Computed tomography imaging of complications of acute cholecystitis

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Abstract

Acute cholecystitis (AC) is a frequent complication of biliary cholelithiasis. Although ultrasound is the first diagnostic imaging procedure, frequently the initial imaging modality is computed tomography (CT). Therefore, familiarization of CT findings in AC and potential related complications are extremely important. This pictorial essay reviews a broad spectrum of complications related to AC and its key findings in CT.

Key words: Acute cholecystitis complications; computed tomography; emphysematous cholecystitis; gallstones

Introduction

Gallstone disease, in particular cholelithiasis and acute cholecystitis (AC), has increasingly become a major cause of abdominal pain and discomfort in the developing countries.[1] Its occurrence has been found to be high around 7.4% in the adult population in the cities of Chandigarh and New Delhi in North India, which is interestingly seven times more frequent than in South India.[2]

Gallstones constitute a significant health problem in developed societies too, affecting 10–15% of the adult population, meaning 20 to 25 million Americans have or will have gallstones. There are approximately 220,000 cases per year of cholecystitis requiring surgery in the United States.[1] Cholelithiasis has a wide range of prevalence between Europe, fluctuating from 5.9% in Italy to 21.9% in Norway,[3] and is considered to be the primary cause of cholecystitis. Furthermore, cholecystitis is also one of the most frequent causes for hospitalization and abdominal surgery.[1] Gallstones are much more common in the female population (61%) as compared to males (39%). The age group most affected is 45–60 years (38.5%) among females, and above 60 years in males (20.8%). A relatively higher prevalence of 39% among males when compared to reports from past studies indicates a significant shift in the pattern of prevalence of gallstone disease.[1,2]

In the evaluation of patients with acute abdominal pain, diagnostic imaging plays an important role, particularly in the characterization of gallbladder pathology.[3] The best epidemiological screening method to accurately determine point prevalence of gallbladder disease is ultrasonography. Abdominal ultrasound (US), due to its simplicity, accessibility, and low cost, is usually the initial examination for the evaluation of acute gallbladder pathology even more so in developing countries. Sonographic evaluation has a high sensitivity and specificity for gallstones, and does not utilize ionizing radiation.[2,3] However, although US

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is the first diagnostic imaging procedure, frequently the initial imaging modality is computed tomography (CT). Usage of CT occurs mainly in the following situations: (1) when symptoms and signs are equivocal as CT allows for a comprehensive assessment of the abdominopelvic cavity, (2) increased availability of CT versus US out of routine office hours, (3) the increasing use of CT as triage method in the Emergency Department, or (4) when complications of AC are suspected.[3,4] Additional advantages of CT include a better visualization of the pancreas, a higher accuracy in obese patients, and a nonoperator-dependent image quality. Being familiar with the CT findings in AC and related complications are, therefore, extremely important.

CT findings of AC include the presence of gallstones, gallbladder distension with diffuse wall thickening, increase in wall enhancement, and edema of pericholecystic fat.[3] Studies show that among these findings the most common are: wall thickening (59%), pericholecystic fat edema (52%), gallbladder distension (41%), and pericholecystic fluid (31%).[3] One of the main limitations to the CT evaluation of AC is the decreased sensitivity in comparison to US for detecting cholelithiasis. Mixed gallstones containing cholesterol and gallbladder pigments have similar attenuation values to the biliary salts present within the gallbladder lumen, therefore, limiting CT visualization.[3]

Complications of cholecystitis have generally decreased due to earlier diagnosis and treatment. It remains necessary to learn to recognize the presence of CT in AC given the potential high morbidity, and possible mortality from associated complications.

Imaging Findings in Cholecystitis Complications

Gangrenous cholecystitis and gallbladder perforation

Gangrenous cholecystitis is a severe complication of AC, occurring more frequent among the elderly and in diabetic patients.[3] In general, the diagnosis is pathognomonic, with a focal defect of the gallbladder wall detected on CT in association with internal membranes.[3] Alternatively, gallbladder perforation is usually secondary to wall gangrene with the most common site occurring at the gallbladder fundus. Perforation may present with a pericholecystic abscess or phlegmon, or less frequently with direct perforation into the peritoneal cavity. Perforation can be detected in CT, or it may be suspected due to the presence of abscess or complex fluid. Occasionally, perforation may present with an adjoining intraparenchymal liver abscess, identified as a hepatic mass either unilocular or multilocular with peripheral enhancement and hyperemia of the adjacent parenchyma [Figures 1 and 2]. The presence of peripheral satellite lesions clustered around the central hepatic lesion and/or gas within the main lesion suggests the presence of an abscess.[3]

