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Fig. 1 Abdominal radiograph.



Fig. 2 Transverse US scan of the RUQ.

CASE PRESENTATION

A 75-year-old man presented with one day history of right upper quadrant (RUQ) pain radiating to the epigastrium and back. There was associated fever. He had no jaundice, nausea or vomiting. Abdominal physical examination revealed an ill-defined mass at the right subcostal area with associated tenderness. His leucocyte count was $14.5 \times 10^9/\text{dL}$ with 90% polymorphonuclear leucocytes. Urinalysis was normal.

What do abdominal radiograph (Fig. 1) and ultrasonography (US) of the RUQ (Fig. 2) show?

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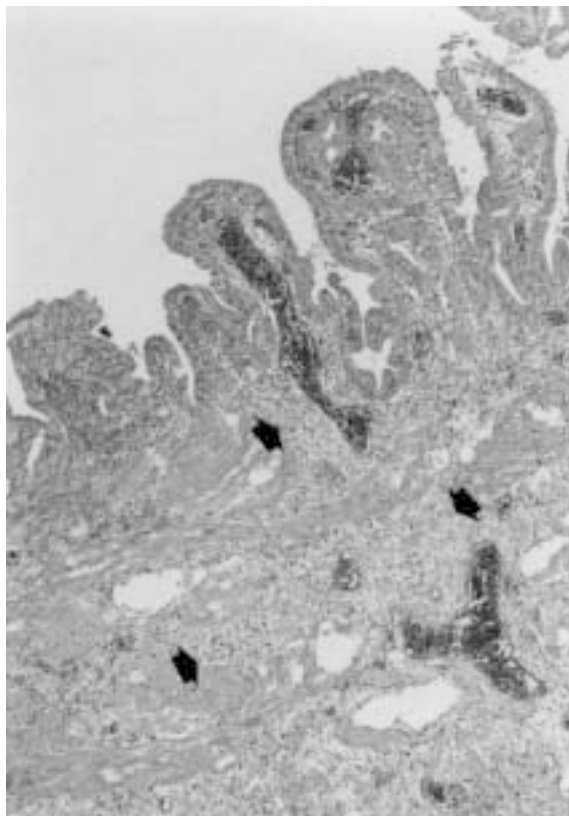


Fig. 3 Photomicrograph of the gallbladder shows thickening of the gallbladder wall with infiltration of inflammatory cells (arrows) [Haematoxylin-eosin stain, original magnification x 40].

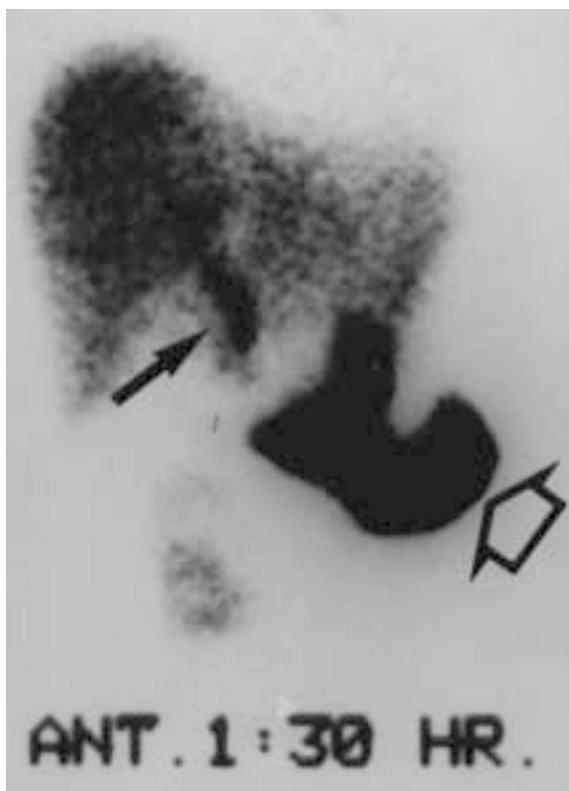


Fig. 4 Acute cholecystitis. Anterior view of cholecystiscan taken 1.5 hours after injection of radioisotope shows non-visualisation of the gallbladder but normal visualisation of the bile duct (small solid arrows) and bowel (large open arrow).

IMAGING INTERPRETATION

Abdominal radiograph shows a round soft tissue mass at the lower margin of the liver and gaseous dilatation of the colon (Fig. 1). US shows enlargement of the gallbladder, thickening of the gallbladder wall, gallstones and minimal pericholecystic fluid collection (Fig. 2).

