CASE SERIES
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Emphysematous liver abscess: Variable clinical presentations, management challenges and outcomes-a case series

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ABSTRACT

Emphysematous liver abscesses (ELAs), characterized by the presence of gas within the hepatic parenchyma, are an uncommon and potentially life-threatening entity. ELAs with clinical presentations mimicking hollow viscus perforation pose a diagnostic conundrum for clinicians. This series highlights the diagnostic challenges posed by such atypical presentations and emphasizes the importance of considering hepatic pathology in the differential diagnosis of pneumoperitoneum. Our objective is to provide a comprehensive analysis of the diverse clinical presentations, diagnostic challenges, and therapeutic strategies employed in managing this unique subset of liver abscesses.

Keywords: Emphysematous liver abscess, liver abscess, gas under diaphragm

INTRODUCTION

Emphysematous liver abscesses (ELAs) are also known as gas-forming pyogenic liver abscesses, with 76-85% occurring in patients with uncontrolled diabetes mellitus (1). Despite its infrequent occurrence, ELA poses a formidable clinical challenge due to its propensity for rapid deterioration and life-threatening complications. Complications are reported in as many as 92% of the cases, respiratory-related complications being the most common (2). The spectrum of clinical presentations ranges from subtle symptoms like fever and abdominal pain to dreaded complications like shock, making it a diagnostic challenge. Management of acute emphysematous liver abscess requires urgent external drainage of the abscess cavity, but pneumoperitoneum on radiological imaging can pose a serious diagnostic dilemma and can misguide surgeons, leading to unnecessary laparotomies. The evolving landscape of treatment options, encompassing medical therapy, percutaneous drainage, and surgical intervention, will be scrutinized in the context of individual cases, offering valuable insights into the optimal management strategies tailored to diverse clinical scenarios.

Case Reports

Case 1

A 22-year-old male with no comorbidities and a history of occasional alcohol intake presented with a history of on and off right upper quadrant pain for seven days with an associated low-grade fever. A chest radiograph (Figure 1A) done elsewhere showed gas under the right hemidiaphragm, suggestive of pneumoperitoneum. On examination, the patient was afebrile, hemodynamically stable, and showed no signs of peritonitis. Repeat chest radiographs revealed similar findings. Ultrasonography (USG) of the abdomen was suggestive of a liver abscess in the right lobe of the liver. Contrast enhanced computed tomography (CECT) of the abdomen and thorax (Figure 1B,C) revealed a hypodense space-occupying lesion with visible air fluid levels inside in the right lobe of the liver. Routine blood investigations were within normal limits, and external drainage via USG-guided pigtail catheter (PCD) insertion in the liver abscess cavity was done. Pus culture revealed the heavy growth of *Klebsiella pneumoniae*. The patient was discharged on oral antibiotics and was asymptomatic on three monthly follow ups.

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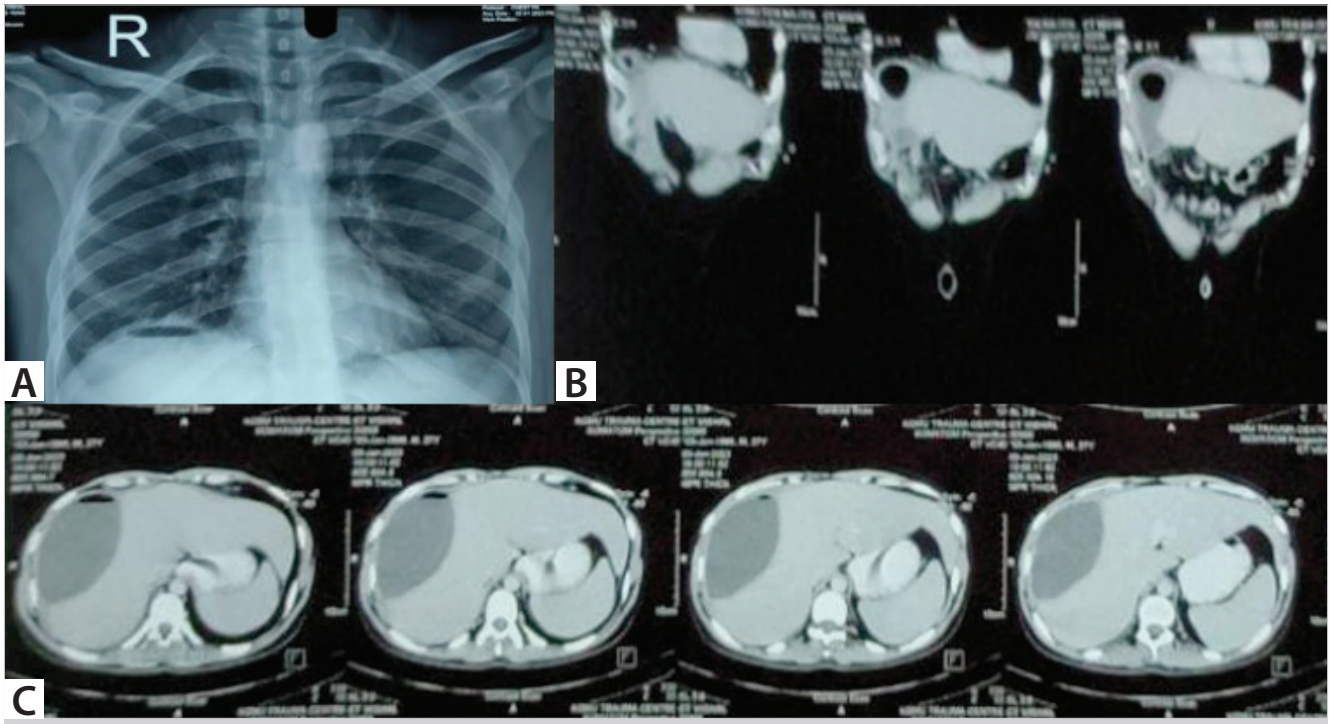

