Computed Tomography Signs in Acute Cholecystitis

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ABSTRACT

Background: Acute cholecystitis remains to be a frequent presentation in emergency rooms worldwide. Role of ultrasound in evaluation of acute cholecystitis is well established however, Computed Tomography (CT) is still under evaluated as a diagnostic modality for detection of acute cholecystitis. In this work we describe frequencies of various CT signs in pathologically proven cases of cholecystitis.

Methods: Retrospective review of CT images of 120 patients with cholecystitis for identifying signs of cholecystitis and their relative frequencies.

Results: Pericholecystic inflammatory changes with or without fluid collection was the most common CT sign followed in order by; gall bladder distention, wall thickening, mucosal enhancement, visualization of calculi, tensile fundus sign and reactive hepatic hyperemia.

Conclusion: An understanding of CT signs in diagnosis of cholecystitis will help improve the diagnostic confidence as well as ensure prompt diagnosis of cholecystitis.

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1. Introduction:

Acute cholecystitis is a frequent presentation to emergency rooms worldwide. Approximately 6 – 11 % of patients with symptomatic gall stones eventually develop acute cholecystitis (Friedman, 1993). It can occur both as a result of gall stone disease (calculous cholecystitis) and in its absence, especially in debilitated chronically ill patients (acute a calculous cholecystitis) (Stinton, & Shaffer, 2012).

Ultrasound has established role as imaging modality in diagnosis of acute cholecystitis with additional benefits of being cheap, reliable, portable and readily available (Pinto et al., 2013). However, Computed Tomography (CT) becomes especially useful in patients who have atypical presentation and need work up for differential diagnoses like pancreatitis, intra-abdominal abscesses or ischemic bowel disease (Chawla et al., 2015). Although, previous literature establishing role of CT in acute cholecystitis are available from as back as 1983, its efficacy as primary diagnostic modality is still not ascertained (Kane et al., 1983). CT is however particularly helpful in detecting complications of cholecystitis like perforation, emphysematous or gangrenous cholecystitis, hemorrhage & gall stone ileus (Table 1). It is also not limited by constraints of ultrasound like obesity, gaseous distention and operator dependency. In the current work, authors try to determine accuracy of different CT signs in diagnosis of acute cholecystitis.

Typical CT findings in acute cholecystitis usually include gallbladder distention, increased wall thickening, mucosal hyper enhancement, pericholecystic fat stranding or fluid, reactive hyperemia, tensile fundus sign and visualization of gallstones that have sufficient attenuation difference from bile.(Shakespear et al., 2010; Leschka et al., 2005; Yamashita et al., 1995; An et al., 2013)

Table 1: *Summary of CT findings in acute cholecystitis & associated complications (Chawla et al., 2015).*

Diagnosis	CT findings
Acute Cholecystitis	Visualization of calculus, thickened (> 3 mm) and enhancing wall, Pericholecystic fat stranding ± fluid, reactive hepatic hyperemia

Gangrenous Cholecystitis	Non enhancing wall, sloughed membranes, mural striations, irregular enhancing wall with defect, presence of calculi, Pericholecystic inflammation
Emphysematous cholecystitis	Similar to acute cholecystitis with additional findings of gas in gall bladder wall.
Perforated cholecystitis	Similar findings to acute cholecystitis with focal defect in wall, pericholecystic or hepatic abscess formation.
Gall stone ileus	Small bowel obstruction with gall stone at site of transition, intraluminal gas in gall bladder and pneumobilia.
Cholecystoenteric fistula	Cholelithiasis with pericholecystic inflammatory changes, contracted gall bladder with intraluminal gas, a loop of bowel inseparable from gall bladder.
Mirizzi syndrome	Dilated intrahepatic biliary channels with normal caliber of common bile duct, large calculus in neck of gallbladder or cystic duct with surrounding inflammation.

2. Materials and Methods:

An exemption from formal ethical review was obtained from institutional ethical review committee of Aga Khan University. Retrospective data of patients who were diagnosed to have acute cholecystitis on CT performed in our department from 2008 – 2015 was included in study. Reference standard for included patients was confirmation of cholecystitis on histopathology. Patients for whom final pathological diagnosis was not available were excluded from study.