DIAGNOSIS

Gallstones with acute cholecystitis.

CLINICAL COURSE

Antibiotics was started. The patient underwent abdominal operation 2 days later. At surgery, the gallbladder was markedly distended, measured 5 x 8.5 cm, and had a thickened wall. Cholecystectomy was performed. Gallstones were confirmed. Microscopic examination of the gallbladder showed heavy infiltration of acute inflammatory cells in all layers of the gallbladder wall (Fig. 3). He made a good post-operative recovery.

DISCUSSION

In patients presenting with RUQ pain and fever, several possible differential diagnoses should be considered. These are listed in Table I. A careful history and physical examination, and laboratory tests are helpful in the differential diagnosis. However, the clinical signs and symptoms, and laboratory results of the many diseases causing RUQ pain may overlap. In such cases, imaging studies will have a role in making the diagnosis. Chest and abdominal radiographs are usually the first imaging modality in patients with RUQ pain because they are rapid and inexpensive means to evaluate the pulmonary and abdominal sources of pain⁽¹⁾.

Acute Cholecystitis

Approximately 90-95% of patients with acute cholecystitis have gallstones and typically, stones cause cystic duct obstruction. The remaining patients have acute cholecystitis without gallstone (acalculus cholecystitis). Although acute cholecystitis is a common cause of RUQ pain, other disease processes can produce similar symptoms (Table I).

Table I Differential diagnosis of RUQ pain and fever.

1.	Acute cholecystitis
2.	Liver abscess
3.	Hepatocellular carcinoma
4.	Renal stone
5.	Acute pyelonephritis
6.	Acute pancreatitis
7.	Peptic ulcer perforation
8.	Basal pneumonia
9.	Acute appendicitis



Fig. 5 Liver abscess. Subcostal US scan of the liver shows a large, well-defined hypoechoic mass (calipers) in the right lobe of liver.



Fig. 6 Hepatoma. Transverse US scan of the liver shows a large circumscribed, heterogeneously-hyperechoic mass in the right lobe (arrows).

Both cholescintigraphy and US are very accurate in evaluating patients with suspected acute cholecystitis. The choice of imaging study depends upon the individual institutional preference. However, in general, US is preferred because it is a more widely available, inexpensive, non-invasive, has no ionising radiation hazard, and allows visualisation of adjacent organs. If there is no evidence of acute cholecystitis, US can often aid in establishing an alternative diagnosis. The US criteria for diagnosis of acute cholecystitis are 1) gallstones, 2) maximal pain over the gallbladder (ultrasonic Murphy's sign), and 3) gallbladder wall thickening of greater than 3 mm.

Occasionally, gallstones cannot be visualised but a thickened gallbladder wall and a positive ultrasonic Murphy's sign are present. In these inconclusive cases, cholescintigraphy is helpful to evaluate the possibility of acute acalculous cholecystitis or acute cholecystitis caused by a cystic duct stone not imaged ultrasonographically (Fig. 4). In normal patients, gallbladder and small bowel are seen within one hour after the radioisotope injection. Non-visualisation of the gallbladder within 4 hours indicates cystic duct obstruction and is considered diagnostic of acute cholecystitis. A negative cholescintigraphy is reliable to rule out acute cholecystitis⁽²⁾.

Acute cholecystitis can initially be treated with antibiotics. However, 25% of patients who initially respond to medical treatment will have recurrent cholecystitis within one year. Therefore, the current treatment of acute cholecystitis is to perform cholecystectomy during or after the first episode of the disease⁽¹⁾.

Liver abscess

Both pyogenic and amoebic liver abscesses may present with RUQ pain and fever. On the basis of

clinical symptoms alone, it is difficult to distinguish between liver abscess and acute cholecystitis. US is the imaging modality of choice to evaluate both the liver and biliary tract. Pyogenic liver abscess as small as 1.5 cm can be detected by US with a sensitivity of 75% to 90%. The US appearance of pyogenic abscess is extremely variable in shape and echogenicity. It may be round, oval, lobulated or lentiform. Its echogenicity varies from being anechoic (50%), hyperechoic (25%), or hypoechoic (25%), with varying degrees of internal echoes and debris.

Septa, fluid-fluid levels, and posterior acoustic enhancement may also be seen. If gas is present in an abscess, it is seen as brightly linear echoes with acoustic shadowing or reverberation artifacts. Early liver abscesses tend to be echogenic and poorly demarcated. With time, they evolve into well demarcated and nearly anechoic lesions. Amoebic liver abscesses usually appear on US as a round or oval sharply-defined hypoechoic mass with fine homogeneous, low-level echoes and distal acoustic enhancement (Fig. 5). However, in many patients, an amoebic abscess cannot be reliably differentiated from pyogenic abscess based on imaging and clinical features alone^(3,4).

