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CASE REPORT

Clostridium perfringens Liver Abscess Disguised as Biliary Disease: A Report of Two Cases and a Review of the Literature

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Abstract: Liver abscesses caused by *Clostridium perfringens* are rare but rapidly fatal. In only a few days, patients progress from liver abscess to sepsis, intravascular hemolysis, multiple organ failure, and even death. These abscesses often occur in patients after trauma or surgery or in those with immunodeficiency. Because patients only show non-specific symptoms such as fever and abdominal pain in the early stage, they can easily be misdiagnosed and miss the therapeutic window, resulting in a poor prognosis. The diagnosis of *Clostridium perfringens* liver abscess mainly depends on computed tomography (CT), needle aspiration, and/or blood culture. After diagnosis, treatments such as antibiotic therapy, surgical abscess drainage, blood transfusion as needed, and correction of metabolic disturbances must be immediately administered to prevent severe complications. Here, we present two cases of liver abscess due to *Clostridium perfringens* infection. Both patients initially presented only with fever, abdominal pain, and jaundice, symptoms that were easily confused with cholangitis caused by cholelithiasis. The patients then progressed rapidly and, despite receiving antimicrobial and multimodal sepsis treatment, both eventually died of multiple organ dysfunction syndrome. Clinicians should be on high alert for *Clostridium perfringens* liver abscesses disguised as biliary disease. Early diagnosis and treatment with the appropriate antibiotics and surgery are fundamental for the survival of the affected patients.

Keywords: intravascular hemolysis, biliary diseases, diagnosis, treatment

Introduction

Clostridium perfringens is an anaerobic, Gram-positive bacterium normally found in the gastrointestinal and genital tracts of humans.[1,2] This bacterium grows rapidly, showing a doubling time of approximately 7 min, and can tolerate up to 3% oxygen.[3] Its virulence mainly depends on the production of more than 20 types of potent toxins, including α-toxin, β-toxin, and *Clostridium perfringens* enterotoxin (CPE). High levels of these toxins in the blood circulation result in the rapid deterioration of the condition of affected patients, including progression to organ and circulatory failure, and even death.[4] *Clostridium perfringens* is classified into seven categories (A–G) according to the types of toxins produced.[5] It is an opportunistic pathogen that can cause a variety of diseases, including food poisoning, emphysematous cholecystitis, and liver abscess.[6] Infection with *Clostridium perfringens* has a wide range of clinical manifestations, from asymptomatic bacteremia, to shock, and death.[6–8] However, liver abscesses caused by *Clostridium perfringens* are very rare, especially as a result of biliary tract infection, but are rapidly fatal and are associated with a high mortality rate. It often takes only a few days for patients to progress from liver abscess to sepsis, intravascular hemolysis, Multiple Organ Dysfunction Syndrome (MODS), and death. Patients with *Clostridium perfringens* liver abscess need to be promptly identified, given that early and accurate diagnosis, followed by specific treatment, can prevent death. Here, we present

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two cases of *Clostridium perfringens* liver abscess. Both patients initially presented only with fever, abdominal pain, and jaundice, symptoms that were easily confused with cholangitis caused by cholelithiasis.

Case Report

Case 1

Case 1 was a 59-year-old male presenting with right upper abdominal pain, chills, diarrhea, and jaundice who was referred to our hospital. Right upper abdominal pain started four days before admission. The pain was sharp, repeated, non-radiating, unrelated to food, and resolved on its own. He denied nausea and vomiting. Gradually, the patient developed chills, jaundice, and diarrhea, and the abdominal pain was relieved after defecation. He was subsequently treated at a local hospital and underwent a computed tomography (CT) scan of the abdomen. CT showed a hypodense shadow consistent with entrapped air in the right liver lobe and an inflamed gallbladder with gallbladder stones. The patient denied diabetes mellitus, coronary heart disease, and hypertension. On physical examination, his heart rate was 109 beats per min, his blood pressure was 80/69 mmHg, and he had scleral and cutaneous icterus. Abdominal examination showed upper abdominal pressure, rebound pain, and muscle tension. Initial laboratory data showed hemoglobin 97 g/L (normal range: 130–175 g/L), a white blood cell count of 41.17×10^9/L ($3.5–9.5\times10^9$/L), total bilirubin 529 μmol/L (5.1–28.0 μmol/L), direct bilirubin 271.5 μmol/L (0.0–10.0 μmol/L), aspartate transaminase 1869 U/L (15–40 U/L), alanine transaminase 813 U/L (9–50 U/L), γ-GGT 395 U/L (10–60 U/L), alkaline phosphatase 244 U/L (45–125 U/L), and a glomerular filtration rate of 19.6 mL/min (80.0–300.0 mL/min). We performed an esophagogastroduodenoscopy, which included an endoscopic retrograde cholangiography, and observed purulent secretion from the common bile duct (Figure 1). Secretion culture was positive for *Clostridium perfringens*. The patient was admitted to the intensive care unit for further treatment after surgery and gradually developed sepsis with hemolysis, hepatic insufficiency, and renal failure. The relevant clinical indicators are listed in Figure 2. Abdominal ultrasound and CT detected a 9×3.5 cm abscess with entrapped air in liver segment VI and a 4×3.5 cm abscess with entrapped air in liver segment VII (Figure 3). CT was repeated after puncture and drainage of the patient's two liver abscesses (Figure 4). The patient received antibiotics (mainly penicillin), blood product transfusion, plasma exchange, an artificial liver, and hemodialysis but eventually died 15 days after admission to the hospital.

