

Enhancing surgical decision-making: the critical need for structured ultrasound training in residency.

A case report of acute necrotic cholecystitis

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Abstract

Acute necrotic cholecystitis (ANC), marked by gallbladder wall necrosis, carries high morbidity if diagnosis and treatment are delayed. Ultrasound is the first-line imaging for suspected cholecystitis, but its sensitivity for necrosis is limited. This case underscores the value of surgical ultrasound competency in emergency decision-making. A 57-year-old woman with diabetes, asthma, and hypothyroidism presented with severe epigastric pain and systemic inflam-

mation. Emergency ultrasound showed gallbladder wall thickening, pericholecystic fluid, and gallstones. CT confirmed necrosis with possible microperforation. An informal ultrasound by surgical residents later that day identified microperforations, expediting the decision for subtotal laparoscopic cholecystectomy. Surgery was successful, and recovery was uneventful. Ultrasound, when performed by trained surgical teams, enables rapid diagnosis and management of complex cholecystitis. Structured ultrasound training during residency could enhance diagnostic accuracy, reduce treatment delays, and improve outcomes in acute surgical emergencies.

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Introduction

Acute necrotic cholecystitis (ANC) is a severe form of acute cholecystitis characterized by gallbladder wall necrosis, which can lead to perforation, peritonitis, and sepsis.¹ This condition represents a surgical emergency due to its rapid progression and potential for systemic complications. Without timely diagnosis and intervention, ANC significantly increases morbidity and mortality, presenting a much higher risk of severe complications, including systemic infection, multi-organ failure, and death, making early detection and intervention paramount.²

Ultrasound remains the first-line imaging modality in the evaluation of suspected acute cholecystitis.³ It is a non-invasive, accessible, cost-effective tool that provides real-time visualization of the gallbladder, allowing clinicians to detect signs such as gallbladder distension, wall thickening, and pericholecystic fluid – all indicative of inflammation.^{4,5} However, in more complex cases such as ANC, ultrasound may fall short in detecting complications. Studies have shown that the sensitivity of ultrasound in diagnosing acute cholecystitis can range from 60% to 80%, with significantly lower sensitivity, particularly in detecting complications like necrosis, micro-fissures, and perforation.^{6,7} In contrast, computed tomography (CT) provides superior sensitivity and specificity compared to ultrasound, with reported sensitivity ranging from 85% to 95% and specificity typically exceeding 90%. CT's ability to clearly define the extent of necrosis, gallbladder wall thinning, fat stranding, and pericholecystic fluid is critical in assessing the severity of the disease.^{8,9} This detailed imaging allows for comprehensive evaluation, enabling clinicians to better plan surgical intervention, especially when complications are suspected.³

In clinical settings, combining ultrasound and CT ensures a more comprehensive evaluation and helps guide urgent surgical decision-making. When CT is not immediately available, having surgeons trained on point-of-care ultrasound can expedite diagnosis

and management, potentially reducing delays in treatment and improving patient outcomes.

The evolving complexity of managing acute abdominal emergencies demands that surgeons develop competency in ultrasound.¹⁰ Although traditionally performed by radiologists, surgeon-performed ultrasound is increasingly recognized as an effective point-of-care diagnostic method that significantly enhances patient care, especially in time-sensitive situations.¹¹ Surgeons who are proficient in ultrasound can perform real-time assessments, as well as carefully make close follow-up evaluations, rapidly identifying key findings that inform treatment decisions.

Studies have shown that surgeon-performed ultrasound improves diagnostic accuracy, reduces time to diagnosis, and enables earlier clinical decisions.^{10,11} A study reported decreased imaging requests, shorter time to surgery, and lower hospital admission rates when surgeons perform point-of-care ultrasound assessment, emphasizing the benefits of integrating ultrasound into surgical practice and offering both clinical and economic advantages.¹²

This case study aims to demonstrate the role of ultrasound performed by surgeons in the diagnosis of acute necrotic cholecystitis. Given the urgency of diagnosing and treating acute necrotic cholecystitis, this study advocates for increased ultrasound training and integration into routine surgical practice and residency programs.

