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## Imaging strategies for evaluating non-traumatic acute abdominal pain

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### Abstract

**Background and Aim:** Acute abdomen poses a big challenge to the general surgeons in terms of both diagnosis and management. Aim of the study was to study, assess and diagnose causes of acute abdomen accurately, to determine the accuracy of MDCT for confirmation of Negative, diagnosed or equivocal USG cases & To establish role of CT as the primary imaging modality.

**Material and Methods:** This prospective study was done on 100 randomly collected patients who were referred to radiology department with Documentation of acute abdomen from Emergency, Surgery, Medicine and Gynecology departments for USG and CT. Axial, coronal, and sagittal reformatted images were studied. Intravenous and oral contrast were also used depending on the clinical condition. All these patients were followed up diagnosis obtained before and after CT were compared with intraoperative findings or final clinical diagnosis at discharge.

**Results:** In our study, majority 60% of the study population were males with male: female ratio of 1.55:1 and majority (25%) of them presented with the right lower quadrant pain followed by periumbilical (25%) and epigastric quadrant be stricture. Six cases (6%) of pancreatitis, 3 cases (3%) of urolithiasis, 2 cases (2%) of peritonitis, 1cases (1%) of pyelonephritis, and 1 case (1%) of gallbladder rupture and intussusception each needed CT for diagnosis. 2 cases (2%) of SMA thrombosis and 1 case (1%) of mesenteric panniculitis were also noted.

**Conclusion:** MDCT has high sensitivity in detecting various pathologies in cases of inconclusive situations on USG, in symptomatic patients with negative USG scans and in patients with suboptimal scan.

**Keywords:** Acute abdomen, conventional radiography, computed tomography, multidetector CT

### Introduction

“Acute abdomen” includes spectrum of medical and surgical conditions ranging from a less severe to life-threatening conditions in a patient presenting with severe abdominal pain that develops over a period of hours. Accurate and rapid diagnosis of these conditions helps in reducing related complications. Clinical assessment is often difficult due to availability of over-the-counter analgesics, leading to less specific physical findings<sup>[1, 2]</sup>.

In patients presenting with acute abdomen radiological diagnosis largely depends on knowledge of basic anatomy of peritoneum and its reflection together with understanding of spread of intraperitoneal infection into various peritoneal spaces, also the knowledge of abdominal organs, gastrointestinal tract and retroperitoneum with its contents<sup>[3, 4]</sup>.

Abdominal Cavity is enclosed by abdominal wall and is completely filled by the abdominal viscera and divided into supra-mesocolic and infra-mesocolic compartment by transverse mesocolon, the root of small bowel mesentery divides the infracolic compartment into right infracolic space and larger left infracolic space. The pelvis is most dependent part of peritoneal cavity and is continuous with both paracolic gutters, on the right the gutter extends superiorly to the subhepatic space, where in extension deep to the liver is known as Morrison’s pouch<sup>[5, 6]</sup>.

The use of conventional radiography (X-rays) has been nowadays of little value with significance being in the setting of bowel obstruction showing dilated bowel loops with air fluid levels. However, computed tomography (CT) is more accurate and more informative in this setting as well. For this reason, plain radiography is avoided in these situations unless there is the suspicion of perforation or bowel dilatation. Ultrasonography (USG) has developed a satisfactory role in evaluating the gallbladder in all patients and the appendix in children and pregnant women.

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Multidetector CT (MDCT), however, has become the Premier modality for evaluation of the gut, mesenteries, omentum, peritoneum, and retro peritoneum unaffected by the presence of bowel gas and fat [7, 8].

#### The objectives of this study were as follows

- To study, assess, and diagnose causes of acute abdomen accurately so as to minimize the chances of exploratory laparotomy and unnecessary operations and consequently improved patient care.
- To establish role of CT as the primary imaging modality in the evaluation of acute abdomen in adult patients.
- To determine the contributions of CT in non-traumatic acute abdomen for confirmation of diagnosed or equivocal USG cases, its management and postoperative follow-up.

#### Material and Methods

The study was conducted in radiodiagnosis department of Tertiary Care Teaching Institute of India for the duration of 1 year.

This prospective study was done on 100 randomly collected patients who were referred to radiology department with Documentation of acute abdomen from Emergency, Surgery, Medicine and Gynecology departments for USG and CT. Proper data including findings of USG and CT along with relevant patient details were undertaken and compared with final discharge diagnosis.

The patient in supine position with arms raised above the head and the abdomen is centered within the gantry. Non-enhanced CT abdomen was done from the level of diaphragm through the symphysis pubis within a single breath hold. The raw data are acquired at a section thickness of 0.625 mm; pitch - 0.8-1.5.

