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Comparative analysis of efficacy of US and CT in diagnosis of acute abdomen

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Abstract
Background: Acute abdominal pain is a common chief complaint in patients examined in the emergency department (ED) and can be related to a myriad of diagnoses. Of all patients who present to the ED, 4%–5% have acute abdominal pain. The causes of acute abdominal pain range from life-threatening to benign self-limiting disorders. Acute appendicitis, diverticulitis, cholecystitis, and bowel obstruction are common causes of acute abdominal pain. Other important but less frequent conditions that may cause acute abdominal pain include perforated viscous and bowel ischemia. A confident and accurate diagnosis can be made solely on the basis of medical history, physical examination, and laboratory test findings in only a small proportion of patients. The clinical manifestations of the various causes of acute abdominal pain usually are not straightforward.
Aim of the study: To compare the efficacy of US and CT in diagnosis of acute abdomen.
Materials and methods: The present study was conducted in the Department of Radio-Diagnosis, Rajindra Hospital, Patiala. The ethical clearance for the study was approved from the ethical committee of the hospital. US was performed with Philips Envisor or GE Logiq α-200 with a 3.5mhz sector or curvilinear probes. CT scan was performed with Siemens- Somatom Emotion 6 slice third generation spiral CT. In our study, we consider 60 patients referred to Department of Radio-Diagnosis, Rajindra Hospital, Patiala with clinical suspicion of acute abdomen. All patients were subjected to ultrasound abdomen. Before doing CT, a detailed history was taken and a thorough clinical examination was performed and findings recorded.
Results: Age distribution in our series ranged from 3-83 years. Maximum number of patients were in 41-60 years age group (50.00%). Second highest incidence was in 21-40 years age group (20.00%) followed by 61-80 years age group (16.67%). There were 33 males and 27 females with M:F ratio 1.2:1. Mean age in our study was 45 years. Median was 47 and Mode was 50. 60 (Maximum number) patients presented with abdominal pain (100%). Second most common symptom was vomiting which was seen in 34 patients (56.67%) followed by non-passage of stools in6 patients (10.00%) and abdominal distension in 5 patients (8.33%). MDCT has accuracy of 100% in mesenteric ischaemia, malrotation of gut, GB perforation, Pancreatitis and pseudomembranous colitis. MDCT has accuracy of approximately 98% in diagnosing other mentioned conditions. USG has accuracy of 100% in diagnosing G.B perforation and small bowel obstruction. USG has less efficacy in diagnosing other acute abdominal conditions.
Conclusion: From our study, it can be concluded that MDCT is an effective imaging modality with results that have a positive effect on the management of many patients with acute abdominal pain. CT may then be reserved for patients with non-diagnostic US results. At present, MDCT can be considered the primary imaging technique for patients with acute abdominal pain.

Keywords: CT scan, US exam, acute abdominal pain

Introduction
Acute abdominal pain is a common chief complaint in patients examined in the emergency department (ED) and can be related to a myriad of diagnoses. Of all patients who present to the ED, 4%–5% have acute abdominal pain [1]. Acute abdominal pain is among the three most common symptoms in patients coming to emergency department or being admitted to hospitals [2]. Imaging studies are often requested because an acute abdomen may be caused by a variety of diseases that have very similar clinical features [3]. Obtaining a careful medical history and performing a physical examination are the initial diagnostic steps for these patients. On the basis of the results of this clinical evaluation and laboratory investigations, the clinician will consider imaging examinations to help establish the correct diagnosis [4]. The causes of acute abdominal pain range from life-threatening to benign self

limiting disorders. Acute appendicitis, diverticulitis, cholecystitis, and bowel obstruction are common causes of acute abdominal pain. Other important but less frequent conditions that may cause acute abdominal pain include perforated viscous and bowel ischemia [4].

A confident and accurate diagnosis can be made solely on the basis of medical history, physical examination, and laboratory test findings in only a small proportion of patients. The clinical manifestations of the various causes of acute abdominal pain usually are not straightforward. For proper treatment, a diagnostic work-up that enables the clinician to differentiate between the various causes of acute abdominal pain is important, and imaging plays an important role in this process. Many patients are referred without a clear pretest diagnosis, and imaging is warranted to determine the diagnosis and guide treatment in these patients. According to American College of Radiology (ACR) appropriateness criteria [5] contrast material enhanced CT of the abdomen and pelvis is considered the most appropriate examination for patients with fever, nonlocalized abdominal pain, and no recent surgery. Nonenhanced CT, US, and conventional radiography are considered less appropriate initial imaging examinations for these patients.