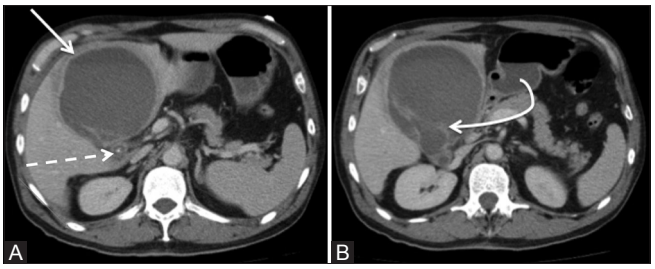

Figure 1 (A and B): Axial CT images. Pericholecystic abscess secondary to gallbladder perforation. Large abscess (*straight arrow* in A) surrounding collapsed gallbladder, which is perforated (*curved arrow* in B) and shows a stone impacted in neck (*dashed arrow* in A)

Bilio-enteric fistula

90% are secondary to cholelithiasis complications and are produced by direct perforation of the gallbladder into the digestive tract. This may be associated with AC, although it is more common in chronic cholecystitis.[5,6] The most frequent biliary-enteric fistulas are cholecystoduodenal [Figure 3] and cholecystocolonic [Figure 4].[5-7] The presence of gas in the gallbladder and/or biliary duct (pneumobilia), without any history of manipulation, is highly suggestive of a fistula.

Gallstone ileus

This is a rare complication developing in 0.5–4% of patients with cholelithiasis, and occurs more frequently in people over the age of 70.[5] It is a mechanical intestinal obstruction usually at the level of the terminal ileum (75–90%), secondary to the passage of a large gallstone through a biliary-enteric fistula.[5,6] Gallstone ileus is responsible for 20% of endoluminal intestinal obstructions in patients over 65 years old.[5] In CT, a gallstone (usually hyperdense) is seen at the site of small bowel obstruction with associated proximal dilatation and biliary tract gas (pneumobilia). The association of intestinal obstruction, pneumobilia, and a gallstone in an ectopic position is known as Rigler's triad[5] [Figure 5]. Absence of pneumobilia does not exclude the diagnosis, because a gallstone impacted in the gallbladder neck may prevent air passage to the biliary ducts.

Duodenal obstruction

Duodenal obstruction, also known as Bouveret syndrome, is an obstruction at the duodenum secondary to the migration of a gallstone through a cholecystoduodenal fistula. In approximately 3–10% of these cases, the gallstone becomes impacted at the duodenum.[5,8] On CT, significant gastric distension can be observed and a gallstone at the level of the duodenal bulb and pneumobilia can be identified[5,8] [Figure 6].

Cholecystocutaneous fistula

This is a very rare complication (2% of biliary fistulas); only 20 cases have been reported in the literature over the last 20 years.[7] The main cause is iatrogenic, secondary to surgical treatment of prior biliary pathology.[7] Occurrence

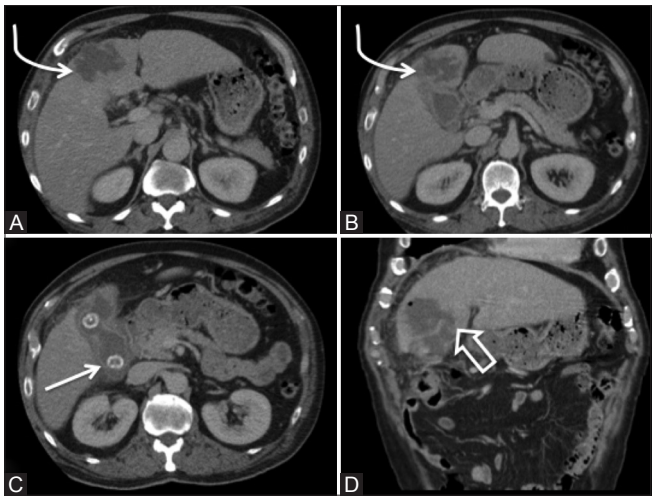

Figure 2 (A-D): Axial CT (A-C) and coronal reformatted (D) images. Hepatic abscess secondary to gallbladder perforation (*curved arrows*). Gallbladder wall thickening with associated gallstones and hepatic abscess (*straight arrow* in C). Wall perforation can be seen on coronal reconstruction (*open arrow*)

