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Original Research Article

EFFICIENCY OF IMAGING MODALITIES IN ACUTE NON-TRAUMATIC ABDOMINAL EMERGENCIES: A PROSPECTIVE STUDY

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ABSTRACT

Background: Acute abdomen is a common surgical emergency with overlapping clinical presentations, making accurate diagnosis challenging. Imaging plays a pivotal role in identifying the underlying cause and guiding timely management. **Objectives:** To evaluate and compare the diagnostic performance of X-ray, ultrasound (USG), computed tomography (CT), and magnetic resonance imaging/magnetic resonance cholangiopancreatography (MRI/MRCP) in patients presenting with non-traumatic acute abdominal conditions.

Materials and Methods: This prospective observational study was conducted in the Department of Radiodiagnosis at a tertiary care center from May 2022 to May 2024. A total of 100 consecutive patients with suspected non-traumatic acute abdomen were evaluated using plain radiography, ultrasound, CT, and MRI/MRCP as indicated. Imaging findings were correlated with clinical, laboratory, and surgical outcomes where applicable. Diagnostic accuracy parameters were calculated for common conditions.

Results: The most frequent diagnoses were ureteric colic (21%), acute appendicitis (18%), intestinal obstruction (10%), and pancreatitis (10%). Ultrasound demonstrated good diagnostic accuracy in acute appendicitis with a sensitivity of 82.35% and specificity of 98.80%, though CT showed 100% sensitivity. In renal/ureteric colic, CT KUB accurately detected all cases, outperforming X-ray and ultrasound. For small bowel obstruction, CT identified both the level and cause in all patients, whereas ultrasound was superior to plain radiography. In acute pancreatitis, CT was essential for evaluating severity and complications, while MRCP showed 100% accuracy in detecting choledocholithiasis.

Conclusion: CT is the most accurate and comprehensive imaging modality for evaluating non-traumatic acute abdomen, particularly in diagnostically equivocal or life-threatening conditions. Ultrasound remains a valuable first-line tool, while MRCP is the modality of choice for biliary pathology. Appropriate imaging selection significantly improves diagnostic confidence and patient management.

Keywords: Acute abdomen; Diagnostic imaging; Ultrasound; Computed tomography; Magnetic resonance imaging; MRCP; Acute appendicitis; Renal colic; Intestinal obstruction; Pancreatitis; Choledocholithiasis; Non-traumatic abdominal pain; Emergency radiology.

INTRODUCTION

Acute abdomen is defined as a clinical syndrome Characterized by acute pain abdomen of sudden onset.[1] Patients with an acute abdomen comprise the largest group presenting to the surgical emergency.[2] Identification of patients who require surgery is crucial for timely management. Acute abdomen may be due to variety of diseases which may involve the gastrointestinal system, biliary tree, solid viscera or genitourinary system. Various pathologies that causes acute abdomen includes,, acute appendicitis, acute cholecystitis, renal colic, small bowel obstruction, gynecological disorders, acute pancreatitis, peptic ulcer disease, diverticular disease and a variety of less common conditions.[3] On account of the considerable overlap of symptoms and signs in an acute abdomen, the clinical accuracy for the specific diagnosis is low.[4] This limitation emphasizes the importance of imaging investigations in the diagnostic work-up of the acute abdomen.

The various imaging modalities available for investigating the acute abdomen include plain films, contrast studies, ultrasound (US), computed tomography (CT), and magnetic resonance imaging (MRI). The choice of the initial modality to be used should be guided by the disease suspected on clinical grounds, for example, plain radiographs continue to be the initial imaging modality in cases of intestinal obstruction and perforation.[2] Contrast examinations have a limited role. An upper GI series with water soluble contrast may be performed in cases of suspected perforation or a contrast enema may be required to confirm a colonic obstruction.

US is the ideal screening modality for suspected hepatobiliary disease or for suspected pelvic pathology such as ectopic gestation or acute pelvic inflammatory disease (PID). It is also indicated for the initial evaluation of a patient with right lower quadrant pain especially in young women. In cases of suspected intestinal obstruction, it may at times be difficult to differentiate between mechanical obstruction and paralytic ileus on plain radiographs. US is of special value in such a situation as it demonstrates increased peristalsis in cases of mechanical obstruction, whereas presence of dilated, atonic loops suggest the diagnosis of paralytic items. US is also helpful in localizing intra-abdominal abscesses, particularly in the solid viscera.

