, while early drainage showed no significant survival benefit after adjustment for confounders. Given the unclear impact of drainage on survival in our cohort, our findings highlight the need for a balanced approach that includes both organ support and source control strategies in the ICU management of LA, rather than relying solely on procedural interventions. Further prospective studies are needed to refine the role of early source control interventions and improve patient outcomes.

Abbreviations

HR	Hazard ratio
ICU	Intensive care unit
LA	Liver abscess
PVT	Portal vein thrombosis
SAPS2	Simplified acute physiology score II
SOFA	Sequential organ failure assessment

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s13054-025-05376-w.

Additional file 1

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Author contributions

MLG conducted data collection, and wrote the manuscript. EM supervised the project, contributed to the study design and developed the initial research concept. VL performed the statistical analyses and contributed to the interpretation of the data. All authors contributed to data collection, revised the manuscript for intellectual content and approved the final version for submission.

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Availability of data and materials

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

This study received ethical approval from the Ethics Committee of the Société de Réanimation de Langue Française (SRLF): reference CE SRLF 21-87. The patient cohort was registered with the Commition Nationale de l'Information et des Libertés (CNIL) under the MR004 framework, registration number 2224428. The methodological quality of the study was assessed according to the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines (Additional file 3).

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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