

Does Liver Resection Remain a Viable Option in Patients With Pyogenic Liver Abscess? A Single-Center Experience

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Abstract

Pyogenic liver abscesses (PLAs) are relatively rare but often fatal if left untreated. Antibiotic therapy combined with percutaneous procedures has replaced surgery as the cornerstone of treatment. However, open surgical drainage or liver resection may be a last resort. This study aimed to review our experience in treating PLA, with a focus on the conditions requiring partial liver resection as the last viable curative option. Medical records of patients with PLA admitted to Jordan Hospital between October 2014 through October 2020 were retrospectively reviewed. Medical and demographic data of all 43 patients admitted to our facility with a diagnosis of PLA were extracted. We reviewed these patients and extracted the cases that required surgical intervention. Four (three males and one female) of the 43 patients with PLA required surgical intervention. The underlying causes of liver abscesses were as follows: one traumatic due to shrapnel injury from an explosion, one following chemoembolization for hepatocellular carcinoma, and two patients with no apparent etiology. All patients were diagnosed with a computed tomography (CT) scan of the abdomen and pelvis with intravenous contrast. Two patients had negative cultures. All patients received broad-spectrum antibiotics, and all underwent CT- or ultrasound-guided percutaneous drainage or aspiration. All four patients required partial hepatic resection due to treatment failure or inaccessible percutaneous procedures with clinical improvement. Although antimicrobial and interventional therapy remains the primary treatment option in PLA, the surgical option with

open surgical drainage or partial liver resection remains viable and curative in selected patients.

Keywords: Liver abscess; Liver resection; Interventional therapy; Antibiotics

Introduction

Pyogenic liver abscess (PLA) is a life-threatening disease with a mortality rate of 11-31% and almost 10,000 acute morbidities per year [1]. PLA is accompanied by risk factors and chronic diseases such as cardiovascular diseases, malignancies, diabetes mellitus, liver cirrhosis, cholangitis, urinary tract diseases, pneumonia, autoimmune diseases, and malnutrition [2]. However, up to 55% of patients with PLA have no known risk factors [3]. Clinical manifestations are initially nonspecific and easily misdiagnosed.

Diagnosing and treating liver abscesses can be challenging. Antibiotic therapy is usually carried out first, followed by ultrasound (US) or computed tomography (CT)-guided percutaneous drainage or aspiration [4]. Historically, surgical drainage was the only adjunct to antimicrobial therapy. Systemic antibiotics and percutaneous intervention are efficient and safe for curing most liver abscesses [5]. Nevertheless, a minority of liver abscesses may require surgical intervention, mainly partial liver resection [5]. In these situations, the surgical option provides a final life-saving anchor with source elimination.

This study retrospectively reviewed our 5-year experience of 43 PLA patients diagnosed and treated at Jordan Hospital. We present the four cases that required surgical intervention to uncover the risk factors, common pathogens, and the surgical option as the last viable curative option.

Case Reports

Methods

Our institution's ethics committee granted ethical approval to this study, which was then conducted per the Declaration

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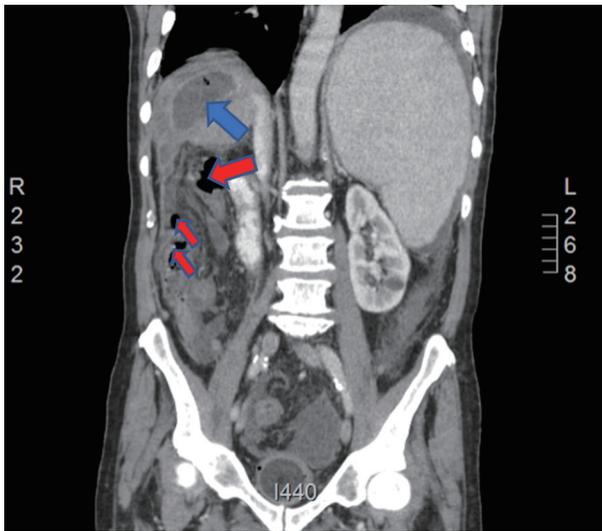