Case Report

A 57-year-old female with a medical history of type 2 diabetes, asthma, hypothyroidism, and a previous total thyroidectomy presented to the emergency department (ED) with a complaint of severe epigastric pain, vomiting, and fever. The onset of the symptoms started four days prior to ED admission. The febrile symptoms subsided the following day, while the epigastric pain and vomiting persisted. The patient had no history of recent trauma or changes in her medical therapy. She had undergone laparoscopic bilateral salpingo-oophorectomy in 2023 for uterine neoplasia. Medications included levothyroxine, escitalopram, metformin, atorvastatin, quetiapine, and trazodone.

Upon ED arrival, the patient was afebrile with a heart rate of 98 beats per minute and blood pressure of 130/85 mmHg. Physical examination revealed epigastric tenderness, with signs of guarding but no rebound tenderness. No peritonism or palpable masses were identified. An abdominal ultrasound was performed upon arrival by the ED doctor, revealing a gallbladder with thickened walls, minimal pericholecystic fluid, and the presence of gallbladder stones.

Initial laboratory tests revealed a white blood cell count of

$25.99 \times 10^9/L$, and C-reactive protein was elevated at 35.22 mg/dL, suggesting acute inflammation. Liver function tests showed mild elevation of total bilirubin (1.55 mg/dL) and direct bilirubin (0.81 mg/dL), indicating possible biliary involvement. Hemoglobin was within normal limits (15.2 g/dL), ruling out significant blood loss. These results, combined with the patient's clinical presentation, raised suspicion for acute cholecystitis.

A contrast abdominal CT scan was performed after initial assessment, and revealed a distended gallbladder with poorly defined walls, concomitant significant effusion, and extension to perihepatic, duodenal, and mesocolic tissues. Mild ectasia of the intrahepatic bile ducts was also observed. No obvious radiopaque cholelithiasis was present, with the findings being consistent with acute cholecystitis, with possible micro-fissuring of the gallbladder wall (Figure 1).

Upon the CT findings, the patient was visited by the on-call surgeon and was admitted to the surgical department for further investigation.

An informal ultrasound performed later the same day by two residents, part of the surgical team assigned to the case, revealed a marked distension of the gallbladder with irregular wall thickening, indicative of acute cholecystitis (Figure 2). There was an absence of well-defined gallbladder walls, with areas suggestive of pericholecystic fluid accumulation, posing concerns for necrosis. The findings were consistent with acute necrotic cholecystitis, which also suggested micro-fissures or impending perforation. Posterior acoustic shadowing was indicative of the presence of gallstones.

Given the severity of the clinical and imaging findings, raising suspicion of a necrotic process and possible rapid deterioration, the surgical team opted for urgent same-day surgery. The surgery was performed using a standard laparoscopic approach and consisted of a subtotal cholecystectomy. Intraoperative findings included a severely inflamed and necrotic gallbladder with marked adhesions to the surrounding tissues, including the duodenum and mesocolon. Gallbladder walls were friable, with evidence of micro-fissures, whereas the surrounding peritoneum and mesocolon showed signs of inflammation and mild exudate (Figure 3). The portion of the gallbladder that was removed was sent for definitive tissue analysis and came back positive for microscopic findings of acute gangrenous cholecystitis with perivisceritis.

The postoperative course was uneventful. The patient was started on intravenous fluids, pain management, gastroprotection, and only prophylactic antibiotics. The patient was monitored for any signs of infection or complications such as a bile leak or sepsis. The follow-up visits in the general surgery outpatient clinic, performed ten days after discharge, revealed no post-operative complications.