Figure 1. A. Chest radiograph showing pneumoperitoneum. **B,C.** CECT of the abdomen showing a hypodense space-occupying lesion with air specks and air-fluid levels.

Case 2

An 18-year-old heavy alcoholic and smoker male with no other comorbidities presented to the surgical emergency with complaints of severe abdominal pain, high-grade fever, and chills for seven days. On examination, the patient was febrile with tachycardia, hypotension, abdominal tenderness with guarding, and rigidity suggestive of peritonitis. An abdominal radiograph did not reveal any abnormalities. USG revealed multiple abscesses in the right lobe of the liver with no intra-abdominal collection. The patient's biochemical parameters were as follows: haemoglobin of eight, total leucocyte count of 28.000 with 85% polymorphocytes, platelet count of 35.000, urea of 180, creatinine of 3.8, INR of 3.7, and prothrombin time of 36. Liver function tests showed: total bilirubin= 3, alkaline phosphatase (ALP)= 400, SGOT= 120, and SGPT= 110, suggestive of multiorgan dysfunction syndrome. The patient was resuscitated, and CECT of the abdomen (Figure 2A, B) was done, which revealed multiple hypodense space-occupying lesions along with homogenous collection in the liver parenchyma, with specks of air noted inside the cavities in the right lobe of the liver, suggesting an emphysematous liver abscess. After initial resuscitation, the patient was managed by external drainage with multiple pigtail catheter insertions in the liver abscess cavity and empirical broad-spectrum antibiotics. Pus culture revealed *K. pneumoniae* as the causative agent. The patient's condition improved after drainage. The patient was discharged on oral antibiotics and was asymptomatic on three monthly follow ups.

Case 3

A 50-year-old diabetic female with poor glycaemic control presented with complaints of intermittent fever, chills, and right upper quadrant pain for 10 days. On examination, the patient was afebrile, hemodynamically stable, and tender in the right hypochondrium. Chest radiograph was suggestive of gas under the right hemidiaphragm and suggestive of pneumoperitoneum (Figure 3A). USG revealed two liver abscesses in the right lobe of the liver. The CECT of the abdomen was suggestive of two large hypodense spaces occupying lesions along with homogenous collection in the liver parenchyma, involving segments VIII, II, and III of the liver along with specks of air and visible air fluid levels inside the hypodense lesions (Figure 3B). The patient was managed by external drainage, pigtail catheter insertion in the liver abscess cavity, and glycaemic control. Pus culture was sterile. The patient was discharged on oral antibiotics and was asymptomatic on three monthly follow up.

Case 4

A 32-year-old male with a history of laparoscopic cholecystectomy a month prior presented with complaints of abdominal pain and intermittent fever for seven days. The patient was hemodynamically stable with localised tenderness

