Acute Cholecystitis: How Urgent as Revealed by CT Signs?

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Various signs of acute cholecystitis can be identified on CT examination, but these signs have not been correlated with clinical severity. Since CT signs of acute cholecystitis reflect underlying pathological changes, it is reasonable to postulate that they may related to clinical severity. CT scans in 65 patients with acute cholecystitis were retrospectively reviewed by two radiologists. Patients were categorized in groups according to the CT signs: group 1 had no radiographic evidence of cholecystitis, group 2 had uncomplicated cholecystitis, group 3 had intraluminal complications, and group 4 had extraluminal complications. We found good correlation between the category based on CT signs of acute cholecystitis and the clinical severity. The frequency of emergency operations increased with increasing severity of CT signs (0% for group 1 disease, 20% for group 2 disease, 41% for group 3 disease, and 75% for group 4 disease). We concluded that CT signs identified in acute cholecystitis are useful not only for diagnosis but also for assessing clinical severity.

Key words: Acute cholecystitis; Complication; Computed tomography (CT); Emergency

Computed tomography (CT) is a popular tool amongst the physicians in the emergency department because it offers a quick and accurate means of providing easily interpretable images [1]. While radionuclide biliary scanning and sonography are presently the diagnostic methods of choice for acute cholecystitis [12], advances in CT, including improved spatial resolution and the increased availability of CT scanners, have increased the utility of CT for the diagnosis of acute cholecystitis [2].

The increasing importance of this tool for diagnosing acute cholecystitis makes it incumbent upon physicians to be familiarize themselves with the CT signs for this disorder. These signs may suggest the diagnosis and can also indicate the presence of complications such as gangrenous cholecystitis or abscess [7]. To the best of our knowledge, however, no one has correlated these CT signs with the degree of clinical severity of the disease. The present study was designed to categorize the CT signs seen in acute cholecystitis with clinical severity and outcome.

MATERIAL & METHODS

Patients
We did a computerized search of the medical record database at our institution to identify patients who had undergone cholecystectomy with a final diagnosis of acute cholecystitis from January 2001 to May 2003. This patient list was cross-referenced with radiology files to identify patients who had CT scans before cholecystectomy. All patients had pathological proof of acute cholecystitis.

The database search yielded a total of 65 patients, 41 men and 24 women, with a mean age of 62.

Image and Report Review
Two radiologists retrospectively reviewed the CT scans, surgical and pathological reports of all the patients. A consensus decision was required for all imaging diagnoses. Classification of the CT signs was
based on the criteria summarized in Table 1. Group 1 patients were those with no CT evidence of acute cholecystitis (Fig. 1). Group 2 had CT signs suggestive of acute cholecystitis without evidence of complications, signs of which included a distended gallbladder (transverse diameter > 4 cm) or wall thickening (wall thickness > 3 mm) [4-6] (Fig. 2). Group 3 had signs of intraluminal complications, for example, hyper-dense content (Fig. 3), desquamation of the gallbladder mucosa, or poor perfusion of the gallbladder wall (Fig. 4). Group 4 consisted of those with CT signs suggestive of extra-luminal complications, including extraluminal air or abcess (Fig. 5). When signs from several categories were present, assignment was based on the most severe degree of CT sign. The grouping system is summarized in Table 2.

**Imaging Procedure**

CT scans were obtained using a conventional helical CT scanner (CTi; GE Medical System, Milwaukee, Wis). All patients routinely received a bolus injection of intravenous contrast material (100-mL, 65% Angiografin). A 7-mm collimation with no interval gap was used for scanning.

**RESULTS**

Variable CT signs for acute cholecystitis were found (Table 1). Four patients who presented without any signs of acute cholecystitis were later confirmed to have mild acute cholecystitis. They were classified as group 1 (Fig. 1). Other patients who presented CT signs consistent with acute cholecystitis were classified as group 2, 3 or 4 (Table 2). For example, when CT evidence of acute cholecystitis in the absence of complications was found, an assignment of group 2 (Fig. 2) was made. Cases with CT signs of intraluminal complications were classified as group 3 (Fig. 4). Finally, when associated CT signs of extraluminal complications were found, these cases were classified as group 4 (Fig. 6).

