

REVIEW

Acute Acalculous Cholecystitis: A Review

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This article has an accompanying continuing medical education activity on page 2. Learning Objectives—At the conclusion of this activity, the successful learner will be able to discern the clinical features, risk factors, and diagnostic criteria for acute acalculous cholecystitis.

Although recognized for more than 150 years, acute acalculous cholecystitis (AAC) remains an elusive diagnosis. This is likely because of the complex clinical setting in which this entity develops, the lack of large prospective controlled trials that evaluate various diagnostic modalities, and thus dependence on a small data base for clinical decision making. AAC most often occurs in critically ill patients, especially related to trauma, surgery, shock, burns, sepsis, total parenteral nutrition, and/or prolonged fasting. Clinically, AAC is difficult to diagnose because the findings of right upper-quadrant pain, fever, leukocytosis, and abnormal liver tests are not specific. AAC is associated with a high mortality, but early diagnosis and intervention can change this. Early diagnosis is the crux of debate surrounding AAC, and it usually rests with imaging modalities. There are no specific criteria to diagnose AAC. Therefore, this review discusses the imaging methods most likely to arrive at an early and accurate diagnosis despite the complexities of the radiologic modalities. A pragmatic approach is vital. A timely diagnosis will depend on a high index of suspicion in the appropriate patient, and the combined results of clinical findings (admittedly nonspecific), plus properly interpreted imaging. Sonogram (often sequential) and hepatic iminodiacetic acid scans are the most reliable modalities for diagnosis. It is generally agreed that cholecystectomy is the definitive therapy for AAC. However, at times a diagnostic/therapeutic drainage via interventional radiology/surgery may be necessary and life-saving, and may be the only treatment needed.

Despite its recognition for more than 150 years,¹ acute acalculous cholecystitis (AAC) remains an elusive diagnosis. This is likely because of the complex clinical setting in which this entity develops, the lack of large prospective controlled trials that evaluate various diagnostic modalities, and thus dependence on a small data base for clinical decision making. Certain assessments are critical for the prompt diagnosis of AAC and its expeditious life-saving therapy.

AAC is defined as an acute necroinflammatory disease of the gallbladder in the absence of cholelithiasis and has a multifactorial pathogenesis.^{2,3} It accounts for approximately 10% (range, 2%–15%) of all cases of acute cholecystitis. AAC occurs in about 0.2% to 0.4% of all critically ill patients—usually about 60 years of age, with an approximate male:

female ratio of 2 to 3:1; and may occur from 1 to 50 days after an inciting event.^{2–9} Clinically, AAC is indistinguishable from acute calculous cholecystitis.^{10,11} Many clinical findings occur but are nonspecific to AAC: right upper-quadrant pain, fever, leukocytosis, and abnormal liver tests (aminotransferases, alkaline phosphatase, and bilirubin).^{2,3,8} Various conditions predispose to its occurrence. It has not been possible to reliably determine the incidence of the risk factors for AAC, but many studies have listed the percentages of their occurrence in their patient populations. From that, the associations of certain plausible risks have been postulated (see Table 1, which is mostly a reproduction from Owen and Jain³ with some additions noted). As noted in Table 1, Pelinka et al¹² appear to have the only prospective study to date to indicate with any certainty several clinical factors that could aid in the diagnosis of AAC.

There are several dreaded complications of AAC—gangrene, perforation, and empyema. These occur in 6% to 82% of cases, but most studies show about 40% occurrence. Attempts at predicting their occurrence have been unsuccessful to date. This is unfortunate because those with such complications die more often.^{2,13–19}

AAC is associated with a high mortality (most studies, 30%; range 10%–90% with early or late diagnosis, respectively^{2,4,5,16,18,20,21}). Mortality depends mostly on the presentation: outpatient versus inpatient (and how critically ill the patient is). AAC is probably an epiphenomenon of the overall critical illness, only occasionally being the primary cause of death. However, AAC certainly can be one of the important contributing factors, and early diagnosis and intervention is the key to decreasing death from AAC.^{2,3} A significant number of outpatients present with AAC, especially associated with diabetes, vascular disease, and hypertension, who unlike the inpatient usually have a very straightforward diagnosis and excellent prognosis with prompt cholecystectomy.^{9,18,22–25}

Abbreviations used in this paper: AAC, acute acalculous cholecystitis; CCK, cholecystokinin; CT, computed tomography; GB, gallbladder; HIDA, hepatic iminodiacetic acid; ICU, intensive care unit; MC, morphine cholescintigraphy; RC, radionuclide cholescintigraphy; TPN, total parenteral nutrition; US, ultrasound.