Case 2

Case 2 was a 62-year-old male admitted to the hospital with abdominal pain, fever, chills, vomiting, and diarrhea after eating, all of which occurred acutely within half a day. The patient presented with dull, recurrent epigastralgia and vomiting after eating. At that time, he was febrile (axillary temperature: 39.8 °C) but had a normal level of

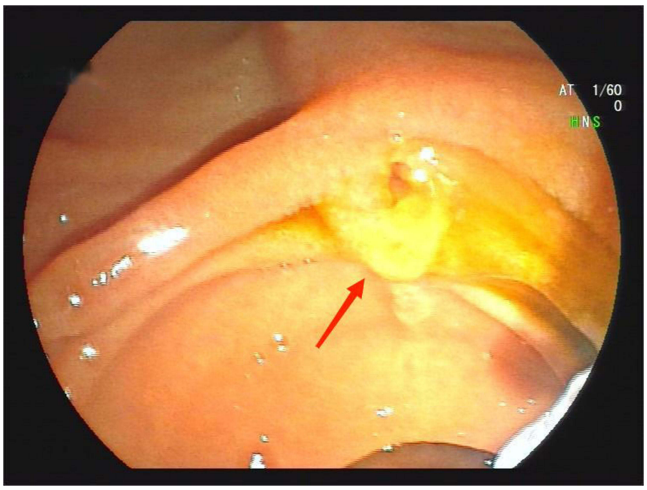

Figure 1 Endoscopic retrograde cholangio-pancreatography (ERCP) image. The common bile duct shows purulent secretions (marked by red arrow).

Figure 2 Important clinical indicators in case 1. (**A**) Liver function indicators. (**B**) Renal function indicators. (**C**) Blood/Infection indicators. (**D**) Coagulation indicators.
Abbreviations: ALT, Alanine aminotransferase; AST, Aspartate aminotransferase; TBIL, Total bilirubin; DBIL, Direct Bilirubin; IBIL, Indirect Bilirubin; GFR, Glomerular filtration rate; Hb, Hemoglobin; WBC, White blood cell; CRP, C-reactive protein; PTA, Prothrombin time activity; INR, International normalized ratio.

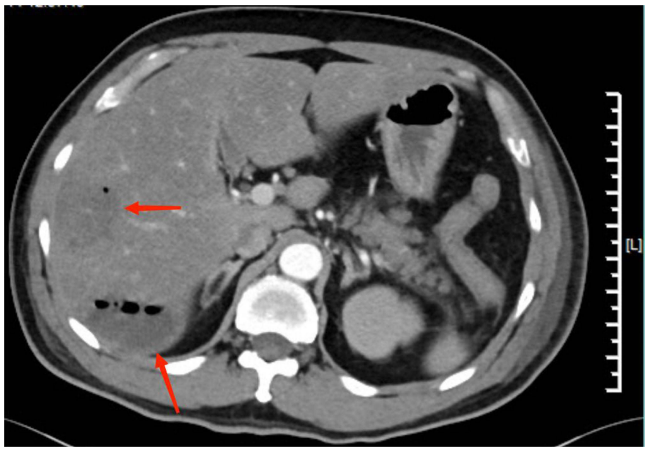

Figure 3 Computer tomography of the abdomen. Two areas of the right hepatic lobe have liver abscesses and both contain air (marked by red arrows).

