Original Research Article

Role of Radiology in Evaluation of Non-Traumatic Acute Abdomen

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Abstract

Acute abdominal pain may be caused by a myriad of diagnoses, including acute appendicitis, diverticulitis, and cholecystitis. Imaging plays an important role in the treatment management of patients because clinical evaluation results can be inaccurate. Performing computed tomography (CT) is most important because it facilitates an accurate and reproducible diagnosis in urgent conditions. Also, CT findings have been demonstrated to have a marked effect on the management of acute abdominal pain. The cost-effectiveness of CT in the setting of acute appendicitis was studied, and CT proved to be cost-effective. CT can therefore be considered the primary technique for the diagnosis of acute abdominal pain, except in patients clinically suspected of having acute cholecystitis. In these patients, ultrasonography (US) is the primary imaging technique of choice. When costs and ionizing radiation exposure are primary concerns, a possible strategy is to perform US as the initial technique in all patients with acute abdominal pain, with CT performed in all cases of non-diagnostic US. The use of conventional radiography has been surpassed; this examination has only a possible role in the setting of bowel obstruction. However, CT is more accurate and more informative in this setting as well. In cases of bowel perforation, CT is the most sensitive technique for depicting free intraperitoneal air and is valuable for determining the cause of the perforation. Imaging is less useful in cases of bowel ischemia, although some CT signs are highly specific. Magnetic resonance (MR) imaging is a promising alternative to CT in the evaluation of acute abdominal pain and does not involve the use of ionizing radiation exposure. However, data on the use of MR imaging for this indication are still sparse. In this study, 76 patients with clinical manifestation of gastrointestinal conditions those were referred to radiology department of Dhiraj general hospital during time period of August 2015 to August 2016 were included. There were 44 male patients (57.9%) and 32 (42.1%) female patients. In our study spectrum of conditions included were: most common condition was

Acute cholecystitis (15.8%), followed by pancreatitis and acute appendicitis (14.4%), Intestinal obstruction (13.1%), acute diverticulitis and malignancy (9.2%), inflammatory conditions (7.7%), Herniation, Midgut volvulus with malrotation, Necrotising Enterocolitis, Hepato-biliary Disorders, Perforated Viscus, acute peritonitis (1.3%).

Key words

Acute abdomen, Non-traumatic, USG, Cholecystitis, Pancreatitis, Appendicitis.

Introduction

Acute abdominal pain may be caused by various clinical conditions such as acute appendicitis, diverticulitis, and cholecystitis. Imaging plays an important role in the treatment management of patients because clinical evaluation results can be inaccurate. Common symptoms with which a patient may present include vomiting (bilious or non-bilious), dysphagia, acute or chronic abdominal pain, jaundice, gastrointestinal hemorrhage, constipation, choking, cyanosis etc.

Imaging plays a pivotal role in diagnosis and in some cases the management of gastrointestinal disease in pediatric population. As in all spheres of radiology, requests for imaging must balance the risks of an examination against the potential benefits to the patient. Radiation burden to the pediatric population is particularly important and all possible measures should be taken to ensure that this is as low as possible, while maintaining examinations of diagnostic quality [1, 2].

Any sedation or anesthetic procedure carries a small complication rate, and adverse reactions to contrast media, although rare, do still occur.

The plain radiograph is often main diagnostic modality in neonates with complete gastric of upper intestinal obstruction and further radiologic evaluation may not be required. An upper gastrointestinal series should be performed in all patients with incomplete intestinal obstruction. Performing computed tomography (CT) is most important because it facilitates an accurate and reproducible diagnosis in urgent conditions.

CT findings have been demonstrated to have a marked effect on the management of acute abdominal pain. The cost-effectiveness of CT was studied in cases of acute abdomen and it proved to be cost-effective. CT scan therefore can be considered the primary technique for the diagnosis of acute abdominal pain, except in patients clinically suspected of having acute cholecystitis. In these patients, ultrasonography (US) is the primary imaging technique of choice.

