



Pyogenic Liver Abscess: A Tertiary Center Experience in Latvia

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Abstract

Background and Objectives: A liver abscess is a serious and potentially life-threatening medical condition characterized by the formation of a pus-filled cavity within the liver tissue. Pyogenic Liver Abscesses (PLA) are primarily monomicrobial, with specific pathogens emerging as predominant agents in most cases. This study was conducted to analyze the epidemiological parameters, diagnostic factors and management strategies employed as well as outcomes in patients presenting with PLA.

Materials and Methods: A retrospective cross-sectional study of patients treated for PLA at Hepatopancreatobiliary (HPB) surgery unit of Pauls Stradiņš Clinical University Hospital - a tertiary teaching center was conducted with a total of 98 patients included in the study. The patient data were retrieved and reviewed after permission of ethics commission. Time period of the study was set for six years and involved data from patients treated at our institution between January 2018 and December 2023.

Results: In this study of 98 patients with PLA, cultures were positive in 68.4% of cases, and 16.3% had positive blood cultures indicating septicemia. *Klebsiella pneumoniae* (42.9%) and *Escherichia coli* (11.2%) were the most common pathogens isolated. *Polymicrobial flora* was found in 17.6% of cases, while 31.6% had no isolated pathogens. Percutaneous drainage or needle aspiration was performed in 85.7% of patients, with surgical management needed in 6.1% due to failed percutaneous drainage and in 8.2% due to abscess location or characteristics. Factors like biliary tract disease, positive antimicrobial resistance, multifocal abscesses, and surgical management – affected hospitalization time.

Conclusion: Multiple factors, including existing biliary disease, antimicrobial resistance (particularly ESBL), abscess size and location, and management strategies, impact the hospital stay of patients with PLA.

Keywords: Pyogenic; Liver abscess; Percutaneous drainage; *Klebsiella*

Introduction

A liver abscess is a serious and potentially life-threatening medical condition characterized by the formation of a pus-filled cavity within the liver tissue. The majority of these abscesses are categorized as pyogenic or amoebic, although a minority are caused by parasites and fungi [1]. Given the geographic area of the center where the study was conducted, it focuses exclusively on Pyogenic Liver Abscesses (PLA). PLAs are primarily monomicrobial, with specific pathogens emerging as predominant agents in most cases, including *E. coli*, *Klebsiella pneumoniae*, *Streptococcus* spp., *Staphylococcus* species, and anaerobes. Historically acute appendicitis was the most common cause of portal vein pyemia leading to PLA, currently approximately half of the cases develop due to biliary infection [2]. Non-appendiceal sources of intraabdominal infection - such as complicated diverticulitis now emerge as more common cause of portal pyemia than acute appendicitis due to improvements of its recognition and management. Occasionally the cause can be a surgical or penetrating wound to the liver parenchyma or a result of a hematogenous spread from systemic circulation. An immunosuppressive state, whether iatrogenic or secondary to underlying medical conditions like diabetes mellitus or cirrhosis, poses a formidable risk factor for the development and recurrence of PLA.

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While the pathology is relatively rare, with an annual incidence in the US of 3.6 cases per 100,000 individuals [3], it is uniformly fatal if left untreated. This underscores the importance of efficient patient recognition, the use of appropriate diagnostic tools, and timely management.

This study was conducted to analyze the epidemiological parameters, diagnostic factors, management strategies, and outcomes in patients presenting with PLA at a tertiary hospital in Riga, Latvia.

Materials and Methods

We conducted a retrospective cross-sectional study of patients treated for PLA at Pauls Stradiņš Clinical University Hospital HPB surgery unit. The study included a total of 98 patients, and patient data were retrieved and reviewed with permission from the Pauls Stradiņš University Ethics Commission. The study period spanned six years, incorporating data from patients treated at our institution between January 2018 and December 2023.

The diagnosis of PLA was confirmed through imaging studies such as abdominal Ultrasound (US), abdominal Computed Tomography (CT), or Magnetic Resonance Imaging (MRI), along with microbiological cultures obtained from material retrieved *via* percutaneous or surgical drainage of the abscess or from blood samples. Identification of pathogen was performed with culture and MALDI-TOF, and antimicrobial sensitivity was measured to EUCAST methodology. Patients with negative abscess cultures or blood cultures but compatible clinical and imaging findings were classified as Culture Negative PLA (CNPLA). Patients with amoebic and hydatid abscesses or underlying oncologic pathology of the liver were excluded from the study.

We performed a comprehensive examination of demographic data, clinical findings, comorbidities, laboratory parameters, identification of microbial pathogens, treatment modalities, abscess dimensions and site, initial outcomes, and associated complications.