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Table 1. Descending Order of Associated Risk Factors for AAC**Commonly associated risk factors for AAC**

- Trauma: leading to hospitalization; some factors particularly leading to the diagnosis of AAC in trauma are blood transfusions (>12 U), Injury Severity Score >12, and tachycardia (>120 bpm)^{12a}
- Recent surgery (unrelated to GB, abdominal, or extra-abdominal,¹³ to include cardiopulmonary disease¹⁴)^a
- Shock of any kind
- Burn
- Sepsis
 - Bacterial—Brucellosis, Q fever, leptospirosis, tuberculosis, scrub typhus, salmonellosis, cholera
 - Fungal—*Candida* (albicans, glabrata, torulopsis)
 - Parasitic—Cyclospora, microsporidia, *Plasmodium falciparum* and *vivax*, *Schistosoma mansoni*
 - Viral—Cytomegalovirus, Epstein-Barr virus,^{15a} Dengue virus
- Critical illness (any patient requiring ICU care)
- TPN
- Prolonged fasting

Rarely associated risk factors for AAC

- Hypovolemia
- Postendoscopic retrograde cholangiopancreatography
- Increased length of hospital stay
- Immunodeficiency: acquired immune deficiency syndrome, transplant
- Chronic illness: diabetes, hypertension, atherosclerotic disease, obesity^{16a}
- Vasculitides: Churg–Strauss, giant cell arteritis, Henoch–Schönlein purpura, polyarteritis nodosa, lupus
- Obstruction: ampullary stenosis, ascariasis, echinococcus, tumor (extrinsic or intrinsic)

^aAdditions from other sources to Table 1 from Owen and Jain.³

Pathophysiology

The etiology of AAC is multifactorial and likely results from bile stasis or ischemia (or both). Bile stasis can be caused by fasting, obstruction, postsurgical/procedural irritation or ileus (total parenteral nutrition [TPN]), which can lead to bile inspissation that is directly toxic to the gallbladder epithelium.^{14,26} Ischemia to the organ may occur from many of the risks noted in Table 1 associated with systemic inflammation and could have deleterious effects directly to all layers of the gallbladder (GB) wall.^{27–30}

Laurila et al⁵ provided excellent histologic data that explain some of the pathology of AAC as a response to systemic inflammation. AAC showed the following: (1) increased leukocyte margination (corresponding to ischemia and reperfusion injury)³¹; (2) increased focal lymphatic dilation with interstitial edema associated with local microvascular occlusion (ischemia related); and (3) increased and deeper bile infiltration in the GB wall of AAC suggesting that bile stasis and increased epithelial permeability exist, leading to epithelial damage. These findings corroborate the hypotheses that bile stasis and ischemia likely are involved in the pathogenesis of AAC.

Others have discussed similar findings in AAC of microvascular involvement related to bile stasis, hypoperfusion, and ischemia.^{32,33} Hakala et al³³ even proposed that AAC be renamed *acute ischemic cholecystitis* to further clarify its cause. McChesney et al¹⁴ proposed a progression from hypoperfusion and ischemia (from any cause, but commonly sepsis), to GB inflammation, to resultant cholestasis and bacterial invasion,

culminating in AAC. They further stated that this progression could explain the frequent complications of gangrene (by local microvascular occlusion), empyema (by secondary infection), and perforation (by weakening of the GB wall).

This model, however, does not explain the development of AAC in the outpatient setting or when AAC occurs without any known risk.^{9,18} It is evident that despite many attempts to elucidate the pathogenesis of AAC, it still is not completely defined.