US is another imaging modality commonly used in the diagnostic work-up of patients with acute abdominal pain. With US, the abdominal organs and the alimentary tract can be visualized. US is widely available and is easily accessible in the ED. It is important that US is a real-time dynamic examination that can reveal the presence or absence of peristalsis and depict blood flow. Furthermore, it is possible to correlate US findings with the point of maximal tenderness. Wide availability in the ED, lower costs, and absence of radiation exposure are advantages of US, as compared with CT. When radiologists perform US in patients, relevant additional information can be obtained during the examination. For example, US findings may suggest a previously unexpected diagnosis, in which case additional clinical history information becomes important.

Currently, computed tomography plays an important role in the evaluation of patients with acute abdominal pain [6]. CT provides the correct diagnosis, increases the emergency physician's level of certainty, excludes alternative diagnoses, alters management decisions, facilitates more timely surgical intervention, and reduces hospital admission rates [7, 8]. Therefore, CT has replaced other imaging modalities as the investigation of choice in the above mentioned specific clinical indications [8]. Hence, the present study was conducted to compare the efficacy of US and CT in diagnosis of acute abdomen.

Materials and methods

The present study was conducted in the Department of Radio-Diagnosis, Rajindra Hospital, Patiala. The ethical clearance for the study was approved from the ethical committee of the hospital.

US was performed with Philips Envisor or GE Logiq α-200 with a 3.5mhz sector or curvilinear probes.

CT scan was performed with Siemens- Somatom Emotion 6 slice third generation spiral CT.

Contrast material: Non-ionic contrast (e.g. iversol) was used in our study. Contrast was given by peripheral i.v. route and oral route. Continuous monitoring of the vital parameters were be done during contrast injection.

Patient selection

In our study, we consider 60 patients referred to Department of Radio-Diagnosis, Rajindra Hospital, Patiala with clinical suspicion of acute abdomen. All patients were subjected to ultrasound abdomen. Before doing CT, a detailed history was taken and a thorough clinical examination was performed and findings recorded.

Inclusion criteria

- Patients presenting with non –traumatic acute abdomen.

Exclusion critertia

- Traumatic acute abdomen
- Children (<14 yrs.) and Pregnant women.
- Patients developing allergic and toxic reactions to iodinated contrast medium or previous history of allergy to contrast medium.
- Deranged RFT"s (S.Creatinine >1.5).

CT Scan

The details of the procedure were explained to the patient. A female attendant was instructed to be present during the procedure in case of female patients. A written consent was obtained from each patient after explaining the possibility of contrast reaction. Patients were scanned with High Resolution Siemens Somatom Emotion, in the supine position with both arms above the head and 6mm to 8mm sections were obtained. Orally or through Ryle's tube water soluble iodinated contrast (Diatrizoate Meglumine and Diatrizole sodium injection USP) diluted in 700ml to 1000ml of water was given before the CT.

The patient was placed on the gantry table in supine position with both arms above the head, 6mm to 8mm sections were obtained. Contrast scan was obtained by injecting 80ml iodinated contrast at the rate of 2.5ml per second using a pressure injector via 20 G angiocath place in antecubital vein. Patients were scanned in the parenchymal phase which is around 50-60 sec after the start of injection. Images were taken and multiplanar reconstructions were performed wherever applicable. Clinical and imaging findings were recorded as per proforma.

Final Diagnosis

Confirmed on clinical follow-up, biochemical profile, operative findings.

The statistical analysis of the data was done using SPSS version 11.0 for windows. Chi-square and Student's t-test were used for checking the significance of the data. A p-value of 0.05 and lesser was defined to be statistically significant.