The introduction of multidetector CT (MDCT) has impacted imaging of all organs of the body, especially the abdomen.[6] Because of the greater speed of coverage and thinner sections with 3D reconstruction now available, MDCT has become the imaging modality of choice for evaluation of the acute abdomen. It provides a comprehensive view of all the intra-abdominal solid and hollow viscera, as well as the peritoneum, mesentery, lymph nodes and retroperitoneum. Data can be acquired in different phases making MDCT an ideal modality for evaluation of suspected mesenteric ischemia or vascular disorders such as abdominal aortic aneurysms. Low dose unenhanced CT has replaced excretory urography as the screening method of choice for the evaluation of renal colic in most centers.[6] Recent improvements in resolution and development of faster breath-hold sequences have drastically increased the utility of MRI in evaluation of the gut.[7] However, MRI is still not routinely used for evaluation of an acute abdomen except in situations where iodinated contrast cannot be administered or in pregnant patients.

Aims and Objectives

- To evaluate the role of imaging in the diagnosis of non-traumatic acute abdomen.
- To enumerate the spectrum of causes of non-traumatic acute abdomen.
- To describe the radiological findings among the patients presenting with non-traumatic acute abdomen.
- To evaluate the usefulness of various imaging modality in evaluation of non- traumatic acute abdomen.
- To evaluate the impact of imaging in early diagnosis on the management of non- traumatic acute abdomen.

MATERIALS AND METHODS

Source of Data: Department of Radio diagnosis & Imaging, SVP hospital, NHL medical college, Ahmedabad.

Duration of the Study: May 2022 to May 2024

sample size: 100 cases.

Procedure of Study

- Patients were evaluated with plain radiograph of abdomen using DRX-Compass X-ray System(Carestream), Routine real-time ultrasound scanner (MindrayResona), CT (Philips multidetector 128 slice) and MRI (Siemens magnetomSkyra MRI machine). IV and rectal contrast was administered as per department protocol.
- Findings were correlated with clinical, laboratory tests, and post-operative findings wherever necessary.

Imaging in this study included X-ray, ultrasound, CT, and MRI using standard emergency protocols. Plain abdominal X-rays were obtained in AP upright, supine, and left lateral decubitus positions when needed, with additional KUB and PA erect views for detecting urinary calculi, air–fluid levels, and free intraperitoneal air. Ultrasound evaluation used gray-scale imaging with graded compression to displace bowel gas, improve visualization (especially of the appendix), and assess abdominal organs including the hepatobiliary system, pancreas, kidneys, bowel, uterus, and ovaries. A moderately filled bladder enhanced pelvic assessment.

CT scans were performed after fasting with oral contrast preparation and multidetector acquisition

using nonionic low-osmolar iodinated IV contrast. Routine scanning covered the abdomen from diaphragm to symphysis pubis in the portal venous phase, with optional rectal contrast and thin-section imaging when needed. MRI was performed on a 3T system using a rapid, non-contrast,
free-breathing protocol with T2 HASTE, T2-weighted, DWI, and MRCP sequences, with scan duration tailored to patient size.

Acute abdominal pain is one of the most frequent emergencies, accounting for nearly 4–5% of all emergency department presentations. Accurate diagnosis requires integrating clinical evaluation with appropriate imaging. Although "acute abdomen" traditionally suggested surgical intervention, modern radiology—particularly ultrasound, CT, and MRI—has significantly improved early diagnosis, often preventing unnecessary operations. Our study evaluated the role and diagnostic performance of various imaging modalities in 100 patients presenting with acute abdominal pain.

Study Design: This was a prospective study of consecutive patients with acute abdomen in the study period from May 2022 to May 2024.

Formal consent for the study was obtained from all the patients.

Inclusion Criteria

- Only those patients who are willing to participate in study were included.
- Patients referred to the radiology department for plain X-Ray, USG abdomen, CT/MR of Abdomen suspected to have a non-traumatic cause of acute abdomen were included in this study.

Exclusion Criteria

- Patients not willing to participate in the study.
- Patients with Traumatic acute abdomen conditions.
- Patient having contraindication for CT and MRI

RESULTS AND DISCUSSION

Table 1: Clinical and anthropometric profile of the children (n = 1000)

DiseaseCondition	Total	%
AcuteAppendicitis	18	18
IntestinalObstruction	10	10
Ileocolitis	10	10
Pancreatitis	10	10
Acutecholecystitis	8	8
Choledocholithiasis	5	5
Renalcolic	21	21
Pyelonephritis	5	5
Gynecologicalconditions	2	2
Rupturedectopic	1	1
Others	10	10
Total	100	100

Table 2: Gender wise distribution of non-traumatic acute abdomen pathologies

DiseaseCondition	Female	Male	Total	%
AcuteAppendicitis	7	11	18	18
IntestinalObstruction	4	6	10	10
Ileocolitis	3	7	10	10
Pancreatitis	3	7	10	10
Acutecholecystitis	4	4	8	8
Choledocholithiasis	1	4	5	5
Renalcolic	9	12	21	21
Pyelonephritis	2	3	5	5
Obstetrics &gynecologicalconditions	3	0	3	3
Others	4	6	10	10
Total	40	60	100	100