Figure 1. Coronal CT of abdomen and pelvis on presentation with IV contrast showing a 7 × 5 cm fluid density with gas pockets in segment VII peripherally (blue arrow) associated with moderate ascites and multiple gas pockets in the right subhepatic region (red arrows). CT: computed tomography.

of Helsinki. Demographic and clinical data of all patients admitted to our hospital with liver abscesses between October 2014 through October 2020 were retrospectively entered into a database. The data were obtained from a combination of chart reviews and records at the Jordan Hospital. These data were reviewed to document clinical presentation, etiology, diagnostic workup, treatment, morbidity, and mortality. Aspiration material at the time of primary abscess drainage was regularly sent for microbial culture and sensitivity analysis.

Case 1

A 75-year-old male with a past medical history of atrial fibrillation, chronic hepatitis B, liver cirrhosis, and hepatocellular carcinoma (HCC) status post-trans-arterial chemoembolization (TACE) 3 months prior presented with upper abdominal pain, abdominal distension, and anorexia. The physical exam was remarkable for a febrile patient with scleral icterus. The abdomen was distended with tenderness to palpation in the right upper quadrant (RUQ) without rebound tenderness or rigidity and with positive bowel sounds. Laboratories were remarkable for a leukocytosis of 17.6×10^3 cells/dL, C-reactive protein (CRP) of 249, albumin of 3.1, alkaline phosphatase (ALP) of 70, and international normalized ratio (INR) of 2. Alanine transaminase (ALT) and aspartate transaminase (AST) were normal, and blood cultures were negative. He was initially treated conservatively via nasogastric tube insertion, intravenous (IV) hydration, and IV antibiotics. Abdominal and pelvic CT scan with IV contrast showed a fluid density of 7 × 5 cm with gas pockets in segment VII peripherally associated with moderate ascites and multiple gas pockets in the right subdiaphragmatic region (Fig. 1). CT-guided aspiration

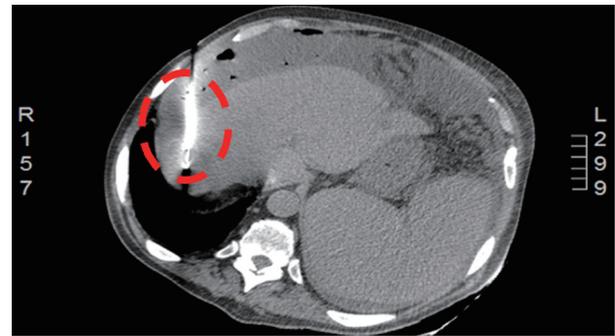


Figure 2. CT of abdomen 9 days after abscess drainage showing a percutaneous drain in segment VII (encircled). CT: computed tomography.

of the abscess was performed, and a small amount of thick gelatinous bloody fluid was aspirated and sent for culture and sensitivity (Fig. 2). Aspiration drainage grew *Enterococcus faecium*. The patient’s clinical condition deteriorated, and he developed multiple peaks of high-grade fever, atrial fibrillation with a rapid ventricular response, hypotension, and altered mental status. CT-guided drainage of the liver abscess was challenging since the abscess was large, and the decision to surgically drain the abscess was pursued. The patient underwent surgery through an inverted L-abdominal incision and was found to have a large subphrenic abscess extending from the anterolateral surface of the liver posteriorly to segment VII, contiguous with the intrahepatic abscess (segment VII). Both abscesses were drained along with the resection of segment VII. The cultures grew *Escherichia coli* (extended spectrum beta-lactamase). His clinical condition remains stable postoperatively, and he was discharged on the sixth postoperative day. Follow-up CRP was 39, and CT of the abdomen and pelvis 3 months later showed enlarged liver with stigmata of cirrhosis with no clear evidence of a focal liver lesion (Fig. 3).