Diagnosis

The diagnosis of AAC is difficult because no clinical findings (review of symptoms, physical examination, laboratory tests) establish it.^{2,3,7,8,11,16,20} There are many confounding factors. Patients usually are critically ill and may have no ability to corroborate findings while sedated, intubated, and/or unconscious in an intensive care setting. Other confounding problems may be that of right upper-quadrant pain, fever, leukocytosis, and abnormal liver tests (aminotransferases, alkaline phosphatase, and bilirubin) that of course are not specific to AAC.^{3,8} Although no combination of clinical factors will lead to the diagnosis, there seems to be consensus that high clinical suspicion for AAC is indicated in all seriously ill patients for whom no etiology for their condition is found. Table 2 lists the composite approaches used to diagnose AAC, but the ultimate diagnosis of AAC usually rests on imaging. This will be the focus of discussion here.

Table 2. Diagnosis

Clinical findings	Radiology	Surgery
Setting (inpatient, outpatient)	US	Aspiration or drainage of the GB
Fever, abdominal pain	CT	Laparotomy
Leukocytosis, abdominal liver tests	HIDA scan	

Table 3. Imaging Criteria

Modality	Criteria	Diagnosis	
US	Major	3.5- to 4-mm (or more) thick wall (if at least 5-cm distended longitudinally with no ascites or hypoalbuminemia) Pericholecystic fluid (halo)/subserosal edema Intramural gas Sloughed mucosal membrane	2 major or 1 major and 2 minor (most studies have favored the diagnostic triad—wall thickness, sludge, hydrops)
	Minor	Echogenic bile (sludge) Hydrops = distension greater than 8-cm longitudinally or 5-cm transversely (with clear fluid)	
CT	Major	3- to 4-mm wall thickness Pericholecystic fluid Subserosal edema Intramural gas Sloughed mucosa	2 major or 1 major and 2 minor
	Minor	Hyperdense bile (sludge) Subjective distension (hydrops)	
HIDA scan	Nonvisualization of the gallbladder 1 hour after injection of radiolabeled technetium (this is RC) Nonvisualization of the gallbladder 30 minutes after injection of morphine (after initial radiolabeled technetium) (this is MC)	RC alone or RC and MC have been used (see HIDA discussion in text)	

Data from multiple studies.^{2,6,7,19,26,34-41}

Radiology

There is controversy as to which imaging modality is best and which to use first in diagnosing AAC. Generally, both retrospective and prospective studies have been quite small, limiting the critical evaluation of radiologic diagnosis. This is likely because AAC is a relatively rare entity. Nevertheless, radiologic criteria for the diagnosis of AAC have been developed for the use of ultrasound (US), computerized tomography (CT), and hepatobiliary iminodiacetic acid scan (HIDA). MRI generally is not used because it is a long procedure with no benefit over the other modalities. CT scan offers little benefit over US, unless there is concern for other intra-abdominal processes that would not be seen by US. Therefore, US and cholescintigraphy (using ^{99m}Tc-labeled hepatobiliary agents) have come to the forefront for diagnosis of AAC. However, there is considerable debate. Some recommend starting with US, then CT, then HIDA,³⁴ and some suggest the reverse order.¹⁸ Considerations in the critically ill patient are the difficulties in transportation

to and from the radiologic suites. Thus, many studies have focused on bedside modalities, namely US. Absence of a unified theme for the radiologic diagnosis of AAC shows that it is a difficult problem and requires a composite approach in all cases. Table 3 shows the most accepted criteria for commonly used imaging modalities.

Figure 1 shows some of the findings that can be seen in AAC. Remember, no findings are sensitive or specific enough on any radiologic modality to make the diagnosis alone.

US

US has been touted as the modality of first choice to evaluate suspected AAC because (under the conditions in which it often occurs) it lends itself to rapidity, repeatability, and portability. The most studied diagnostic criteria for US are GB wall thickness, pericholecystic fluid or subserosal edema, intramural gas, sloughed mucosa, sludge, and hydrops.³⁴⁻³⁹ The major and minor criteria are listed in Table 3. Deitch and

