Acute Cholecystitis

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7.1 Introduction

Acute cholecystitis (AC) is considered the inflammation of the gallbladder, and it is caused in most cases by the presence of gallstones. It can be associated to local or general signs of inflammation and the diagnosis is given from a combination of detailed clinical history and clinical examination, laboratory tests and images as reported by the recent World Society of Emergency Surgery (WSES) guidelines [1]. AC can affect 10–20% of patients with gallstones, and in up to 39% of cases, a gangrenous AC was found [2, 3].

Another clinical entity that mimics the lithiasic AC is the acute acalculous cholecystitis (AAC) [4] that represents 2–15% of all AC. However, AAC is related with a high mortality (10% up to 90% comparing to 1% of AC) because patients with AAC are often critically ill patients with hypovolemic shock, heart failure, diabetes mellitus, dehydration, sepsis, and vasculitis.

Abdominal ultrasound (US) is considered the first and preferred initial imaging technique to detect the presence of gallstones and to evaluate the inflammatory changes in the gallbladder [1]. US is also valuable because it is free from ionizing radiation and is easily available and not invasive with a good diagnostic accuracy [1].

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However computed tomography (CT), even if it is related to ionizing radiation, seems to be more useful when US is not diagnostic and in patients with confusing clinical condition or to evaluate eventual AC complications [1].

7.2 Value of Computed Tomography

As mentioned above, the role of CT in AC is not clearly defined. In the literature comparing with US, CT shows sensitivity from 85 to 94% (95% CI, 66–95 and 95% CI, 73, 99%, respectively) and specificity from 59 up to 81% (95% CI 42, 74 and 95% CI 69–90%, respectively), while for US they are, respectively, 81 and 83% [15].

A recent meta-analysis that summarized the role of the different diagnostic techniques in AC shows that cholescintigraphy has the highest diagnostic accuracy and the accuracy of US leaves a substantial margin of error, comparable to that of MR imaging, while CT is still under evaluation [5].

The use of US remains crucial in AC (Figs. 7.1 and 7.2), however there is an increased number of patients undergoing CT especially in suspected complicated AC (Table 7.1) [3, 6].

In patients where AC is suspected, in watching the CT images, the attention should be focused on the gallbladder wall (thickness, enhancement, continuity, irregularity, and the presence or absence of gas), the gallbladder lumen (presence or absence of gallstones, gas, high-density fluid, sloughed mucosa), the pericholecystic space (fat stranding, fluid, abscess), and the characteristics of pericholecystic organs (the liver, peritoneal collection, small bowel obstruction) [3, 6].

Gallbladder perforation is rare, without specific clinical signs at presentation, and often requires an urgent surgical intervention to reduce morbidity and mortality rates. For this reason, some authors like Niemeier proposed a classification for perforated gallbladder dividing it in type I (acute free perforation into the peritoneal cavity without protective adhesions), type II (subacute perforation surrounded by a pericholecystic abscess walled off by adhesions), and type III (chronic perforation with a fistula between the gallbladder and viscus) [7]. It has been pointed out that CT scan scores better than US in detecting gallbladder perforations, establishing a

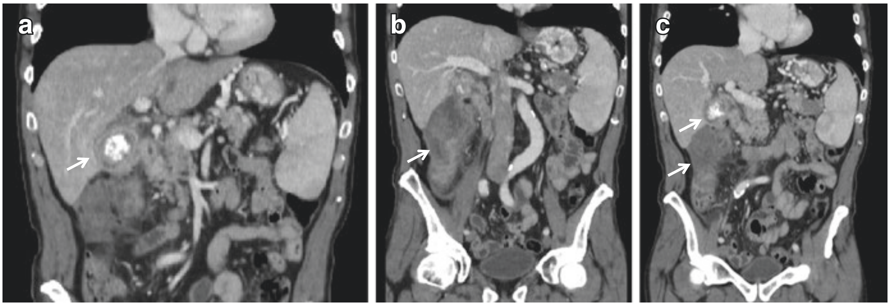

Fig. 7.1 Coronal reconstruction CT scan with use of intravenous contrast. (**a**, **c** *white arrow*) shows enhancing thickness wall of gallbladder with gallstone inside in acute cholecystitis. (**b**, **c** *white arrow*) shows pericholecystic fluid