All CT images of included subjects were obtained using two MDCT scanners (Aquilon One & Aquilon 64 from Toshiba Healthcare systems). Contrast-enhanced images were acquired during short breath-holds, starting 65 seconds after the IV administration of 2 mL/kg of nonionic iodinated contrast material injected at a rate of 2.5–2.8 mL/s via power injector. The same CT parameters were used for both CT scanners, as follows: slice thickness, 5 mm; tube voltage, 120 kVp; and tube current–exposure time product, 80-700 mAs in conjunction with dose modulation techniques. All images, including coronal multiplanar reformatted images were reviewed on "Zillion" Picture Archiving and Communication systems (PACS) by Rogan-Delft, The Netherlands.

CT signs for acute cholecystitis for purpose of this study were defined as follows; gall bladder distention was considered positive if the gall bladder measured more than 8 cm in long axis. Wall thickening was defined as more than 0.3 cm in non-collapsed gall bladder. Reactive hyperemia was presence of increased enhancement of the hepatic parenchyma adjacent to gall bladder fossa, visualized in dedicated liver window. Tensile fundus sign was considered positive when there was absence of flattening of the gall bladder fundus by contact with anterior abdominal wall. Stranding of adjacent mesenteric fat or visualization of fluid were both taken as positive pericholecystic inflammatory changes.

The sample size for this study was calculated using sample size calculator by Lin Niang. According to previously reported literature, the expected sensitivity was taken to be 0.92 and expected prevalence taken as 40 % (Average value from worldwide reported incidence of 22 – 62 %) (Stinton, & Shaffer, 2012; Shakespear et al., 2010). Keeping the desired precision at 0.08 and confidence interval of 0.95, a sample size of 113 was obtained. In order to attain a rounded off value, 120 patients were included in study. Results were abstracted in a standardized Excel sheet and analyzed using Statistical package for social sciences (SPSS) version 19 software.

3. Results:

In total 120 patients were included in this study with ages ranging from 15 – 87 years. Most common presenting complains were abdominal pain (88.3%) followed by nausea & vomiting (32.5%). Lab workup showed leukocytosis (total leukocyte count more than 11 x 109/L) in 69.1 % of patients.

Pericholecystic inflammatory changes was most commonly observed of CT signs and identified in 88.3%. This was followed in order by gall bladder distention (87.5%), wall thickening (78.3%), enhancement of gall bladder mucosa (77.5 %), visualization of gall stones (60.8%), tensile gall bladder fundus (40.8%) and reactive hyperemia (39.1%) (Figure 1). Most commonly encountered complication was perforation and abscess formation.

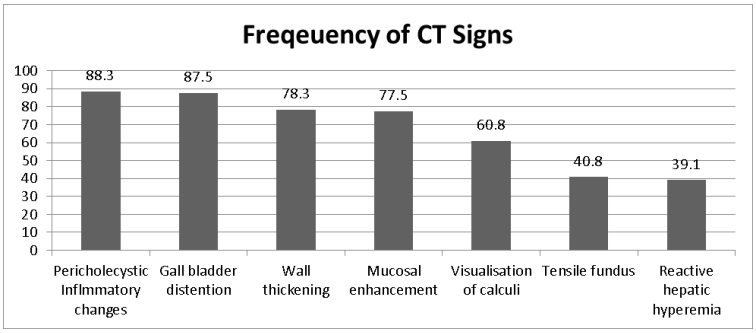

Figure 1. Frequency of various CT signs in detection of acute cholecystitis.

4. Discussion:

Imaging modalities form an integral part for evaluation of abdominal pain, including acute

cholecystitis. Though the role of certain imaging modalities like Cholescintigraphy and ultrasound have been quite well established in literature with sensitivities reaching up to 94% and 82% respectively, CT remains to be under evaluated as modality for imaging in suspected cases of acute cholecystitis (Kiewiet et al., 2012).

Though acute cholecystitis has been reported in pediatric population as well, most of the patients in our study were adults. This is primarily because of judicious use of ultrasound in evaluation of pediatric abdominal pain in order to decrease radiation exposure (Siddiqui et al., 2014).

In our study Pericholecystic inflammatory changes were most common CT findings. This was in agreement with results from the experienced observer in study by An et al., (2013). The tensile fundus sign which was the next significant observations in results by An et al. was not as commonly seen in results of this study, however its addition proved useful in improving the overall diagnostic ability of CT.

