# SYSTEMATIC REVIEW AND ANALYSIS OF THE DIAGNOSTIC ACCURACY OF ULTRASOUND VERSUS COMPUTED TOMOGRAPHY IN ACUTE ABDOMINAL PAIN

**Javed Taquir[1], Noraze Ali[2], Tauqir Ahmad[3], Syed Amir Gilani[4]**

**Abstract:** The cases coming in Hospital's emergency usually belong to acute pain in the abdominal (AAP). The doctors on duty in emergency wards often facing problem to make diagnosis just on basis of the patient's history. The choice of diagnostic (imaging) modality is very important in this scenario to save time and hence, patient's life. This investigation was made to demonstrate the precision of imaging modalities in acute pain of abdomine. **Objective:** To assess the demonstrative precision of ultrasound versus tomograph in intense midriff torment. **Methodology:** A total of 35 articles fulfilling the selection criteria and published between 2002-2014 were included for this systematic review. These articles retrieved from Medline, Embase, Cochrane Library, Cinahl and Google. The search criteria of this study based on eleven imaging modalities. **RESULT:** The investigation was performed on 5042 AAP with age 48.5 ±5 years, 49.5 % females and 51.5 % males. A total of 2054 patients had inflammation of appendix while 1764 and 1224 had inflammation in diverticulum and gallbladder. True positive rate of CT in recognizing an infected appendix was 93% ($p<0.01$) and of diverticulum was 74% ($p = 0.049$) that was altogether higher than that of ultrasound. For cholecystitis, true positive rate of both CT versus US was almost same: 74 % ($p>0.052.00$). Ultrasound true positive rate in recognizing an infected appendix and diverticulum was not appreciably influenced by patient's age/gender and experience of evaluators. **Conclusion:** The computed tomograph misses less than ultrasound the cases of intense midriff torment.

**Key words:** Acute pain of abdomen, ultrasound, computed tomography, cholecystitis, diverticulitis, appendicitis, perforated viscus, acute peritonitis, hernia.

## INTODUCTION

Roughly 5-10 percent of cases coming in Hospital's emergency usually are of acute pain in abdominal and identified with inflammation of appendix, diverticulum and gall bladder other significant, however less common conditions that may cause such acute pain are of perforated abdominal viscera and gut ischemia.[1] The clinical appearances of the ailments for this pain are not usually straightforward. For appropriate treatment, the diagnostic imaging that empower the clinician to make definite diagnosis of the different causes for such pain are decisive.[2] Therefore, the imaging techniques are generally employed as a part of the work-up of these cases.[3] Ultrasound and computed tomograph are both frequently used in health and medical research centers for identification of ailments of these patients. The American College of Radiology (ACR) recommends computed tomograph for diagnosis of such acute pain while other authorities of radiology are supportive of ultrasound as the essential imaging system mostly on the grounds that ultrasound is cost effective and does not introduce ionizing radiations and is ideal than X-beams[4]. Intense

**Article Citation:** Taquir A, Ali N, Ahmad T, Gilani SA, systematic review and analysis of the diagnostic accuracy of ultrasound versus computed tomography in acute abdominal pain. Indep Rev Jan-Jun 2018;20(1-6): 4-9.

**Date received:** 26/03/2018
**Date Accepted:** 08/05/2018

**Correspondence Address:**
**Javed Taquir,**
University Institute of Radiological Sciences and Medical Imaging Technologies
The University of Lahore, Lahore, Pakistan

**Javed Taquir**
University Institute of Radiological Sciences and Medical Imaging Technologies, The University of Lahore, Lahore, Pakistan

**Noraze Ali**
University Institute of Radiological Sciences and Medical Imaging Technologies, The University of Lahore, Lahore, Pakistan

**Tauqir Ahmad**
HOD & Professor of Anatomy
Research Cell (RC) Islam Medical Collage and Hospital, Sialkot

**Syed Amir Gilani**
Faculty of Allied Health Sciences,
The University of Lahore, Lahore, Pakistan

Abdominal Pain can be analyzed on MRI and Conventional Radiograph but however MRI is not accessible in routine hospital's emergency and recommended by ACR suggestions.

Usually researchers choose "Ultrasound or Computed tomograph" in these circumstances to diagnose ailments of AAP.[5,6]

The purpose for the present investigation was to show the near analytic exactness of ultrasonograph and C.T to figure out which one is best modality to decide the most conceivable reason for acute pain in abdomen.[7,8]

## Methods:

Preapproval was obtained from the institutional review board (IRB) and ethical committee.