consciousness. The vomit was stomach contents, and the stool was yellow watery material. The patient had no relief of symptoms after taking non-steroidal anti-inflammatory drugs. His medical history included diabetes mellitus, hypertension, and hyperlipidemia. The initial vital signs were axillary temperature 38.6 °C, pulse 82 beats per min, blood pressure 119/70 mmHg, and oxygen saturation 95% in ambient air. Physical examination revealed epigastric pain, rebound pain, and muscle tension in the right upper abdomen. Laboratory findings showed hemoglobin 94 g/L (normal range: 130–175 g/L), a white blood cell count of 10.6×10^9/L ($3.5–9.5\times10^9$/L), total bilirubin 281.6 μmol/L (3.42–20.5 μmol/L), direct bilirubin 233.9 μmol/L (0.0–6.84 μmol/L), aspartate transaminase 782.2 U/L (15–40 U/L), alanine transaminase 324.7 U/

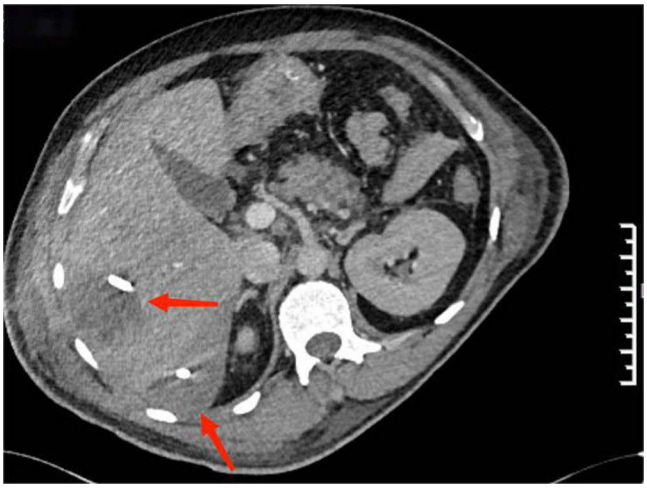

Figure 4 Computed tomography of the abdomen after drainage of liver abscess. Liver abscesses in both areas of the right hepatic lobe have shrunk (marked by red arrows).

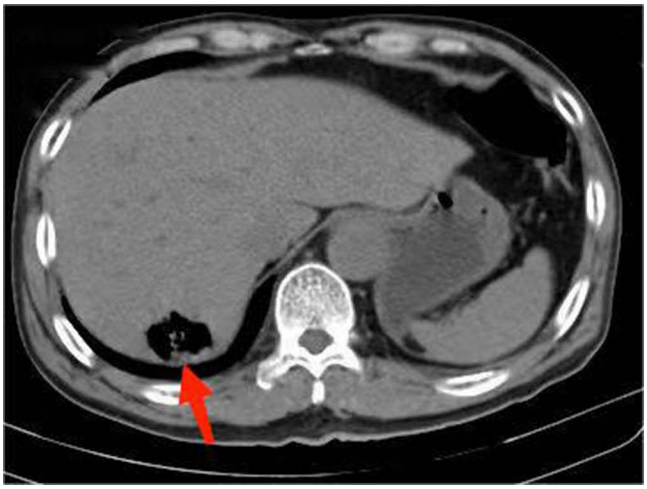

Figure 5 Computer tomography of the abdomen. The right lobe of the liver shows an inflated area (marked by a red arrow) and is accompanied by perihepatic fluid exudate.

L (9–50 U/L), γ-GGT 453.7 U/L (10–60 U/L), alkaline phosphatase 124.2 U/L (45–125 U/L), and a glomerular filtration rate of 84 mL/min (>90 mL/min). CT of the abdomen revealed a gas-filled area in the seventh liver segment with perihepatic fluid exudate (Figure 5). Abdominal X-ray showed subdiaphragmatic free gas (Figure 6). We performed emergency surgery, which showed an enlarged gallbladder with edema, a thickened common bile duct (1.2 cm), and hemorrhagic exudation around the pancreas. We then removed the gallbladder and incised the common bile duct for drainage. After the incision of the gallbladder and bile duct, we observed sediment-like stones and placed a drainage tube around the pancreas for drainage. The patient was admitted to the intensive care unit for further treatment after surgery. A few days after undergoing the procedure, he appeared severely jaundiced and presented with deterioration in hemoglobin levels and renal function as well as anemia. The relevant clinical indicators are listed in Figure 7. Blood cultures grew *Clostridium perfringens* and *Klebsiella*. A repeat CT scan of the abdomen after the procedure showed a gas-forming abscess in segment VII of the liver and subdiaphragmatic free gas. We performed a combination of anti-infective treatments including penicillin, metronidazole, and other antibiotics, plasma exchange, CRRT, and blood transfusion. The patient eventually died of sepsis combined with MODS.