Hepatocellular carcinoma (HCC)

Clinically, patients with HCC usually present with hepatomegaly, weight loss, malaise, fever, and abdominal pain. Rapid growth, bleeding or infarction of tumour may cause acute RUQ pain and simulate acute cholecystitis. US appearances of HCC are varied. It may appear as an isoechoic, hypoechoic or hyperechoic lesion (Fig. 6). Small HCC (less than 3 cm) tends to be hypoechoic with posterior acoustic enhancement. Tumours larger than 3 cm in diameter more often have a mosaic or mixed pattern^(5,6).



Fig. 7a Right hydronephrosis. Abdominal radiograph shows staghorn renal calculi and focal bulging of upper pole of right kidney (arrowheads).



Fig. 7b Same patient as Fig. 7a Longitudinal US scan of the right kidney shows focally dilated calyces in the upper pole (arrow) and multiple renal calculi in the lower calyces and renal pelvis (arrowheads).



Fig. 8 Acute pancreatitis. Transverse US scan of the pancreas shows diffuse swelling of the entire pancreas (small arrows).

Right renal stone and other right renal diseases

Stones in the right kidney, right pyelonephritis, pyonephrosis, renal abscess, and other right renal diseases may present with atypical symptoms. In the absence of haematuria or pyuria, clinical symptoms may be confused with those of acute cholecystitis. In these circumstances, imaging studies will often be helpful in making the differential diagnosis. Abdominal radiography may show stones in the renal collecting system (Fig. 7a) as many renal stones contain calcium. US is valuable in establishing the presence of dilatation of the pelvicalyceal system (Fig. 7b). It is also helpful to confirm or exclude other renal diseases such as pyonephrosis, and large renal or peritoneal abscesses. If US is unremarkable, further imaging with CT is necessary. CT is superior to US in diagnosis of acute pyelonephritis, small renal and peritoneal abscesses. CT is also better for determining the anatomical extension of gas-forming renal and perirenal abscesses^(7,8).

Peptic ulcer

The major complications of peptic ulcer are haemorrhage, perforation and obstruction. Perforation of ulcers on the anterior wall of the stomach or duodenum result in acute peritonitis, whereas perforation of ulcers on the posterior wall of the stomach or duodenum usually result in a walled-off or confined perforation. Thus the presence of pneumoperitoneum in patients with clinical signs of peritonitis is strongly suggestive of peptic ulcer perforation but this diagnosis cannot be excluded in the absence of pneumoperitoneum. CT is extremely useful to demonstrate fluid collections or abscesses in the lesser sac or retroperitoneal space in patients with perforated ulcers on the posterior wall of the stomach or duodenum⁽⁹⁾.

Acute pancreatitis

Acute pancreatitis is an acute inflammatory process of the pancreas with variable involvement of other regional or remote organ systems. Clinically, acute pancreatitis ranges from mild to severe forms. Most patients present with mild acute pancreatitis that is generally self-limiting. Severe acute pancreatitis is associated with organ failure and/or local complications such as necrosis, abscess or pseudocysts⁽¹⁰⁾.

Acute pancreatitis is usually diagnosed on the basis of history, physical examination and a serum amylase test. However, some patients have atypical presentations and imaging studies may be needed for the correct diagnosis. Although, abdominal radiography may not give a specific diagnosis of acute pancreatitis, it may reveal indirect evidence



Fig. 9 Appendicolith. Abdominal radiograph shows a small round calcification in the right lower quadrant (arrowheads) and multiple right distal ureteric calculi (long arrows).

of acute pancreatitis and other causes of acute abdominal pain such as pneumoperitoneum and bowel obstruction.

US is useful to evaluate patients with suspected acute pancreatitis. The gallbladder and bile ducts can be assessed to determine if stones are the cause of acute pancreatitis. On US, acute pancreatitis appears diffusely or focally enlarged, or normal in size (Fig. 8). Its echogenicity typically decreases because of interstitial oedema. Heterogeneous echoes of the parenchyma may be evident if there is haemorrhage, necrosis, or fat saponification. Associated extra-pancreatic abnormalities such as fluid collection in the retroperitoneum, perivascular space and thrombosis of the portal veins can be detected with US. These associated abnormalities are helpful in diagnosis for those cases with a normal pancreatic contour. CT is also used in cases with an uncertain diagnosis of acute pancreatitis and to detect complications of acute pancreatitis. Both US and CT are useful for guiding aspiration and drainage in complicated cases⁽¹¹⁾.