The presence of fever was determined as a body temperature over 38°C measured upon admission. Other physical findings, including Right Upper Quadrant (RUQ) pain, malaise, and jaundice, were also recorded. Laboratory values observed included White Blood Cell (WBC) and C-Reactive Protein (CRP) levels upon admission and on discharge. Abscess size was determined by the largest diameter of the abscess or, in cases of multiple lesions, the diameter of the largest as determined by Ultrasound (US), Computed Tomography (CT), or Magnetic Resonance Imaging (MRI).

The management of choice was antibiotics plus either Percutaneous Drainage (PD) or surgical intervention, with surgical intervention being reserved for cases where PD was not feasible or unsuccessful. Conservative management was attempted in one case. Underlying medical conditions posing as risk factors for PLA were reviewed, including a history of PLA, diabetes mellitus, other causes of immunosuppression, and primary bacterial infections in different locations, as determined by medical history and existing biliary tract disease. Early outcomes were assessed based on the length of hospital stay, recurrent need for interventions such as repeated drainage, and adverse outcomes such as death. Statistical analysis was performed using SPSS software, version 24.

Results

There were 98 patients included in the study, 51 (52%) males and 47 (48%) females, mean (SD) age was 64.8 (\pm 12.9), the youngest

Table 1: Demographic and presenting clinical parameters of patients with liver abscess at PSCUS 2018-2024.

Characteristics	
Male, n (%)	51 (52%)
Female, n (%)	47 (48%)
Age, years (Med (Q1-Q3))	64.8 (27-89)
Fever, n (%)	59 (60.2%)
Abdominal pain n (%)	55 (56.1%)
Malaise, n (%)	15 (15.3%)
Nausea, n (%)	5 (5.1%)
Jaundice, n (%)	3 (3.1%)
WBC count, median (IQR)/mm ³	11.9 (16.0 - 9.0)
CRP, median (IQR)/mg/dl	186.0 (247.0-117.0)

Table 2: Pyogenic liver abscess causative pathogens by number of cases (n) and percentage (%).

Pathogen	Number (n)	Percentage (%)
<i>Kl. Pneumoniae</i>	42	42.9
<i>E. Coli</i>	11	11.2
<i>Enterococcus</i>	4	4.1
<i>E. Coli + Kl. Pneumoniae</i>	3	3.1
<i>Citrobacter freundii</i>	2	2
<i>Proteus mirabilis</i>	2	2
<i>Streptococcus spp.</i>	2	2
<i>Staphylococcus aureus</i>	1	1
CNPLA	31	31.6

Table 3: Antimicrobial resistance distribution among specimens obtained from PLA by number of cases (n) and percentage (%).

Characteristic	Number	Percentage
Overall antimicrobial resistance	60	61.2
Antimicrobial resistance		
Ampicillin	59	60.2
Amoxiclav	13	13.3
Ceftazidime	10	10.2
Ciprofloxacin	9	9.2
Trimethoprim/Sulfamethoxazole	7	7.1
ESBL positive	9	9.2

patient was 27 years old, and the oldest – 89. Presenting signs and symptoms are summarized in Table 1. The most frequent presenting complaints were fever (n=59, 60.2%) and abdominal pain (n=55, 56.1%). Fifteen patients presented with malaise (n=15, 15.3%), while nausea and jaundice was present in only 5 (n=5, 5.1%) and 3 (n=3, 3.1%) patients respectively. The median level of leucocytes on admission was 11.9 (IQR=16-9) while CRP levels were 186.0 (IQR=247.0-117.0).

Distribution of microbial pathogens is summarized in Table 2. Cultures were positive in 67 (68.4%) patients. Septicemia - positive blood cultures were present in 16 (16.3%). The most common pathogens isolated were *Kl. pneumoniae* (n=42, 42.9%) and *E. Coli* (n=11, 11.2%). There were 12 (17.6%) patients with polymicrobial pathogenic flora. In 31 patient (n=31, 31.6%) no pathogen was isolated, these patients were attributed to CNPLA group.

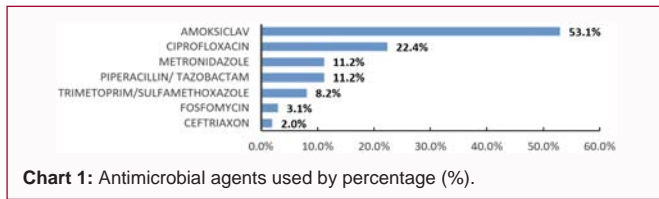


Chart 1: Antimicrobial agents used by percentage (%).

