Original Research Article

Correlation of MDCT imaging findings with intraoperative findings following acute cholecystitis

Rakesh Dharmarajan[1], Adarsh K M[2*]

[1]Postgraduate, [2]Assistant Professor, Department of Radiodiagnosis, Yenepoya Medical college, Mangalore, Karnataka, INDIA.
Email: adiarticles@gmail.com rakeshdrajan@gmail.com

Abstract

Background: The purpose of our study was to describe the CT findings of acute cholecystitis and correlate with intra-operative findings. **Material and methodology:** retrospective study was undertaken for patients who were referred for CT abdomen with features of cholecystitis, over a period of six months. CT abdomen was performed using a 16 slice GE bright speed MDCT and characteristic findings of gallbladder, and associated complications were observed. **Results:** highest sensitivity and specificity were pericholecystic effusion, gallbladder wall thickness of 7 mm or more, and local or widespread absence of gallbladder wall enhancement. Absence of gallbladder wall enhancement on the preoperative CT image was accurately associated with the presence of intraoperatively identified and pathologically confirmed gangrenous acute cholecystitis **Conclusion:** While diagnosing acute cholecystitis CT can be useful. CT findings for acute cholecystitis commonly include wall thickening, pericholecystic stranding, high-attenuation bile, pericholecystic fluid, distention and subserosal edema. With the presence of these findings, diagnosis of acute cholecystitis can be suggested.
Key Word: Radiology, MDCT, Gastrointestinal, Acute cholecystitis

***Address for Correspondence:**
Dr. Adarsh K. M. Assistant Professor, Department of Radiodiagnosis, Yenepoya Medical College, Deralakatte, Mangalore, Karnataka, 575018, INDIA.
Email: adiarticles@gmail.com rakeshdrajan@gmail.com
Received Date: 07/01/2019 Revised Date: 01/02/2019 Accepted Date: 16/02/2019
DOI: https://doi.org/10.26611/1013923

Access this article online	
Quick Response Code:	Website: www.medpulse.in
	Accessed Date: 18 February 2019

INTRODUCTION

Acute cholecystitis is an acute inflammatory condition of the gallbladder; acute cholecystitis is mainly due to an obstructing calculus in the neck of gallbladder or cystic duct in 95% of cases.[1] Gallbladder overdistension and increase in intraluminal pressure are results of Obstruction of the cystic duct. This increased pressure, along with cholesterol bile, triggers an acute inflammatory response. Inflammatory response by stimulating prostaglandins I2 and E2 are mainly contributed by Gallstones.[2] Secondary bacterial infection is present in 20% of cases of acute cholecystitis. Mural ischaemia resulting from the increased intraluminal pressure may also contribute to complications such as gangrenous cholecystitis and perforation.[3]

There are three stages of inflammatory disease: (a) oedematous cholecystitis; (b) necrotising cholecystitis; and (c) suppurative cholecystitis.[1]There is wide availability of computed tomography (CT) scanners in emergency departments, leading to increasing numbers of patients undergoing CT examinations for suspected acute cholecystitis. Patients clinically suspected of having acute cholecystitis ultrasonography (US) is the most common diagnostic method of choice[4,5], it is common practice in France for patients with acute abdominal pain and tenderness to undergo contrast material–enhanced computed tomography (CT) during the initial work-up. According to the Tokyo Guidelines CT has been validated as use in the diagnosis of acute cholecystitis[6].

Anatomy of Gallbladder: Gallbladder is a pear-shaped sac measuring up to 10 cm long and 3 cm diameter and hangs down from inferior surface of liver (fig 1). Thickness of gallbladder wall measures < 4 mm. Cystic

How to cite this article: Rakesh Dharmarajan, Adarsh K M. Correlation of MDCT imaging findings with intraoperative findings following acute cholecystitis. *MedPulse – International Journal of Radiology*. February 2019; 9(2): 46-50.
http://www.medpulse.in/Radio%20Diagnosis/

duct arises from neck and runs along liver surface to the porta hepatis. Gallbladder neck and cystic duct have a spiral appearance to folds in the mucosa, it is covered by peritoneum on fundus and inferior surface; and occasionally hangs on its own mesentery.