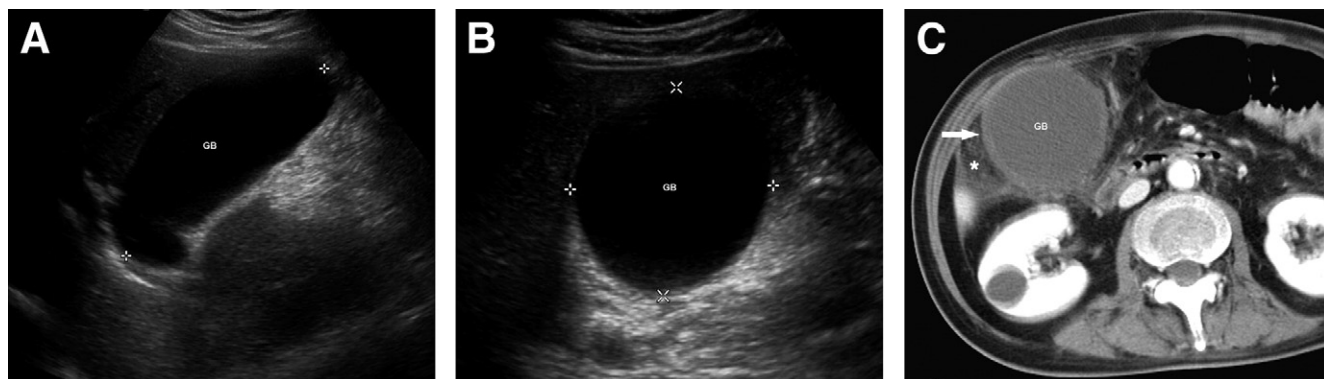


Figure 1. (A and B) Longitudinal and horizontal sonogram of a 64-year-old man with positive Murphy sign, showing hydrops. (C) CT scan 6 hours later showing thickened GB wall (white arrow), hydrops, and pericholecystic inflammation (asterisk). Figure courtesy of Dr Shaile Choudhary, MD (Department of Radiology, University of Texas Health Science Center at San Antonio, San Antonio, TX).

Table 4. Variance in Sensitivity and Specificity of US

Study	Type	Number in study	Criteria	Sensitivity of US, %	Specificity of US, %
Puc et al ⁴⁴	R	62	NStd	30	93
Mirvis et al ³⁴	R	40	Std	92	96
Shuman et al ²⁶	R	33	NStd	67	NA
Kalliafas et al ¹⁸	R	4	Std	29	NA
Mariat et al ⁷	P	28	Triad	50	94
Prevot et al ⁴⁵	P	32	NStd	36	89
Pelinka et al ¹²	P	27	Std	NA	100

NStd, nonstandard criteria; P, prospective study; R, retrospective study; Std, standard criteria as per Table 3; sensitivity, (true positives)/(true positives + false negatives); specificity, (true negatives)/(true negatives + false positives); triad (wall thickness, hydrops, sludge).

Engel^{19,37} were among the first to establish the utility of US and GB wall thickness as a reliable means to diagnose AAC. GB wall thickness (3.5–4 mm) has since been regarded as a crucial component for the diagnosis of AAC.^{34,39} The most studied and cited criteria have been for the so-called diagnostic triad of GB wall thickness, sludge, and hydrops.^{2,6,7,11,26,35,36,39–43} The triad is not absolute. Some studies show that part or all of the triad may be present in some intensive care unit (ICU) patients who never manifest AAC.^{35,39} Boland et al³⁵ (similar to Molenat et al³⁹) showed many abnormal GB findings in the ICU without AAC—a few even with the triad. This does not imply that these US findings are not useful or do not point to AAC as the diagnosis. It simply shows that these findings may not be specific and should not be relied on in isolation without consideration of the clinical picture and possibly other imaging modalities.

The sensitivity and specificity of US range from 30% to 100%, with representative studies showing this in Table 4.^{7,8,12,20,26,27,34,37,44,45} It is evident that the major weakness is variable sensitivity. The variance in sensitivity and specificity comes from the rarity of AAC, and the small, mostly retrospective studies with use of different criteria for sonographic diagnosis. Clearly, some of the studies in which the sensitivity and specificity for US are low have been suboptimal.^{18,26,44} Thus, Shuman et al²⁶ used 6-mm GB wall thickness for the cut-off value that would have excluded potentially positive patients. Kalliafas et al¹⁸ suggested that because of the very low sensitivity for US in their study, US should not be used at all. However, they presented a mix of 22 inpatients and 5 outpatients, in whom very few had US (4 of 22 inpatients, and 2 of 5 outpatients) and from which nevertheless the sensitivity was derived.