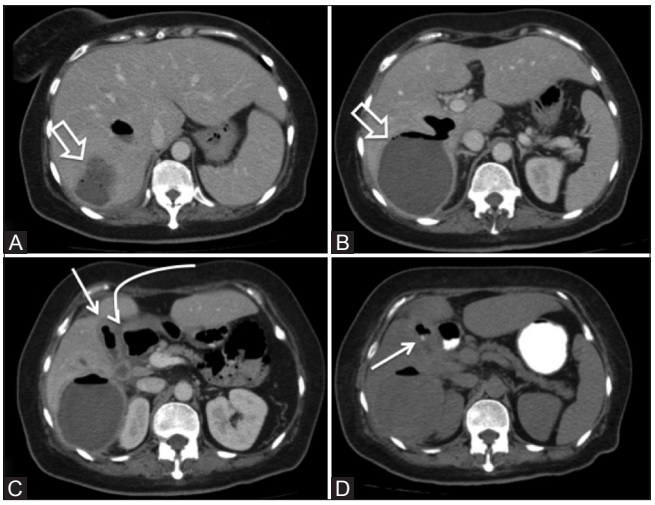

Figure 3 (A-D): Axial CT images show a liver abscess (*open arrows* in A and B), in continuity with a collapsed gallbladder with gas (*straight arrow* in C), immediately adjacent to duodenal bulb (*curved arrow* in C). Oral contrast entering the gallbladder lumen (*straight arrow* in D) confirmed the cholecystoduodenal fistula

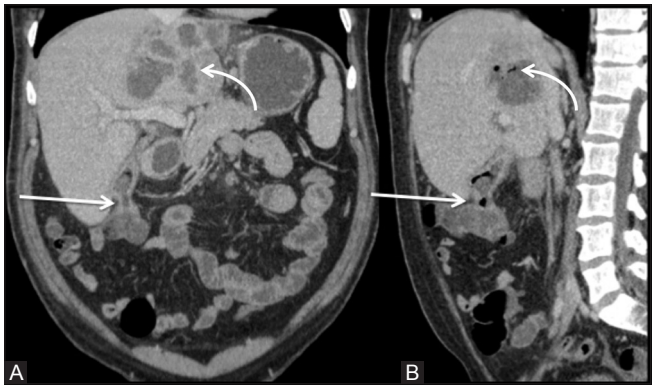

Figure 4 (A and B): CT coronal (A) and sagittal reformatted (B) images. Cholecystocolonic fistula. A fistulous tract is identified between gallbladder and transverse colon (*straight arrows*). Hepatic abscess (*curved arrows*)

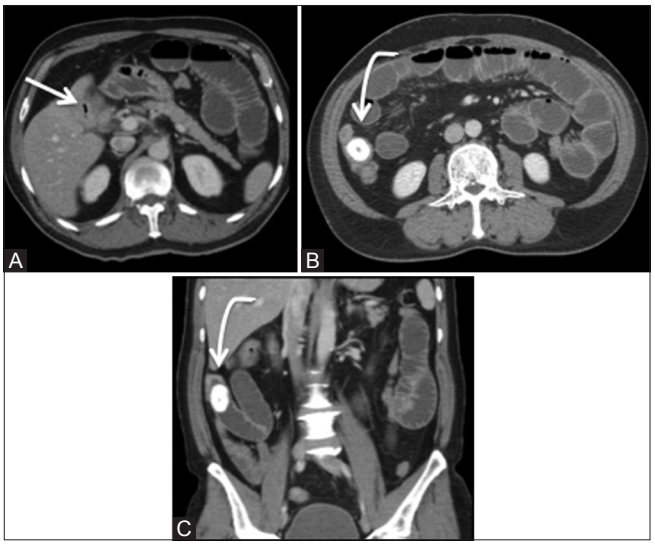

Figure 5 (A-C): Axial CT (A and B) and coronal (C) reformatted images. Gallstone ileus. Collapsed gallbladder with endoluminal gas and inflammatory changes on gallbladder (*straight arrow*). Gallstone (*curved arrows*) in distal ileum producing intestinal obstruction

