

CASE REPORT

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# Point of care ultrasound in rapid diagnosis of acute cholangitis and emphysematous cholecystitis: a case report

Min Seok Chae<sup>1\*</sup> and Olga A. Kravchuk<sup>1</sup>

## Abstract

**Background** Emphysematous cholecystitis is a rare and rapidly progressive disease that requires prompt diagnosis and intervention. Point of care ultrasound (POCUS) is a useful diagnostic imaging tool in the emergency department that can help expedite diagnosis and management of biliary etiology.

**Case presentation** In our case, we describe an 85 year old female with a history of diabetes mellitus with a presentation consistent with undifferentiated cholecystitis. Point of care ultrasound performed in the emergency department showed a characteristic “champagne sign”, along with other findings including dilated common bile duct and pericholecystic fluid. These findings ultimately led to the diagnosis of emphysematous cholecystitis and acute cholangitis. The use of ultrasound expedited the patient’s cholecystostomy tube placement and subsequent endoscopic retrograde cholangiopancreatography, proving to be a life-saving tool in the management of this patient.

**Conclusion** POCUS can be an important tool for the diagnosis of undifferentiated biliary etiology, expediting the management of these patients.

**Keywords** Emphysematous cholecystitis, Champagne sign, Point of care ultrasound, Cholangitis, Gas

## Background

Emphysematous cholecystitis (EC) is a severe and rare variant of acute cholecystitis characterized by presence of gas with gallbladder lumen, wall, or pericholecystic structures. The pathology is rapidly progressive with a high mortality rate. EC is also a rare diagnosis, seen in only 1 – 4% of all cases of cholecystitis [1, 4]. Bacteria, most commonly, *Clostridium perfringens* and *Escherichia coli*, proliferate and cause ischemia, leading to gas formation in the gallbladder lumen or wall. Similarly to

non-emphysematous cases of acute cholecystitis, patients present with right upper quadrant pain, fever, and vomiting. However, the mortality rate in EC is as high as 15–20%, relative to 4% in cases of non-emphysematous acute cholecystitis [2]. Such marked difference in the rates of mortality is due to increased likelihood of perforation, abscess, and gangrene, making EC a more emergent diagnosis compared to the more common disease process of non-emphysematous acute cholecystitis [3].

Risk factors for EC include advanced age, male gender, and diabetes mellitus. Diabetes predisposes to ischemic environment and increases possibility of infection. This likely plays a part in the etiology of EC. Other risk factor includes recurrent gallstones and cholecystitis [4].

In the ED setting, POCUS is a valuable tool in diagnosis of biliary pathology. It has a sensitivity and specificity

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of 89.8% and 88.0%, respectively, to diagnose cholelithiasis, and 87.0% and 82.0%, respectively, to diagnose acute cholecystitis [5]. In addition, finding a dilated common bile duct (CBD) on POCUS had a sensitivity and specificity of 23.7% and 90.27%, respectively, for complicated biliary pathology [6]. Dilated CBD is defined as internal diameter greater than 6 mm if under 60 years of age and an additional 1 mm for every subsequent decade after 60 years. The dilatation can aid in the diagnosis of choledocholithiasis and cholangitis. Thickening of the walls of the CBD is a hallmark sign of cholangitis [7].

Previous studies have observed the evidence of gas in the gallbladder lumen or wall, termed “champagne sign” or “effervescent cholecystitis”, where locules of gas collect in a non-gravity dependent manner along or in the gallbladder wall. This is reminiscent of the bubbles rising in a glass of champagne [4, 8]. On ultrasound, small amounts of gas may present as a linear echogenic focus with a reverberation artifact, while a greater amount of gas can result in a wide band of acoustic shadowing [2, 4]. In the correct clinical setting, these ultrasound findings suggest diagnosis of EC. False negative ultrasound may occur due to poor acoustic window or due to overlying bowel gas that can obscure the gallbladder, necessitating further evaluation with a CT [5].

In our case, we have a female patient that presented with EC to the emergency department. POCUS was an effective tool in the diagnosis of EC with acute cholangitis in our patient.