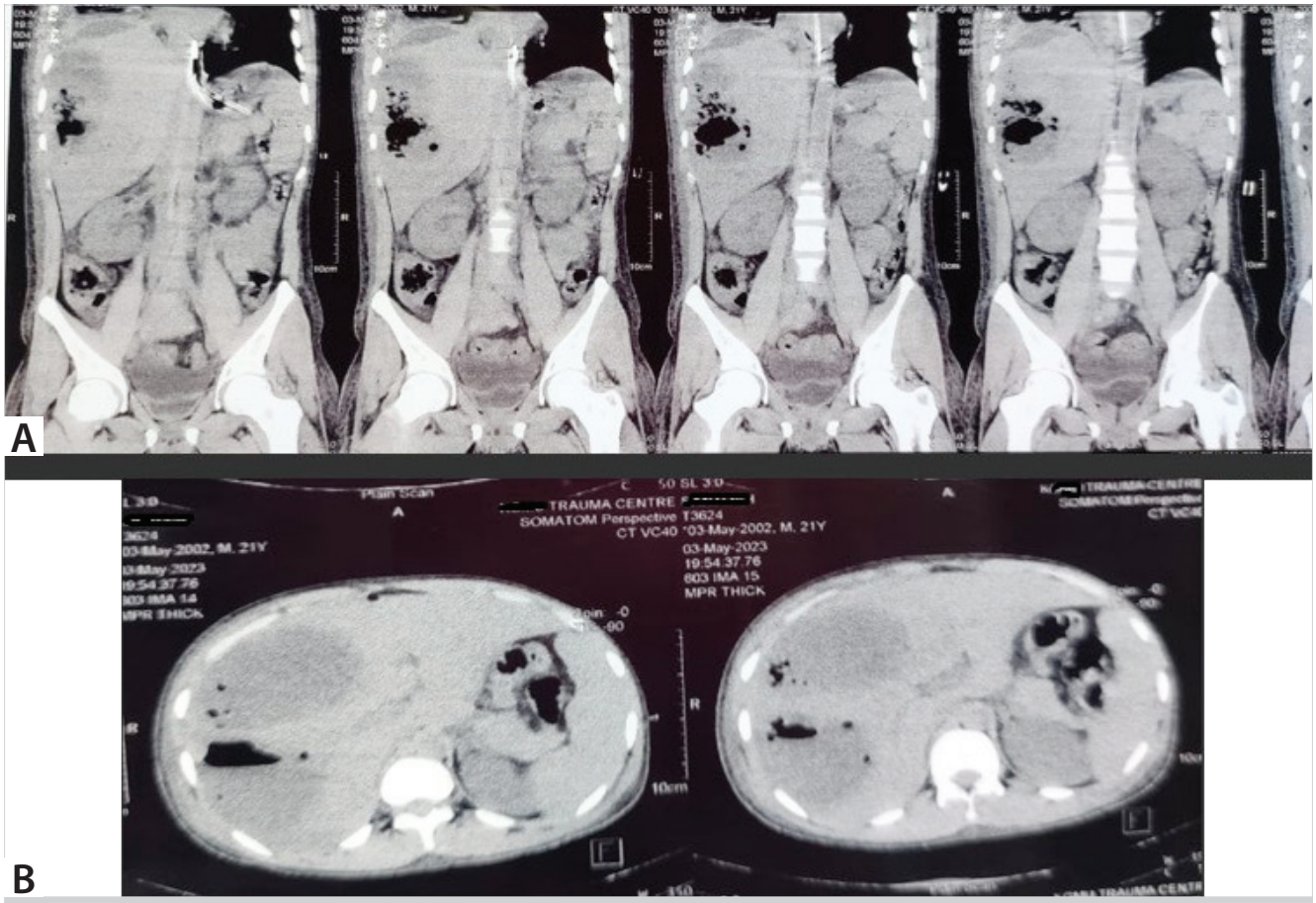

Figure 2. A,B. CECT of the abdomen showing multiple hypodense space-occupying lesions with air specks.

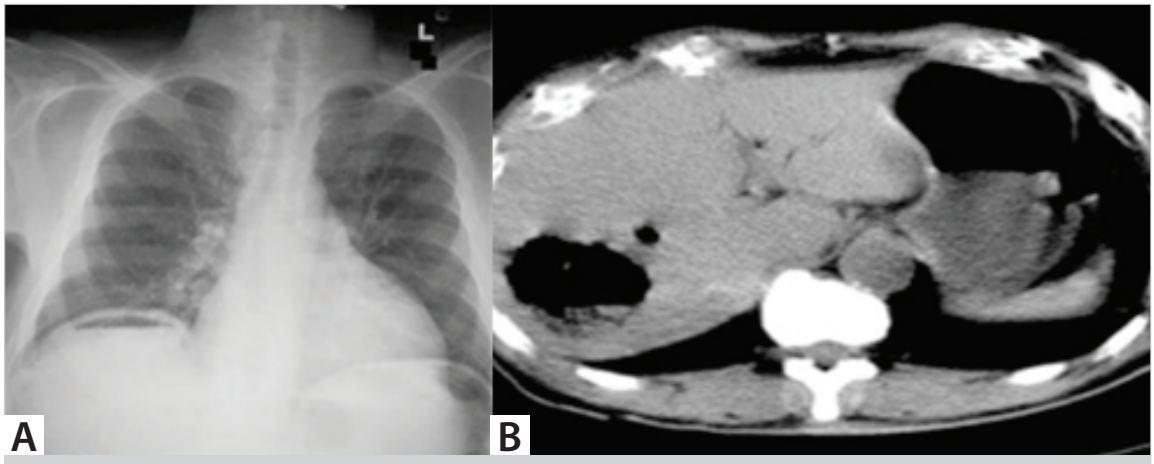

Figure 3. A. Chest radiograph showing pneumoperitoneum. **B.** CECT of the abdomen showing two large hypodense space occupying lesions with air specks and air-fluid levels.

in the right hypochondrium. Radiograph of the chest showed gas under the right dome of the diaphragm, suggestive of pneumoperitoneum, and USG showed a 400 mL hypoechoic lesion in segment seven of the liver, suggestive of a liver abscess (Figure 4A). The CECT of the abdomen showed a hypodense lesion with a speck of air in segment seven of the liver, suggesting an emphysematous liver abscess (Figure 4B,C). The patient was managed by external drainage, pigtail catheter insertion in the liver abscess cavity, and IV antibiotics. Pus culture was sterile. The patient was discharged on oral antibiotics and was asymptomatic on three monthly follow ups.