Case 2

A 48-year-old female with a past medical history of nonspecific inflammatory cecal mass and recurrent multiple liver ab-

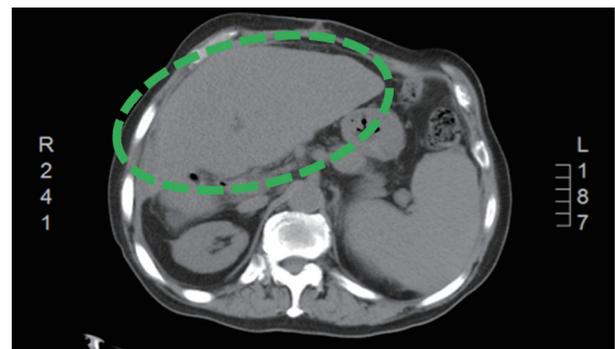


Figure 3. A follow-up CT of abdomen and pelvis (3 months after discharge) showing enlarged cirrhotic liver without definite evidence of a focal liver lesion (green encircled). CT: computed tomography.

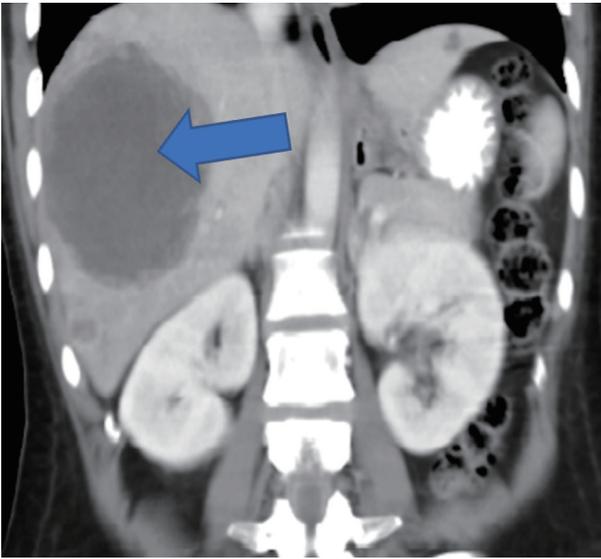


Figure 4. CT of abdomen and pelvis (2 months prior to presentation) showing multiple different sized cystic lesions, many of them with ring enhancement seen scattered in both lobes of the liver, with the largest measuring about 10 cm and located in segment VII (blue arrow). CT: computed tomography.

scases presented with epigastric pain, abdominal distention, and fever. CT of abdomen and pelvis with IV contrast 2 months prior showed numerous cystic lesions scattered in both lobes of the liver, with the largest measuring 12×10 -compressing segment VII (Figs. 4, 5). She failed 6 weeks of IV antibiotics and two attempts at percutaneous liver abscess drainage (Figs. 4, 5). Physical examination was notable for a soft abdomen and tenderness in the RUQ area, with no rebound tenderness or rigidity. Laboratory evaluation was notable for leukocytosis of 14.4×10^3 cells/dL (with a shift to the left), a CRP of 240, albumin of 2.8, and ALP of 46. Blood cultures were negative. CT of abdomen and pelvis showed a recurrence of abscess in segment VII measuring 11.6×10.4 cm (Fig. 6). CT-guided drainage of the right liver abscess was performed with negative aspirated fluid cultures. Due to treatment failure, the sur-

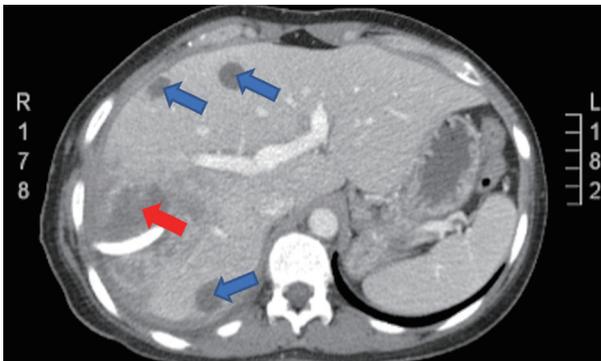


Figure 5. CT of abdomen and pelvis with IV contrast 2 months prior showing numerous cystic lesions (blue arrows) scattered in both lobes of the liver, with the largest measuring 12×10 cm compressing segment VII (red arrow). CT: computed tomography.