The 35 articles of of Medline, Embase, Cochrane Library, Cinahl and Google were shortlisted for this study. Acute Abdominal Pain", "Ultrasound", "Computed tomography", "Cholecystitis' Diverticulitis", "Appendicitis", "Perforated viscus", "Acute peritonitis"and "Hernia" phrases were used as keywords for selection of relevant articles. The duration of the selected articles ranged from 2002-2014. Only articles in English language were retrieved. Total 5042 cases were analysed during the present study[9,10].

Eleven imaging modalities were followed in the present study.

The diagnostic protocol of these modalities were

1. Clinical diagnosis;

### Single test strategies

2. Clinical diagnosis after plain skiagrams;
3. Ultrasonograph in all patients ;
4. Computed tomograph in patients; if ultrasonoraph was not helpful;

### Conditional strategies

5. CT, if ultrasonograph was uncertain;
6. CT for patient of age 45 or more years but Ultrasonogragh for patients of age less than 45 years.

### Strategies driven by patients' characteristics

7. C.T. for negative or uncertain Ultrasonograph of patient having age less than 45 years
8. CT for patient of body mass index more or equal[30]. Ultrasonograph for patients having body mass index less than 30, C.T. for negative or uncertain ultrasonograph cases of body mass index less than 30.
9. Ultrasonograph for cases of age less than 45 years. CT for ultrasonograph not helpful or uncertain cases of body mass index less than 30 or age less than 45 years.

### Strategies driven by location of pain

10. Ultrasonograph for cases having tenderness in right cephalic abdominal quadrant but C.T If tenderness is in right caudal abdominal quadrant.
11. C.T for cases having tenderness in left caudal or left cephalic abdominal quadrant and also for diffuse tenderness cases.

Bar chart (Fig.1) is drawn for comparative sensitivity and specificity values of 11 imaging methodologies.

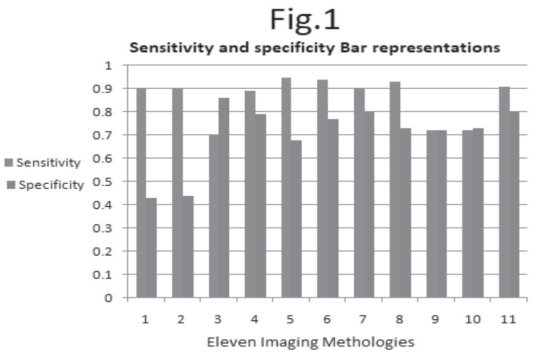


Fig-I.

## RESULT:

Out of 5042, 3731 (74%) cases had been assessed by surgical trainees and 1311 (26%) cases by a radiological trainee.

Urgent and non-urgent cases of this study (Table.1.) indicated:

- The highest cases were of an infected appendix and second serious diverticulitis.
- Total dire cases were 3445 (68%) and Total non-critical diagnoses1597 (32%).
- A high true positive rate and deficient true negative rate for critical cases was found by the C.T with or without ultrasound.
- The 5 percent increase in true positive rate and 5 percent decrease of true negative cases occur, when changing from a general to a conditional computed tomograph methodology.
- The statistical significance value of relative urgent cases of appendicitis was (P = 0.008).
- The utilization of ultrasound scan in cases matched with the clinical analysis decreased the numbers of fake positive critical determinations.
- The estimations of ultrasound versus computed tomograph indicated that computed tomograph as a superior lonely test (computed tomograph procedure) for the identification of critical conditions than Ultrasound scan as the affectability was fundamentally higher for computed tomograph (90%) than for ultrasound scan (70 %, P lesser than 0.001).[21, 22]

**Table .1. Diagnosis in 5042 Cases**

| Urgent cases | | | |
|---|---|---|---|
| Diagnosis | Patients Number (%) | Diagnosis | Patients number (%) |
| Acute appendicitis | 1465 (29) | Acute diverticulitis | 655 (13) |
| Bowel obstruction | 405 (8) | Acute cholecystitis | 255 (5) |
| Acute pancreatitis | 200 (4) | Gynaecological diseases | 150 (3) |
| Urological diseases | 50 (1) | Perforated viscus | 50 (1) |
| Abscess | 50 (1) | Pneumonia | 50 (1) |
| Bowel ischaemia | 50 (1) | Acute peritonitis | 15 (0.3) |
| Retroperitoneal or abdominal wall bleeding | 50 (1) | | |
| Total urgent cases | 3445 (68%) | | |
| Non-urgent cases | | | |
| Non-specific abdominal pain | 860 (17) | Gastrointestinal diseases | 200 (4) |
| Hepatic, pancreatic, and biliary diseases | 150 (3) | Inflammatory bowel disease | 150 (3) |
| Urological diseases | 100 (2) | Gynaecological diseases | 50 (1) |
| Malignancy | 25 (0.5) | Hernia | 12 (0.2) |
| Other | 50 (1) | | |
| Total non-urgent diagnoses 1597 (32%) | | | |