Prospectively, Pelinka et al¹² adeptly showed that US has an excellent specificity. Their study was not set up to calculate sensitivity. However, in their study, which included trauma patients with proven inclusion criteria to predispose to AAC (high Injury Severity Score, tachycardia, blood transfusions), they accurately diagnosed AAC with a combination of US and clinical criteria, and proved it by histology. Two other excellent prospective studies are not listed in Table 4 because they were not designed to calculate sensitivity and specificity, but show that US is quite useful for diagnosing AAC (Imhof et al,⁴⁰ Raunest et al⁴²). They prospectively found US to be a valuable method for early detection of AAC even though many ICU patients have one or more GB abnormalities without the diag-

nosis of AAC. They highly recommend daily US to follow up such patients to avoid misdiagnosis. Thus, US is a very useful tool for diagnosing AAC as these prospective studies have strongly suggested. Many others cite US as a useful test because it is real-time, easy to use, fast, portable, and easily repeated at the bedside.^{6,7,12,13,17,46}

A reasonable approach to using US is as follows: (1) have high initial index of suspicion, (2) know the associated risk factors for AAC, (3) appreciate that some ICU patients can have abnormal GB findings without AAC, and (4) realize that in those with abnormal findings, subsequent daily US until resolution or worsening of their condition is reasonable. If they have a normal sonogram, they will not likely have AAC, but this can be revisited if other causes of illness are not found.

US is the most practical modality for ICU patients, but CT and HIDA scans sometimes are indicated.

CT

CT is useful for the diagnosis of AAC or for other abdominal pathology (if AAC is in the differential but other causes could explain the presentation).^{34,38} It requires transportation of the patient, which may not be feasible, and it offers little benefit over US. However, with normal US, CT may make the diagnosis of AAC if it is still high in the differential.^{8,34,47} CT diagnostic criteria are similar to US³⁸ (Table 3).

HIDA

HIDA is a procedure that lasts from 1 to 6 hours (sometimes up to 24 h) and involves the transportation of a patient to the nuclear medicine suite; it has a well-established protocol and criteria.⁴¹ Several modalities of HIDA have been studied for AAC: radionuclide cholecintigraphy (RC), morphine cholecintigraphy (MC), and cholecystokinin (CCK)-augmented HIDA. Briefly, the radiolabeled technetium is injected, and if at 1 hour the GB is not visualized, the RC is considered positive. In this case some advocate the injection of intravenous morphine to augment the study (as a confirmatory measure because of the high false-positive rates [see later]). If the GB is not visualized in 30 minutes after morphine injection, it is considered a positive study. CCK HIDA has been relegated to evaluation of either chronic acalculous cholecystitis or, rarely, to exclude AAC. Thus, if the RC and MC are positive or indeterminate, standard CCK can be injected. If the GB responds normally by contracting and emptying, AAC is unlikely because the sick GB should not respond.^{25,41}

GB physiology is key to interpreting the HIDA scan because false positives and false negatives can occur. According to Krishnamurthy et al,²² the liver makes about 600 mL bile per day (0.4 mL/min) and approximately 50% (0.2 mL/min) enters the GB and the rest flows directly into the duodenum while fasting. The GB fills by concentration and pressure gradients. The normal GB selectively removes water and increases bile salt concentration 5- to 6-fold, thereby creating an osmotic gradient drawing bile into the GB. The pressure gradient is created mainly from contraction of the sphincter of Oddi. The effect of low levels of CCK (in periods of normal fasting) on the GB, common bile duct, and sphincter of Oddi causes a high- to low-pressure gradient from the sphincter of Oddi to the GB, respectively. Therefore, normal fasting favors a pressure gradient for bile collection into the GB. CCK release is stimulated by

Table 5. Society of Nuclear Medicine Data⁴¹

Causes of HIDA scan false positive results	
False positive	Explanation
Prolonged fast (>24–48 h), especially TPN	GB stasis, very low CCK levels
Severe hepatocellular disease	Tracer has decreased uptake, leading to nonvisualization of the GB
Severe chronic acalculous cholecystitis	Looks the same as AAC
Rapid biliary to bowel transit	Bypasses the GB
Prior cholecystectomy	No GB to fill
Analgesics	Uncertain, but may lead to stasis
Severe illness	Uncertain, but overall depressed physiology
Causes of HIDA scan false-negative results	
False negative (very rare)	Explanation
Patent cystic duct	There is no obstruction per se in AAC and tracer could enter the GB
Bile leak from GB perforation	Tracer leaks out and GB does not fill, but this may in fact be diagnostic of AAC (because of the high incidence of secondary complications such as perforation)
Activity in kidneys simulating small bowel or GB	Imaging of other organs
Bowel loop simulation of GB	Imaging of other organs