### Case presentation

An 85 year old female with past medical history of atrial fibrillation on apixiban, mitral valve regurgitation, congestive heart failure, type 2 diabetes mellitus, and hypertension presented to the ED with abdominal pain and non-bilious, non-bloody emesis for 2 days. On arrival, patient was mildly confused according to her daughter, who accompanied the patient to the ED and contributed to the history of present illness. The patient had a previous surgical history notable for appendectomy and hysterectomy. Initially, her vital signs included temperature of 98.8 °F, heart rate of 79, oxygen saturation of 96% on room air, respiratory rate of 24, and blood pressure of 161/83. On exam, the patient was jaundiced and had right upper and lower quadrant abdominal tenderness. She was encephalopathic and had difficulty following commands.

Expedient POCUS was performed, which revealed intraluminal gas in the gallbladder, consistent with the “champagne sign” (Fig. 1). Bedside ultrasound also revealed a gallstone at the gallbladder neck, as well as pericholecystic fluid. The ultrasound also revealed a dilated common bile duct (CBD) measuring up to

1.29 cm (Fig. 2). These findings were highly concerning for emphysematous cholecystitis and CBD obstruction.

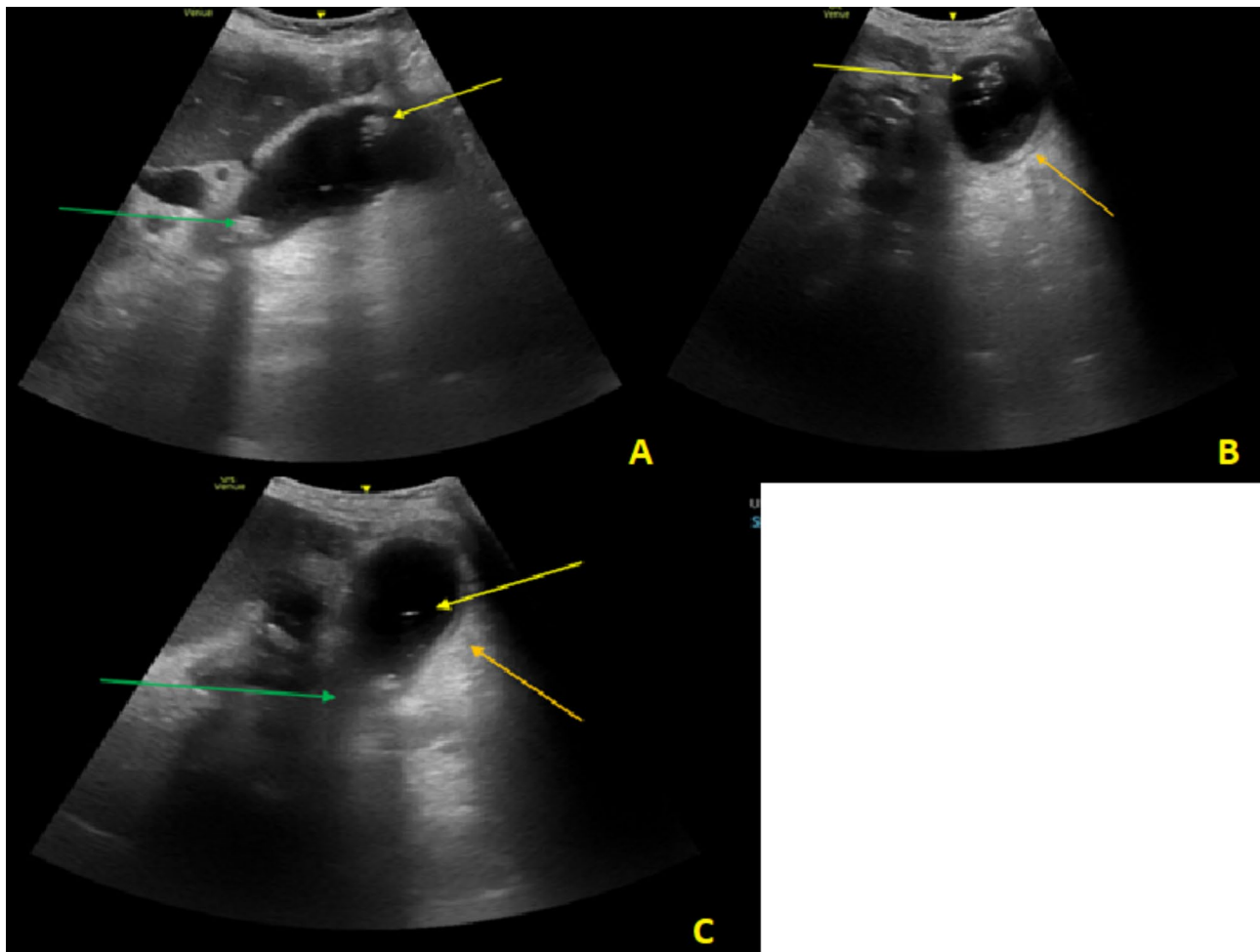
Based on the POCUS findings of EC as well as the clinical picture concerning for ascending cholangitis and sepsis, patient was emergently taken to Computed Tomography (CT) for confirmation of EC and suspected CBD obstruction. She was started on piperacillin-tazobactam for antibiotic coverage as well as crystalloid intravenous fluid resuscitation. Laboratory studies showed elevation of liver function tests including Aspartate aminotransferase U/L 929, Alanine aminotransferase 765 U/L, Alkaline phosphatase 225 IU/L and total and direct bilirubin 3.70 mg/dL and 3.06 mg/dL, respectively. Lactic acid was elevated at 7.3mmol/L and patient was leukopenic with White blood cell count of 2.46 thousand/mm<sup>3</sup>.