Gall bladder distention, increased wall thickness and mucosal hyper enhancement followed in order after pericholecystic inflammatory changes, similar to signs previously reported in published literature (Shakespear et al., 2010; An et al., 2013)

Least common finding in this study was reactive hyperemia of liver parenchyma (Yamashita et al., 1995), despite the fact that this was assessed on dedicated liver window which is not available when interpreting examination on hard films instead of PACS workstation. This observation was in agreement with previous literature as well, suggesting that there is little importance of reactive hepatic hyperemia in diagnosis of acute cholecystitis (An et al., 2013).

CT scanning however is widely accepted as modality of choice in evaluating complications of cholecystitis such as gangrenous & emphysematous cholecystitis, gall bladder perforation, abscess formation and gall stone ileus (Table: 1). Perforation with abscess formation was also seen in some of cases included in this work.

Although CT as yet does not surpass the established diagnostic abilities of ultrasound in diagnosis of acute cholecystitis,(Pinto et al., 2013; Kiewiet et al., 2012), a detailed understanding of its signs is essential for improving confidence of both radiologists as well as referring physicians in use of this modality.

This study was not without limitations; prime limitation being that this work is a retrospective review with all cases being already diagnosed on histopathology, hence false positives findings of CT could not be ascertained. Further work in this relatively unexplored arena may help in better understanding of CT as imaging modality for acute cholecystitis.

5. Conclusion

CT remains to be an important diagnostic tool in evaluation of abdominal pain. An understanding of CT signs in diagnosis of acute cholecystitis will help improve the diagnostic confidence as well as ensure prompt diagnosis of acute cholecystitis.

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Author's contributions

SS along with MAS and AAA conceived the idea. RS, AS, MSK worked on data collection and abstraction. Final manuscript was written by SS and reviewed by MAS.

Conflicts of Interest:

The authors unanimously declare that this work does not involve any conflicting interests.

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References:

1. An, C., Park, S., Ko, S., Park, M. S., Kim, M. J., & Kim, K. W. (2013). Usefulness of the tensile gallbladder fundus sign in the diagnosis of early acute cholecystitis. *American Journal of Roentgenology*, *201*(2), 340-346.
2. Chawla, A., Bosco, J. I., Lim, T. C., Srinivasan, S., Teh, H. S., & Shenoy, J. N. (2015). Imaging of acute cholecystitis and cholecystitis-associated complications in the emergency setting. *Singapore medical journal*, *56*(8), 438.
3. Friedman, G. D. (1993). Natural history of asymptomatic and symptomatic gallstones. *The American journal of surgery*, *165*(4), 399-404.
4. Kane, R. A., Costello, P., & Duszlak, E. (1983). Computed tomography in acute cholecystitis: new observations. *American journal of roentgenology*, *141*(4), 697-701.
5. Kiewiet, J. J., Leeuwenburgh, M. M., Bipat, S., Bossuyt, P. M., Stoker, J., & Boermeester, M. A. (2012). A systematic review and meta-analysis of diagnostic performance of imaging in acute cholecystitis. *Radiology*, *264*(3), 708-720.
6. Leschka, S., Alkadhi, H., Wildermuth, S., & Marincek, B. (2005). Multi-detector computed tomography of acute abdomen. *European radiology*, *15*(12), 2435-2447.
7. Pinto, A., Reginelli, A., Cagini, L., Coppolino, F., Ianora, A. A. S., Bracale, R., ... & Romano, L. (2013). Accuracy of ultrasonography in the diagnosis

of acute calculous cholecystitis: review of the literature. *Critical ultrasound journal*, *5*(1), S11.
8. Shakespear, J. S., Shaaban, A. M., & Rezvani, M. (2010). CT findings of acute cholecystitis and its complications. *American Journal of Roentgenology*, *194*(6), 1523-1529.
9. Siddiqui, E. H., Siddiqui, S., Ayub, R., & Shah, N. (2014). Pediatric Abdominal Pain; Role Of High Frequency Ultrasonography In Its Evaluation. *Professional Medical Journal*, *21*(3).
10. Stinton, L. M., & Shaffer, E. A. (2012). Epidemiology of gallbladder disease: cholelithiasis and cancer. *Gut and liver*, *6*(2), 172.
11. Yamashita, K., Jin, M. J., Hirose, Y., Morikawa, M., Sumioka, H., Itoh, K., & Konish, J. (1995). CT finding of transient focal increased attenuation of the liver adjacent to the gallbladder in acute cholecystitis. *AJR. American journal of roentgenology*, *164*(2), 343-346.

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