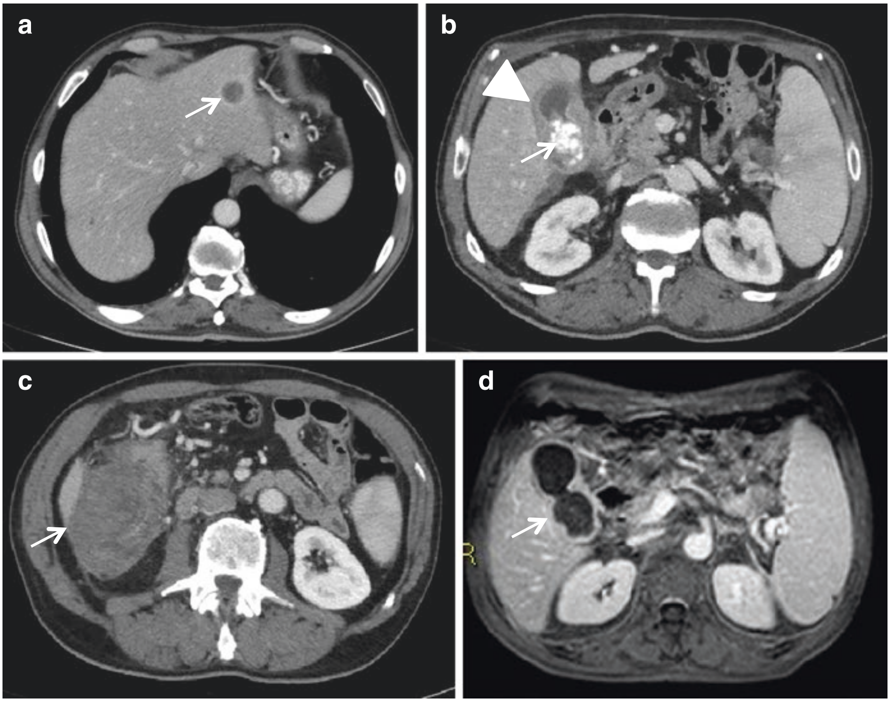

Fig. 7.2 Axial reconstruction of a CT scan with intravenous contrast shows gallbladder fundus with enhancing thickness wall (**a**, *white arrow*); enhancing thickness wall of gallbladder (**b**, *head-arrow*) with gallstone inside in acute cholecystitis (**b**, *white arrow*); pericholecystic fluid (**c**, *white arrow*); Magnetic Resonance Image shows acute cholecystits (**d**, *white arrow*)

Table 7.1 Clinical condition related to CT findings

Clinical condition	CT findings
Acute cholecystitis	Detecting (or not) gallstones in the gallbladder, thickened (more than 3 mm) and enhancing wall, stranding pericholecystic fat with or without pericholecystic fluid
Gangrenous cholecystitis	Detecting (or not) gallstones, non-enhancing wall or irregular enhancing wall with defect, sloughed membranes, pericholecystic fat with fluid
Perforated cholecystitis	Detecting (or not) gallstones, focal defect of gallbladder wall, pericholecystic fluid with or without pericholecystic or hepatic abscess
Emphysematous cholecystitis	Detecting (or not) gallstones in the gallbladder, presence of intramural gas and enhancing wall, stranding pericholecystic fat with or without pericholecystic fluid

prompt definitive diagnosis of gallbladder perforation and hence decreasing morbidity and mortality [7].