First, the images are acquired in pre-contrast phase. Then, 1-2 mL/kg of water soluble non-ionic IV contrast medium (Iohexo) with an iodine content of 275-370 mg was given at a rate - 4 mL/sec through a power injector. Then, postcontrast arterial, venous, and delayed phases were taken at 25 s, 45 s, and 7 min, respectively, by bolus tracking and automated triggering technology. In necessary cases, oral contrast was given an hour before the, 30 mL ionic contrast medium containing 250 mg I/mL in 1 L of water. All the patients undergoing contrast scan were screened for renal function and iodine contrast allergies.

#### Statistical analysis

The recorded data was compiled and entered in a spreadsheet computer program (Microsoft Excel 2019) and then exported to data editor page of SPSS version 15 (SPSS Inc., Chicago, Illinois, USA). Quantitative variables were described as means and standard deviations or median and interquartile range based on their distribution. Qualitative variables were presented as count and percentages. For all tests, confidence level and level of significance were set at 95% and 5% respectively.

#### Results

In our study, majority 60% of the study population were males with male: female ratio of 1.55:1 and majority (25%) of them presented with the right lower quadrant pain followed by periumbilical (25%) and epigastric quadrant be stricture. Six cases (6%) of pancreatitis, 3 cases (3%) of urolithiasis, 2 cases (2%) of peritonitis, 1cases (1%) of pyelonephritis, and 1 case (1%) of gallbladder rupture and intussusception each needed CT for diagnosis. 2 cases (2%) of SMA thrombosis and 1 case (1%) of mesenteric panniculitis were also noted.

**Table 1:** Equivocal cases diagnosed only on CT

Cause	Number on USG	Percentage on USG	Number on CT	Percentage on CT
Appendicitis	17	17	26	26
Bowel obstruction	7	7	8	8
Pancreatitis	8	8	14	14
Cholecystitis/cholelithiasis	12	12	12	12
Urolithiasis	7	7	10	10
Gut rotation	1	1	1	1
Pyelonephritis	3	3	5	5
Mesenteric lymphadenopathy	2	2	2	2
SMA thrombosis	0	0	1	1
Liver abscess	0	0	3	3
Splenic abscess	2	2	2	2
Peritonitis	4	4	6	6
Intussusception	1	1	2	2
Ovarian cyst/ovarian torsion/ pid / ruptured ectopic	8	8	8	8
Total	72	72	100	100

#### Discussion

Out of the 100 patients satisfying the inclusion criteria recruited into this study, the majority of cases found belongs to 3rd and 4th decades with mean age of 36.10±14.05 which was similar to the study conducted by Ihezue *et al.*, (1998) [2] who reported the 405 consecutive patients with acute abdomen with mean age of 29 years (3rd decade). In our study, majority 61% (73) of the study population were male which is consistent with the various similar studies conducted worldwide with male preponderance such as by

Al-Mulhim (2006) [9].

Furthermore, the most common site of pain in our study were right lower followed by periumbilical and epigastric quadrant which are in agreement with study conducted by Asefa Z *et al.*, (2000) [10] who reported the most common site as lower abdomen. Furthermore, in our study, USG was able to make probable diagnosis alone in 72 (74% cases), while rest 28 cases (28%) were equivocal/normal on USG. In our study, 72 out of 100 cases (72) were having abnormal USG and among that fluid, fat stranding, and nodes were the

major findings constituting 72%, 48%, and 32%, respectively. 2 cases (2%) were normal and 24 cases (24%) were equivocal which were correlated with CT findings which were similar to the study conducted by Balamurugan *et al.*

Among the various CT findings, the majority of findings were in the form of fluid constituting 74% followed by fat stranding, nodes, calcifications, and air, 55%, 34%, 18%, and 17%, respectively. Furthermore, there was significant correlation between patient's age and presence of fat stranding in our study. Age < 40 year presenting with acute abdomen had fatter stranding with significant Pearson Chi-square coefficient. In a study done on 299 patients by Hagos *et al.* in Ethiopia (Africa), the most common cause for acute abdomen was Acute appendicitis 53.2% and Bowel obstruction 28.7% followed by performative peritonitis 4.3%.<sup>[11]</sup> In a study done by Jain *et al.* in India, the most common cause was performative peritonitis (39.7%), followed by acute appendicitis (37.7%), and followed by intestinal obstruction (14.2%)<sup>[12]</sup>.

In our study, bowel was the most commonly involved organ constituting 36% which was well correlating with the similar recent study conducted by the Balamurugan *et al.*, who found 67 out of 126 cases (53.17%) with predominate bowel involvement. Furthermore, vessels were the least commonly involved organ in our study constituting two cases (2%) presenting with acute abdomen had CT findings confirming SMA thrombosis with bowel wall thickening and focal lack of enhancement which was similar to the study conducted by the Moschetta *et al.*, (2014)<sup>[13]</sup> who stated that nearly 1% of cases present with acute ischemic bowel disease in the emergency department.