When costs and ionizing radiation exposure are primary concerns, a possible strategy is to perform USG as the initial technique in all patients with acute abdominal pain, with CT can be performed in all cases of not diagnosed with USG [3].

The use of conventional radiography has been surpassed; this examination has only a possible role in the setting of bowel obstruction. However, CT is more accurate and more informative in this setting as well. In cases of bowel perforation, CT is the most sensitive technique for showing free intraperitoneal air and is valuable for determining the cause of the perforation. Imaging is less useful in cases of bowel ischemia, although some CT signs are highly specific. Magnetic resonance (MR) imaging is a promising alternative to CT in the evaluation of acute abdominal pain and does not involve the use of ionizing radiation exposure. However, data on the use of MR imaging for this indication are still sparse [4-6].

Materials and methods

Clinical history with the operative history was taken. Routine investigations including Hemogram, renal function tests etc. were documented. Radiological investigations were performed such as conventional x-rays, contrast procedures and ultrasonography and CT scan.

Conventional X-rays included Chest X-ray PA view, X-ray abdomen erect AP and lateral views with prone cross table lateral view as required.
Contrast procedures included barium swallow, barium meal, barium meal follow through, barium enema and fistulogram. Ultrasonography of abdomen was performed using Philips HD 9 machine and GE logic P5 and GE logic P9 using curvilinear and linear array probes. CT scan was performed in required patients using Siemens somatom emotions 16 slice MDCT scanner. Compilation of all the observational data of Dhiraj General Hospital was done in the form of frequencies and percentage which has been depicted in the form of pie-charts, bar charts andtables.

Study sample
Patients with any age group presenting to radiology department of Dhiraj general hospital with acute abdomen.

Source
In addition to Baroda city and its suburbs, a large cross section of population comes to Dhiraj General Hospital from the state of Rajasthan, Madhya Pradesh and Maharashtra.

Inclusion criteria

- Only those patients who are willing to participate in study will be included.
- Patients referred to the radiology department for plain X-Ray, USG-Abdomen and/or CT scan of Abdomen suspected to have a non-traumatic cause of acute abdomen will be included in this study.
- Patients coming for evaluation for other diseases, and are accidentally found to have any pathology causing acute abdomen, will be included in this study.

Exclusion criteria

- Patients not willing to participate in the study.
- Patients with Traumatic acute abdomen conditions.

Results

There were total 76 patients. Out of 76 patients there were 44 (57.9%) male patients, 32 (42.1%) female patients as per **Table - 1**.

Table – 1: Gender Distribution.

Sex	Frequency	%
Male	44	57.9
Female	32	42.1
Total	76	100.0

In this study most common cause of acute abdomen was Acute cholecystitis (15.8%), pancreatitis and acute appendicitis (14.4%), Intestinal obstruction (13.1%), acute diverticulitis and malignancy (9.2%), inflammatory conditions (7.7%), Herniation, Midgut volvulus with malrotation, Necrotising Enterocolitis, Hepato-biliary Disorders, Perforated Viscus, acute peritonitis (1.3%) as per **Table - 2**.

12 CT examinations of patients with pathologically proven acute cholecystitis were reviewed. Of the 12 patients, 4 had no gallstones identified at pathology and were considered to have acalculous cholecystitis. 8 had gallstones identified at pathologic examination and were considered to have calculous cholecystitis. Charts were available for review for 8 of the 12 patients as per **Table – 3**.

Correlation of CT and Intraoperative Findings were as per **Table – 4**. Types of Intestinal Obstruction were as per **Table – 5**.

Table - 6 shows Modalities used for detection of Intestinal Obstruction Contrast Study was performed in 3 patients and was able to diagnose low grade intestinal obstruction in 2 patients. In both these patients X-rays and USG were negative. Thus enteroclysis study was more useful in low grade intestinal obstruction. X-rays were positive in 8 patients of high grade intestinal obstruction making it most useful modality for diagnosis of high grade intestinal obstruction. USG was positive in 5 patients out of

these 8 patients. Findings of Intussusception on USG were as per **Table – 7**. Comparison of USG and CT in detection of acute appendicitis was as per **Table – 8**.