Some authors suggest that a dual-phase (unenhanced and contrast-enhanced images) abdominal CT can be important to predict the rate of conversion from laparoscopic to laparotomic cholecystectomy [8]. The most factors that seem to be associated with conversion were the absence of gallbladder wall enhancement (58% vs. 40% in non-conversion group, $p = 0.02$) and the presence of infundibular gallstones (78% vs. 22% in non-conversion group, $p = 0.04$) [8]. These data could suggest that contrast-enhanced CT can give a better selection of patients and can minimize time of conversion.

7.3 CT Findings in AC

The detection of the following findings at the CT scan is reported as highest sensitivity and specificity criteria of AC: a gallbladder distention (in 41% of cases), pericholecystic fat density and collection (respectively, in 52 and 31% of cases), gallbladder wall thickness of more than 7 mm (in 59% of cases), subserosal edema (in 31% of cases), local or widespread absence of gallbladder wall enhancement, and high gallbladder bile attenuation (in 24% of cases) (Figs. 7.3, 7.4, and 7.5) [3, 8, 9]. In case of pericholecystic abscess, it is possible to find focal mural defects or mural abscess with a focal intramural bulge [3]. These signs have specificity for complicated or perforated AC close to 90% [3].

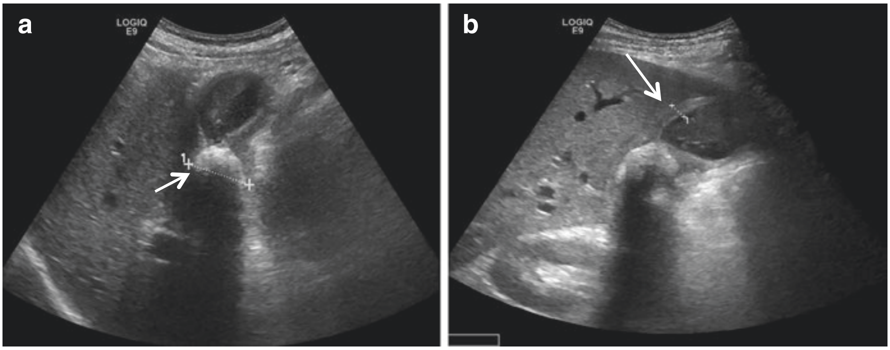

Fig. 7.3 Abdominal US shows acute cholecystitis with gallstone inside and posterior shadow cone (**a**, *white arrow*); enhancing thickness wall of gallbladder (**b**, *white arrow*)

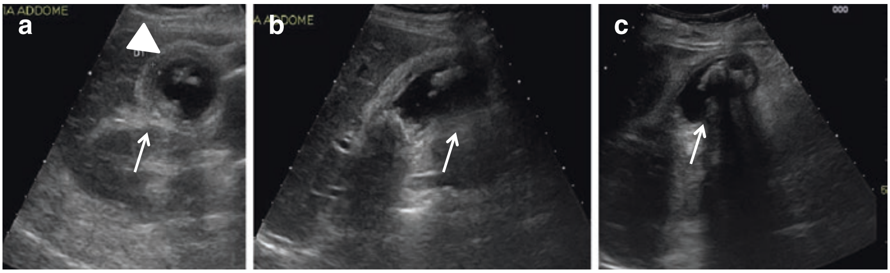

Fig. 7.4 Abdominal US shows acute cholecystitis with enhancing wall with very thickness wall of gallbladder (**a**, *white arrow*); gallstone inside and posterior shadow cone (**b**, *white arrow*)