Acute appendicitis

The diagnosis of acute appendicitis is usually obtained from clinical symptoms and laboratory tests, and does not require imaging. However, in patients with equivocal symptoms or complications, imaging studies can be helpful in achieving the correct diagnosis and to provide proper management. Acute appendicitis occasionally presents as

RUQ pain and may cause confusion with acute cholecystitis. Imaging studies can differentiate among acute cholecystitis and other causes of RUQ pain.

Abdominal radiography and barium enema are of limited use in the diagnosis of acute appendicitis. Abdominal radiography may show calcified appendicoliths (Fig. 9) but it is an uncommon finding. Other findings such as an abnormal bowel gas pattern and pneumoperitoneum are non-specific in the diagnosis of acute appendicitis. CT and US have recently been used to evaluate patients who have questionable findings of acute appendicitis, resulting in a decrease in unnecessary appendectomies. The choice of imaging modalities, i.e. between CT and US, for patients with possible acute appendicitis depend on institutional preference and available expertise.

The US findings for diagnosis of acute appendicitis are a non-compressible appendix with a maximum outer diameter greater than 7 mm. The presence of appendicoliths is always indicative of acute appendicitis regardless of the size of the appendix. US is more sensitive than abdominal radiography for the detection of appendicoliths. The US diagnosis of acute appendicitis has a sensitivity of 78% to 96%, and specificity of 85% to 98%. Obesity and overlapping loops of gas-filled bowel may give a lower US sensitivity. CT is preferred in obese patients and patients with possible perforation⁽¹²⁾.

REFERENCES

- Middleton WD. Right upper quadrant pain. In: Bruth EI, Arger PH, Benson CB, Ralls PW, Siegel MJ, eds. *Ultrasound: A Practical Approach to Clinical Problems*. New York: Thieme, 2000; 3-16.
- Jeffrey RB, Ralls PW. *CT and Sonography of the Acute Abdomen*. 2nd edition. Philadelphia: Lippincott-Raven, 1996; 74-121.
- Ros PR, Barreda R, Gore RM. Focal hepatic infections. In: Gore RM, Levine MS, Laufer I, eds. *Textbook of Gastrointestinal Radiology*. Philadelphia: WB Saunders, 1994; 1947-65.
- Ralls PW. Focal inflammatory disease of the liver. *Radiol Clin North Am* 1998; 36:377-89.
- Takayasu K, Moriyama N, Muramatsu Y, et al. The diagnosis of small hepatocellular carcinomas: efficacy of various imaging procedures in 100 patients. *AJR* 1990; 155:49-54.
- Choi BI, Kim CW, Han MC, et al. Sonographic characteristics of small hepatocellular carcinoma. *Gastrointest Radiol* 1989; 14:255-61.
- Teefey SA. Flank pain. In: Bruth EI, Arger PH, Benson CB, Ralls PW, Siegel MJ, eds. *Ultrasound: A Practical Approach to Clinical Problems*. New York: Thieme, 2000; 76-85.
- Jeffrey RB, Ralls PW. *CT and Sonography of the Acute Abdomen*. 2nd edition. Philadelphia: Lippincott-Raven, 1996; 205-55.
- Levine MS. Peptic ulcers. In: Gore RM, Levine MS, Laufer I, eds. *Textbook of Gastrointestinal Radiology*. Philadelphia: WB Saunders, 1994; 562-97.
- Bradley EL III. A clinically based classification system for acute pancreatitis. *Arch Surg* 1993; 128:586-90.
- Ralls PW. Hyperamylasemia. In: Bruth EI, Arger PH, Benson CB, Ralls PW, Siegel MJ, eds. *Ultrasound: A Practical Approach to Clinical Problems*. New York: Thieme, 2000; 67-75.
- Jeffrey RB, Ralls PW. *CT and Sonography of the Acute Abdomen*. 2nd edition. Philadelphia: Lippincott-Raven, 1996; 256-314.

ABSTRACT

A 75-year-old man presented with right upper quadrant pain and fever. Ultrasonography showed gallstones, gallbladder enlargement, gallbladder wall thickening and pericholecystic fluid collection. Cholecystectomy confirmed the diagnosis of

acute cholecystitis. The differential diagnosis of right upper quadrant abdominal pain and fever is discussed, and the role of imaging in its evaluation is emphasised.

Keywords: Gallstone, acute cholecystitis, right upper quadrant pain, ultrasonography

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