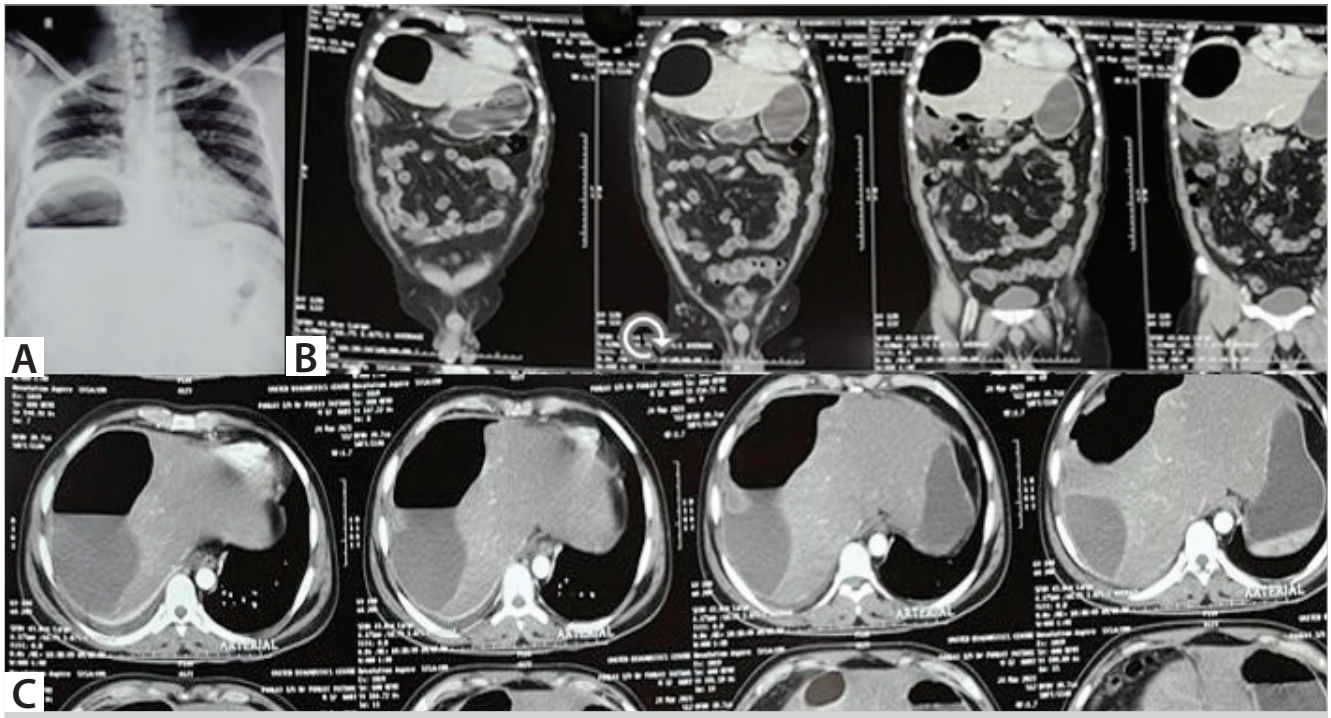

Figure 4. A. Chest radiograph showing pneumoperitoneum. **B,C.** CECT of the abdomen showing a hypodense space-occupying lesion with air speck.

Case 5

A 55-year-old chronic alcoholic male with no comorbidities presented with high-grade fever, abdominal distension, and right upper quadrant pain for one week. On examination, the patient was hemodynamically stable with a distended abdomen and right upper quadrant tenderness. USG revealed two liver abscess cavities, and CECT revealed a right lobe liver abscess along with an emphysematous left lobe abscess (Figure 5A,B). After initial resuscitation, the patient was managed by external drainage with pigtail catheter insertion in the liver abscess cavity, and cultures revealed *Klebsiella* spp. The patient was discharged on oral antibiotics and was asymptomatic on three monthly follow ups.

Case 6

A 54-year-old diabetic female with poor glycaemic control presented with upper abdominal pain and fever for one week. The patient was hemodynamically stable with right upper quadrant tenderness. USG was suggestive of emphysematous cholecystitis. Blood investigations showed hemoglobin= 6, total leukocyte count= 38.000, creatinine= 3, urea= 160, total bilirubin= 3.2, SGOT= 140, SGPT= 200, and alkaline phosphatase= 300. Non-contrast computed tomography of the abdomen showed a large liver abscess with emphysematous changes (Figures 6A,B). The patient was managed by external drainage with pigtail catheter insertion in the liver abscess cavity, glycaemic control, and broad-spectrum antibiotics. Pus culture

