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Pyogenic liver abscess following biliary stent placement in pancreatic cancer patients: a retrospective case series

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Abstract

Biliary stent placement is widely used in clinical, especially in patients with pancreatic cancer complicated with obstructive jaundice. Pyogenic liver abscess (PLA) is a severe complication following biliary stent placement which predominantly occurs in the right lobe of the liver, with an incidence rate ranging from 4.3% to 13.5% and a mortality rate up to 30%. It is related to the following mechanisms: retrograde bacterial infection; bile stasis and increased bile duct pH; stent-related bile duct injury; biofilm formation; immune system suppression. The main causative pathogens are gram-negative bacilli, particularly *Escherichia coli* and *Klebsiella pneumoniae*. The combination of antibiotic therapy and percutaneous transhepatic abscess drainage is the main treatment option.

Keywords Pyogenic liver abscess, Biliary stent, Pancreatic cancer

Biliary stent placement is a common surgical procedure used to treat biliary strictures and obstructions [1], and it is widely applied in both malignant and nonmalignant biliary strictures [2]. Although this procedure offers significant advantages in reducing biliary pressure, alleviating jaundice, and improving patients' quality of life, it also presents potentially serious complications, one of which is pyogenic liver abscess (PLA) [3]. The incidence of PLA following biliary stent placement has been reported to range from 4.3% to 13.5% [4–6], with a mortality rate as high as 30% [4]. However, most studies have little samples and include a variety of disease categories, and no systematic studies have specifically focused on the occurrence of PLA in pancreatic cancer patients with obstructive jaundice following biliary stent placement. This article analyses 9 cases of pancreatic cancer patients who were diagnosed with PLA after biliary stent placement at our center, describes their clinical characteristics and treatment outcomes, and aims to provide a reference for future clinical research.

Materials and methods

We retrospectively identified 9 patients diagnosed with PLA following biliary stent placement among 98 pancreatic cancer patients treated at our center between October 2020 and May 2024. Cases were confirmed via imaging, clinical symptoms, and microbiological records. Postoperative complications (e.g., pancreatitis, biliary leakage) were monitored using standardized criteria [7–9], though none occurred in this series. The retrospective study was conducted in accordance with the principles of the Declaration of Helsinki, which was approved by the hospital's Medical Ethics Committee(ethics approval number: 2024-KL020, date of approval: July 31, 2024). As

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this study is a retrospective clinical study, patients were exempted from informed consent.

Statistical analysis was performed via SPSS version 29.0. Continuous variables with a normal distribution are expressed as the means ± standard deviations, whereas skewed data are presented as the medians (M) with ranges. Categorical variables are described as frequencies and percentages (%).

Results

Among 98 pancreatic cancer patients with biliary stents, 9 (9.2%) developed PLA. The clinical characteristics of these cases are summarized below. Among 9 PLA patients, 6 were male and 3 were female, with a mean age of 63.3 ± 5.5 years (range: 56–71 years). All 9 patients were diagnosed with pancreatic ductal adenocarcinoma of the pancreatic head. The preoperative laboratory results for these patients were as follows: CA19-9: 757.4 ± 167.5 U/mL; glycated hemoglobin (%): 6.3 ± 0.2; alanine transaminase (ALT): 291.2 ± 66.2 U/L; aspartate transaminase (AST): 258.1 ± 59.3 U/L; plasma albumin: 37.4 ± 1.8 g/L; total bilirubin: 87.2 ± 16.5 μmol/L; and alkaline phosphatase: 367.8 ± 44.7 U/L (Table 1).

The mean duration of endoscopic surgery was 38.9 ± 2.7 min, with no recorded intraoperative blood loss and transfusions. No postoperative complications (e.g., pancreatitis, biliary leakage) were observed.

Seven pancreatic cancer patients (77.8%, 7/9) received chemotherapy after biliary stent placement, and 1 patient (11.1%, 1/9) underwent radiofrequency ablation (RFA). The average time to the occurrence of PLA was 4.3 ± 1.3 months post stent placement (range: 2.0–14.5 months). According to the imaging results, the average size of the PLA poststent placement was 4.2 ± 0.8 cm (range: 1.5–10.9 cm). Single abscess patients accounted for 66.7% (6/9), whereas multiple abscess patients accounted for 33.3% (3/9). Among the single abscesses, 1 was located in the left lobe of the liver (1/6), and the remaining were located in the right lobe (5/6) (Fig. 1). All 9 patients had fever. Blood cultures were performed for 8 PLA patients, with a positivity rate of 75.0% (6/8). 8 patients underwent percutaneous liver abscess puncture and drainage, 7 of whom had pus cultures; the positivity rate was 85.7% (6/7).