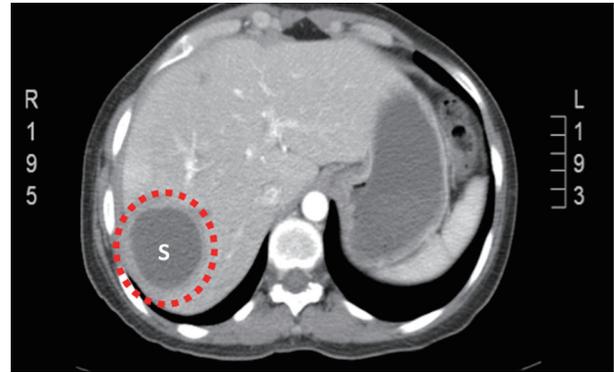


Figure 6. CT of abdomen and pelvis (on admission) showing abscess recurrence in segment VII (encircled). CT: computed tomography.

gical option was planned. The patient underwent a cholecystectomy with resection of segment VII and most of segment VI through the right abdominal subcostal incision. Follow-up ultrasound 3 weeks later showed complete resolution with no evidence of liver abscess.

Case 3

A 44-year-old male with no significant past medical history presented with fever, chills, rigors, right upper abdominal pain, and shortness of breath. Four weeks earlier, he had similar manifestations and was diagnosed with a right-sided pleural effusion and basal consolidation and treated conservatively with oral antibiotics. Labs were notable for leukocytosis of 15.7×10^3 cells/dL with left shift, CRP of 201, erythrocyte sedimentation rate (ESR) of 104 mm/h, albumin of 2.9, and ALP of 186 with negative blood cultures. CT of abdomen and pelvis showed a large liver abscess in segment VII measuring 5×6.1 cm and segment VI measuring 8.7×8 cm (Fig. 7). CT-guided drainage failed to improve the patient's clinical condition; hence surgical intervention with a cholecystectomy with resection of segment VII and segment VI through a right subcostal abdominal incision was performed. The aspirated cul-



Figure 7. CT scan of abdomen and pelvis showing a large liver abscess in segment VII measuring 5×6.1 cm (encircled) and segment VI measuring 8.7×8 cm (not shown). CT: computed tomography.

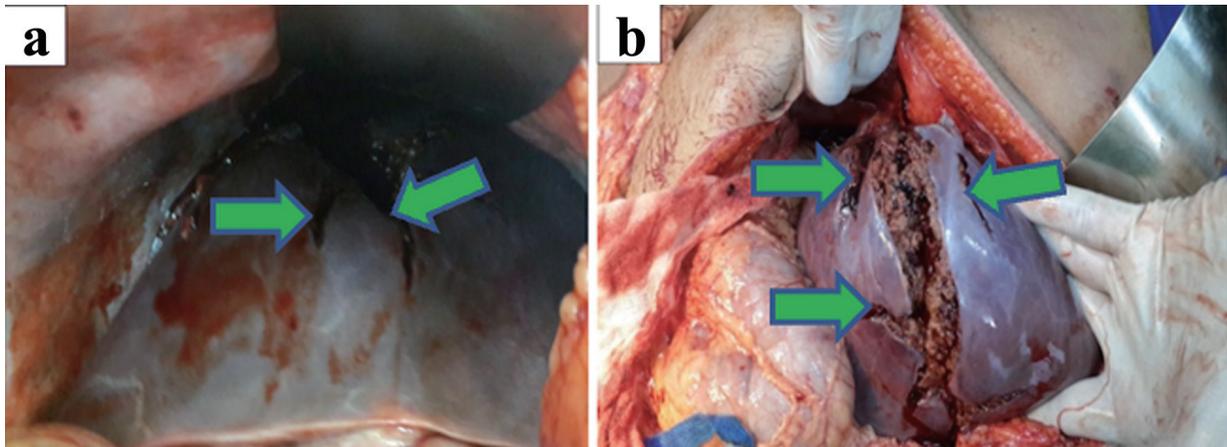


Figure 8. (a, b) Laparotomy findings of extensive grade V liver injury of segments V, VII, and VIII (green arrows) with diaphragmatic perforation.

ture showed no growth. A follow-up ultrasound 1 week later showed no fluid accumulation and a CRP level of 147.