On the basis of CT findings, there were 4 patients

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**Table 1. Category of CT signs in acute cholecystitis**

<table>
<thead>
<tr>
<th>Category</th>
<th>CT signs</th>
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<tbody>
<tr>
<td>Normal</td>
<td>No CT sign suggestive of acute cholecystitis</td>
</tr>
<tr>
<td>Uncomplicated acute cholecystitis</td>
<td>Distended gallbladder (transverse diameter &gt; 4 cm), wall thickening (wall thickness &gt; 3 mm), pericholecystic stranding</td>
</tr>
<tr>
<td>Intraluminal complications</td>
<td>Gallbladder content &gt; 20 HU, intraluminal air, irregular wall, poor enhancing, luminal membrane</td>
</tr>
<tr>
<td>Extraluminal complications</td>
<td>Pericholecystic abscess, extraluminal air, intrahepatic or abdominal abscess</td>
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**Table 2. Group category of acute cholecystitis**

<table>
<thead>
<tr>
<th>group</th>
<th>CT definition</th>
<th>Pathology &amp; surgery</th>
<th>CT findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Normal</td>
<td>Mild acute cholecystitis</td>
<td>Negative</td>
</tr>
<tr>
<td>2</td>
<td>Acute cholecystitis</td>
<td>Non-complicated acute cholecystitis</td>
<td>Uncomplicated acute cholecystitis</td>
</tr>
<tr>
<td>3</td>
<td>Complicated cholecystitis</td>
<td>Acute cholecystitis with complications confined within gallbladder</td>
<td>Intraluminal complications</td>
</tr>
<tr>
<td>4</td>
<td>Ruptured cholecystitis</td>
<td>Acute cholecystitis with complications indicating rupture</td>
<td>Extraluminal complications</td>
</tr>
</tbody>
</table>

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Figure 1. Group 1: Acute cholecystitis with a normal CT in a 76-year-old man with epigastric pain. Contrast-enhanced CT scan showed a normal gallbladder, and the pericholecystic region appeared clear. Elective operation one day later confirmed mild cholecystitis.

Figure 2. Group 2: Uncomplicated acute cholecystitis in a 66-year-old man. Contrast-enhanced CT scan showed gallbladder distention with wall thickening (arrow). The operation three days later confirmed uncomplicated acute cholecystitis.
in group 1, 20 in group 2, 29 in group 3, and 12 in group 4. The 4 patients in group 1 were subsequently diagnosed with mild acute cholecystitis at surgery. Most cases were typically associated with multiple CT signs. The most common findings overall were pericholecystic stranding (54 of 65 patients; 83%) (Fig.6) followed by gallbladder wall thickening (42 of 65 patients; 65%) (Fig. 2). Some CT signs suggestive of complications occurred infrequently, with liver abscess identified in two patients only, intra-abdominal abscess in another two patients, and extraluminal air due to emphysematous cholecystitis in

<table>
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<th>Group</th>
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<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>0%</td>
<td>20%</td>
<td>40%</td>
<td>60%</td>
</tr>
</tbody>
</table>

| Emergency OP |

Table 3. Relation of CT category and emergency operation percentage

Figure 3. Group 3: Complicated cholecystitis in a 84-year-old woman. Un-enhanced CT scan showed hyperdense (more than 20 HU) content (arrow) within the gallbladder and calcium sludge with a calcium-fluid level in the dependant portion of the gallbladder. Emergency operation confirmed acute cholecystitis with hemorrhage and pus within the gallbladder.

Figure 5. Group 4: Pericholecystic stranding and intraluminal membrane in a 73-year-old man. Contrast-enhanced CT scan showed stranding in the pericholecystic region and an intraluminal membrane (arrow) in the inner wall of the gallbladder. Emergent operation confirmed acute gangrenous cholecystitis.

Figure 4. Group 3: Acute cholecystitis with intraluminal complications in a 59-year-old man. Contrast-enhanced CT scan showed irregular thickening of the wall (arrow) of the gallbladder. The operation one day later confirmed acute gangrenous cholecystitis.

Figure 6. Group 4: Pericholecystic abscess in an 84-year-old man with acute gangrenous cholecystitis. Contrast-enhanced CT showed a loculated fluid collection (arrow) adjacent to the gallbladder. It was later confirmed to be an abscess secondary to gallbladder perforation.
only one patient.

The most common signs responsible for placing patients in the CT diagnostic categories were pericholecystic stranding in group 2 (17 of 20 patients; 85%) (Fig. 5), irregular wall thickening in group 3 (21 of 29 patients; 72%) (Fig. 4), and pericholecystic abscess in group 4 (8 of 12 patients; 67%) (Fig. 6).

Table 3 summarizes the relationships between the CT groups and the frequency of emergency surgery. None of the patients in group 1 had an emergency operation, but 20% (4/20) in group 2, 41% (12/29) in group 3, and 75% (9/12) in group 4 underwent emergency procedures.