Table – 2: Non-traumatic causes of acute abdomen.

Disease Condition	Female	Male	Total	%
Acute Appendicitis	5	6	11	14.4
Intestinal Obstruction	7	3	10	13.1
Acute Divericulitis	2	5	7	9.2
Acute Cholecystitis	4	8	12	15.8
Inflammatory conditions	3	3	6	7.7
Pancreatitis	1	10	11	14.4
Abscess	1	2	3	3.9
Hepato-biliary Disorders	0	1	1	1.3
Perforated Viscus	1	0	1	1.3
Acute Peritonitis	1	0	1	1.3
Malignancy	4	3	7	9.2
Intusseception	1	1	2	2.6
Spleenic Infarcts	0	1	1	1.3
Herniation	1	0	1	1.3
Midgut volvulus with malrotation	1	0	1	1.3
Necrotising Enterocolitis	0	1	1	1.3
Total	32	44	76	100

Table – 3: CT Observations in Patients with Cholecystitis.

CT findings	Calculous	Acalculous	Total
Wall thickening	7	3	10
Pericholecystic stranding	6	2	8
GB distention	4	2	6
Pericholecystic free fluid	3	2	5
Subserosal edema	4	1	5
High attenuation bile	3	1	4
Sloughed membranes	1	0	1
Intramural gas	0	0	0
Positive criteria	4	2	6
Total	8	4	12

Table – 4: Correlation of CT and Intraoperative Findings.

Morphological criteria	Extrapancreatic necrosis		Pancreatitis associated with ascitis	
	Patients	%	Patients	%
Acute interstitial pancreatitis	4	36.3	7	63.7
Necrotizing pancreatits	3	27.3	4	36.3
Necrotizing pancreatitis with minor necrosis	2	18.2	1	9.1
Necrotizing pancreatitis with extended necrosis	1	9.1	1	9.1

Table - 5: Types of Intestinal Obstruction.

Types of Intestinal Obstruction	No of Patient (N=10)
High grade Intestinal Obstruction	8
Low grade Intestinal obstruction	2

Table – 6: Modalities used for detection of Intestinal Obstruction.

Type of Intestinal Obstruction	X-ray positive (N=10)	USG Positive (N=10)	Enteroclysis/ Contrast Enema Positive (N=3)
High grade Intestinal Obstruction (N=8)	8	5	1
Low grade Intestinal obstruction (N=2)	0	0	2

Table – 7: Findings of Intussusception on USG.

USG Findings	Present	Absent
Target sign	2	0
Pseudo-kidney sign	0	2
Associated lead points	1	1

Table – 8: Comparison of USG and CT in detection of acute appendicitis.

Result	USG Findings	CT Findings
Positive	8	11
Normal	3	0

Discussion

Acute abdominal pain is a common chief complaint in patients examined in the emergency department and can be due to various diagnoses. Of all patients who present to the ED, 4%–5% have acute abdominal pain [1]. 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 [7].

Acute abdomen is a term frequently used to describe the acute abdominal pain in a subgroup of patients who are seriously ill and have abdominal tenderness and rigidity. Before the advent of widespread use of imaging, these individuals were candidates for surgery. However, with the present role of imaging, some patients with acute abdomen will not undergo surgery. Other patients with acute abdominal pain that do not meet the criteria to be defined as acute abdomen—for example, many patients suspected of having acute appendicitis—will need surgery. In this article, we use the term acute abdominal pain to refer to the complete spectrum of acute abdominal pain in patients who are treated in the ED and require imaging [8].

The accuracy of imaging techniques performed in carefully selected patients suspected of having a specific diagnosis in research studies cannot always be generalized to routine clinical practice in non-selected patients with acute abdominal pain because the pretest probabilities differ per disease in different settings. The spectrum of

disease in this group of patients is broad and varies according to referral and demographic patterns. The added value of imaging after clinical evaluation is important to confirm them.