Enterococcus was isolated in 4 (4.1%) of cases and facultative anaerobes such as *Proteus mirabilis*, *Citrobacter freundii* in 2 (2%) of cases.

Antimicrobial resistance after obtaining abscess or blood cultures was noted in 60 (61.2%) of the patients Table 3. Ampicillin resistance was the most common in 59 (60.2%) cases, Amoxiclav - 13 (13.3%), Cefazidime - 10 (10.2%), Ciprofloxacin - 9 (9.2%), Trimethoprim/Sulfamethoxazole - 7 (7.1%) of cases. ESBL positive microorganisms were isolated from 9 (9.2%) patient cultures.

In 66.7% of cases, the liver abscess was solitary, while in 33.3% - the pathology was multifocal. The most common location of the abscess was in the right lobe (62.5% of cases), with 14.6% of cases showing abscess formation in both lobes. The median size of the abscess was 6.7 cm ([IQR] = 8.0-5.0 cm).

The most common risk factor observed was concomitant non-malignant biliary tract pathology, noted in 30 patients (30.6%). Diabetes mellitus was present in 26 patients (26.5%), while an initial infection at another site was found in 5 cases (5.1%). Additionally, for 24 patients (24.5%) this was a recurrence of PLA, with at least one previous episode. Amoxiclav was the most used antimicrobial agent employed in treatment of 52 patients (53.1%). The summary of antimicrobial agents used is provided in Chart 1.

Alongside antibiotic treatment, percutaneous drainage or needle aspiration was performed in 84 (85.7%) patients. Surgical management was required in 6 (6.1%) cases following a failed percutaneous approach, while abscess location beyond the reach of percutaneous drainage or the presence of large, multiloculated abscesses not amenable to percutaneous drainage warranted an outright surgical approach in 8 (8.2%) cases. Additionally, one patient received antimicrobial treatment alone without any interventions.

The percutaneous drainage was left in place for a median of 6 days ([IQR] = 10.5-4.0), while the median hospitalization time was 9 days (IQR = 13.0-6.0). Upon discharge, the median leukocyte level was 8.0/mm³ (IQR = 10.6-6.0), and CRP levels were 56.0 mg/dl (IQR = 115.5-31.09).

The study revealed a median hospitalization duration of 9 days ([IQR] = 13.0-6.0). Upon evaluating its correlation with various factors, we found association in multiple parameters. Notably, biliary disease emerged as the sole risk factor impacting hospitalization time, with a median of 11 days (IQR= 14.8-7.0) compared to 8 days (IQR = 11.5-5.0) for patients without biliary tract conditions (Mann-Whitney U=670; p=0.028). Patients exhibiting antimicrobial resistance also experienced a noteworthy impact on hospitalization duration, with a median of 10.0 days (IQR = 14.0-6.00) compared to 6.5 days (IQR = 10.3-5.0) for those without such resistance (Mann-Whitney U=775; p=0.027).

The number of abscesses also played a role in hospitalization duration. Patients with solitary abscesses had a median hospitalization time of 7 days (IQR = 11.0-5.0), whereas those with multifocal spread

experienced a median of 11 days (IQR = 16.0-8.25) (Mann-Whitney U=520; p=0.001).

Patients treated with Percutaneous Drainage (PD) had a median stay of 8 days (IQR = 12.0-6.0), compared to 11 days (IQR = 14.0-8.5) for those undergoing surgery, and 17 days (IQR = 25.3-9.5) for patients who required surgical management following an unsuccessful PD (Kruskal-Wallis $X^2=6.40$; $df=2$; $p=0.041$).

All patients were recommended to attend a follow-up visit one to two months after discharge. Of these, 43 patients returned for follow-up at PSKUS. Imaging control was conducted on 32 patients using either Ultrasound (US), Computed Tomography (CT), or Magnetic Resonance Imaging (MRI). Disease clearance was observed in 17 patients (53%), while 5 patients showed residual changes in liver parenchyma after PD (such as a cavity without content or calcification around the abscess cavity). Additionally, 10 patients (31%) exhibited a residual abscess. Recurrence during the study period was noted in 8 patients from our cohort. Intrahospital mortality was 2% (n=2).