Case 4

A 22-year-old man with no significant medical history was admitted to our hospital 1 month after an explosion with shrapnel injuries to his right chest and upper right abdomen. At the time of the injury, the patient was admitted to a peripheral hospital in Yemen. He had sustained multiple shrapnel injuries with entry points in his right posterior chest, and exit points were in the right anterior axillary line at the level of the 10th rib. At that time, he underwent a laparotomy and was found to have extensive grade V liver injury of segments V, VII, and VIII with diaphragmatic perforation and primary lung injury. Ex-

tensive hemostasis was secured, and he was transferred to the intensive care unit (ICU) with a right chest drain and two abdominal drains (Fig. 8). During his follow-up course, he complained of severe persistent chest pain, progressive shortness of breath, and developed high-grade fever on several occasions. CT scans of the chest, abdomen, and pelvis with IV contrast showed liver space damage occupied with devitalized tissue and air-fluid levels, a right posterior diaphragmatic defect connecting the pleural space with the injured part of the liver, and multiple shrapnel fragments were seen scattered throughout the damaged liver space (Fig. 9). He was transferred to our hospital for further evaluation and management.

On presentation to our facility, he complained of shortness of breath, right chest pain, and right upper abdominal pain. The abdomen was distended with diffuse tenderness and absent bowel sounds. His laboratory workup revealed leukocytosis of

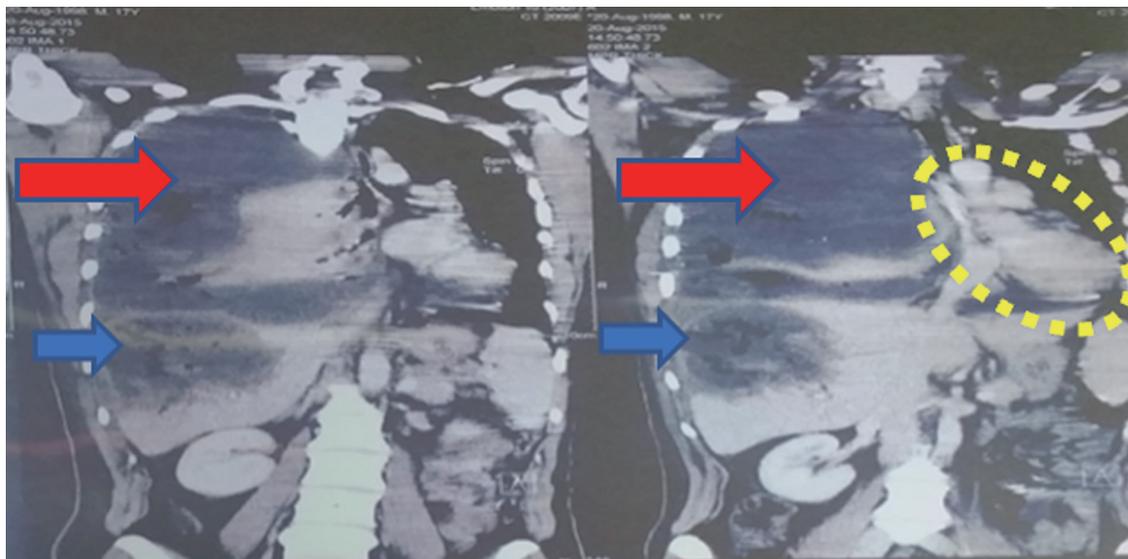


Figure 9. CT scan of abdomen and pelvis showing a massive fluid collection in the right pleural space (red arrows) herniated through the anterior mediastinum into the left side and displaced mediastinum (encircled), collapsed right lung, and large liver heamtoma (blue arrow). CT: computed tomography.