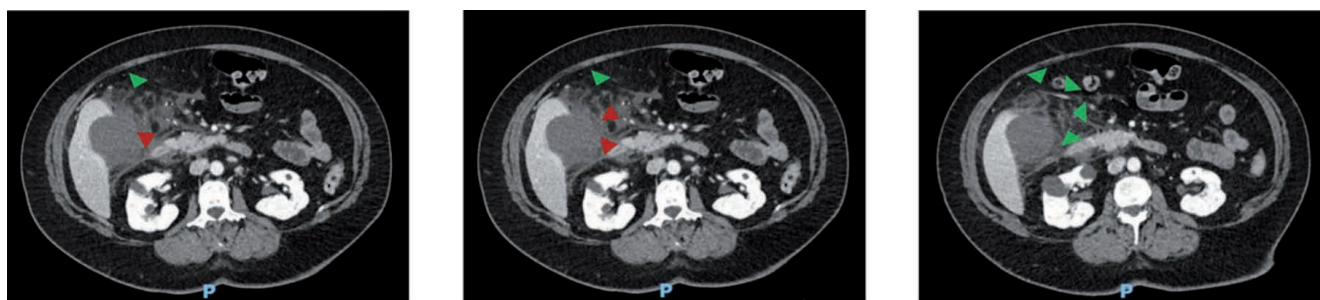


Figure 1. CT scan images performed upon emergency room admission. In red arrowheads, the irregularities in the gallbladder wall, and in green, the pericholecystic effusion.

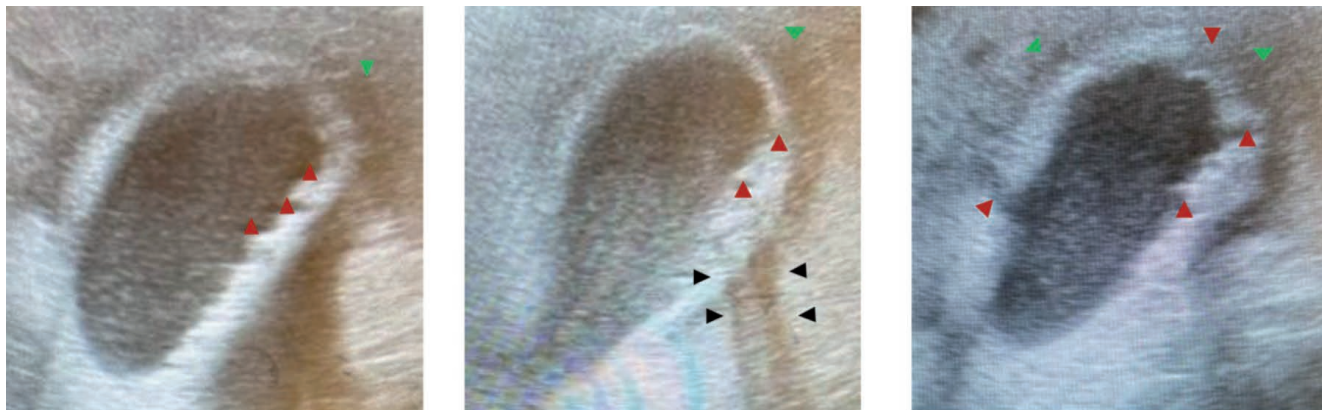


Figure 2. Images from the informal ultrasound performed by the surgical residents in the department. In red arrowheads, the irregularities in the gallbladder wall, in green, the pericholecystic effusion, and in black, the posterior acoustic shadowing.