Based on POCUS findings, labs and clinical presentation, interventional radiology, general surgery, and critical care were consulted. Patient’s condition worsened, with a declining mental status, hypoxia and respiratory distress requiring Bilevel Positive Airway Pressure, a fever up to 103.0°F and tachycardia up to 110. CT abdomen pelvis imaging redemonstrated POCUS findings including air within gallbladder lumen as well as a dilated CBD up to 1.3 cm, though a stone could not be visualized (Fig. 3).

Patient was admitted to the medical intensive care unit and was started on norepinephrine drip due to developing septic shock. Within 4 h of initial presentation to the ED, patient underwent cholecystostomy tube placement by interventional radiology, resulting in a rapid improvement in her clinical status which permitted further interventions including endoscopic retrograde cholangiopancreatography(ERCP) with stent placement and subsequent cholecystectomy. Patient recovered uneventfully and was discharged to a skilled nursing facility. Blood and bile cultures later revealed *Clostridium perfringens* and *Escherichia coli*.

### Discussion and conclusions

POCUS is well-established as a valuable tool in the emergency medicine setting. Rapid evaluation for gallbladder pathology is one of the applications of POCUS in the ED. Though CT is the most sensitive and specific study for EC and allows for further characterization of disease as well as assessment for other etiologies of a patient’s presentation, obtaining a CT presents certain challenges [9]. Patients should be hemodynamically stable to undergo CT imaging. While the study itself may take minutes to obtain, interpretation by the radiologist may be delayed. On the other hand, POCUS, though not as sensitive or specific as a CT for EC, can aid the clinician in clinching the diagnosis at bedside in a matter of minutes and without risking patient decompensation in the CT suite.



**Fig. 1** (from top left to bottom) **A**: longitudinal gallbladder view with the “champagne sign” and pericholecystic fluid. **B**: Transverse gallbladder view with further evidence of the champagne sign. A gallbladder neck gallstone is present, with evidence of acoustic shadowing. **C**: longitudinal with evidence of champagne sign and pericholecystic fluid (Yellow = gas, Orange = pericholecystic fluid, green = gallstone).

Another advantage of POCUS is that the examiner who acquires the study is also the interpreter. The POCUS user has the knowledge of the patient’s presentation when performing the ultrasound and can interpret the images in context of the patient’s presentation. For instance, while the “champagne sign” indicates presence of gas, it may be present in conditions other than EC [9]. In the cases by Niderhayuser et al., gas was found in asymptomatic patients due to gas-forming gallstones [10]. However, in our case, we knew that the presence of a “champagne sign” was due to a far more sinister etiology given patient’s history and physical exam.