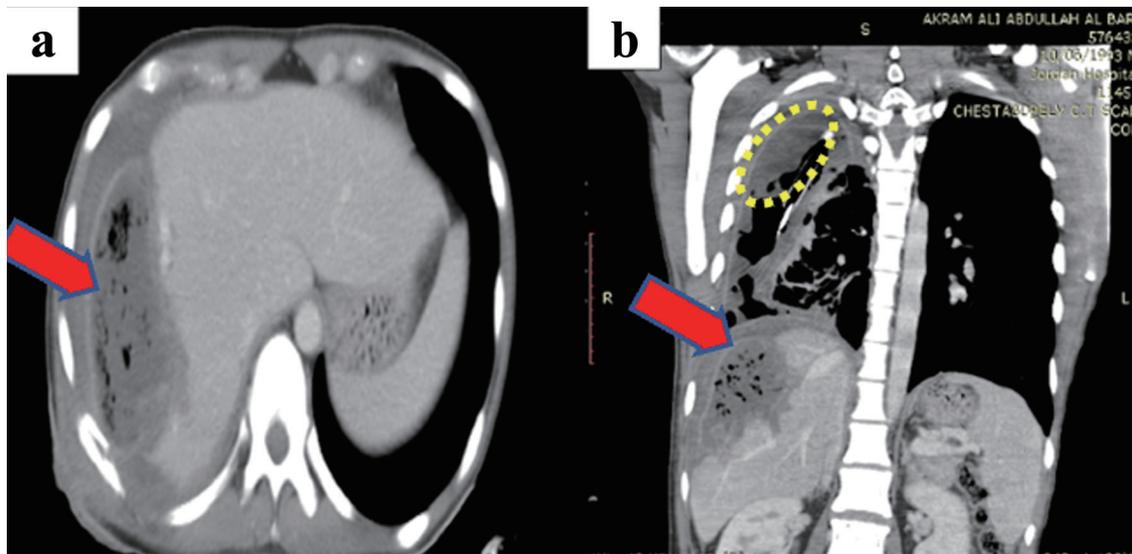


Figure 10. (a, b) CT scan of chest and abdomen showing the peripheral enhancement of the pleural fluid collection (encircled) indicating empyema, multiple right-sided fluid loculations and partial right lung collapse noted with atelectasis. Right hepatic lobe shows large fluid collection with multiple air pockets (red arrow). CT: computed tomography.

15.2×10^3 , CRP of 250, albumin of 3.7, and ALP of 332, along with negative blood cultures. CT-guided aspiration was performed with cultures positive for *Pseudomonas aeruginosa*. CT scans of the chest, abdomen and pelvis (Fig. 10) revealed an irregularity of the lateral aspect of the right hepatic lobe with multiple hypodensities associated with a large fluid collection of approximately $11 \times 10 \times 7$ cm containing gas inclusions and small metal splinters, which indicated an infection hematoma. Ultrasound-guided drainage of the right liver abscess was performed, and the culture was positive for *Pseudomonas aeruginosa*. During his hospitalization, he had a persistent fever, and his laboratory tests revealed a total bilirubin of 1.5 with direct bilirubin of 0.93, white blood cell (WBC) of 12.8, and ALP of 332. An endoscopic retrograde cholangiopancreatography (ERCP) with a common bile duct (CBD) stent was performed, but it did not improve his clinical condition.

Repeated abdominal CT showed an increasing size of the liver abscess. The patient underwent right hepatectomy. During his postoperative course, he remained clinically stable, with his fever decreasing and his laboratory values improving. He was discharged on the eighth postoperative day. Follow-up ultrasound 1 week later showed no evidence of a liver abscess.