Discussion

Epidemiology

The epidemiological parameters of patients with pyogenic liver abscess have evolved over the last few decades due to changes in its etiology [2]. Biliary tract disease has emerged as the primary cause of the PLA, surpassing the previously most common cause, acute appendicitis, due to improvements in its recognition and management [3]. The predominance of biliary tract disease as the main cause of pyogenic liver abscess is also in line with our findings. Portal spread is now considered a very rare cause in most cohorts [4] and our study did not identify any cases directly linked to underlying peritonitis due to purulent intra-abdominal pathology (e.g., appendicitis, diverticulitis). The mean age of 64.8 years and slight male predominance at 52% are also consistent with recent data from multiple cohorts and have been influenced by shifts in etiology.

Clinical presentation

Elevated White Blood Cell counts (WBCs) and C-Reactive Protein (CRP), along with nonspecific clinical findings such as abdominal pain and fever, can raise suspicion for an unknown bacterial infection but are not pathognomonic. A more specific sign, jaundice, was present in only 3 patients (3.1%), thus not proving to be a potentially useful indicator for PLA.

Imaging

Ultrasound is a cost-effective and sensitive modality for screening possible liver abscesses in patients with compatible clinical findings. The sensitivity of abdominal ultrasound performed in the Emergency Department (ED) is reported to be 85% [5], but this figure varies widely, ranging from 97% to just 62% in some studies [2,5,6], potentially due to its reliance on the expertise of the operator. It's worth noting that liver abscesses lack a definitive sonographic appearance and exhibit high variability [6]. Point-of-Care Ultrasound (POCUS) has demonstrated a sensitivity of up to 92% [5] offering potential improvements in abscess detection, particularly in anatomically challenging areas such as liver segment 8. In our study, all patients underwent an abdominal CT scan (with intravenous contrast if renal function allowed) and/or MRI to identify underlying biliary diseases. CT scans can detect liver abscesses with up to 97% sensitivity [5,7] and are valuable in identifying underlying pathology as well as detecting all lesions, especially in cases of multiple liver abscesses.

Location

This study revealed a predilection for the right lobe (62.5% of cases) as the location of PLA, with involvement of both lobes observed in 14.6% of cases – a common finding in PLA cohorts [8]. This distribution is often attributed to the anatomy of the portal vein and the larger size of the right lobe. While this explanation clarifies abscesses originating from other sites in the Gastrointestinal (GI) tract, it does not offer further insight beyond the sheer size discrepancy between the right and left lobes when discussing PLA originating from biliary disease.

Antimicrobial treatment

Antibiotic treatment was initiated in all patients. Broad-spectrum antibiotics are commonly employed before culture results as a cornerstone of management in most institutions. However, no randomized controlled studies have evaluated antimicrobial regimens in the treatment of PLA. Recommendations largely rely on local resistance data, which are subject to rapid change. In our institution, most patients were initially treated with Amoxiclav (53.1%), with adjustments made in 13.3% of cases due to resistance. Our current guidelines recommend initiating treatment with Ceftriaxone in combination with Metronidazole for PLA. However, in our study, Ceftriaxone was used in only 2% of cases and Metronidazole in 11.2%. Ciprofloxacin was the preferred choice for prolonged oral use after adjustment based on culture results.

Percutaneous drainage vs. surgical management

Most patients in our institution underwent Percutaneous Drainage (PD) in conjunction with antibiotic therapy. PD was successful in 83 cases (84.7%). Six patients (6.1%) required surgical intervention following unsuccessful PD attempts, while eight patients (8.2%) underwent surgical treatment without attempting PD due to abscess location or dimensions. This approach aligns with other cohorts advocating for surgical management of large, multilocular liver abscesses [9]. From the patients requiring surgical management due to unsuccessful PD, it was mostly due to septated abscess or due to multiple abscesses in proximity to one another but with no anatomical junction. Only one patient in our study was managed solely with antibiotic treatment, receiving Amoxiclav, and demonstrated disease clearance during the two-month follow-up period. This patient presented with multiple bi-lobar (PLAs), with the largest measuring 5.2 cm in diameter. We advocate for invasive management - emphasizing at least percutaneous needle aspiration as both curative and investigative, however we recommend the utilization of Percutaneous Drainage (PD) whenever feasible. This approach is consistent with recommendations and allows for targeted antimicrobial therapy following culture acquisition [10].

Microbiological findings

Abscess cultures yielded positive results in 68.4% of cases, while positive blood cultures indicating septicemia were present in 16.3%. These findings align with results from larger cohort studies [11], yet fall short in terms of obtaining positive cultures compared to certain studies with smaller sample sizes [12]. This discrepancy may be attributed to delayed PD procedures, initiated after antibiotic treatment has already commenced. A potential solution to this issue could involve prompt utilization of PD, ideally immediately after diagnosis is established in the emergency department, prior to the patient's admission to the ward.