Table 3: Distribution according to organs specific pathologies

Organ	TotalCases
Gallbladder	14
Liver	1
Bowel	42
Kidney	26
Vascular	1
Ovary	3
Pancreas	10

Table 4: Diagnostic Performance of X-ray and Ultrasound in Common Non-Traumatic Acute Abdominal Conditions

Condition	Modality	Present(TP)	Absent(FP)	Present(FN)	Absent(TN)	Sensitivity	Specificity
AcuteAppendicitis	Ultrasound	14	1	3	82	82.35%	98.80%
Renal/UretericColic	X-ray	14	3	4	79	77.78%	96.34%
Renal/UreericColic	Ultrasound	12	1	8	79	60%	98.75%
AcuteSmallBowelObstruction	X-ray	7	2	3	88	70%	97%
AcuteSmallBowelObstruction	Ultrasound	9	1	1	89	90%	98.88%
AcutePancreatitis	Ultrasound	9	1	1	89	90%	98.90%
Choledocholithiasis	Ultrasound	3	0	1	96	75%	—

Table 5: Comparative Diagnostic Yield of X-ray, Ultrasonography, CT, and MRCP in Non-Traumatic Acute Abdomen

Condition	Modality	Advised	Detected
AcuteAppendicitis	X-ray	18	0
	USG	18	14
	CT	7	7
Renal/UretericCalculi	X-ray	21	14
	USG	21	12
	CT	16	16
Cause of Acute Small BowelObstruction	X-ray	10	0
	USG	10	0
	CT	10	10
Choledocholithiasis	X-ray	5	0
	USG	5	3
	MRCP	5	5
AcutePancreatitis	X-ray	10	0
	USG	10	9
	CT	9	9
	MRCP	2	2

Study Population: A total of 100 patients were included, with a male-to-female ratio of 60:40. Most patients were between 30–60 years of age; 17 were younger than 30, and 9 were older than 60. The majority were referred from the surgery department (87%), followed by medicine (5%), obstetrics &gynecology (4%), and pediatrics (2%).

Overall Distribution of Diagnoses: The most common cause of acute abdomen was ureteric colic (21%), followed by acute appendicitis (18%), intestinal obstruction (10%), ileocolitis (10%), pancreatitis (10%), acute cholecystitis (8%), choledocholithiasis (5%), pyelonephritis (5%), hollow viscus perforation (3%), gynecologic conditions (3%), intussusception (2%), and miscellaneous causes such as rectus sheath hematoma, SMA syndrome, and epiploic appendagitis (10%). The bowel was the most frequently involved organ (in 40 patients), followed by kidney/ureter (26), gallbladder (14), pancreas (10),ovary (3), and liver (1).

Appendicitis: Eighteen patients were diagnosed with acute appendicitis. Plain X-ray abdomen was normal in all cases. Ultrasound detected appendicitis in 14 patients (true positives), while 3 cases were false negative (due to excessive bowel gas or retrocecal position). One case was a false positive. The overall sensitivity and specificity of ultrasound were 82.35% and 98.80%, respectively.

CECT was performed in patients with equivocal ultrasound or suspected complications and successfully diagnosed all cases, indicating superior sensitivity. These results correlate with previous studies by Leite et al. and Abu-Yousef et al. confirming CT as the most accurate modality.

Ureteric Colic & Pyelonephritis: Twenty-one patients presented with ureteric colic. On X-ray KUB, 17 showed radio-opacities, of which 14 were true positives and 3 were false positives. Four patients had negative X-rays but were later confirmed to have calculi. The sensitivity and specificity for X-ray KUB were 77.78% and 96.34%, higher than that reported by Jung SI et al.

Ultrasound identified calculi in 12 patients (true positives), but 8 cases were missed due to bowel gas or distal ureteric obstruction. Back-pressure changes were visible in almost all cases. Sensitivity and specificity for ultrasound were 60% and 98.75%, consistent with studies by Sheafor et al. and Unan et al.

CT IVP was performed in 16 patients and accurately determined the size, location, associated obstruction, renal function status, and complications. It also diagnosed pyelonephritis in cases missed on ultrasound.

Among five patients with pyelonephritis, ultrasound detected abnormalities in only one, while CT identified all cases. Hence CT IVP was found to be superior to X-ray and ultrasound for diagnosing ureteric calculi, back-pressure changes, and pyelonephritis.

Pancreatitis: Ten patients had either acute or acute-on-chronic pancreatitis. X-ray abdomen was normal in eight patients, showed pancreatic calcification in one, and left-sided pleural effusion in another. Ultrasound identified inflammatory changes in 9 of 10 patients, with one false-negative and one false-

positive. The sensitivity and specificity were 90% and 98.90%, slightly better than previous reported values.