Biliary tree: Segmental biliary ducts unite to form left and right hepatic ducts, which unite to form the common hepatic duct (CHD) at the porta hepatis; in two-thirds of individuals, the CHD passes anterior to the right hepatic artery.

The CHD is joined by the cystic duct at a variable position (usually 3.5 cm) to form the CBD.

Divisions and relations of the CBD:

- Upper – above the duodenum within the lesser omentum, anterior to the portal vein and to the right of the hepatic artery
- Middle – posterior to the first part of the duodenum with the gastroduodenal artery, sloping away to the right from the portal vein; immediately anterior to the IVC
- Lower – grooves the posterior aspect of the pancreatic head, anterior to the right renal vein; joined by the main pancreatic duct at the ampulla of Vater, opening into the posteromedial wall of the second part of the duodenum.

Diameter of CBD is variable:

- Up to 5 mm till age of 50 years then 1 mm/decade after that age
- Larger in post-cholecystectomy patient (up to 10 mm)

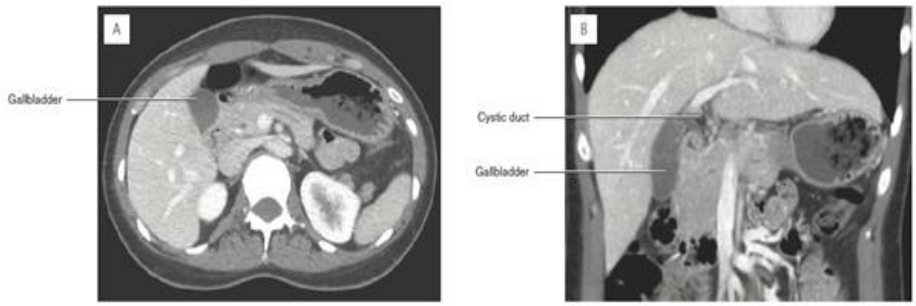


Figure 1: The appearance of the gallbladder on CT. (A) Axial and (B) coronal CT images.

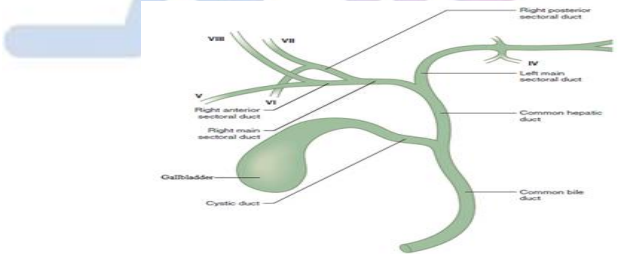


Figure 2: Segmental biliary drainage of the liver.

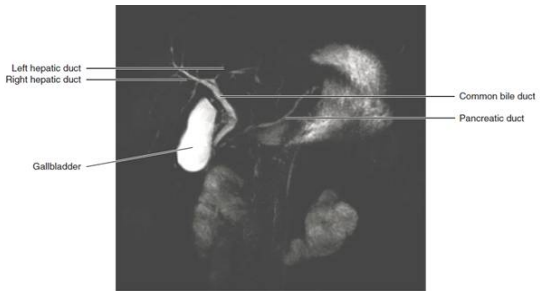


Figure 3: Normal MRCP. Highly T2-weighted MR sequence which shows fl uid within the pancreaticobiliary system.