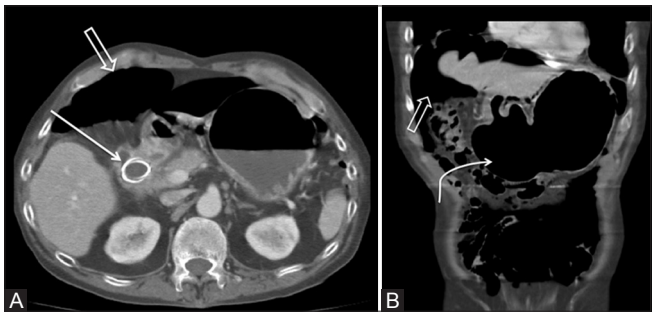

Figure 6 (A and B): Axial CT (A) and coronal reformatted (B) images. Bouveret syndrome. Large gallstone impacted on duodenal bulb (*straight arrow* in A) and pneumoperitoneum (*open arrow* in A and B) can be identified. Gastric distention is also present (*curved arrow* in B)

is more common among older adults, with women more often affected due to the associated increased incidence of cholelithiasis in females. At the time of diagnosis, fever in association with diaphoresis and anorexia may

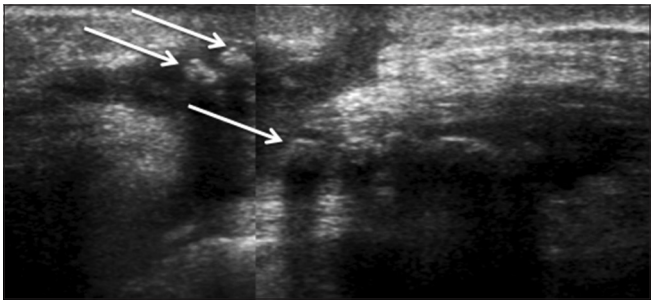

Figure 7: Abdominal wall ultrasound images. Abdominal wall abscess secondary to cholecystocutaneous fistula. An abdominal wall collection containing hyperechogenic calculi (*arrows*) with acoustic shadowing can be identified

occur with or without concomitant abdominal pain.[7] On physical examination, the fistulous tract can be identified discharging bile or possibly gallstones. Erythema and swelling indicative of an abdominal wall abscess can occur, similar to the presentation of *empyema necessitatis* of the chest.[7] CT can identify the wall abscess, confirm presence or absence gallstones within the fistula tract, gallbladder, or pericholecystic soft tissues[7] [Figures 7–9].

Hemorrhagic cholecystitis

This is an infrequent complication of AC, secondary to the erosion of the gallbladder wall blood vessels with hemorrhage within the gallbladder lumen and resultant hemobilia.[6] Fewer frequent causes of hemobilia include gallbladder carcinoma, patients on anticoagulant therapy, or iatrogenic causes such as postliver biopsy or percutaneous transhepatic procedures.[9] Noncontrast-enhanced CT findings include hyperdense material within the gallbladder consistent with hemorrhage or hematoma[6,9] [Figure 10]. A potential pitfall, could be vicarious excretion of intravenous contrast, yet in the latter there will be history of a recent contrast-enhanced CT performed.

Emphysematous cholecystitis

This is the result of gallbladder wall infection produced by gas-forming organisms.[5] It mainly affects diabetic patients (30–50%), and occurs approximately twice as frequent in males.[5,10] Three stages of this entity have been described: Stage 1, where gas is observed in the gallbladder lumen; Stage 2, characterized by the presence of gas in its wall; and Stage 3, gas is observed in the pericholecystic tissues.[10] CT is the most specific and sensitive diagnostic

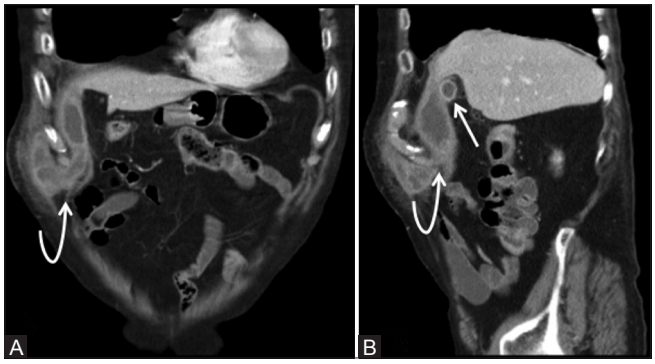

Figure 8 (A and B): Abdominal CT coronal (A) and sagittal (B) reformatted images. Abdominal wall abscess secondary to cholecystocutaneous fistula. Collapsed gallbladder (*straight arrow*) immediately adjacent to abscess on abdominal wall (*curved arrows*)