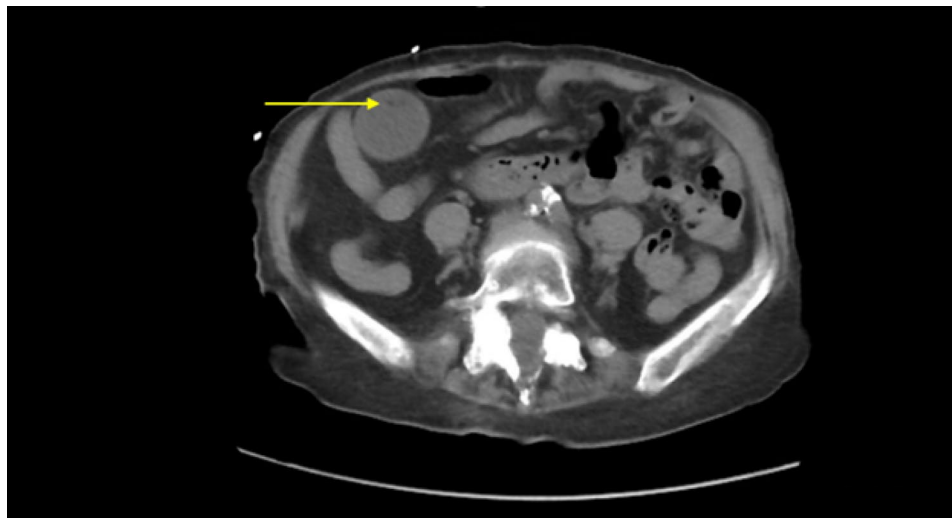
In our case, POCUS revealed several findings that guided further patient evaluation and interventions. Not only was there presence of gas, an obstructing stone at the gallbladder neck, and pericholecystic fluid, necessitating prompt resuscitation and early consultation with interventional radiology and surgery, but there was also presence of a dilated common bile duct, suggesting CBD

obstruction and cholangitis. She presented with altered mental status and fever, and had elevated liver function tests. In association with the CBD dilatation, this was consistent with acute cholangitis. This warranted an emergency consultation with gastroenterology for ERCP to address CBD obstruction and manage the cholangitis aspect of the disease.

Our case demonstrates the need for early diagnosis, since the patient decompensated in a matter of hours, requiring vasopressors and respiratory support. With POCUS, the diagnosis was made within one hour of arrival to the ED allowing rapid mobilization of specialty services. The diagnosis was confirmed with CT only two hours after POCUS raised initial concern for EC. Prompt identification of the “champagne sign” on POCUS, along with other signs of acute cholecystitis on POCUS raised concern for the rare pathology of EC and allowed for early involvement of interventional radiology, general surgery, and critical care medicine.



**Fig. 2** Dilated CBD: dilated to 1.29 cm in this picture



**Fig. 3** Transverse CT abdomen & pelvis revealing gas (yellow) in the gallbladder

The patient's diagnosis of EC with acute cholangitis is a rare diagnosis that can be a rapidly decompensating disease. Early diagnosis is important in order for proper medical and surgical interventions. POCUS is a readily available tool in most emergency department that can diagnose this disease. Emergency medicine physicians should be aware of this tool for diagnosis in this sinister disease to safely and quickly diagnose this disease to properly treat the patient. We conclude that POCUS is a valuable tool in making a timely diagnosis emphysematous cholecystitis and has the potential to improve morbidity and mortality of this dangerous disease.

#### Abbreviations

EC	Emphysematous cholecystitis
POCUS	Point of Care Ultrasound
ED	Emergency Department
CBD	Common Bile duct
ERCP	endoscopic retrograde cholangiopancreatography
CT	Computed Tomography

#### Author contributions

Min Seok Chae wrote the manuscript initially and examined the patient primarily. Olga Kravchuk contributed to the writing of the manuscript including edits. All authors read and approved the final manuscript.

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**Data availability**

No datasets were generated or analysed during the current study.

**Declarations****Ethics approval and consent to participate**

The authors certify that they obtained all appropriate consent forms from family. The family understand that the patient's name and initials will not be published.

**Consent for publication**

Written informed Consent was obtained from patient's family member for the publication of this case report and accompanying images as patient is deceased and unable to give consent.

**Competing interests**

The authors declare no competing interests.

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