Table 1: Distribution of Patients According To Age Group (n=60)

Age group	No. of Patients	Percentage
≤20	7	11.67
21-40	12	20.00
41-60	30	50.00
61-80	10	16.67
>80	1	1.66
Total	60	100

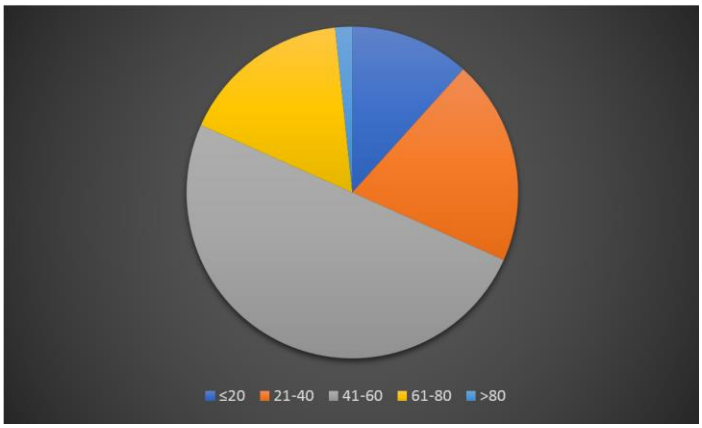

Fig 1: Distribution of patients according to age group

Table 2: Duration of clinical symptoms (n=60)

Duration of Clinical Symptoms (hours)	No. of patients	Percentage
0-24	10	16.67
25-48	23	38.33
49-72	14	23.33
73-96	10	16.67
>96	3	5.00

Table 3: Clinical Symptoms (n=60)

Clinical symptoms	No. of patients	Percentage
Abdominal pain	60	100
Vomiting	34	56.67
Non passage of stools	6	10.00
Abdominal distension	5	8.33
Others	3	5.00

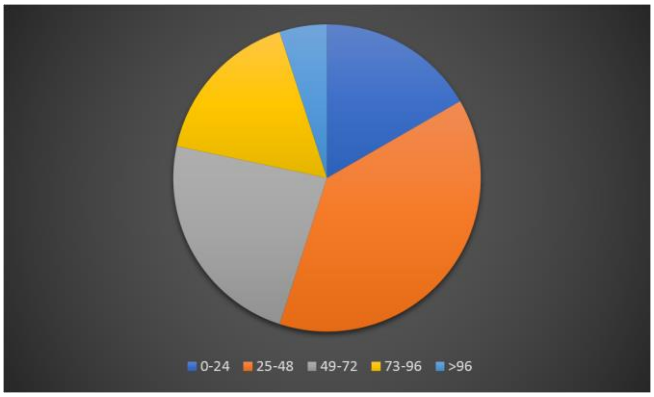

Fig 2: Duration of clinical symptoms

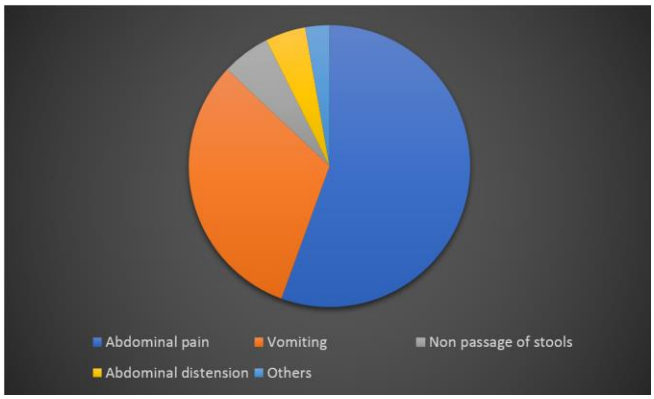

Fig 3: Clinical Symptoms

Table 4: Statistical analysis of MDCT for acute abdomen

Final diagnosis	True positive	False positive	False negative	True negative	Sensitivity	Specificity	Accuracy	Total
Mesenteric ischemia	2	0	0	58	100	100	100	60
Malrotation of gut	2	0	0	58	100	100	100	60
Gut Perforation	3	1	0	56	100	98.2	98.3	60
Appendicitis	12	1	1	46	92.3	97.8	96	60
Gallbladder perforation	2	0	0	58	100	100	100	60
Pancreatitis	14	0	0	46	100	100	100	60
Pyelonephritis	5	1	1	53	83.3	98.1	96.6	60
Epiploicae appendagitis	1	0	0	59	100	100	100	60
Small bowel obstruction	6	0	0	54	100	100	100	60
Pseudo-membranous colitis	1	0	0	59	100	100	100	60
Cholecystitis	6	0	1	53	86	100	98.3	60
Others	1	0	0	59	100	100	100	60