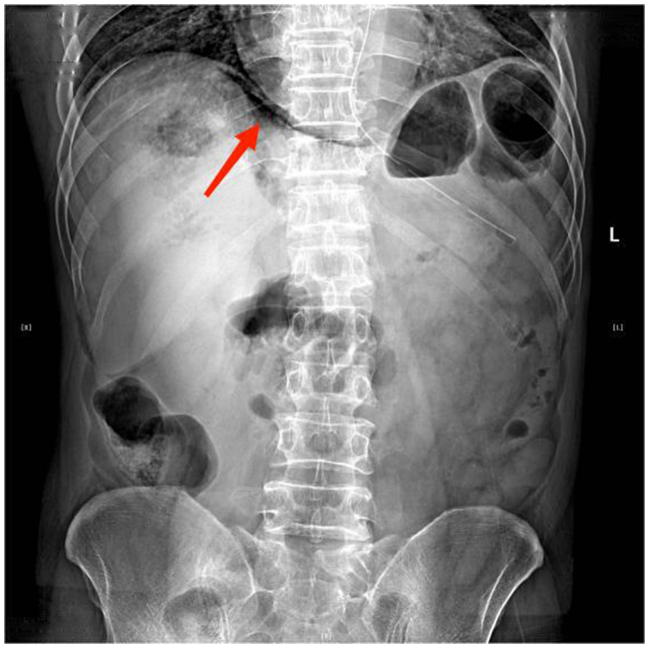

Figure 6 Plain film of the abdomen. There is a crescent-shaped free gas formation under the diaphragm (marked with a red arrow).

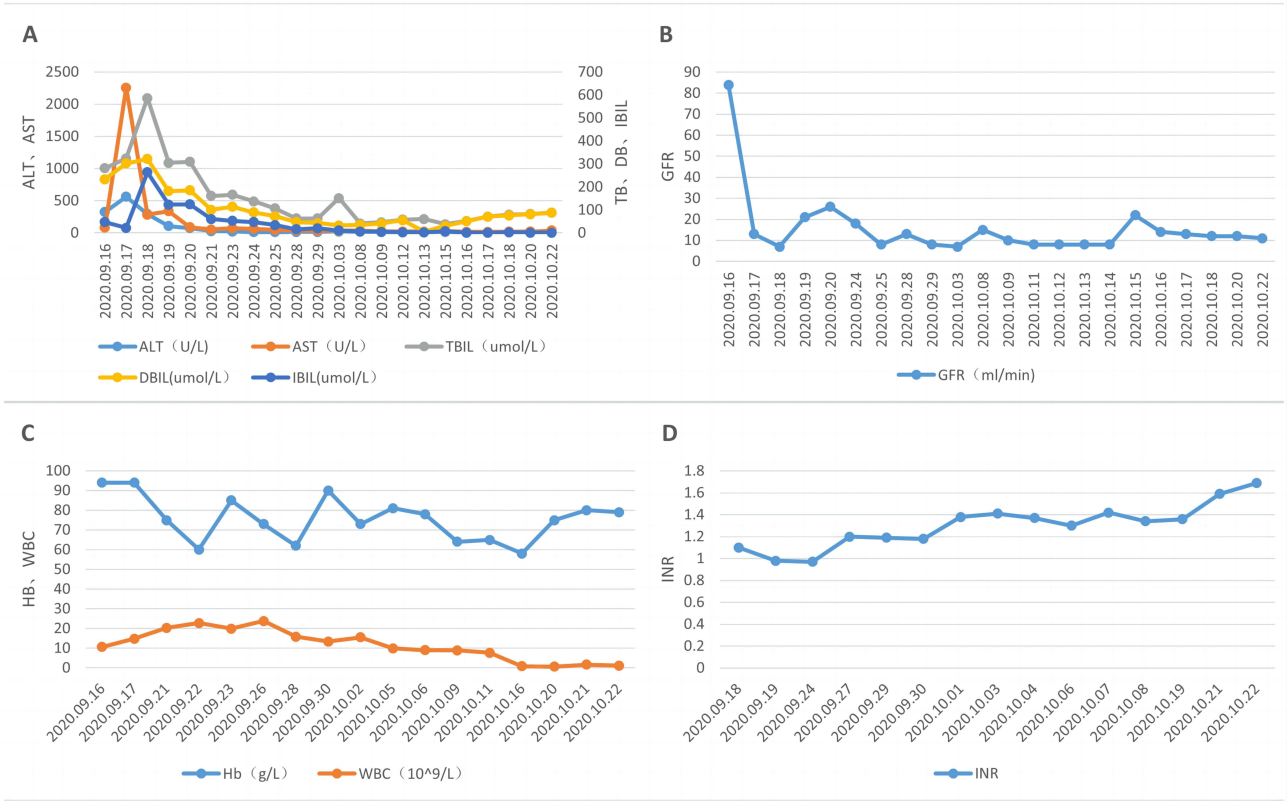

Figure 7 Important clinical indicators in case 2. (**A**) Liver function indicators. (**B**) Renal function indicators. (**C**) Blood indicators. (**D**) Coagulation indicators.
Abbreviations: ALT, Alanine aminotransferase; AST, Aspartate aminotransferase; TBIL, Total bilirubin; DBIL, Direct Bilirubin; IBIL, Indirect Bilirubin; GFR, Glomerular filtration rate; Hb, Hemoglobin; WBC, White blood cell; INR, International normalized ratio.