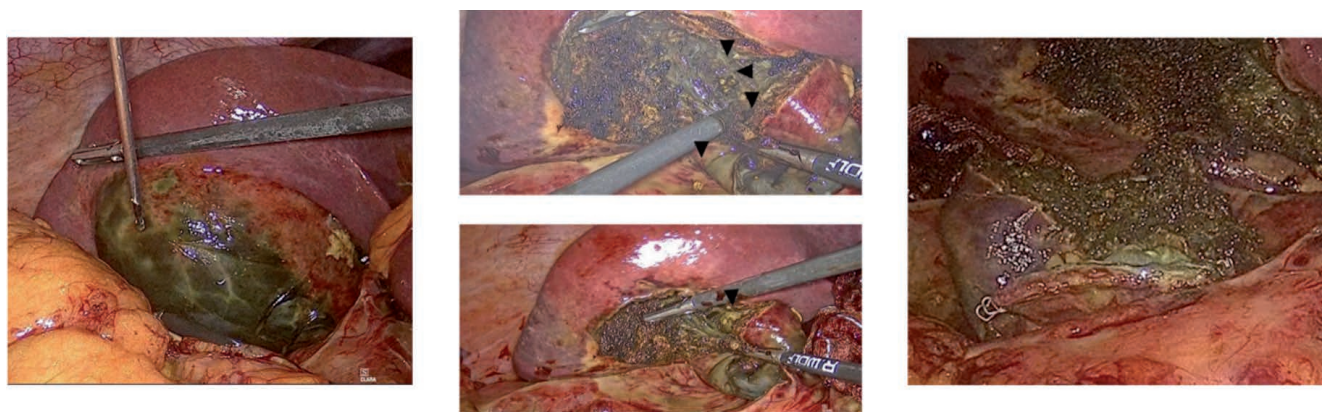


Figure 3. Intra-operative images of the gallbladder. In black arrowheads, gallstones.

Discussion

Ultrasound has become an indispensable tool, not only for initial evaluation but also for monitoring the progression of abdominal pathologies in real time. In many surgical settings, especially those requiring immediate decision-making, point-of-care ultrasound may be the only readily available imaging modality to assess the evolution of a patient's condition.¹³ Traditionally performed by radiologists, ultrasound is now increasingly recognized as a valuable skill for surgeons.¹⁴ When used at the bedside, it allows rapid assessments that can accelerate intervention and improve outcomes.^{6,15,16}

The growing use of ultrasound in emergency surgical care is particularly noteworthy in cases like acute necrotic cholecystitis, when rapid intervention is crucial. In such scenarios, the use of ultrasound by surgeons has been shown to significantly improve diagnostic accuracy, proceeding with appropriate management, avoiding unnecessary delays. For instance, a randomized trial involving 800 patients demonstrated that incorporating surgeon-performed bedside ultrasound led to significant reductions in additional imaging requests, a 7.2% lower admission rate, and an 18.5% higher rate of proceeding directly to surgery from the emergency department.¹⁷

Despite these advantages, ultrasound use among surgeons remains inconsistently implemented. Many residency programs lack a structured, competency-based curriculum for ultrasound training.

Where present, such training is often informal or sporadic, resulting in variability in proficiency across trainees. In this case, although the residents lacked formal certification in ultrasound, they demonstrated the capability to accurately assess the gallbladder's condition, confirming key signs such as distension, wall irregularity, and pericholecystic fluid. Their evaluation closely followed the progression of the patient's ANC complications.

Given the elevated bilirubin levels and the dilation of the intrahepatic bile ducts observed on the CT scan, standard practice would have suggested performing either an endoscopic ultrasound or intraoperative cholangiography.⁵ However, based on the ultrasound findings indicative of acute necrotic cholecystitis, the surgical team opted for immediate surgical intervention instead of completing the preoperative diagnostic workup. The presence of necrosis observed during surgery contraindicated cholangiography, and postoperatively, the normalization of bilirubin levels rendered any further endoscopic procedures unnecessary.

To address this educational gap, we propose a formalized ultrasound curriculum that should be integrated into surgical residency programs, comprising:

Early introduction: introducing ultrasound training at the beginning of residency allows residents to develop essential skills early on. This early foundation prepares them for more complex ultrasound applications in later years of their training.

Competency-based training: a structured curriculum should

combine didactic learning with hands-on experience, with clear competency benchmarks to ensure residents achieve proficiency in performing and interpreting ultrasound. Regular assessments would monitor progress and provide feedback.

Clinical integration: ultrasound training should be embedded into clinical rotations, especially in high-acuity areas like emergency surgery, trauma care, and intensive care units. Direct exposure to real-life ultrasound applications reinforces learning and enhances retention of skills.

Ongoing mentorship and support: Faculty members with specialized ultrasound training should mentor residents throughout their education. This mentorship, combined with continuous assessments, ensures residents continue refining their skills and can independently perform ultrasound exams with confidence.