Table 5: Statically Analysis of USG For Acute Abdomen

Final diagnosis	True positive	False positive	False negative	True negative	Sensitivity	Specificity	Accuracy	Total
Gut Perforation	2	1	1	56	66.6	98.2	96.6	60
Appendicitis	11	1	2	46	84.6	97.8	95	60
Gallbladder perforation	2	0	0	58	100	100	100	60
Pancreatitis	10	0	4	46	71.4	100	93.3	60
Pyelo-nephritis	4	1	2	53	67	98.1	96.3	60
Small bowel obstruction	6	0	0	54	100	100	100	60
Cholecystitis	6	0	1	53	86	100	98.3	60
Others	1	0	0	59	100	100	100	60

Results

Table 1 shows the distribution according to age group. Age distribution in our series ranged from 3-83 years. Maximum number of patients were in 41-60 years age group (50.00%). Second highest incidence was in 21-40 years age group (20.00%) followed by 61-80 years age group (16.67%). There were 33 males and 27 females with M:F ratio 1.2:1. Mean age in our study was 45 years. Median was 47 and Mode was 50. [Fig 1] Table 2 shows distribution of patients according to onset of clinical symptoms.23 (Maximum number) patients (38.33%) presented clinically to emergency within 25-48 hour of onset of symptoms followed by 14 patients within 49-72 hour of onset of symptoms (23.33%). [Fig 2] Table 3 shows distribution of patients on the basis of clinical symptoms. 60 (Maximum number) patients presented with abdominal pain (100%). Second most common symptom was vomiting which was seen in 34 patients (56.67%) followed by non-passage of stools in6 patients (10.00%) and abdominal distension in 5 patients(8.33%). [Fig 3] Table 4 shows accuracy of MDCT in diagnosing acute abdomen. MDCT has accuracy of 100% in mesenteric ischaemia, malrotation of gut, GB perforation, Pancreatitis and pseudomembranous colitis. MDCT has accuracy of approximately98% in diagnosing other mentioned conditions. Table 5 shows accuracy of USG in diagnosing acute abdomen. USG has accuracy of 100% in diagnosing G.B perforation and small bowel obstruction. USG has less efficacy in diagnosing other acute abdominal conditions.

Discussion

The sample of study was limited to 60 patients. Sixty patients with acute abdomen referred to the department of Radio-diagnosis were subjected to abdominal US. MDCT was done in those cases where US findings or diagnosis was inconclusive. Clinical data was collected, analyzed and results were correlated with MDCT findings, operative findings and final diagnosis.

Age distribution according to age group and sex. Age distribution in our series ranged from 3-83 years. Maximum number of patients were in 41-60 years age group (50%). Second highest incidence was in 21-40 years age group (20%) followed by 61-80 years age group (16.6%). There were 33 males (55%) and 27 females (45%) with M:F ratio 1.2:1. Mean age in our study was 45 years. Median was 47 and Mode was 50.

Similar studies by Sala *et al.* [9] (2007) had an age range of 42-73 years (median age - 57.5 yrs, middle age) with sex distribution of M:F:1:2. Foinant *et al.* [10] (2007) and Siewert *et al.* [2] (1997) studies had mean age of 57.7 years and 59 year (middle age) with sex distribution of M:F:1.2:1 and 1:0.8 respectively. Van Randen *et al.* [11] (2009) conducted study on 1,021 patients presented with acute abdomen where mean age was 47 years with 45% males and 55% females. The mean age in our study was similar to studies conducted previously i.e. 45 years. The mean in our study was 45 years which is similar to the study conducted by Van Randen *et al.* [11] (2009). The sex distribution in our series was M:F:1.2:1 (male-55% and females 45%) which is similar to the study coducted by Foinant *et al.* [10] (2007) and Siewert *et al.* [2] (1997). Maximum number of patients (38.33%) presented clinically to emergency within 25-48 hour of onset of symptoms followed by 49-72 hour of onset of symptoms (23.33%). Similar study by Siewert *et al.* [2] (1997) concluded that CT is excellent imaging technique for patients with acute abdomen regardless of duration of signs and symptoms.