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Discussion

Clostridium perfringens was first discovered in 1891 by William H. Welch following an autopsy on a male.[9] This bacterium is ubiquitous and is also normally found in the gastrointestinal and genital tracts of humans. *Clostridium perfringens* can produce more than 20 toxins,[4] and is categorized into seven toxinotypes (A–G) according to which combinations of 6 of these toxins (α-toxin, β-toxin, ε-toxin, ι-toxin, CPE, and necrotic enteritis B-like toxin) is produced.[5] However, to date, only toxinotype A has been associated with human cases of hemolysis.[10] These toxins are usually disease-specific. For example, α-toxin is involved in human clostridial myonecrosis or gas gangrene,[11] CPE causes food poisoning in humans,[12] and β-toxin, ε-toxin, and *Clostridium perfringens* necrotic enteritis B-like toxin primarily mediate infection in animals.[5] In humans, these toxins, especially α-toxin, can enter the blood circulation and cause toxemia, resulting in circulatory failure, organ failure, and death.[13]

Clostridium perfringens infections are common in immunocompromised patients and after trauma or surgery. Indeed, invasive hepatobiliary and gastrointestinal surgery, gynecological surgery, catheter placement, and other traumatic operations can easily lead to *Clostridium perfringens* infection. Advanced age, type II diabetes, and malignant tumors are also risk factors for infection.[2] However, it has been reported that *Clostridium perfringens* can cause septicemia through bacterial translocation even in the absence of any clear potential risk factors.[14] Meanwhile, *Clostridium perfringens*-induced sepsis is associated with a high mortality rate, ranging from 70% to 100%, and patients usually experience rapid deterioration.[15] This happened in Case 1 in our report, where the patient was infected with *Clostridium perfringens* in the absence of chronic disease, and eventually died of sepsis.

Liver abscesses can be categorized into different types depending on the etiology, with amebic liver abscesses (ALAs) and pyogenic liver abscesses (PLAs) representing the major types.[16] ALAs are more common in developing countries and are caused by *Entamoeba*.[17] In contrast, PLAs constitute the bulk of liver abscesses in developed countries and are usually caused by *Escherichia coli, Klebsiella*, and *Streptococcus*,[16] with the bacteria mainly spreading through the portal vein or hepatic artery.[1] In most of Asia, the pathogens most commonly associated with PLA are *Klebsiella pneumoniae* serotypes K1 and K2.[18] Cases of PLA due to *Clostridium perfringens* infection are very rare, albeit rapidly fatal.[15] At first, patients only show non-specific symptoms such as fever and abdominal pain, or jaundice and right upper abdominal pain, which can be easily misdiagnosed as biliary diseases. The PLA subsequently develops into a gas-forming pyogenic liver abscess (GPLA) within a few days, and the condition of patients rapidly deteriorates, often complicated with septicemia, massive intravascular hemolysis, and renal failure, eventually progressing to MODS or even death.[1]

The total mortality rate for liver abscesses ranges from 6% to 14%.[19] However, liver abscesses caused by *Clostridium perfringens* infection are markedly more deadly than other types of liver abscesses due to their early and rapid undetectable progression. We searched PubMed and identified 60 cases of *Clostridium perfringens* liver abscess (Table 1). A detailed search strategy is provided in the Supplementary Material. Among the 60 cases reviewed in the literature, the mortality rate was 60% (36/60), with 65% of cases (39/60) experiencing intravascular hemolysis and 21.7% (13/60) MODS. Among the 36 patients who died, only one patient survived for 48 days after early surgery and multidisciplinary support treatment, while the average survival time for the remaining 35 patients was only 27.6 h (0.8–168 h). Notably, of the 35 patients who died, 71.4% (25/35) received no treatment or received only a single treatment (antibiotics or abscess drainage), and the average survival time for these patients was only 12.6 h (1.5–48 h). The remaining 10 patients received two or more treatments, including antibiotics, abscess drainage, and surgery, and the average survival time was 64.9 h (2.5–168 h), substantially longer than that for patients who received only a single treatment. This observation emphasizes the importance of combined treatment, especially the combined use of antibiotics and abscess drainage, which can significantly improve the prognosis of patients and increase their average survival time. The most common underlying disease was diabetes (23/60), followed by an underlying malignancy (17/60), and both were seen in elderly patients. This suggests that immunocompromised populations are susceptible to infection by *Clostridium perfringens*, particularly so elderly patients with underlying disease, and reminds clinicians that they should be highly vigilant for *Clostridium perfringens* infection in such populations. Interestingly, 12 patients were found to have no clear underlying medical disease, like the patient in Case 1 in this report.