Conclusions

Incorporating ultrasound training into surgical residency programs not only improves diagnostic accuracy but also streamlines patient management by reducing unnecessary imaging and minimizing delays in treatment.^{18,19}

This case highlights the value of such training in real clinical decision-making. In ANC, where timing is critical, the ability to perform and interpret a focused ultrasound can decisively influence outcomes. Formalizing this training could thus enhance care quality and surgical preparedness.

References

1. Nve E, Badia JM, Amillo-Zaragüeta M, et al. Early Management of Severe Biliary Infection in the Era of the Tokyo Guidelines. *J Clin Med* 2023;12:4711.
2. Fugazzola P, Podda M, Tian BW, et al. Clinical update on acute cholecystitis and biliary pancreatitis: between certainties and grey areas. *EClinicalMedicine* 2024;77:102880.
3. Kiewiet JJ, Leeuwenburgh MM, Bipat S, et al. A systematic review and meta-analysis of diagnostic performance of imaging in acute cholecystitis. *Radiology* 2012;264:708-20.
4. Shea JA, Berlin JA, Escarce JJ, et al. Revised estimates of diagnostic test sensitivity and specificity in suspected biliary tract disease. *Arch Intern Med* 1994;154:2573-81.
5. Pisano M, Allievi N, Gurusamy K, et al. 2020 World Society of Emergency Surgery updated guidelines for the diagnosis and treatment of acute calculus cholecystitis. *World J Emerg Surg* 2020;15:61.
6. Hwang H, Marsh I, Doyle J. Does ultrasonography accurately diagnose acute cholecystitis? Improving diagnostic accuracy based on a review at a regional hospital. *Can J Surg* 2014;57:162-8.
7. Borzellino G, Motton M, Minniti F, et al. Sonographic diagnosis of acute cholecystitis in patients with symptomatic gallstones. *J Clin Ultrasound* 2016;44:152-8.
8. Fidler J, Paulson EK, Layfield L. CT evaluation of acute cholecystitis: findings and usefulness in diagnosis. *AJR Am J Roentgenol* 1996;166:1085-8.
9. Marincek B. Nontraumatic abdominal emergencies: acute abdominal pain: diagnostic strategies. *Eur Radiol* 2002;12:2136-50.
10. Wyrick DL, Smith SD, Burford JM, Dassinger MS. Surgeon-performed ultrasound: accurate, reproducible, and more efficient. *Pediatr Surg Int* 2015;31:1161-4.
11. Rozycki GS, Cava RA, Tchorz KM. Surgeon-performed ultrasound imaging in acute surgical disorders. *Curr Probl Surg* 2001;38:141-212.
12. Lentz B, Fong T, Rhyne R, Risko N. A systematic review of the cost-effectiveness of ultrasound in emergency care settings. *Ultrasound J* 2021;13:16.
13. Beggs AD, Thomas PR. Point of use ultrasound by general surgeons: review of the literature and suggestions for future practice. *Int J Surg* 2013;11:12-7.
14. Menon N, Kumar S, Keeler B, et al. A systematic review of point-of-care abdominal ultrasound scans performed by general surgeons. *Surgeon* 2021;19:e559-63.
15. Martin R, Lau HA, Morrison R, et al. The Rising Tide of Point-of-Care Ultrasound (POCUS) in Medical Education: An Essential Skillset for Undergraduate and Graduate Medical Education. *Curr Probl Diagn Radiol* 2023;52:482-4.
16. Huang SS, Lin KW, Liu KL, et al. Diagnostic performance of ultrasound in acute cholecystitis: a systematic review and meta-analysis. *World J Emerg Surg* 2023;18:54.
17. Lindelius A, Tömgren S, Pettersson H, Adami J. Role of surgeon-performed ultrasound on further management of patients with acute abdominal pain: a randomised controlled clinical trial. *Emerg Med J* 2009;26:561-6.
18. Kotagal M, Quiroga E, Ruffatto BJ, et al. Impact of point-of-care ultrasound training on surgical residents' confidence. *J Surg Educ* 2015;72:e82-7.
19. Jiang Z, Wang J, Chen X, et al. Competency-based ultrasound curriculum for standardized training resident: a pre- and post-training evaluation. *BMC Med Educ* 2024;24:1516.