CECT abdomen was the main modality for evaluating complications, necrosis, collections, vascular thrombosis, and for assigning modified CTSI scores. It provided essential information for management. MRI/MRCP was used in patients with renal impairment or when ductal anatomy required further evaluation, demonstrating characteristic findings of chronic pancreatitis, including ductal dilatation and intraductal calculi.

Intestinal Obstruction: Ten patients had small bowel obstruction. X-ray diagnosed obstruction in 7 patients (true positives) but also showed 2 false positives and missed 3 cases. Its overall sensitivity and specificity were 70% and 97%, respectively.

Ultrasound detected obstruction in 9 patients, missing one case of adynamic ileus and showing one false positive in a patient with acute diarrhea. Overall sensitivity and specificity were 90% and 98.88%, similar to Suri et al.

CECT abdomen was performed in all cases and identified both the cause and the level of obstruction in every patient, demonstrating its superiority over X-ray and ultrasound.

Choledocholithiasis: Five patients were diagnosed with choledocholithiasis. X-ray abdomen was negative in all. Ultrasound detected dilated bile ducts in all patients and directly visualized calculi in three. Two cases were false negatives due to obscuring bowel gas. Sensitivity was 75%, matching previous studies by Zahur et al.

MRCP detected common bile duct calculi in all five patients with high clarity, confirming its value as the modality of choice before ERCP.

Intussusception: One 16-year-old patient presented with symptoms suggestive of obstruction. X-ray was normal. Ultrasound revealed the classic target sign in transverse scan, although pseudo-kidney sign was absent. CECT abdomen clearly demonstrated duodeno-duodenal intussusception with involvement of pancreatic structures. Surgery confirmed a duodenal polyp as the lead point.

Gynecologic Causes: A 20-year-old female presented with acute pelvic pain. Ultrasound showed a bulky left ovary with peripheral follicles, a hypoechoic adnexal lesion, and the whirlpool sign of torsion. MRI pelvis confirmed ovarian torsion and suggested an ovarian fibroma, later proven on histopathology.

Hollow Viscus Perforation: Two patients were diagnosed with bowel perforation. X-ray erect abdomen detected free air in both cases. Ultrasound demonstrated features like echogenic air anterior to the liver and bowel wall thickening. CT abdomen confirmed pneumoperitoneum and the exact cause—transverse colon diverticular perforation in one patient and ischemic ileal perforation due to SMA branch thrombosis in the other.

CONCLUSION

- The purpose of the study is to evaluate the importance of imaging in diagnosing non-traumatic acute abdomen and to describe the spectrum of imaging findings in acute abdomen.
- Acute abdominal pain is a common presenting symptom in the emergency department. Pain being a subjective symptom and the spectrum of causes of acute abdominal pain being broad, imaging plays a pivotal role in diagnosing the cause of acute abdominal pain. Making an appropriate diagnosis is essential in planning the appropriate management and reducing morbidity and mortality.
- Though radiography is widely available, its use is limited mainly for hollow- viscus perforation and intestinal obstruction. USG can be inconclusive in the presence of extensive bowel gas or abdominal fat which would prevent adequate visualization of abdominal organs.
- Despite the small risk of radiation and the slightly increased cost, prompt utilization of CT in investigating cases of acute abdomen gives more accurate diagnosis and leads to better decision making regarding management, thus improving outcomes.
- Where resources are limited and CT is not available, patients presenting with plain abdomen radiograph should undergo a supine radiograph with an erect chest film. Where CT is available, the use of plain abdomen radiograph would probably be limited for radiopaque foreign body search and confirmation of fecal impaction in the elderly or the bed ridden.
- US examination would remain the investigation of choice for the RUQ pain, gynecologic, and pelvic emergencies, acute appendicitis or the search for abscess formation anywhere in the abdomen or pelvis. It is the first line test for the jaundiced patient.
- CT is more accurate than ultrasonogram and plain X-Ray. Diagnostic accuracy of contrast enhanced CT is better than ultrasonogram. Thus, CT can be advocated both as a primary diagnostic modality or as a valuable adjunct to preliminary ultrasound whenever evaluation of acute abdomen is needed in the adult patient with normal renal function.
- Contrast enhanced CT is irreplaceable for critical and life threatening conditions such as hollow viscus perforation, bowel ischemia, and severe pancreatitis. Pathologies causing intestinal obstruction can be readily diagnosed as well as other structural lesions such as adhesions and hernia.
- Magnetic resonance imaging is of high value as a second line in hepatobiliary and pancreatic

disease including magnetic resonance cholangiopancreatography (MRCP).

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