Table 1 Literature Overview of Human Cases with *Clostridium perfringens* Liver Abscess

Number	Author	Year	Age	Gender	Underlying Disease	Intravascular Hemolysis	MODS	Mode of Treatment	Survival	Time to Live
1	RAYMOND M. KIVEL[20]	1958	68	F	DM	N	N	Surgery, antibiotic	N	96h
2	C L Mera[21]	1984	6	F	None	Y	N	Antibiotic	N	14h
3	O Nakano[22]	1988	68	M	DM	Y	N	–	N	0.8h
4	Florian Eckel[23]	2000	65	F	Bile duct cancer	Y	N	Drainage, antibiotic	Y	–
5	Kreidl, Ken O BS[24]	2002	80	M	DM	Y	N	–	N	11h
6	W Y Au[25]	2005	65	M	DM	Y	N	Antibiotic	N	48h
7	Shoichiro Ohtani[26]	2006	78	M	DM	Y	N	–	N	3h
8	J J Daly[27]	2006	80	M	DM	Y	N	–	N	3h
9	Andreas Umgelter[28]	2007	87	F	Colon cancer	N	N	Drainage, antibiotic	Y	–
10	Walther Tabarelli[29]	2009	65	F	Pancreatic cancer	N	Y	Drainage, antibiotic	N	120h
11	Isaías Alarcón Del Agua[30]	2009	74	——	None	N	Y	Surgery	N	1152h
12	Inés Macías[31]	2009	72	M	None	Y	Y	Antibiotic	N	22h
13	E Meyns[32]	2009	64	M	DM	N	N	Antibiotic	N	48h
14	H Ng[15]	2010	61	F	DM, hypertension	Y	Y	Drainage, antibiotic	Y	–
15	G. Rajendran[33]	2010	58	M	None	Y	Y	Surgery, drainage, antibiotic	Y	–
16	C.C. van Bunderen[34]	2010	74	M	None	Y	N	Antibiotic	Y	–
17	Anna Merino[35]	2010	83	F	Cholangitis	Y	N	Antibiotic	N	48h
18	H Qandeel[36]	2012	59	M	DM, biliary pancreatitis	Y	N	Surgery, drainage, antibiotic	Y	–
19	Siu-Tong Law[2]	2012	50	F	Rectal cancer	Y	Y	Drainage, antibiotic	N	168h
20	Jung Ho Kim[37]	2012	80	F	Hilar cholangiocarcinoma	N	N	Drainage, antibiotic	N	48h
21	Jin Imai[38]	2014	76	M	Hypertension	Y	Y	Drainage	N	6.5h
22	Miwa Kurasawa[39]	2014	65	M	DM, hypertension	Y	N	Antibiotic	N	6h

(*Continued*)

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Table 1 (Continued).