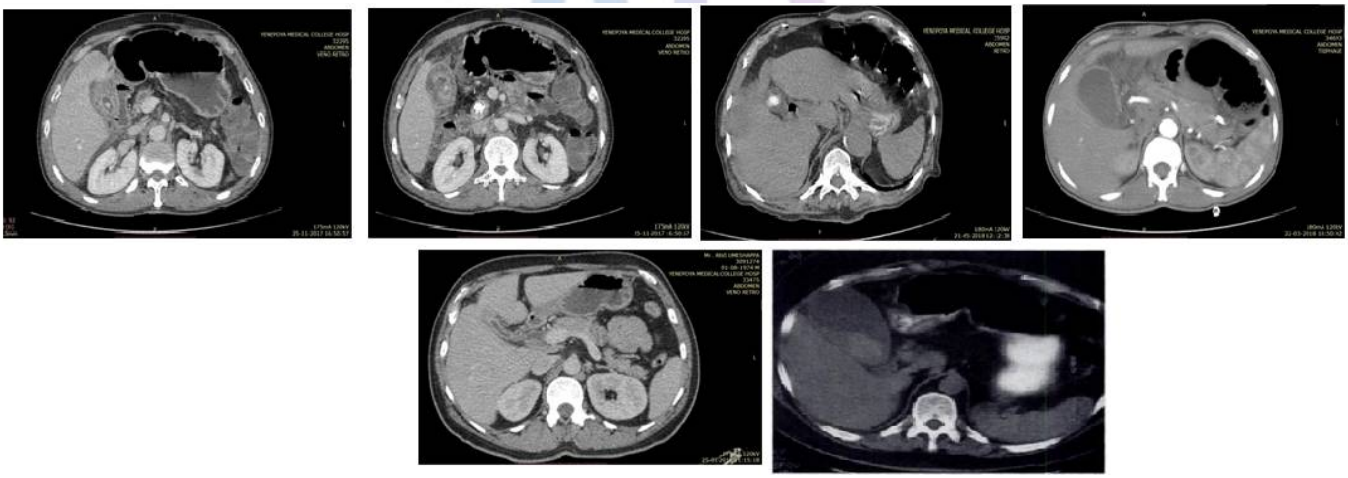
Acute cholecystitis pathophysiology: Acute cholecystitis is mostly associated with gallstones (90–95%). In Western societies It is estimated that approximately 10–20% of people have cholelithiasis and out of that one third of those with gallstones usually develop cholecystitis[7]. Mechanism is transient or persistent gallbladder outlet obstruction due

to calculus, which leads to cholestasis and subsequent mechanical, chemical, or infectious irritation of the gallbladder wall. Bile breakdown products (lysolecithin), prostaglandins, bacterial infection (present in 40–70%), and mechanical erosion from calculus are thought to be key factors in mucosal irritation.

CT Findings in Acute Cholecystitis: CT findings in acute cholecystitis include distention of gallbladder, wall thickening, hyperenhancement of mucosa, pericholecystic fat stranding or fluid, and gallstones with a sufficient attenuation difference from bile to be visualized (about 65–75%). A mixed cholesterol or pigment stones have similar attenuation to bile and are not identified by standard CT kilovoltage settings[8-11]. Reactive hyperaemia resulting in increased enhancement of the hepatic parenchyma of the gallbladder fossa may also be present (CT rim sign). The gallbladder is considered distended if it measures greater than 5 cm in the short axis and greater than 8 cm in length. Wall thickening was defined at greater than 4 mm in a non-collapsed gallbladder (short axis greater than 2 cm)[9]. Diffuse gallbladder wall thickening is a nonspecific finding that is associated with a wide variety of disease states including hypoalbuminemia, ascites, chronic cholecystitis, hepatitis, and unrelated inflammatory processes elsewhere in the abdomen (such as pancreatitis)[12,13].

METHODOLOGY

We had reviewed hospital discharge records of the past one year period to identify patients with a discharge diagnosis of acute cholecystitis. This list of patients was cross-referenced with radiology files to identify patients who had CECT scans before cholecystectomy. All of these patients had subsequent pathologic documentation of acute cholecystitis. All CT scans were performed using 16 slice GE bright speed MDCT and all of the patients had received IV contrast material. The CT scans were reviewed by two other abdominal imagers in consensus for the presence of gallstones, gallbladder size, bile attenuation, gallbladder wall thickening, pericholecystic fluid, subserosal edema, pericholecystic stranding, gas within the lumen or wall of the gallbladder, and sloughed membranes. Patients with other diagnoses, such as acute diverticulitis of the right sided colon or acute appendicitis, were excluded.