Data from Society of Nuclear Medicine.⁴¹

a food bolus. At postprandial concentrations CCK causes contraction and empties the GB, relaxes the sphincter of Oddi, increases intestinal motility, contracts the pyloric sphincter, inhibits gastric emptying, relaxes gastroesophageal sphincter tone, stimulates hepatic bile secretion, and stimulates pancreatic enzyme secretion.²⁴ These events allow for normal emptying of the GB to promote digestion.

In a seriously ill patient with AAC the GB does not empty properly. Bile stasis and the stress of systemic inflammation and ischemia most likely cause this. In the critically ill the risk factors for bile stasis are commonly present (TPN, fasting, obstruction, postsurgical/procedural irritation or ileus—all lead to bile inspissation). CCK is at low levels because of these factors, leading to further bile collection and inspissation in the GB. Likewise, the most commonly associated risk factors for AAC often lead to a systemic inflammatory state and ischemia. Considering the hypothesized pathogenesis of bile stasis and ischemia, a positive HIDA is understandable. The GB will be full of inspissated bile and will be unable to empty normally to fill with the radiotracer. However, false-positive and false-negative tests occur for various reasons (Table 5). False positives have been noted to occur from 5% for MC and up to 60% to 90% for RC.^{48–51} False-positive HIDA scans can occur from prolonged fasting (>24 h), especially associated with TPN, severe hepatocellular disease, severe illness, rapid biliary to bile transit, severe chronic acalculous cholecystitis, analgesics, and of course prior cholecystectomy (Table 5).

False-negative results occur rarely in about 1% of cases for RC or MC.⁵⁰ False-negative results may occur because of cystic duct patency despite a diseased GB,²⁶ bowel loop simulation of the GB, bile leak from GB perforation, and tracer activity in the kidneys simulating the small bowel or the GB (Table 5).

The sensitivity of HIDA ranges from 67% to 100% and the specificity ranges from 38% to 100% (Table 6). Most of the studies performed for AAC have been small and retrospective and thus fraught with the selection bias of those patients who could actually tolerate transportation and duration of the HIDA scan. Several modalities of HIDA have been examined

but standard HIDA (RC) and MC are the most widely touted. Weissman et al⁵² retrospectively stated that RC should be the primary tool for diagnosis of AAC in hospitalized patients (even without US). Swayne⁵³ elegantly presented a series of studies along with his own and found a sensitivity of 91.2% for RC and suggested it be the primary modality for diagnosis of AAC. Flancbaum et al^{48,49,54} studied MC and suggested it to be useful in the hospitalized and critically ill. They only briefly addressed the issues of the critically ill patient in the radiology suite. Kalliafas et al¹⁸ retrospectively suggested that MC has a very high sensitivity but can have low specificity because of false positives. Nevertheless, they recommended it as the initial examination in suspected AAC.

Prevot et al⁴⁵ prospectively found MC to be very useful to diagnose AAC. Mariat et al,⁷ in an excellent prospective study of ICU patients, favors multiple (if necessary) MC with US to make the diagnosis, noting that false positives can be a problem in the critically ill but are reduced significantly with MC. The representative studies in Table 6 show that HIDA has a good sensitivity and specificity when MC is used in the critically ill. Therefore, MC could be a good adjunctive diagnostic modality if the patient could be transported safely and housed in the radiology suite for prolonged periods.

Table 6. Variance in Sensitivity and Specificity of HIDA

Study	Type	Number in study	HIDA modality	Sensitivity, %	Specificity, %
Mirvis et al ³⁴	R	45	RC	95	38
Shuman et al ²⁶	R	19	RC	68	NA
Puc et al ⁴⁴	R	20	RC	100	88
Fig et al ⁵⁰	R	52	MC	94	69
Kalliafas et al ¹⁸	R	10	MC	90	NA
Flancbaum and Choban ⁴⁸	R	45	RC → MC ^a	100	88
Mariat et al ⁷	P	28	RC → MC ^a	67	100
Prevot et al ⁴⁵	P	32	MC	79	100

^aCombined both the RC and MC modalities.