Discussion

Pyogenic abscesses account for almost 80% of all liver abscesses in developed countries and are most commonly polymicrobial [6]. Traditionally, treatment for liver abscesses has been open surgical treatment. However, percutaneous and laparoscopic drainage has gradually expanded [5]. Despite these innovative techniques and improved imaging, clinicians may face significant challenges in diagnosing and treating liver abscesses [6]. Surgical intervention remains a viable rescue option in certain situations [7]. Here we present four cases of

PLA of different etiologies requiring partial liver resection to achieve a definitive cure. We highlight the risk factors, common pathogens, and treatment options (Table 1).

The etiology of PLA can be divided into six categories: 1) biliary infection; 2) seeding of the portal vein (pylphlebitis); 3) direct spread; 4) seeding of the hepatic arteries; 5) penetrating trauma; and 6) cryptogenic cause [1]. The etiology of these abscesses has changed in the last decades. Historically, the most common cause was acute appendicitis. The series by Johns Hopkins, which first described these categories, reported a shift of appendicitis with transvenous spread as the leading cause of biliary obstruction, often caused by cholangiocarcinoma and particularly after palliative stenting [1]. Also, the increasing frequency of cholelithiasis and biliary tract pathologies, with their potential to induce ascending cholangitis, have increased biliary etiology as the leading cause of liver abscesses [8]. In our series, the underlying etiologies of liver abscesses were as follows: one traumatic from a shrapnel blast injury, one following trans-arterial chemoembolization in HCC, and two patients with no apparent etiology. In the first case, the patient had underlying risk factors such as liver cirrhosis, hepatitis B, and chemoembolization for HCC 2 years ago. The coexistence of malignancies in PLA is common, ranging from 16.2% in a general hospital to 86% in a specialized surgical center [9]. The association between radiofrequency ablation and transarterial chemoembolization and PLA has been described, and these procedures are associated with infections by skin flora, such as streptococci and staphylococci [9]. In the second case, the patient had an inflammatory cecal mass and recurrent liver abscesses, but we could not recognize the source of the infection. Recent reports have linked PLA to subclinical colon cancer. The associations appear to be more prominent in patients with Klebsiella infection, although whether all patients with PLA should undergo colonoscopy remains controversial [10]. In the third case, the patient had no

Table 1. Demographic and Clinical Profiles of the Four Cases

Characteristic	Case 1	Case 2	Case 3	Case 4
Age (years)	75	48	44	22
Gender	Male	Female	Male	Male
Past medical history	Atrial fibrillation, chronic hepatitis B, liver cirrhosis, and HCC	Inflammatory cecal mass and recurrent multiple liver abscesses	None	None
Cirrhosis (Child-Pugh score)	Yes (10)	No	No	No
History of chronic hepatitis	Hepatitis B	No	No	No
Previous history of liver abscess	None	Yes	No	No
Presentation	Fever, epigastric pain, abdominal distention, anorexia, jaundice	Fever, epigastric pain, abdominal distention	Fever, chills, right upper abdominal pain and shortness of breath	Shortness of breath, right-sided chest pain and RUQ abdominal pain
Initial CRP (mg/L)	249	240	201	250
Alkaline phosphatase	70	46	186	332
Albumin	3.1	2.8	2.9	3.7
Aspirate culture (intraoperative cultures)	<i>Enterococcus faecium</i> (<i>E. coli</i>)	No growth	No growth	<i>Pseudomonas aeruginosa</i>
Blood cultures	Negative	Negative	Negative	Negative
Source of the abscess			Unknown	Traumatic (shrapnel injury after explosion)
Liver abscess site and location	Segment VII, measuring (7 × 5 cm)	Segment VII, multiple abscesses largest (11.6 × 10.4 cm)	Segment VII (5 × 6.1 cm) cm and segment VI (8.7 × 8 cm)	Lateral aspect of the right hepatic lobe, approximately 11 × 10 × 7 cm
Percutaneous drain trial (modality, number)	Yes (CT-guided aspiration, once)	Yes (CT-guided drainage, twice)	No	Yes (ultrasound-guided drainage, once)
Surgical modality	Open drainage with resection of segment VII	Cholecystectomy with resection of segment VII and most of segment VI	Cholecystectomy with resection of segment VII and segment VI	Right hepatectomy
A follow-up modality and timing	CT of abdomen and pelvis 3 months later	Ultrasound 3 weeks later	Ultrasound after 1 week	Ultrasound 3 weeks
Follow-up condition	Improved	Improved	Improved	Improved
Follow-up CRP (mg/dL)	39	146	147	86