The role of imaging in adults who present with acute abdominal pain to the ED is discussed here. Our focus is acute abdominal pain in general, but we also discuss a number of frequently encountered urgent diagnoses in patients with acute abdominal pain: appendicitis, diverticulitis, cholecystitis, and bowel obstruction. Although perforated viscus and mesenteric ischemia are less frequently seen, these are also addressed because imaging is of paramount importance for the timely diagnosis of these abnormalities [9].

Conventional radiography, ultrasonography (US), and computed tomography (CT) are frequently used in the diagnostic work-up of patients with acute abdominal pain. Magnetic resonance (MR) imaging and diagnostic laparoscopy are also available, but they are used far less frequently for initial diagnostic work-up. In the literature, the accuracy of imaging in patients with acute abdominal pain usually is not expressed in terms of well-known parameters such as sensitivity, specificity, and predictive values because of the lack of adequate reference standards in many reports [10, 11].

The study was carried out at the Department of Radiology, Dhiraj Hospital, Vadodara. A total of 76 patients were selected for the study those were referred to radiology department of Dhiraj Hospital during the time period of august 2015 to august 2016.

The 76 patients were subjected to conventional radiography, contrast studies, USG, CT scan and MRI as needed and detailed work up of these patients was performed; their clinical history, relevant past history and any laboratory data recorded.

Out of 76 patients there were 44 (57.9%) male patients, 32 (42.1%) female patients. The spectrum of diseases included in the study were: Acute cholecystitis (15.8%), followed by pancreatitis and acute appendicitis (14.4%), Intestinal obstruction (13.1%), acute diverticulitis and malignancy (9.2%), inflammatory conditions (7.7%), Herniation, Midgut volvulus with malrotation, Necrotising enterocolitis, Hepato-biliary Disorders, Perforated Viscus, acute peritonitis (1.3%).

The geographic location was mostly from Vadodara city and surrounding towns, rest from adjoining areas of Madhya Pradesh, Maharashtra and Rajasthan.

There were 12 patients (15.8%) out of 76 patients of acute cholecystitis diagnosed with radiological investigations. Out of 12 patients there were 8 male patients and 4 female patients. Out of 16 patients those were referred to us there were 3 patients (3.6%) had who underwent surgery. Rest recovered after conservative management.

There were 10 (13.1%) cases referred to us with clinical suspicion of intestinal obstruction. There were 3 male patients and 7 female patients. In our study intestinal obstruction was more common in female patients. These results correlate well with other study [12] who reported figures of 44.8. Patients presented with complaints of abdominal pain, vomiting, constipation and some presented with bleeding P/R. We performed erect standing abdomen and left lateral decubitus view. In our study The presence of ≥ 2 air fluid levels, differential air fluid levels in the same loop of bowel more than 2 cm in height and a mean air–fluid level of >25 mm. in width on erect abdominal radiographs was considered highly suggestive of high grade obstruction [13-15]. We were able to diagnose intestinal obstruction from plain X-ray abdomen in 8 (80%)out of 10 patients who had high grade intestinal obstruction. 5 out of 8 (62.5%)patients had positive ultrasonography 2 (25%).of these 8 patients had free intra- peritoneal air (Associated small bowel perforation) on plain x-ray erect abdomen. These patients who had high grade intestinal obstruction were immediately operated. On ultrasonography there were dilated bowel

loops with to and fro peristalsis in 5 (62.5%) patients. In 2 patients (25%) ultrasonography was normal in which plain X-rays erect abdomen standing were positive. Ultrasonography results were equivocal in 1 patient (12.5%).Thus plain X- ray abdomen erect standing was more diagnostic as compared to ultrasonography. However, plain X-rays abdomen was not able to diagnose 2 patients (20%) who had low grade intestinal obstruction. In these patients USG were also normal. Thus USG did not give any additional benefit than plain X-rays abdomen. We subjected these 2 patients to enteroclysis study and were able to diagnose intestinal obstruction. All of these patients showed evident obstruction with dilated bowel loops and collapsed loops distal to obstruction (100%) with beak sign in 2 (20%). Hence CT was more effective method in patients with intestinal obstruction.