## DISCUSSION

The true positive rate i.e sensitivity and a high affectability of abdominal pain indicate critical conditions, which are essential to treat or operate such cases promptly to save their lives. False positive cases of critical condition, if determine in time, it helps to avoid over-treatment.[31,32] This investigational study indicate that the Clinical analysis or Ultrasonograph alone overlook number of cases of high sensitivity & affectability so it is not possible to decide the accurate diagnosis on basis of them alone.[33,34] However Computed tomograph limits these ignored cases of high sensitivity & affectability. "Roughly the 5 percent increase in true positive rate and 5 percent decrease of true negative cases is also seen, when changing from a general to a conditional computed tomograph methodology.[35] These discoveries assessed by present study match imaging research work performed by a number analysts like Broder et.al Emergency radiology. 2006) 4; Dhillon et.al. (ClinRadiol 2002)[34]

There were a few potential impediments of 11 imaging modalities like "the research outline only after its full analytic findings in all selected cases; and management of cases depend on the finding of each and every 11 imaging methodologies.[19,20] Most cases were referred to the outdoor by medical practioners, were sent back from outdoor without imaging & this brought about a moderately high slipping of cases of critical condition.[21,22] It is a generally accepted fact the precision of investigation relies upon evaluator's understanding and experience. Trainee in surgery and radiology mostly involved in this present investigational research did not account this factor.[23,24]

## Conclusion:

The C.T. misses less than ultrasound the cases of intense midriff, however both ultrasound and computed tomograph can dependably identify similar ailments causing intense midriff torment. Ultrasound true positive rate was not appreciably influenced by patient's age/gender and experience of evaluator.

## REFERENCES


1. Saito JM, Yan Y, Evashwick T, Warner BW,Tarr PI. Use and accuracy of diagnostic imaging by hospital type in pediatric appendicitis. Pediatrics. 2013; 131(1). : 123-125.

2. Raval MV, Deans KJ, Rangel SJ, Kelleher KJ, Moss RL. Factors associated with imaging modality choice in children with appendicitis. J Surg Res. 2012;177(1):131–136.

3. Smith-Bindman R, Miglioretti DL, Johnson. Use of diagnostic imaging studies and associated radiation exposure for patients enrolled in large integrated health care systems, 1996-2010. JAMA. 2012;307(22): 2400–2409.

4. Broder J, Warshauer DM. Increasing utilization of computed tomography in the adult emergency department, 2000–2005. Emergency radiology. 2006 Sep 1;13(1):25-30. 17.

5. Johnson AK, Filippi CG, Andrews T. Ultrafast 3-T MRI in the evaluation of children with acute lower abdominal pain for the detection of appendicitis. AJR Am J Roentgenol. 2012; 198(6):1424–1430.

6. Mitka M. Costly surge in diagnostic imaging spurs debate. Jama. 2005 Feb 9;293(6):665-7.

7. Moore MM, Gustas CN, Choudhary AK, MRI for clinically suspected pediatric appendicitis. PediatrRadiol.2012;42(9):1056–1063.21.

8. Fahimi J, Herring A, Harries A, Gonzales R, Alter H. Computed tomography use among children presenting to emergency departments with abdominal pain. Pediatrics.2012;130(5): 116-26.

9. Pearce MS, Salotti JA, Little MP. Radiation

exposure from CT scans in childhood and subsequent risk of leukaemia and brain tumours: a retrospective cohort study. Lancet. 2012; 380(9840):499–505.

10. Bachur RG, Hennelly K, Callahan MJ, Chen C, Monuteaux MC. Diagnostic imaging and negative appendectomy rates in children: effects of age and gender. Pediatrics. 2012; 129(5):877–884

11. Thirumoorthi AS, Fefferman NR, Ginsburg HB, Kuenzler KA, Tomita SS. Managing radiation exposure in children—reexamining the role of ultrasound in the diagnosis of appendicitis. J Pediatr Surg. 2012;47(12): 2268–2272. 5.

12. Huunho R, Mege D, Ouaïssi M, Sielezneff I, Sastre B. Incidence and prevention of ventral incisional hernia. J ViscSurg 2012; 149(5 suppl):e3–e14.