CRP: C-reactive protein; CT: computed tomography; HCC: hepatocellular carcinoma; RUQ: right upper quadrant.

significant past medical history, and the cause of PLA was unknown, with negative growth on cultures. The fourth case was challenging, with PLA attributed to a traumatic explosion and *Pseudomonas* growing on aspirated and intraoperative drainage cultures.

CT of abdomen with IV contrast is the preferred imaging modality for PLA with a sensitivity reaching 100% [9, 11]. A positive bacterial culture supports the radiographic diagnosis from peripheral blood or abscess aspirate [12]. However, over 30% of cases can be culture-negative [1]. In our series, CT of the abdomen and pelvis with IV contrast was used for diagnosis in all cases. Cultures from abscess aspirates grew *E. coli* with CT-guided drainage and *Enterococcus faecium* with open surgical drainage in the first case. In contrast, *Pseudomonas aeruginosa* grew with US-guided drainage aspirate culture in the fourth case. The second and third cases had negative cultures.

Combined with targeted antimicrobial therapy, percutaneous drainage techniques are now the mainstay of treatment. However, a small proportion of patients do not respond adequately to minimally invasive strategies, for which traditional open surgery is the definitive option [7]. Surgical options include surgical drainage or partial liver resection [13]. Surgical resection was considered in certain clinical circumstances: 1) Liver abscess not amenable to percutaneous drainages, such as huge, multiseptated, or multifocal abscesses [14]; 2) Ruptured liver abscess or fistula formation in which surgery is highly likely required [11]; 3) Failed treatment with an optimal antibiotic therapy and percutaneous drainage [15]; and 4) concomitant pathologies requiring surgical intervention, such as malignancy or biliary abnormality [15]. Depending on the surgeon's experience and the location of the liver abscess, liver resection can be performed by (mini)laparotomy or a less inva-

sive laparoscopic approach [15]. In the first case, open surgical abscess drainage with partial liver resection (segment VII resection) was necessary due to the failure of antibiotics and percutaneous aspiration. In the second case, a cholecystectomy with partial hepatic resection (resection of segment VII and most of segment VI) was required after two failed attempts at antibiotics in combination with CT-guided drainage. In the third case, the abscess was large and not amenable to percutaneous intervention, necessitating cholecystectomy with partial hepatic resection (segment VII and segment VI resection). Finally, in the fourth case, a right hepatectomy was required after failure of the US-guided drainage and clinical deterioration of the patient.

Conclusion

Percutaneous aspiration or drainage and aggressive antibiotic treatment have become the mainstays of treatment, replacing surgery as the first line of treatment. Under certain circumstances, surgical options, such as open drainage or liver resection, may offer a viable and curative alternative.

Acknowledgments

None to declare.

Financial Disclosure

None to declare.

Conflict of Interest

None to declare.

Informed Consent

Informed consent to publish these cases, including images, was obtained from the four included patients.

Author Contributions

Aiman Obed, Mohammad Abuassi, and Saqr Alsakarneh wrote and revised the manuscript. Fouad Jaber, Mahmoud Fakhri, Fadi Abufares, Abdalla Bashir, Mahmood Syam, Anwar Jarad, Ody Abdelhadi, and Hassan Ghaz participated in writing and revising the manuscript.

Data Availability

The authors declare that data supporting the findings of this study are available within the article. Any inquiries regarding

supporting data availability of this study should be directed to the corresponding author.

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