About 16 out of 100 cases of our study had CT findings confirming acute pancreatitis with sensitivity of approximately 100%. USG had missed seven cases and it could diagnose only ten cases. Comparable results are shown by Beger *et al.*, (1997)<sup>[13]</sup> and Balthazar *et al.*, (2003).<sup>[14]</sup> Acute pancreatitis and CT findings very well correlate with severity index in the study conducted by them. It accurately detects the complications such as pseudo aneurysm of splenic artery and portomesenteric venous occlusion. In our study, 10 out of 100 cases had CT findings confirming urolithiasis with sensitivity of approximately 100%. The above findings were in comparison to the data arrived by Boulay *et al.*, (2015)<sup>[15]</sup>, in which sensitivity was 100%. Furthermore, in our study, majority of cases were male with peak age in 4th decade and majority of cases were involving mid and distal ureter followed by renal calyces which were similar to the study conducted by Reddy and Reddy (2010)<sup>[16]</sup> who did prospective study for patients with loin pain, who are clinically suspected for urinary stone disease. It was found that maximum patients belonged to the age group of 41-50 years followed by 31-40 years and males were much more than females and maximum patients presented with distal ureteric calculi, that is, 40% followed by renal calculi.

In our study, 12 out of 100 cases had CT findings confirming acute cholecystitis with cholelithiasis with sensitivity of almost 98-100% which is comparable to other international studies. Out of 12 cases, 62% cases belong to females of 3<sup>rd</sup> and 4<sup>th</sup> decade which is comparable to the study findings of Chaudhry *et al.*<sup>[17]</sup> In study done in 3538 patients by Barai *et al.*, pain abdomen was the main

complaint in all the patients (100%), followed by vomiting in 42%, constipation in 27%, abdominal distension in 22.13% and fever in only 4% of the patients<sup>[18]</sup>.

In our study, 8 out of 100 cases were diagnosed to have bowel obstruction. MDCT picked the etiology in additional one case as stricture which was equivocal on USG. The sensitivity and positive predictable value of MDCT were around 88% which is in agreement with study conducted by Mallo *et al.*, (2005)<sup>[19]</sup> in which sensitivity of MDCT in diagnosis of bowel obstruction is 81-100% and specificity 68-100%. The accuracy rate for perforation in our study was 85.70% which was comparable to the study done by Sung Hwan Kim *et al.*, (2017)<sup>[20]</sup> who gave an accuracy of 82-90% for predicting site of perforation by CT. Because, in our study, the accuracy rate was less because one case was presented very late to us after a week of diagnostic dilemma. The CT findings were discordant with intraoperative findings in 8 cases: Under estimating 4 cases of appendicular abscess and misinterpreting multiple sealed perforation sites as case of perforation peritonitis and misinterpreting 1 case of appendicular perforation as ascending colon perforation. Furthermore, in our study, 1 case of GB rupture could not be followed up. Hence, the sensitivity, accuracy rate, and positive predictive value of MDCT for diagnosing cases in our study were 95.80%, 94.10%, and 98.30%, respectively, which were comparable to the study results of Mackersie *et al.*, (2005)<sup>[21]</sup> who reported sensitivity, specificity, and accuracy rate of MDCT as 96%, 95%, and 95.6%, respectively.

The etiology of intestinal obstruction in most of the patients was obstructed ventral hernias followed by adhesions followed by tubercular stricture, volvulus and malignant growth causing luminal obstruction.

As most of the patients are taken up for emergency laparotomy after USG examination, the number of patients who come for further CT examination are less in number.

## Conclusion

The results obtained in this prospective study were comparable to pioneer studies conducted worldwide. However, the major limitation was limited sample size, cost of CT, and majority of patients went to urgent laparotomy after USG. MDCT is the most rapid, specific, time efficient, objective, and informative imaging technique. MDCT is a widely accepted primary investigation of choice in patients coming with intense abdominal pain with the exception of acute cholecystitis, in which USG is highly sensitive in diagnosis.

MDCT has high sensitivity in detecting various pathologies in cases of inconclusive situations on USG, in symptomatic patients with negative USG scans and in patients with suboptimal scan. Despite the small risk of radiation and increased cost, prompt use of MDCT is recommended when the clinical examination is in suspicion, and investigations, such as plain radiograph of abdomen and USG examinations, are equivocal or inconclusive.

## Conflict of interest

No! Conflict of interest is found elsewhere considering this work.

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