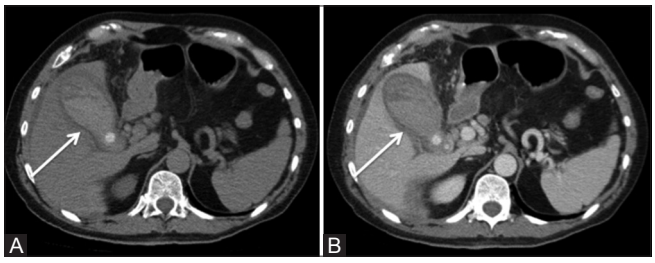

Figure 10 (A and B): Nonenhanced CT axial images. Hemorrhagic cholecystitis. Distended gallbladder with high attenuation material, corresponding to fluid containing blood (*straight arrows* in A and B). Cholelithiasis is present in the gallbladder neck. Confirmation was made during urgent cholecystectomy.

Figure 9: Drainage of abdominal wall abscess secondary to cholecystocutaneous fistula. Percutaneous drainage of abdominal wall abscess with emergence of multiple stones of biliary origin (*arrow*)

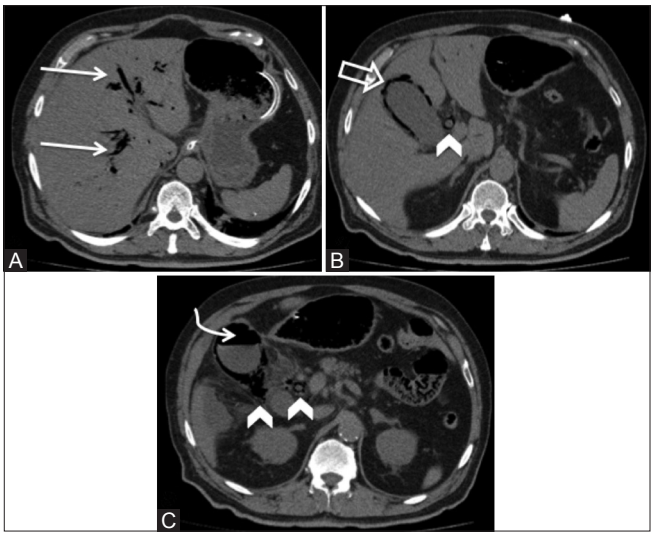

Figure 11 (A-C): Emphysematous cholecystitis. Abdominal CT axial images. Gas within the gallbladder (*curved arrow* in C), gas in gallbladder wall (*open arrow* in B), and also in pericholecystic tissues (*arrowhead* in B and *straight arrows* in A) can be identified

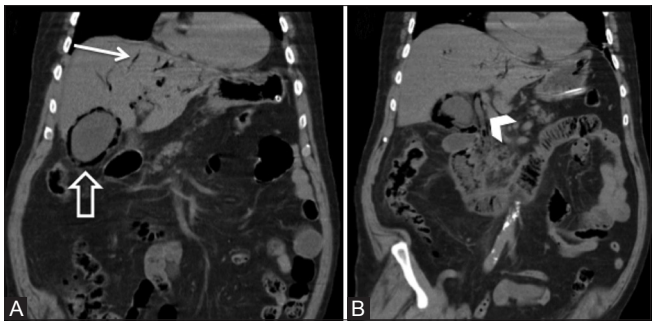

Figure 12 (A and B): Abdominal CT coronal reformatted images. Emphysematous cholecystitis, Pneumobilia (*straight arrow*), and gas on gallbladder wall (*open arrow*) can be identified

method, identifying the presence of gas in the gallbladder wall or lumen[5,10] [Figures 11 and 12].

Portal vein thrombosis

This is one of the most frequent vascular complications of ACs,[5] present in 8.3% of patients.[11] Thrombosis occurs as a consequence of local inflammation of the portal vein.[5,11] Contrast-enhanced CT shows areas of a transient attenuation increase in the arterial phase in the hepatic parenchyma, either pericholecystic or segmental, with an absence of portal vein filling on delayed phases.[5,11] Thrombus in the lumen of the portal vein can occasionally be seen [Figure 13].