Out of the 67 (68.4%) patients with positive abscess cultures, 12

(17.6%) were polymicrobial. The most commonly isolated pathogens were *Klebsiella pneumoniae* (n=42, 42.9%) and *Escherichia coli* (*E. coli*) (n=11, 11.2%), with three patients (3.1%) exhibiting a combination of both. Additionally, facultative anaerobes such as *Enterococcus* (n=4), *Citrobacter freundii* (n=2), and *Proteus mirabilis* (n=2) were identified in acquired cultures. The predominance of *E. coli* and *K. pneumoniae*, either alone or in combination, in our study aligns with findings from other studies involving similar Caucasian populations [13]. The significant proportion of patients with polymicrobial and anaerobic abscess cultures supports the utilization of initial broad-spectrum anti-microbial regimens [11]. Due to the phenomenon of antibiotic resistance, bacterial infections pose challenges in terms of treatment efficacy. The impact of antibiotic resistance varies geographically across different regions worldwide. Within South China, a study involving patients diagnosed with pyogenic liver abscesses highlights the prevalence of carbapenem-resistant *Klebsiella pneumoniae* strains, which demonstrates resistance to most antibiotics. Tigecycline and Cotrimoxazole emerge as the only agents displaying effectiveness against these strains. Conversely, carbapenem-sensitive *Klebsiella pneumoniae* strains exhibit susceptibility to most antibiotics, with resistance observed solely against Ampicillin and Nitrofurantoin [14]. In Peshawar, Pakistan, research indicates resistance among *E. coli* and *Kl. pneumoniae* strains responsible for pyogenic liver abscesses against Amoxicillin and Oxacillin [15]. Studies within the United Kingdom, particularly in London, have identified resistance among isolated microorganisms such as *E. coli* and *Kl. pneumoniae*. Notably, resistance is observed against first-line empiric antibiotics including Co-amoxiclav, Piperacillin/Tazobactam, and Metronidazole [16]. Similarly, research in the United States has revealed *Kl. pneumoniae* resistance against Ampicillin, Piperacillin/Tazobactam, and Cefuroxime [17].

Factors prolonging hospitalization

We identified multiple factors that significantly prolonged hospitalization time, including biliary tract disease, positive antimicrobial resistance, multifocal abscesses, and surgical management. Patients presenting with biliary tract disease had either cholecystitis or choledocholithiasis, with several requiring ERCP during hospitalization, contributing to longer stays. Antimicrobial resistance had a significant impact on hospitalization time, particularly resistance to Ampicillin (Mann-Whitney U=766; p=0.019) and ESBL-positive cultures (Mann-Whitney U=189; p=0.012). Resistance to Amoxiclav, Cefazidime, and Trimethoprim/Sulfamethoxazole showed no statistical significance, nor did positive blood cultures indicating septicemia. Patients with multilocular abscesses also had prolonged hospitalization times. This can be attributed to the need for repeated PD procedures for adequate drainage, potential switching to a surgical approach, and a slower response to antimicrobial treatment due to the combined size of the lesions. Although some studies link maximal abscess diameter with longer hospitalization times and poor prognosis, our study did not find statistical significance for this parameter [18]. There was a statistically significant difference in hospitalization times when comparing invasive management options. Notably, surgical management following a failed initial PD resulted in the longest hospitalization times. This can be attributed to the prolonged decision-making process and multiple PD attempts to achieve adequate drainage. However, there was no statistically significant difference when comparing PD with an outright surgical approach. This finding underscores the importance of initial decision-making and suggests that in certain cases, guidelines should

recommend opting for a surgical approach without attempting PD first.

Limitations of the study

Follow-up was limited due to the heterogeneity of the cohort, with many patients receiving follow-up care at regional hospitals or missing it altogether. A significant limitation of our study is that the cohort does not fully represent the local incidence of PLA, nor the full incidence within our institution, as it includes only patients treated by the surgical hepatobiliary unit. A comprehensive, population-based study would provide a more thorough understanding of current management practices and facilitate further systematization to improve outcomes.

Conclusion

The primary treatment for a Pyogenic Liver Abscess (PLA) is Percutaneous Drainage (PD), but there are no universal guidelines for antimicrobial management, leading to institution-specific practices. Our study observed various antimicrobial regimens, with few aligning with the current hospital guidelines for initial broad-spectrum antibiotics. We identified several factors that extend hospitalization for PLA patients, but found discrepancies with the literature regarding conservative management, which was attempted in only one case. Enhancing the process of obtaining cultures and increasing the number of positive culture cases could improve targeted antimicrobial therapy, thereby reducing the risk of developing antimicrobial resistance.

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