The blood culture results revealed that *Klebsiella pneumoniae* (37.5%, 3/8) was the most common pathogen. Other 3 results included *Enterobacter cloacae* + *Enterococcus faecium*, *Enterococcus faecalis*, and *Escherichia coli*. In pus cultures, *Klebsiella pneumoniae* (42.9%, 3/7) and *Enterococcus faecalis* (28.6%, 2/7) were the most common pathogens. Among the 7 patients with positive pus cultures, 2 had mixed infections with two types of bacteria (28.6%, 2/7). Additionally, atypical infections such as *Pseudomonas aeruginosa* were also observed (Table 2).

For patients with PLA following biliary stent placement, considering the immunosuppression caused by tumors and chemotherapy, the preferred treatment approach is the combination of antibiotics and percutaneous drainage (77.8%, 7/9). All patients received intravenous antibiotics upon hospitalization. Initially, third-generation cephalosporins, carbapenems, and other effective antibiotics were chosen before microbiological sensitivity data were available, with antibiotics adjusted on the basis of culture results. The average hospitalization cost was 86,589.2 ± 26,258.8 CNY, with antibiotic costs amounting to 9,484.8 ± 1,764.6 CNY, accounting for 10.9% of the total costs. The average length of hospital stay for the 9 PLA patients was 32.7 ± 9.2 days (range: 17–104 days). 2 patients experienced recurrent PLA requiring further treatment, and no surgical drainage was performed. Follow-up until May 31, 2024, revealed 6 deaths among the 9 PLA patients, with an average overall survival of 14.6 ± 5.7 months for the deceased PLA patients.

Table 1 Preoperative laboratory results of 9 patients with PLA following biliary stent placement

Case	CA19-9(U/mL)	Glycated Hemoglobin (%)	ALT(U/L)	AST(U/L)	Albumin(g/L)	Total Bilirubin(umol/L)	Alkaline Phosphatase(U/L)
1	542.9	6.0	224.0	138.0	37.0	174.1	219.0
2	736	6.1	401.0	188.4	37.3	93.2	380.0
3	1587.3	5.9	82.9	171.3	28.2	72.5	338.0
4	980.4	6.1	42.8	237.3	43.0	42.8	356.0
5	40.5	7.4	408.0	180.0	44.1	81.3	453.0
6	68.7	5.9	62.1	44.0	30.9	23.1	105.0
7	823.5	5.7	333.9	260.0	42.8	42.0	477.0
8	788.3	6.3	467.9	521.9	35.6	113.9	459.0
9	1248.8	7.5	598.2	581.7	38.1	141.9	523.0