Legend

Figure 4: Axial MDCT of the abdomen shows Gall bladder calculus with wall thickening, **Figure 5:** Axial MDCT of the abdomen shows Gall bladder wall thickening with calculus and pericholecystic fluid, **Figure 6:** Axial CT of the abdomen shows Gall bladder calculus. **Figure 7:** Axial MDCT of the abdomen shows overdistended gall bladder with wall enhancement. **Figure 8:** Axial MDCT of the abdomen shows contracted Gall bladder. **Figure 9:** 37 year-old man with hemorrhagic cholecystitis. CT scan shows high-attenuation bile.

RESULTS

Our study included 54 patients with MDCT imaging before their initial surgical procedure who had surgically proved acute cholecystitis. The MDCT images of each case were examined and each feature was tabulated. Approximately 4 out of 5 were male patients, forming approximately 81% of the cases. Of the total cases, 3 out of 4 were within the age range of 20 to 39 yrs of age (75%) while the remaining were of age 40 and above. In the 54 patients we had examined according to the MDCT findings we had given 31 patients with distended gall bladder, 22 with thick gall bladder wall. 15 patients of the 54 had absent wall enhancement of the gall bladder; 25 patients had calculus within the gall bladder infundibulum. 15 patients where to have pericholicystic fluid and 8 had pericholicystic abscess. Intraoperative findings of these 54 patients showed that 39 patients distended gall bladder. Six of the patients were found to have gangrenous gall bladder. 19

patients had calculus within the gall bladder infundibulum in contrast to the 25 we had given on MDCT. 11 patients where to have pericholicystic fluid and 4 had pericholicystic abscess. 50 of the 54 patients had pericholecystic adhesions and 18 had intra-abdominal adhesions.

Association between CT Criteria and Acute Cholecystitis: Radiological criteria with highest sensitivity and specificity were pericholecystic effusion, gallbladder wall thickness of 7 mm or more, and local or widespread absence of gallbladder wall enhancement (Table 3). Local or widespread absence of gallbladder wall enhancement on the preoperative CT image was accurately associated with the presence of intraoperatively identified and pathologically confirmed gangrenous acute cholecystitis (sensitivity of 83% [5 of 6 patients]; negative predictive value, 97% [38 of 39 patients]).

Table 1: Intraoperative findings of 54 patients with acute cholecystitis

Intraoperative Findings	Number Of Patients
Distanded gallbladder >8cm	39
Contracted gall bladder <3cm	1
Gangrenous cholecystitis	6
Gallbladder stone in the infundibulum	19
Pericholecystic effusion	11
Intraabdominal adhesions	18
Pericholecystic adhesions	50
Pericholecystic abscess	4

Table 2: CT findings of 54 patients with acute cholecystitis

Ct Findings	Total Patients	True Positive	True Negative
Distanded Gallbladder >8cm	31	24	8
Thick Gallbladder Wall ≥ 7mm*	22	8	30
Absent Gallbladder Wall Enhancement	15	5	38
Gallbladder Stone In The Infundibulum	25	13	23
Pericholecystic Effusion	15	10	38
Pericholecystic Abscess	8	3	45

* Gallbladder wall thickness at CT was compared with a pathologic measurement of the gallbladder wall specimen.
† Absence of gallbladder wall enhancement was evaluated after intravenous administration of contrast agent.

Table 3: CT findings of 54 patients with acute cholecystitis

Ct Findings	Sensitivity %	Specificity %	Positive Predictive Value %	Negative Predictive Value %
Distanded gallbladder >8cm	61 (24/39)	53 (8/15)	77 (24/31)	34 (8/23)
Thick gallbladder wall ≥ 7mm*	80 (8/10)	68 (30/44)	36 (8/22)	93 (30/32)
Absent gallbladder wall enhancement	83 (5/6)	88 (38/43)	33 (5/15)	97 (38/39)
Gallbladder stone in the infundibulum	68 (13/19)	65 (23/35)	52 (13/25)	79 (23/29)
Pericholecystic effusion	90 (10/11)	88 (38/43)	66 (10/15)	97 (38/39)
Pericholecystic abscess	75 (3/4)	90 (45/50)	37 (3/8)	97 (45/46)

Data in parentheses are numerators and denominators. * Gallbladder wall thickness at CT was compared with a pathologic measurement of the gallbladder wall specimen. † Absence of gallbladder wall enhancement was evaluated after intravenous administration of contrast agent.