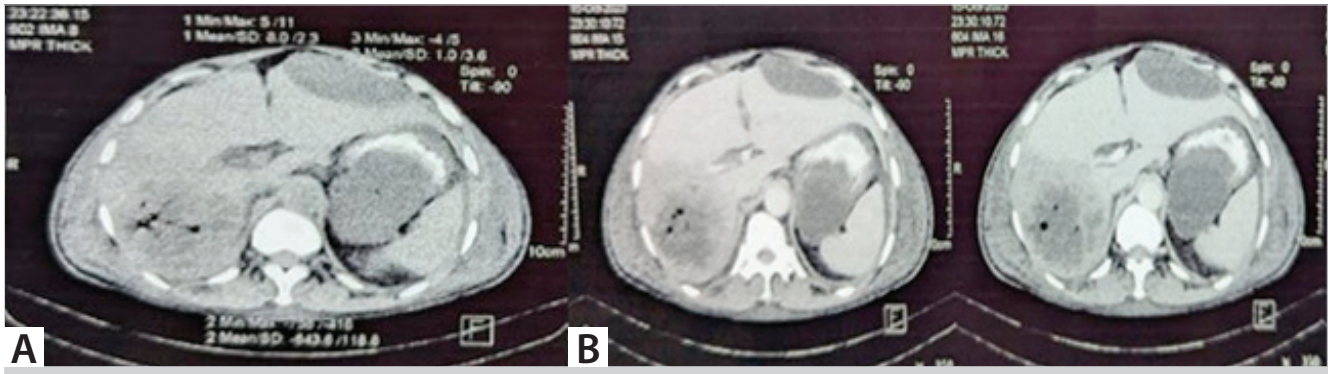

Figure 5. A,B. CECT showing a right lobe liver abscess and an emphysematous left liver lobe abscess.

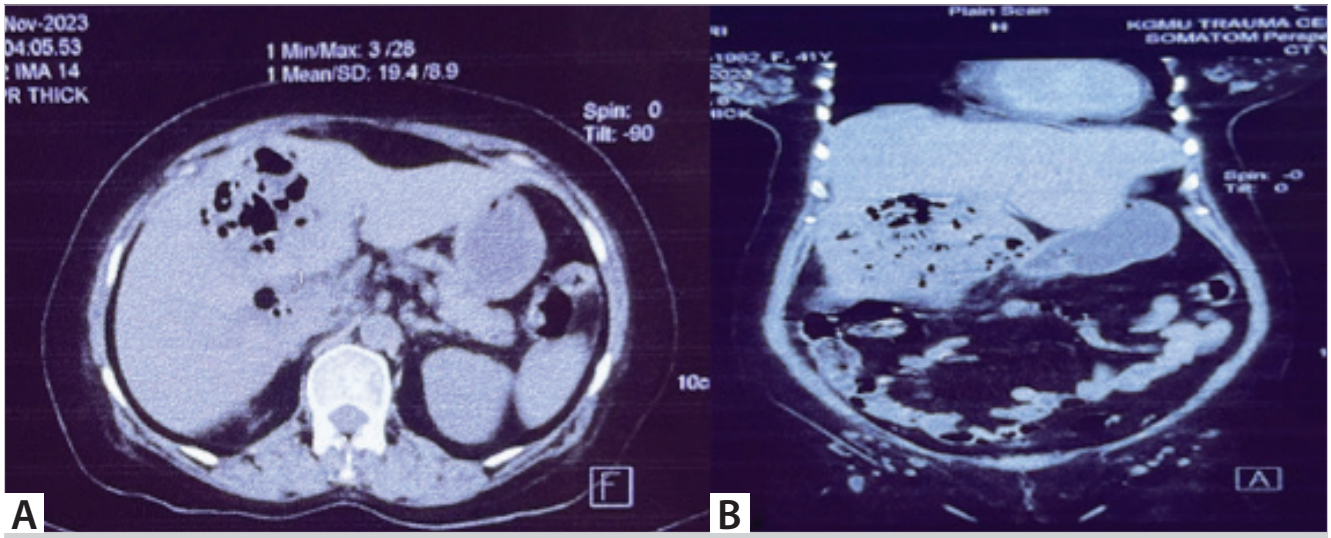

Figure 6. A,B. Non-contrast CT scan showing a large liver abscess with emphysematous changes.

revealed *Klebsiella* spp. The patient was discharged on oral antibiotics and was asymptomatic on three monthly follow ups.

Case 7

A 48-year-old alcoholic and diabetic male presented with complaints of high-grade fever, abdominal distension, and right upper quadrant pain for one week. On examination, the patient was hemodynamically stable with right upper quadrant tenderness. USG revealed a single liver abscess cavity, and CECT revealed a right lobe liver abscess with emphysematous changes and pleural effusion. After initial resuscitation, the patient was managed by external drainage with pigtail catheter insertion in the liver abscess cavity and glycaemic control (Figure 7A,B). Pus culture revealed *Escherichia coli* spp. The patient was discharged on oral antibiotics and was asymptomatic on three monthly follow ups.

Case 8

A 50-year-old chronic alcoholic male with no comorbidities presented with a high-grade fever and generalised pain in the abdomen for five days. On examination, the patient was hemodynamically stable with generalised peritonitis. Abdominal radiographs showed gas under the right dome of the diaphragm, suggestive of pneumoperitoneum; USG was suggestive of liver abscess (Figure 8A). CECT revealed a liver abscess with emphysematous changes and was managed by external drainage with pigtail catheter insertion in the liver abscess cavity (Figure 8A-C). Pus culture showed *E. coli* spp. The patient was discharged on oral antibiotics and was asymptomatic on three monthly follow ups.