Conclusion

CT is frequently the first diagnostic imaging examination requested when a complication of AC is suspected or in cases of atypical presentation of biliary pathology. In these cases, the radiologist should look for pneumobilia, pericholecystic wall thickening, focal gallbladder wall defects, adjacent collections, hepatic abscesses, or hemorrhage. CT also allows detection of diagnosis of abdominal diseases that may mimic biliary pathology, and provides a better characterization of the neighboring organs such as the pancreas, duodenum, and liver.

As AC is a frequently encountered pathology, it is important for radiologists, gastroenterologists, and surgeons to be familiar with the potential complications and their associated CT findings.

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Conflicts of interest

There are no conflicts of interest.

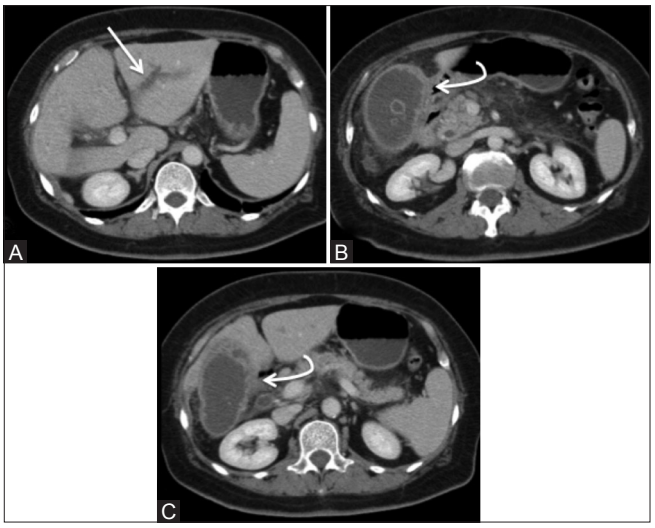

Figure 13 (A-C): Axial CT images. Portal vein thrombosis secondary to AC. Thrombosis of the left portal vein (*straight arrow*) associated with a distended gallbladder with thickened walls (*curved arrows*)

References

1. Stinton LM, Shaffer EA. Epidemiology of gallbladder disease: Cholelithiasis and cancer. Gut Liver 2012;6:172-87.
2. Unisa S, Jagannath P, Dhir V, Khandelwal C, Sarangi L, Roy TK. Population-based study to estimate prevalence and determine risk factors of gallbladder diseases in the rural gangetic basin of North India. HPB 2011;13:117-25.
3. Aerts R, Penninckx F. The burden of gallstone disease in Europe. Aliment Pharmacol Ther 2003;18:49-53.
4. Csikesz N, Ricciardi R, Tseng JF, Shah SA. Current status of surgical management of acute cholecystitis in the United States. World J Surg 2008;32:2230-6.
5. Shakespear J, Shaaban A, Rezvani M. CT findings of acute cholecystitis and its complications. AJR Am J Roentgenol 2010;194:1523-9.
6. Bennett G, Balthazar E. Ultrasound and CT evaluation of emergent gallbladder pathology. Radiol Clin North Am 2003;41:1203-16.
7. Pickhardt P, Bhalla S, Balfe D. Acquired gastrointestinal fistulas: Classification, etiologies, and imaging evaluation. Radiology 2002;224:9-23.
8. Singh A, Shirkhoda A, Lal N, Sagar P. Bouveret's syndrome: Appearance on CT and upper gastrointestinal radiography before and after stone obturation. AJR Am J Roentgenol 2003;181:828-30.
9. Jenkins M, Golding RH, Cooperberg PL. Sonography and computed tomography of hemorrhagic cholecystitis. AJR Am J Roentgenol 1983;140:1197-8.
10. Grayson D, Abbott R, Levy A, Sherman P. Emphysematous infections of the abdomen and pelvis: A pictorial review. Radiographics 2002;22:543-61.
11. Choi SH, Lee JM, Lee KH, Kim SH, Kim YJ, An SK, *et al*. Relationship between various patterns of transient increased hepatic attenuation on CT and portal vein thrombosis related to acute cholecystitis. AJR Am J Roentgenol 2004;183:437-42.