13. Taniuchi K, Tanaka H, Iwamura S, Mori I. Meckel's diverticulum preoperatively diagnosed by double-balloon endoscopy. Intern Med. 2012; 51: 1023-1026.

14. Ding Y, Zhou Y, Ji Z, Zhang J, Wang Q. Laparoscopic management of perforated Meckel's diverticulum in adults. Int J Med Sci. 2012; 9: 243-247.

15. Lorenzen AW, O'Dorisio TM, Howe JR. Neuroendocrine tumors arising in Meckel's diverticula: frequency of advanced disease warrants aggressive management. J Gastrointest Surg. 2013; 17: 1084-1091.

16. Petroianu A, Alberti LR. Accuracy of the new radiographic sign of fecal loading in the cecum for differential diagnosis of acute appendicitis in comparison with other inflammatory diseases of right abdomen: a prospective study. J Med Life.2012;5:85-91.

17. Hopkins CL, Madsen T, Foy ZY. Does limiting oral contrast decrease. emergency department length of stay? West J Emerg Med. 2012; 13:383-7.

18. Petroianu A, Alberti LR. Accuracy of the new radiographic sign of fecal loading in the cecum for differential diagnosis of acute appendicitis in comparison with other inflammatory diseases of right abdomen. J Med Life. 2012;5:85-91.

19. Kim K, Kim YH, Kim SY. Low-dose abdominal CT for evaluating suspected appendicitis. N Engl J Med. 2012; 366:1596-605.

20. Spalluto LB, Woodfield CA, DeBenedectis CM, et al. MR imaging evaluation of abdominal pain during pregnancy: appendicitis and other nonobstetric causes. Radiographics. 2012; 32:317-34.

21. Terada T. Diverticulitis of multiple diverticulosis of the terminal ileum. Int J Clin Exp Pathol 2013; 6:521-523.

22. Jump NA, Stat PB, Sunny KL. Liver and Intrahepatic Bile Duct Cancer. NCI. Retrieved 18 June 2014.

23. World Cancer Report 2014. World Health Organization. 2014. pp. Chapter 11 ISBN 9283204298.

24. Pedersen T FM; "[Photodynamic therapy of cholangio carcinomas]. Ugeskrift for laeger 2013; 175 (9): 579–82.

25. Kim K, Kim YH, Kim SY. Low-dose abdominal CT for evaluating suspected. appendicitis. N Engl J Med. 2012;366:1596-605.

26. JB Blum HE; "Locoregional therapy for cholangiocarcinoma." Current opinion in gastroenterology 2013; 29 (3): 324–8.

27. N Gores GJ; "Classification, diagnosis, and management of cholangiocarcinoma." Clinical gastroenterology and hepatology: the official clinical practice journal of the American Gastroenterological Association 2013; 11 (1):13–21.e1; quiz e3–4.

28. Meyers RL, Czauderna P, Otte JB; "Surgical treatment of hepatoblastoma." Pediatric blood & cancer 2012; 59 (5): 800–8.

29. Moak J, Lyons MS, Lindsell CJ. Bedside renal ultrasound in the evaluation of suspected ureterolithiasis. Am J Emerg Med 2012;30:218e21.

30. Pearle MS, Lotan Y. Urinary lithiasis: etiology, epidemiology, and pathogenesis. In: Wein AJ, Kavoussi LR, Novick AC, eds. Campbell-Walsh Urology. 10th edn. Philadelphia: Elsevier

Saunders, 2012:1257e86.

31. Ferrandino MN, Pietrow P, Preminger P. Evaluation and medical management of urinarylithiasis. In: Wein AJ, Kavoussi LR, Novick AC, eds. Campbell-Walsh Urology. 10th edn. Philadelphia: Elsevier Saunders, 2012:1288e332.

32. Matlaga B, Lingeman JE. Surgical management of upper urinary tract calculi. In: Wein AJ, Kavoussi LR, Novick AC, eds. Campbell-Walsh Urology. 10th edn. Philadelphia: Elsevier Saunders, 2012:1359e10.

33. Leeuwenburgh MM, Wiarda BM, Bipat S. Acute appendicitis on abdominal MR images training readers to improve diagnostic accuracy. Radiology 2012;264(2):455–463.

34. Dhillon S, Halligan S, Goh V, Matravers P, Chambers A, Remedios D. The therapeutic impact of abdominal ultrasound in patients with acute abdominal symptoms. Clinical radiology. 2002 Apr 1;57(4):268-71.

35. Laméris W, van Randen A, Dijkgraaf MG, Bossuyt PM, Stoker J, Boermeester MA. Optimization of diagnostic imaging use in patients with acute abdominal pain.