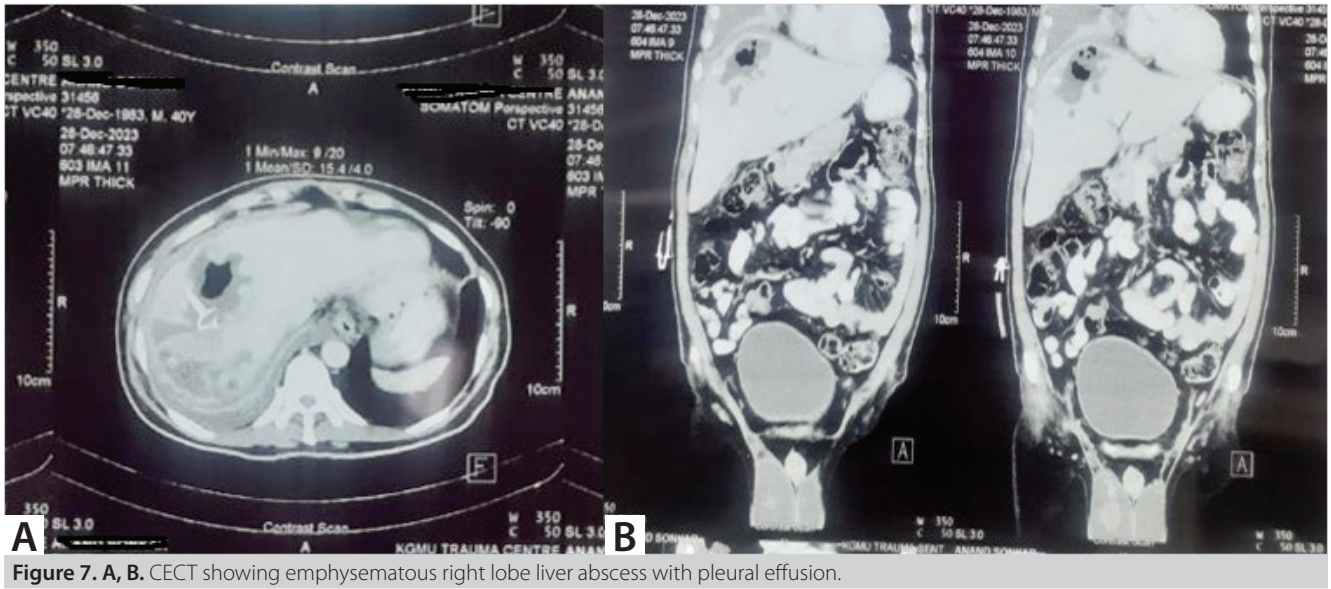

Figure 7. A, B. CECT showing emphysematous right lobe liver abscess with pleural effusion.

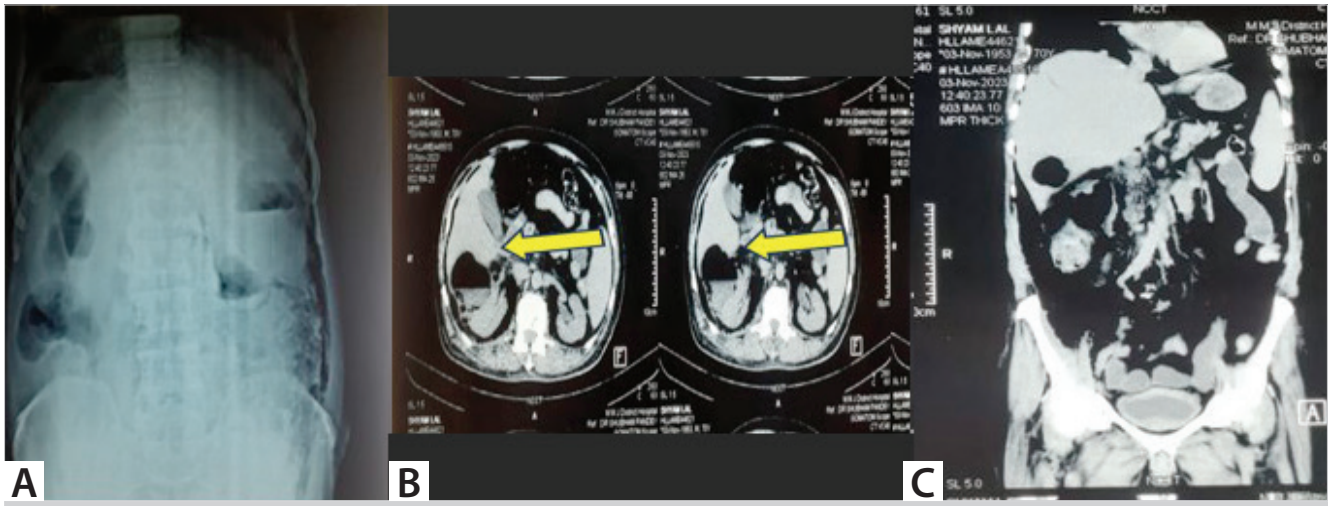

Figure 8. A. Chest radiograph showing pneumoperitoneum. **B,C.** CECT showing liver abscess with emphysematous changes.