Number	Author	Year	Age	Gender	Underlying Disease	Intravascular Hemolysis	MODS	Mode of Treatment	Survival	Time to Live
23	Kiyonori Kusumoto[40]	2014	64	M	None	Y	N	Surgery, drainage, antibiotic	Y	–
24	Daniel Kitterer[41]	2014	71	M	Gastroenteritis	N	N	Surgery, antibiotic	N	13h
25	Sherif Ali Eltawansy[42]	2015	81	F	Stroke	N	Y	Drainage, antibiotic	–	–
26	Muhammad S Khan[43]	2015	77	M	DM, hypertension	Y	Y	Antibiotic	N	7.5h
27	Jing-Huan Li[44]	2015	71	M	Liver cancer	N	N	Antibiotic	Y	–
28	Juichiro Yoshida[45]	2015	66	M	DM	Y	N	Drainage, antibiotic	N	43h
29	F O Meeuwes[46]	2015	71	F	Pancreatitis	Y	N	Drainage	–	–
30	Charles Rives[3]	2015	63	M	Colon cancer	N	N	Drainage, antibiotic	Y	–
31	Lee S Kyang[47]	2016	84	M	Gastric cancer	N	N	Drainage, antibiotic	Y	–
32	Rafael García Carretero[48]	2016	65	M	DM, syringomyelia	Y	N	Drainage, antibiotics	Y	–
33	Masamitsu Hashiba[49]	2016	82	M	DM	Y	N	Antibiotic	N	2h
34	Andrew George Lim[50]	2016	58	M	None	Y	N	Antibiotic	N	7.5h
35	Christoph Paasch[51]	2017	65	M	DM, hypothyroidism	N	N	Surgery, drainage, antibiotic	Y	–
36	Yong K Kwon[14]	2018	23	F	Polycystic ovary syndrome	N	N	Drainage, antibiotic	Y	–
37	Keisuke Takemura[52]	2018	80	M	Liver cancer, duodenal cancer	N	N	Antibiotic	Y	–
38	Laura Martí Gelonch[53]	2018	66	M	None	Y	N	Antibiotic	N	3h
39	Laura Martí Gelonch[53]	2018	63	M	None	Y	N	Antibiotic	N	6h
40	A Guridi Mugica[54]	2018	66	M	None	Y	Y	–	N	3h
41	Kazuyuki Hamada[55]	2018	68	M	Gastric cancer	Y	N	Antibiotic	N	10h
42	Shunichi Shibazaki[8]	2018	68	F	DM	Y	N	Antibiotic	N	1.5h
43	Takaaki Yoshikawa[56]	2018	70	M	Liver cancer	N	N	Antibiotic	Y	–
44	Waseem Amjad[57]	2019	77	M	DM	Y	Y	Antibiotic	N	24h

45	Haruki Uojima[58]	2019	83	M	Liver cancer, pancreatic cancer	Y	N	Surgery, antibiotic	N	6h
46	Åsa Lindberg[59]	2019	67	F	None	Y	N	Antibiotic	N	3h
47	Masahide Sakaue[60]	2019	76	M	None	Y	N	Drainage, antibiotic	N	2.5h
48	Hirohisa Fujikawa[61]	2020	77	F	DM, bile duct cancer	N	N	Antibiotic	N	14h
49	Stig Søgaard Dahl[62]	2020	68	M	Pancreatic cancer, hypertension	N	N	Drainage, antibiotics	Y	–
50	Ryoga Hamura[63]	2020	69	M	Liver cancer	N	N	Surgery, drainage, antibiotic	Y	–
51	Joseph De Zylva[64]	2020	63	M	DM, hypertension	Y	N	Drainage, antibiotic	N	144h
52	Kelly L Olds[65]	2021	85	F	Breast cancer	Y	N	Antibiotic	N	4h
53	Ming-Hung Wang[66]	2021	63	F	DM, liver cancer, hypertension	N	N	Drainage, antibiotics	Y	–
54	Mari Satoh[67]	2021	88	F	DM, hypertension	N	N	Drainage, antibiotics	Y	–
55	Jiang Guo[1]	2022	62	M	Liver cancer	Y	N	Antibiotic	N	12h
56	Goro Takahashi[68]	2022	70	M	DM	Y	N	Drainage	Y	–
57	H Lang[69]	2022	60	M	Crohn's disease	Y	Y	Drainage, antibiotic	Y	–
58	Alice Ching Ching Wong[70]	2022	80	M	DM, hypertension	Y	N	Antibiotic	N	8h
59	Naoya Itoh[71]	2022	77	M	Hilar cholangiocarcinoma, hypertension	N	N	Antibiotic	Y	–
60	Catarina Osório[72]	2023	74	M	Hypertension, hyperlipidemia	Y	Y	Drainage, antibiotic	N	8h

Abbreviations: MODS, Multiple Organ Dysfunction Syndrome; DM, diabetes mellitus.

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In the early stage, it is critical to accurately diagnose patients with *Clostridium perfringens* liver abscess, thereby significantly improving their prognosis. First, infection by *Clostridium perfringens* necessitates high vigilance for all types of trauma, epigastric pain, vomiting, nausea, and disturbance of consciousness after surgery,[73] especially biliary and gastrointestinal surgery. If a patient's condition progresses, GPLA can be diagnosed by abdominal X-ray, ultrasound, and CT. After diagnosis, needle aspiration and/or blood culture of the liver abscess should be performed immediately to determine the types of bacteria causing the infection[14] and provide patients with the correct treatment. In the laboratory, the identification of *Clostridium perfringens* is divided into two steps. Purified isolates are preliminary identified based on their culture and morphological features, motility testing, double hemolysis on blood agar, and the reverse Christie–Atkins–Munch–Petersen test.[74] Subsequently, the isolates are confirmed using biochemical tests, such as nitrite reduction, lactose fermentation, and lecithinase production assays.[75] In addition, the disk diffusion method should be used to determine the sensitivity of *Clostridium perfringens* isolates to a variety of antibiotics, which is important for guiding the use of appropriate antibiotics in subsequent treatment.[76] In the future, greater availability of rapid polymerase chain reaction-based testing should assist with diagnosis.[77]