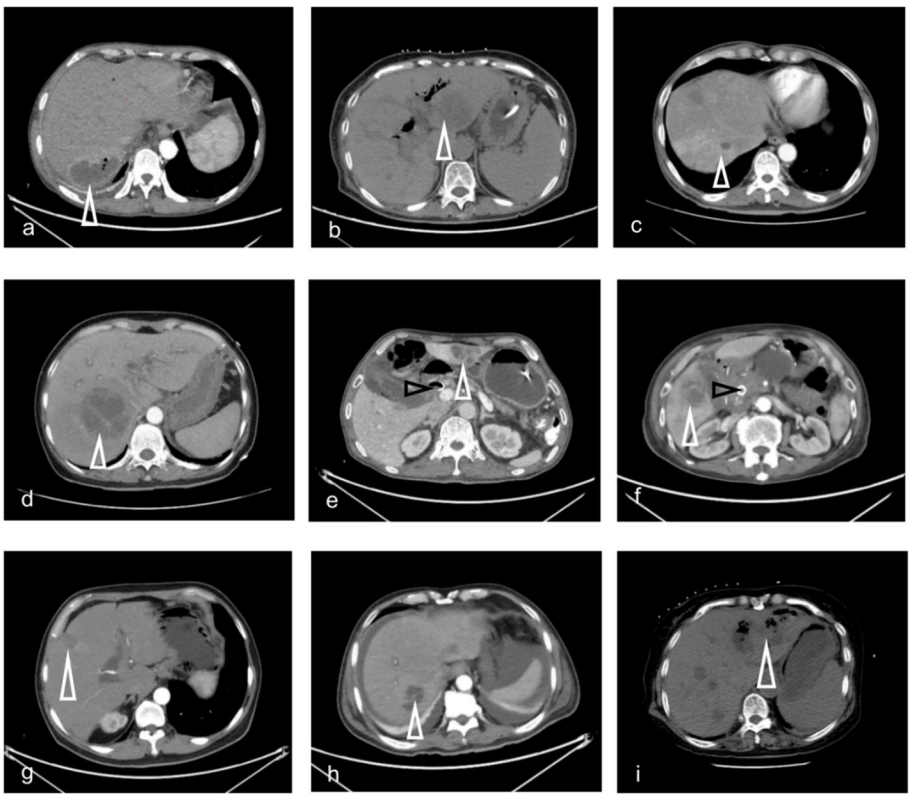

Fig. 1 CT images of 9 PLA patients. The black arrows indicate the biliary stent. The white arrows indicate the PLA lesions, which typically present as hypoechoic areas in the liver with possible peripheral enhancement. Images (**a**) and (**i**) show gas within the abscess. Image (**c**) corresponds to a patient with a small PLA lesion who did not undergo puncture treatment. Image (**f**) corresponds to a patient who received RFA treatment postoperatively, with the PLA developing in the original RFA treatment area one month later)

Table 2 Clinical characteristics of the PLA patients

Case	Number	Location	Treatment Method	Pus Culture	Blood Culture	Total Cost	Antibiotic Cost
1	Single	VI	Antibiotics + Drainage	*Klebsiella pneumoniae, Enterococcus faecalis*	*Klebsiella pneumoniae*	79,356.1	12,316.1
2	Single	IV	Antibiotics + Drainage	*Klebsiella pneumoniae*	*Klebsiella pneumoniae*	61,600.1	9,278.71
3	Single	VII	Antibiotics + Drainage	*Klebsiella pneumoniae*	Negative	70,453.4	5,776.8
4	Multiple	Right Lobe	Antibiotics + Drainage	*Enterococcus faecalis*	*Enterococcus faecalis*	71,890.4	9,906.2
5	Multiple	Left Lobe	Antibiotics + Drainage	*Enterobacter cloacae, Enterococcus faecium*	*Enterobacter cloacae,Enterococcus faecium*	290,933.7	21,666.4
6	Single	VI	Antibiotics	Not Punctured	Not tested	60,132.7	4,990.6
7	Single	V	Antibiotics + Drainage	*Pseudomonas aeruginosa*	*Escherichia coli*	76,141.8	9,234.9
8	Single	VII	Antibiotics + Drainage	Negative	Negative	18,927.6	3,795.4
9	Multiple	Left Lobe	Antibiotics	Not tested	*Klebsiella pneumoniae*	49,866.6	8,397.9

Discussion

PLA is a serious infection that can lead to sepsis, liver failure, and death [10]. The incidence of PLA in the general population is reported to be 2.3 to 15.5 per 100,000 people [11, 12], whereas the incidence following biliary stent placement ranges from 4.3% to 13.5% [4–6], which is significantly higher than that in the general population. However, there are no published studies specifically addressing the incidence of PLA in pancreatic cancer patients undergoing biliary stenting.

Cameron et al. reported that in patients with malignant biliary obstruction and stent placement, PLAs are often solitary and located in the right liver lobe [13]. In our retrospective study, 55.6% of patients had solitary abscesses in the right liver lobe, which is consistent with the findings of previous studies. Following biliary stent placement, bacteria can ascend retrogradely through the bile duct into the intrahepatic bile duct system [14]. Once within the liver, bacteria can localize and proliferate, ultimately forming liver abscesses [15]. In cases of PLA, gram-negative bacteria are the most frequently isolated pathogens, accounting for 40% to 60% of cases [16], with *Escherichia coli*, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa* being the most common [17]. *Anaerobes* account for 35% to 45% of liver abscess pathogens, whereas *Streptococcus*, *Staphylococcus*, and *Enterococcus* infections are relatively less common [17, 18]. In recent years, infections caused by highly pathogenic *Klebsiella pneumoniae* have increased, particularly in Southeast Asia, where some reports indicate an infection rate as high as 80% [19, 20]. Similar cases have also been increasingly reported in the US and Europe [21]. Zheng et al. reported that *E. coli* infections account for 21% to 36% of cases in patients with PLA after biliary surgery, followed by *Klebsiella pneumoniae* infections (9% to 31%), with *polymicrobial* infections occurring in 40% to 68% of cases [4]. When studying the microbiome of the PLA in pancreatic cancer patients post biliary stenting, it is important to consider not only the displacement of the gut flora but also the changes in the gut microbiota induced by pancreatic cancer. Sammallahti et al. reported increased abundances of *Firmicutes*, *Bacteroides*, and *Proteobacteria* in the gut microbiota of patients with pancreatic cancer compared with normal individuals [22]. Similar results were reported by Thomas et al. [23]. Our study also identified *Klebsiella pneumoniae* and *Escherichia coli* as the primary pathogens, which aligns with previous reports by Zheng et al., but further research with larger sample sizes is needed to validate these findings.