Surgery

Aspiration and laparotomy have been used to diagnose AAC. Aspiration of GB contents may be helpful to make the diagnosis of AAC if it yields positive cultures, but this rarely happens.^{34,49} Diagnostic laparoscopy and potentially laparotomy have been recommended by the Society of American Gastroenterological and Endoscopic Surgeons for AAC. It should be considered in all critically ill patients when AAC is suspected, cannot be ruled out by noninvasive means, and would otherwise require an initial exploratory laparotomy. It has had excellent diagnostic accuracy ranging from 90% to 100%, but the studies have been small.^{55,56} The real utility of laparoscopy and/or laparotomy is for treatment of AAC (see later), not as the principal means for diagnosis.⁵⁶

Treatment

The 2 prevailing treatment options for AAC are cholecystostomy (drainage of the GB) and/or cholecystectomy. Other methods, such as direct endoscopic retrograde cholangiopancreatographic GB drainage by stenting or tubes, have been attempted but without much success. Cholecystectomy generally is considered the definitive therapy if it can be performed,^{2,3,8,11,18,57-59} and some aggressively perform only open cholecystectomies.⁴ However, there is debate as to its optimal timing.¹¹ Some propose cholecystostomy as the sole treatment.⁵¹ Others affirm that cholecystostomy is only a bridge to safer cholecystectomy or only a trial therapy to see if AAC resolves.⁵⁷⁻⁵⁹ Thus, Boland et al⁵¹ recommend prophylactic cholecystostomy for all ICU patients with abdominal sepsis who are not improving and for whom no other etiology can be found. In their series almost 60% of these patients improved without further treatment. In the rest, the GB was ruled out as the problem, leaving room to search for other causes. This situation may indicate the patient who has AAC but lacks significant ischemia to the GB, where mere drainage relieves the problem. Ginat and Saad⁵⁷ reviewed the topic of cholecystostomy in detail with an excellent discussion of the pros and cons and the complications. Cholecystostomy is generally plausible, rapid, and safe. It can be performed transperitoneally or transhepatically under US or CT guidance by surgeons or by interventional radiology. Maturation of the cholecystostomy tract occurs in about 3 weeks. If cholecystectomy is needed, cholecystostomy may provide time to optimize the patient's condition for surgery.^{57,60,61} Thus, there seems to be a tendency to favor cholecystostomy before cholecystectomy, unless strong evidence of an ischemic GB exists, which drainage alone would not alleviate.

Cholecystectomy is definitive therapy when it is performed, either by open or laparoscopic surgery. Laparoscopic surgery has been favored in recent years because it can be both diagnostic and therapeutic, is less invasive, and has a similar morbidity and mortality compared with the open procedures.⁵⁶ However, it is noted that it may have to be converted to open cholecystectomy because of the inflammatory state of the GB.^{56,59,62} Laurila et al⁴ aggressively favor open cholecystectomy, even in the critically ill, to reverse or prevent multiorgan failure. With either laparoscopic or open cholecystectomy, there is strong support for GB removal.^{4,62}

When neither cholecystostomy nor cholecystectomy can be performed, direct endoscopic retrograde cholangiopancreato-

graphic GB drainage can be attempted to assist decompression. This generally is believed to be inferior therapy and seldom is performed.^{3,63,64}

Ideally, when AAC is suspected cholecystostomy should be performed immediately because the patient may improve with this alone. If improvement occurs with decompression and drainage by cholecystostomy, the tube can be removed after 3 weeks, and this may be the only treatment needed. If there is no improvement, the diagnosis should be reconsidered and, if positive, urgent cholecystectomy should be strongly entertained because it can be life-saving when this is the source of abdominal sepsis.

Summary

Acalculous cholecystitis is difficult to diagnose, but an early correct assessment is essential to successful treatment, which is readily available. In the absence of meaningful evidence-based trials, a pragmatic approach is vital. A timely diagnosis will depend on a high index of suspicion in the appropriate patient, and the combined results of clinical findings (admittedly nonspecific), plus properly interpreted imaging. This usually consists of US (often sequential) and HIDA. The approach is multifaceted. At times a diagnostic/therapeutic drainage via interventional radiology/surgery may be necessary and life-saving.

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Conflicts of interest

The authors disclose no conflicts.