DISCUSSION

ELAs are typically characterised by gas formation within the abscess cavity. 6-24% of all bacterial liver abscesses are emphysematous in nature, with the maximum incidence in Asia, particularly Taiwan (1). The most common pathogens are *K. pneumoniae* and *E. coli*, with *Klebsiella* accounting for 82% of cases (2). ELAs have a case fatality rate of 12-40% and a mortality rate of 27-37%, as compared to only 12% in non-gas-forming liver abscesses (3,4).

The clinical presentations vary from simple fever, malaise, pain in the abdomen, and respiratory difficulty to deadly complications like septic emboli, meningitis, endophthalmitis, or even shock (1). Yang et al. have reported hepatocellular damage in 57% of ELAs and 19% of non-gas-forming liver abscesses; similar findings were noted in our series, with all the patients having deranged ALP (5). Around 6% of the patients present with intrapleural or intraperitoneal rupture and features of peritonitis mimicking those of hollow viscus perforation (6). Diabetic patients might present with milder or no pain because of diabetic neuropathy, adding an additional layer of complexity and warranting careful assessment. A similar case of pneumoperitoneum because of a ruptured liver abscess has also been reported by Maliyakkal et al. (7).

The commonly identified risk factor is poor glycaemic control, as hyperglycaemia provides a favourable condition for gas formation via the mixed acid fermentation pathway of glucose, leading to the production of formic acid, which breaks down further into carbon dioxide and hydrogen by the action of formic hydrogenylase (3). ELAs are more prone to rupture due to mass tissue damage, gas formation, and impaired transport of gas and catabolic products away from the lesion because of diabetic microangiopathy, leading to gas accumulation and a rise in internal pressure (6).

Investigations usually show a raised total leukocyte count, alkaline phosphate, and liver enzymes, with or without coagulopathy. Abdominal USG, simple radiography, and other imaging techniques might prove to be helpful for diagnosis, but computed tomography is the diagnostic tool of choice for accurate detection of gas within the abscesses, along with abscess location, size, number, and associated complications. Differential diagnoses include subphrenic abscess, emphysematous cholecystitis, right renal abscess, perinephric abscess, hepatic flexure interposed between the diaphragm and liver, and partial abdominal heterotaxia. It is often difficult to differentiate ELAs from emphysematous hepatitis. Chromatographic analysis of the formed gas has shown nitrogen (N_2= 65.8 to 78.1%), oxygen (O_2= 1.2 to 7.3%), carbon dioxide (CO_2= 5.4 to 14.8%), and hydrogen (H_2= 9.0 to 18.3%) as constituents (3).

Treatment is mainly percutaneous abscess drainage, along with antibiotic therapy and glycaemic control, with a reported success rate of 94% (8). Surgery is indicated if peritonitis and rupture are suspected, and surgery as extensive as an emergency hepatectomy might be needed (9). The summary, blood parameters, and outcome of all patients are shown in Table 1, Table 2, and Table 3.

In our study, four hemodynamically stable patients with unremarkable clinical examinations were found to have gas under the right hemidiaphragm, which was a diagnostic dilemma. Such findings can easily misguide the surgeon to perform an unnecessary laparotomy, suspecting hollow viscus perforation, especially in low-resource settings where facilities for USG and CECT are not available, as reported by Pham et al. (10). Contrastingly, another patient with signs and symptoms of acute abdomen with multiorgan dysfunction had no gas under the right hemidiaphragm and was found to have ELAs, indicating the variability in the presentations of this rarer entity.

Table 1. Summary of all patients

Case no	Age/sex	Habits	Comorbidity	Symptoms	Examination	Blood parameters	X-ray	USG (Number and location)	CT	Pus culture
1.	22/M	Alcoholic	None	RUQ pain Fever	WNL	WNL	Gass under diaphragm	1 Right lobe	Single emphysematous abscess	*K. pneumoniae*
2.	18/M	Alcoholic Smoker	None	Generalised pain abdomen Fever Chills	Febrile, Hypotension peritonitis	MODS	WNL	Multiple Right lobe	Multiple liver abscess with emphysematous change	*K. pneumoniae*
3.	50/F	None	DM	RUQ pain Fever Chills	RUQ Tenderness	Elevated TLC	Gass under diaphragm	2 Right lobe	Two large emphysematous abscesses	Sterile
4.	32/M	None	None	RUQ pain Fever	RUQ Tenderness	Elevated TLC	Gass under diaphragm	1 Right lobe	Single emphysematous liver abscess	Sterile
5.	55/M	Alcoholic	None	Fever RUQ pain	RUQ Tenderness	Elevated TLC	WNL	2 Right and left lobe	Right lobe abscess with left lobe emphysematous abscess	*K. pneumoniae*
6.	54/F	None	DM	Fever RUQ pain	RUQ Tenderness	Elevated TLC	WNL	Emphysematous cholecystitis	Large liver abscess with emphysematous changes	*K. pneumoniae*
7.	48/M	Alcoholic	DM	Fever RUQ pain	RUQ Tenderness	Elevated TLC	WNL	1 Right lobe	Right emphysematous liver abscess with Pleural effusion	*E. coli*
8.	50/M	Alcoholic	DM	Fever RUQ pain	Peritonitis	Elevated TLC	Gass under diaphragm	1 Right lobe	Right emphysematous liver abscess with pleural effusion	*E. coli*