Biliary stent placement can lead to obstructed bile flow and bile reflux, resulting in increased pressure within the bile ducts, bile stasis, and elevated bile duct pH. These conditions create a favourable environment for intestinal bacteria to proliferate within the bile ducts [24, 25]. Mechanical damage to the bile duct mucosa caused by stent placement can disrupt the integrity of the bile duct and serve as a portal for bacterial invasion [26], making it easier for bacteria to penetrate the bile duct wall and enter the surrounding liver tissue. Additionally, the long-term presence of the stent may trigger a chronic inflammatory response, further increasing the risk of infection. Previous studies have also identified biofilm formation as a significant factor in bacterial infections and the development of PLA following stent placement. Biofilms formed on the stent surface can resist antibiotic penetration and host immune clearance [27], leading to the development of difficult-to-treat infections. Moreover, in pancreatic cancer patients, the immune system may be compromised by various factors, including the tumor itself, diabetes, and the use of immunosuppressive drugs [28, 29]. Reduced immune function diminishes the body's ability to defend against bacterial infections, facilitating bacterial growth and proliferation in the liver and ultimately leading to the formation of PLA.

Early empirical antibiotic therapy is crucial for controlling infection following the development of PLA after biliary stent placement. The choice of antibiotics should initially cover common gram-negative and anaerobic bacteria. Antibiotic therapy should be adjusted on the basis of the results of pus and blood cultures. However, many experts believe that percutaneous transhepatic abscess drainage (PTAD) remains the most effective treatment for these infections [30, 31]. Currently, the primary approach for treating PLA includes antibiotic therapy combined with PTAD. As early as 1953, McFADZEAN et al. reported the successful treatment of 14 cases of single liver abscesses via intravenous antibiotics, percutaneous aspiration, and abscess cavity antibiotic lavage [32]. Recent studies increasingly support the use of image-guided percutaneous drainage (such as ultrasound or CT-guided drainage) as the preferred method for larger or multiple liver abscesses, with surgery as a secondary option if necessary [33–35]. In our retrospective study, 8 of 9 patients received PTAD combined with antibiotic therapy, whereas 1 patient refused PTAD and received only antibiotics. All patients experienced symptom relief and had their drainage tubes removed before discharge. 2 patients experienced recurrence of PLA after discharge; however, the abscesses resolved after additional PTAD. Furthermore, for PLA resulting from stent obstruction, it is advisable to consider stent replacement or cleaning to restore bile drainage and reduce the risk of reinfection.

To our knowledge, this is the first case series specifically investigating PLA in pancreatic cancer patients with biliary stents. This population faces unique challenges due to immunosuppression from both malignancy and chemotherapy, altered biliary anatomy post-stenting, and biofilm formation on stents. Our findings highlight two key distinctions from prior studies: (1) a high rate of polymicrobial infections (44.4%, 4/9 cases), contrasting with the predominantly monomicrobial flora reported in non-cancer populations [16, 17]; and (2) delayed abscess resolution despite PTAD, suggesting the need for prolonged antibiotic regimens in immunocompromised patients. We propose a surveillance protocol for early PLA detection in this high-risk group, including routine

bile cultures and imaging follow-up at 3-month intervals post-stent placement.

Conclusion

Postoperative PLA in patients with pancreatic cancer, although a rare complication, significantly impacts patient prognosis. The occurrence of PLA may be related to the following mechanisms: bacterial retrograde infection; biliary stasis and increased pH; stent-associated biliary injury; biofilm formation; immune system suppression. Understanding these mechanisms, the evolving patterns of pathogenic bacteria, and effective treatment strategies is essential for advancing the understanding of this condition and developing new approaches for treating PLA.

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Authors' contributions
DXG and YM designed the research. DXG and NL collected the data and performed the analysis. DXG and NL prepared the manuscript draft. YM provided research support and revised the manuscript. All the authors read and approved the final manuscript.

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Data availability
Data is provided within the manuscript.

Declarations

Ethics approval and consent to participate
This study was approved by the ethics committee of the Affiliated BenQ Hospital of Nanjing Medical University (Approval No. 2024-KL020; Date: July 31, 2024). The requirement for informed consent was waived by the ethics committee due to the retrospective nature of the study, in accordance with national regulations and the Helsinki Declaration.

Consent for publication
Not Applicable.

Competing interests
The authors declare no competing interests.

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