Among 60 patients, in 55 cases MDCT diagnosis was consistent with final diagnosis with accuracy of MDCT in current study of 91.6%. Tsushima *et al.* [6] (2002) conducted effect of contrast enhanced computed tomography on diagnosis and management of acute abdomen study on 125 number of patients presenting with acute abdominal symptoms. They concluded that MDCT diagnosis were consistent with the final diagnosis in 116 patients (92.8%).

MacKersie *et al.* [12] (2005) studied 91 patients and concluded that, unenhanced helical CT yielded an overall sensitivity, specificity, and accuracy of 96.0%, 95.1%, and 95.6%, respectively. Foinant *et al.* [10] (2007) determined the contribution of MDCT to non-traumatic acute abdomen management by comparing initial management, post-CT management, and final management on 90 patients. Of the 90 patients included in the study, for 83, the post-CT diagnosis was identical to the final diagnosis (92.2%). Sala *et al.* [9] (2007) conducted randomized controlled trial of routine early abdominal computed tomography in patients presenting with non-specific acute abdominal pain and concluded that the correct diagnosis established after randomization in 84% of CT patients. Mangini *et al.* [13] (2008) evaluated the role of 64-row multi-detector computed tomography (MDCT) in the differential diagnosis of non-traumatic acute bowel disease and reviewed CT findings of 57 patients. A total concordance between the MDCT findings and discharge diagnosis (based on surgical findings and histological examinations) was found in 47/57 cases (82.4%). Lameris *et al.* [14] (2009) performed a fully paired multicentric diagnostic accuracy study with prospective data collection in 1021 patients who presented with non-traumatic abdominal pain and concluded that CT is the most sensitive imaging investigation for detecting urgent conditions in patients with abdominal with accuracy of 89% for CT and 70% for US. Udayasanker *et al.* [15] (2009) conducted a study to evaluate a non-enhanced ultralow-dose (ULD) abdominopelvic multi-detector row computerized tomography (MDCT) to assess the patients with acute abdominal pain who would otherwise undergo three view abdominal x-rays series and MDCT showed a high sensitivity of 100%. In our study, findings were very similar to studies conducted previously.

In the present study, sensitivity and specificity of USG for appendicitis was 84.6% and 97.8% respectively. Accuracy was 95% in our study for detection of appendicitis. In the present study, sensitivity and specificity of CT for appendicitis was 92.3% and 97.8% respectively. Accuracy was 96% in our study for detection of appendicitis. In the present study for detection of gut perforation sensitivity and specificity of USG was 66.6 and 98.2% respectively. Accuracy was 96.6% for gut perforation in our study. In the present study for detection of gut perforation sensitivity and specificity of CT was 100 and 98.2% respectively. Accuracy was 98.3% for gut perforation in our study. Hainaux *et al.* [16] (2006) observed that sensitivity and accuracy for detection of site of gut perforation were 85% and 86% respectively. For acute pancreatitis sensitivity and specificity of CT was 100% in the our study. Balthazar *et al.* [17] (2002) concluded that CT has been shown to yield an overall early detection rate of 90% with close to 100% sensitivity similar to our study. For acute cholecystitis

sensitivity and specificity of CT was 86% and 100% with positive predictive value of 100% and negative predictive value of 98.15%. For acute cholecystitis negative predictive value was 98.15% in our study. For detecting small bowel obstruction CT had sensitivity, specificity and accuracy of 100% in our study. USG also detected the presence of small bowel obstruction in all cases with sensitivity of 100%. Megibow *et al*. [18] (1991) concluded that CT had a sensitivity of 90%–96%, specificity of 96%, and accuracy of 95% in the detection of intestinal obstruction.

Conclusion

From our study, it can be concluded that MDCT is an effective imaging modality with results that have a positive effect on the management of many patients with acute abdominal pain. CT may then be reserved for patients with non-diagnostic US results. At present, MDCT can be considered the primary imaging technique for patients with acute abdominal pain.

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