DISCUSSION

In a study conducted by Morris *et al* he had reported 17 patients had developed gallbladder perforation in association with emphysematous cholecystitis, gangrenous acute cholecystitis, or both [14]. The MDCT features of these patients included mainly poor definition and irregularity of the gallbladder wall with or without a defect [15]. One patient in our study had a disrupted gallbladder wall and pericholecystic abscess. However, 6 of the 11 non selected patients who were diagnosed with severe acute cholecystitis had gallbladder perforation.

CONCLUSIONS

While diagnosing acute cholecystitis, CT can be useful. CT findings for acute cholecystitis commonly include wall thickening, pericholecystic stranding, high-attenuation bile, pericholecystic fluid, distention and subserosal edema. With the presence of these findings, diagnosis of

acute cholecystitis can be suggested. Widespread absence of gallbladder wall enhancement on CT image can be associated with gangrenous acute cholecystitis.

REFERENCES

1. Kimura Y, Takada T, Kawarada Y, *et al*. Definitions, pathophysiology, and epidemiology of acute cholangitis and cholecystitis: Tokyo Guidelines. J Hepatobiliary Pancreat Surg 2007; 14:15-26.
2. Indar AA, Beckingham IJ. Acute cholecystitis. BMJ 2002; 325:639-43.
3. Byrne JJ, Berger RL. The pathogenesis of acute cholecystitis. Arch Surg 1960; 81:812-6.
4. Hirota M, Takada T, Kawarada Y, *et al*. Diagnostic criteria and severity assessment of acute cholecystitis: Tokyo guidelines. J Hepatobiliary Pancreat Surg 2007;14(1):78–82.
5. Stoker J, van Randen A, Laméris W, Boermeester MA. Imaging patients with acute abdominal pain. Radiology 2009;253(1):31–46.
6. Alponat A, Kum CK, Koh BC, Rajnakova A, Goh PM. Predictive factors for conversion of laparoscopic cholecystectomy. World J Surg 1997;21(6):629–633.
7. Laing FC. The gallbladder and bile ducts. In: Rumack CM, Wilson SR, Charboneau JW, eds. Diagnostic ultrasound, 2nd ed., vol. 1. St Louis, MO: Mosby Year Book, 1998:175–223
8. Paulson EK. Acute cholecystitis: CT findings. Semin Ultrasound CT MR 2000; 21:56–63
9. Fidler J, Paulson EK, Layfield L. CT evaluation of acute cholecystitis: findings and usefulness in diagnosis. AJR 1996; 166:1085–1088
10. Barakos JA, Ralls PW, Lapin SA, *et al*. Cholelithiasis: evaluation with CT. Radiology 1987; 162:415–418
11. Chan WC, Joe BN, Coakley FV, *et al*. Gallstone detection at CT in vitro: effect of peak voltage setting. Radiology 2006; 241:546–553
12. Cooperberg PL, Gibney RG. Imaging of the gallbladder: 1987. Radiology 1987; 163:605–613
13. Shlaer WJ, Leopold GR, Scheible FW. Sonography of the thickened gallbladder wall: a nonspecific finding. AJR 1981; 136:337–339
14. Morris BS, Balpande PR, Morani AC, Chaudhary RK, Maheshwari M, Raut AA. The CT appearances of gallbladder perforation. Br J Radiol 2007; 80(959):898–901.
15. Pedrosa CS, Casanova R, Rodríguez R. CT findings in subacute perforation of the gallbladder: report on 5 cases. Eur J Radiol 1981;1(2):137–142.

Source of Support: None Declared
Conflict of Interest: None Declared