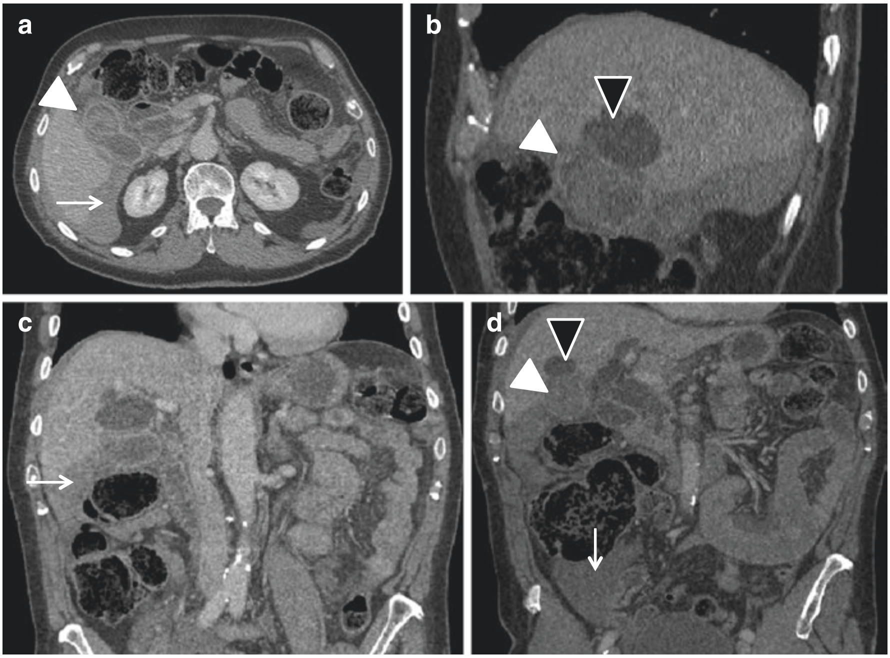

Fig. 7.5 Axial reconstruction of a CT scan with intravenous contrast shows gallbladder fundus with enhancing thickness wall (**a**, *headarrow*) and pericholecystic fluid (**a**, *white arrow*); sagittal reconstruction of CT scan with use of intravenous contrast shows irregular enhancing wall with defect (**b**, *white headarrow*) and intrahepatic abscess (**b**, *black headarrow*); coronal reconstruction of CT scan with use of intravenous contrast shows periheaptic fluid (**c**, *white arrow*); coronal reconstruction of CT scan with use of intravenous contrast shows periheaptic fluid (**d**, *white arrow*) with irregular enhancing wall with defect (**d**, *white headarrow*) and intrahepatic abscess (**d**, *black headarrow*)

However, it has to be pointed out that CT has a lower sensitivity in detecting gallstones compared to US [3].

Gangrenous AC (GAC) shows an increase in transient focal enhancement of the liver adjacent to the gallbladder during the arterial phase of dynamic CT and an attenuation ratio of the arterial phase $\geq$1.46 [10]. These characteristics seem to be predictive for GAC helping for a rapid diagnosis to reduce complication rates [10].

A particular entity is the xanthogranulomatous cholecystitis that is a rare inflammatory disease of the gallbladder due to an acute and chronic inflammatory cell infiltration and macrophages containing lipids forming such as foamy histiocytes [11]. Clinical manifestations are similar to AC, and the CT images show in most of patients a diffuse thickening of the gallbladder wall with an aggressive presentation and extent into adjacent structures, which mimic a gallbladder carcinoma, with intramural hypo-attenuated nodules that are suggestive for (but also similar to) adenomyomatosis [11].

A particular CT finding is the emphysematous AC secondary to infections by gas-forming organisms such as *Clostridium welchii*, especially in diabetic patients [3].

Other rare cases are the Mirizzi syndrome (impacted gallstone in the gallbladder neck or cystic duct that causes an extrinsic compression of the common hepatic duct, dilatation of intrahepatic bile ducts) and the cholecystocholedochal fistula from recurrent gallbladder inflammation around the impacted gallstones [3].

Conclusions

Although according to the literature and WSES guidelines the first radiologic technique for diagnosis of AC remains US, CT scan may play an important role in complicated AC or in patients where no clear symptoms are present. Furthermore, some CT scan findings may help to stratify patients with probable high or low difficulties in the execution of surgery, either laparoscopic or laparotomic.

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