DM: Diabetes mellitus, WNL: Within normal limits, RUQ: Right upper quadrant, MODS: Multi organ dysfunction syndrome, M: Male, F: Female, *K. pneumoniae: Klebsiella pneumoniae, E. coli: Escherichia coli.*

Table 2. Blood parameters at admission

Case no	Hb	TLC	INR	Bilirubin	SGOT/SGPT	ALP	Urea	Creatinine	CRP	HBA1C	Lactate
1.	10.2	11000	1.1	0.8	60/55	120	40	0.8	2	5.2	3
2.	8	28000	3.7	3	120/110	400	180	3.8	65	5.6	6
3.	9.4	32000	1.2	2.4	80/65	200	64	1.2	28	10.4	2
4.	13	26000	1.24	4	110/75	180	68	0.8	15	6.2	2
5.	8.9	22000	1.8	2	80/55	160	120	2.2	8	5.4	1.8
6.	6	38000	3.2	2	140/200	300	160	3	55	8.8	4
7.	12	24600	2.2	1.2	60/45	140	70	1.8	15	9.2	3
8.	10.8	20800	2.6	1.4	50/45	150	72	1.1	10	10	3.8

Hb: Haemoglobin, TLC: Total leucocyte count, INR: International normalized ratio of prothrombin time, SGOT: Serum glutamyl ornithine transferase, SGPT: Serum glutamic pyruvate transferase, ALP: Alkaline phosphatase, CRP: C-reactive protein, HBA1c: Glycosylated haemoglobin.

Table 3. Outcomes of all patients

Case no	Age/sex	Habits	Outcome	Total duration of PCD in-situ	Condition at three monthly follow up
1.	22/M	Alcoholic	Discharged to home	12 weeks	Stable
2.	18/M	Alcoholic/Smoker	Discharged to home	16 weeks	Stable
3.	50/F	None	Discharged to home	14 weeks	Stable
4.	32/M	None	Discharged to home	8 weeks	Stable
5.	55/M	Alcoholic	Discharged to home	10 weeks	Stable
6.	54/F	None	Discharged to home	6 weeks	Stable
7.	48/M	Alcoholic	Discharged to home	8 weeks	Stable
8.	50/M	Alcoholic	Discharged to home	16 weeks	Stable, required PCD reinsertion

PCD: Percutaneous drainage tube, M: Male, F: Female.

CONCLUSION

To conclude, heightened awareness among clinicians, radiologists, and surgeons regarding the potential for emphysematous liver abscess to mimic other acute abdominal emergencies is warranted. A comprehensive understanding of the varied clinical presentations, particularly distinguishing ELAs from hollow viscus perforations, and the incorporation of advanced imaging techniques like contrast-enhanced computed tomography are crucial for accurate and timely diagnosis, guiding appropriate therapeutic interventions, avoiding unnecessary laparotomies, and improving patient outcomes with less invasive modalities like percutaneous drainage.

Informed Consent: Informed consent was obtained from the all patients participating in this case.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - All of authors; Design - SS, SKS, AA, AAS; Supervision - RK, SC, AA, AAS; Fundings; SC, SS, SKS, RK; Data Collection and/or Processing - SS, SKS, RK; Analysis and/or Interpretation - SS, SKS, AA, RK, SÇ; Literature Search - SS, SK, AA, SC; Writing Manuscript - SS, SKS, AA, AAS; Critical Reviews - AAS, AA, RK.

Conflict of Interest: The authors have no conflicts of interest to declare.

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OLGU SERİSİ-ÖZET
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Amfizematöz karaciğer apseleri: Değişken klinik sunumlar, yönetim zorlukları ve sonuçlar-bir olgu serisi

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ÖZET

Karaciğer parenkimi içinde gaz varlığı ile karakterize olan amfizematöz karaciğer apseleri (AKA) nadir görülen ve potansiyel olarak yaşamı tehdit eden bir durumdur. İçi boş organ perforasyonunu taklit eden klinik tablolara sahip AKA'lar klinisyenler için tanısal bir bilmece oluşturmaktadır. Bu seri, bu tür atipik sunumların yarattığı tanısal zorlukları ve pnömoperitoneumun ayırıcı tanısında hepatik patolojinin göz önünde bulundurulmasının önemini vurgulamaktadır. Bu çalışmanın amacı, karaciğer apselerinin bu benzersiz alt kümesinin yönetiminde kullanılan çeşitli klinik sunumların, tanısal zorlukların ve terapötik stratejilerin kapsamlı bir analizini sunmaktır.

Anahtar Kelimeler: Amfizematöz karaciğer apsesi, karaciğer apsesi, diyafram altında gaz

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