**DISCUSSION**

Computed tomography (CT) has become an increasingly important imaging modality in the evaluation of acute abdominal distress, especially in the emergency room setting. Increased CT use is attributed to many factors, including the high detection accuracy, rapidity of examination, patient tolerance of the procedure, and the ease of interpretation. Unlike the sonogram, which requires well-trained experts who are not always available in an emergency setting, CT is considerably less operator dependent, and the imaging results can be viewed and discussed by a number of physicians. Hence, CT is often performed if sonography is inconclusive or if acute cholecystitis is not the primary diagnostic consideration at the time of imaging [3,11].

Recent advances in spatial resolution and new CT diagnostic criteria have significantly increased the identification of patients with acute cholecystitis [6], thereby further highlighting the important role of CT examination in diagnosis of this entity. Early in the course of acute cholecystitis, trapped concentrated bile irritates the gallbladder wall, causing increased secretions. These secretions lead to gallbladder distension, edema and hypervascularity of the wall [4]. On CT, these symptoms are apparent as gallbladder distension, wall thickening, and strong wall enhancement. Additionally, inflammation in the adjacent fat planes may be seen as pericholecystic stranding (Fig. 5). As the intra-luminal pressure rises, the vascular supply is compressed, which may result in thrombosis, ischemia, and subsequent necrosis of the gallbladder wall, with or without associated cystic artery thrombosis [3]. These symptoms result in intra-luminal changes such as an irregular or poorly enhancing wall [4], intraluminal membrane (Fig. 5), hyper-dense content (Fig. 3) or air collection within the gallbladder [4,10]. With disease progression, perforation of gallbladder may occur, which presents on CT as pericholecystic abscess (Fig. 6), extraluminal air [8,9], intrahepatic or intra-abdominal abscess [3].

The underlying pathophysiology of the CT signs evident in the present study reflects not only the presence of acute cholecystitis, but, as indicated in Table 3, may also serve as indicators for disease acuteness. The use of emergency surgery rose progressively as the category of the disease increased, reflective of its increasing severity and acuteness ($\chi^2 = 9.38$, indicating $p > 0.01$ with a chi-square test, with group 1 excluded because of the small number of cases). Pericholecystic stranding was the most common CT sign for acute cholecystitis, but other less frequent signs should not be overlooked. For example, an irregular wall occurred most frequently in group 2 while abscess was the most common finding responsible for assigning a patient to group 3. Even more uncommon signs such as a fistula following perforation are nonetheless of utmost importance in signifying a severe complication.

Despite the widespread use of CT in clinical or emergency practice, it is still reserved for sicker patients rather than being used as a routine examination for abdominal distress. This explains why there were only a few patients in group 1. Although CT is not helpful in making a definitive diagnosis in such patients, it is helpful in selecting treatment options, or at least in ruling out the need for immediate surgery. This leaves room for further sonographic evaluation, conservative treatment or invasive treatment such as elective surgery or percutaneous cholecystostomy [13, 14], which may in turn increase the diagnostic accuracy and reduce the economic and social burden for diagnosis and treatment.

Finally, when CT signs suggestive of advanced or complicated acute cholecystitis are seen, prompt consultation for emergent treatment is required. The category of CT signs may thus be helpful in suggesting the clinical severity of the disease and which patients should need immediate or urgent treatment.

**REFERENCES**

急性膽囊炎：由電腦斷層攝影徵象反映有多緊急？

吳淑萍 鄭旭萌 施美鍾

馬偕紀念醫院 放射線科

急性膽囊炎可以有很多電腦斷層攝影可以看到的徵象，但對於臨床的急性程度相關性卻沒有被討論。因為電腦斷層攝影中看到的徵象往往是病理解變的表現，所以推論應該與臨床表現有一定的相關性。65個急性膽囊炎病人的電腦斷層攝影徵象由四位放射科醫師追溯研究，根據所看到的電腦斷層攝影徵象作分類：第一組為無急性膽囊炎徵象；第二組為急性膽囊炎但沒有併發症徵象；第三組為有囊內併發症徵象，及第四組為合併囊外併發症徵象。我們發現這個分組和臨床的急性程度有相關，表現在緊急開刀的比例。對於第一組病人，沒有人進行緊急開刀。緊急開刀的比例與徵象所表示的嚴重程度相對逐步升高（第一組 0%，第二組 20%，第三組 41%，第四組 78%）。我們總結電腦斷層攝影上所見的徵象並不是只能單純作為診斷有沒有急性膽囊炎，它還可以作為臨床上嚴重程度的參考。

關鍵詞：急性膽囊炎，併發症，電腦斷層攝影，緊急情況