If there is sufficient clinical evidence to suspect/diagnose a liver abscess caused by *Clostridium perfringens*, early and specific treatment must be administered immediately to prevent the death of patients. Specific therapy includes antibiotic treatment and surgical abscess drainage, while other treatments involve correcting metabolic disorders and performing blood transfusion as needed.[57] First, the immediate use of antibiotics can significantly improve patient survival.[34,49] Simon et al[78] reported that the combination of penicillin and clindamycin was the most effective regimen for the treatment of *Clostridium perfringens* infection. Clindamycin can inhibit the activity of α-toxin secreted by *Clostridium perfringens* in the early stage, which greatly reduces the risk of fatal toxemia in patients.[79] Secondly, timely drainage is essential for suspected *Clostridium perfringens* liver abscesses. Patients who underwent surgical excision and drainage of the infected lesion not only had a significantly higher survival rate but also had a significantly longer mean time to death compared with those who received conservative treatment.[78] This indicates that puncture and drainage, continuous irrigation, and anti-infective treatment must be performed immediately after abscess formation. When surgical debridement is difficult, hyperbaric oxygen therapy (HBOT) may be a viable adjunct therapeutic option because it can reduce toxin production and disrupt the anaerobic environment required for bacterial growth.[2] The use of HBOT in acute necrotizing infections may save the lives of patients. In addition, adjuvant hemodialysis therapy, which is effective against infectious shock, may be used to treat patients with *Clostridium perfringens* liver abscesses in the future.[80,81]

Here, we report two cases of *Clostridium perfringens* liver abscess, one with postprandial infection and many underlying diseases, and the other with unknown etiology and no underlying diseases. However, although the basic conditions of the patients were different, the initial clinical manifestations were similar to biliary diseases, and rapidly progressed to GPLA. Both patients were diagnosed with *Clostridium perfringens* infection and received multidisciplinary treatment; however, neither of them survived. This highlights the importance of early identification of *Clostridium perfringens* infection by clinicians, especially in patients with atypical clinical manifestations and without any underlying diseases, given that the infection progresses rapidly and is highly fatal. Once patients progress to GPLA or sepsis before treatment, the best window for treatment has often already been missed, resulting in a poor prognosis. Therefore, it is strongly suggested that clinicians should be more alert to *Clostridium perfringens* infection and that the strains infecting suspected cases are identified as soon as possible, so that specific treatment can be administered promptly, thereby improving patient prognosis.

This study had several limitations. The 60 cases reviewed were all from PubMed and were all open access. Accordingly, studies with non-open access were not included, which may have resulted in the exclusion of cases similar to those of the two patients presented here. In addition, although all 60 cases reviewed in this study referred to patients presenting with *Clostridium perfringens* liver abscess, the specific etiology differed among patients, and was mainly seen in postoperative infection, such as pancreatic resection,[29] pancreaticoduodenectomy,[68] and cholecystectomy.[36] At the same time, there were also cases of post-eating infection that initially presented as biliary disease, similar to that seen in Case 2 in this study, but these cases were less common.[51] In the future, we encourage the publication of cases of *Clostridium perfringens* liver abscess, as well as their collection and summation according to etiology, to propose better diagnostic and therapeutic protocols, and thus improve patient survival.

Conclusion

Liver abscesses caused by *Clostridium perfringens* infection can rapidly progress to sepsis, diffuse intravascular coagulation, MODS, and even death. The two cases presented here initially presented only with abdominal pain, fever, and jaundice, symptoms that were easily confused with cholangitis caused by cholelithiasis. Owing to the rapid deterioration of the condition of the patients, the window for antibiotic therapy and/or surgical treatment was minimal.[15] Clinicians should be alert to patients with initial clinical manifestations similar to biliary diseases. In particular, when a patient's condition rapidly progresses to GPLA, *Clostridium perfringens* infection should be highly suspected. Early accurate diagnosis and treatment with the appropriate antibiotics and surgery are fundamental for the survival of affected patients.

Ethics Statement

The study involving a human participant was reviewed and approved by the Ethics committee of Chongqing Medical University. The families of both patients provided written informed consent to participate in this study. Written informed consent was obtained from the families of both patients for the publication of any potentially identifiable images or data included herein.

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Disclosure

The authors report no conflicts of interest in this work.

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