There were 2 patients (2.6%) with clinical suspicion of intussusception. There were 1 female patient and 1 male patient. Patients presented with complaints of abdominal pain, currant jelly stools. Palpable abdominal mass was present in none (0%) patients. We evaluated patients initially by ultrasonography. By USG we were able to diagnose intussusception in both patients. On ultrasonography we performed both longitudinal and transverse scan. On transverse scans most important sign we found was target sign with concentric ring like appearance with alternating hyper echoic and hypo echoic layers. Target sign was found in all both the patients (100%).On longitudinal scans most common sign we found was pseudo kidney/sandwich sign which was found in no patient. We were able to identify associated lead points only by ultrasound like lymphoma in 1 patient and inflammatory polyp in 2 patients which were later confirmed by CT Scan. Both the patients who were positive on USG were confirmed by plain X-ray abdomen standing.

One study [16] concluded that USG is more accurate and safe modality for diagnosing intussusception which also helps to detect lead points. Plain radiography and contrast enema has limited role in current scenario. Our findings were consistent with the study.

There was 1 (1.3%) patient of necrotizing enterocolitis. We investigated by plain X-ray abdomen AP view and if required lateral and left lateral decubitus views. We were able to suspect necrotizing enterocolitis in him patients by plain X-rays. Further investigation included USG. USG showed bowel wall thickening with altered vascular status due to infarction.

There were 11(14.4%) cases of acute appendicitis in our study which we diagnosed on ultrasonography which showed tubular, blind ended, non-compressible, non- peristaltic structure of mixed echogenicity in right iliac fossa with average diameter of >6 mm and associated probe tenderness in right iliac fossa in 8 cases. There was appendicolith in 1 patient as echogenic lesion with acoustic shadowing and associated appendicular perforation as periappendiceal fluid .Plain X-rays revealed appendicolith as calcified concretions in appendix. Plain X-ray abdomen was normal in two patients. Ultrasound proved out to be most useful modality in our study than X-Ray. CT Scan proved to be better than USG as all 11 cases were diagnosed by it along with apendicolith and fluid collection and fat stranding.

There were two patients 6 (7.7%) of inflammatory etiology. 3 were male patients and 3 were female. We performed ultrasound .There was inflammatory thickening noted in terminal ileum , cecal and ascending colon and there were multiple enlarged mesenteric lymph nodes noted, features diagnostic of infective/inflammatory etiology detected in 2 patients. Rest of the patients showed fat stranding with reactive inflammatory lymph nodes. 1 of the patients showed reactive inflammatory wall thickening as well (proved on biopsy). On histopathology report patient proved to be having tuberculosis of ileo-cecal junction.

There was one case of meconium ileus in neonate with meconium cyst formation and meconium peritonitis. Plain X-ray abdomen showed feature of distal small bowel obstruction with clear cut air fluid levels in muconium cyst and few calcified deposits in peritoneum. There was free gas under domes of diaphragm suggestive of perforation. We as well confirmed findings on ultrasonography which revealed obstruction with echogenic bowel contents features of distal bowel and formation of pseudo cyst as echogenic material lying outside bowel loops with associated calcification. Patient was operated and there was meconium cyst found in ileum with meconium peritonitis and small bowel obstruction with perforation. CT scan of the same patient showed a large collection with thin wall displacing the bowels posteriorly and calcification along the walls of the collection.

Findings of air fluid level in meconium cyst on plain X-ray in our study was consistent with other studies [15, 16].

There was one case of midgut volvulus with malrotation in our study. On plain X-ray there were features of distal bowel obstruction .Upper gastrointestinal barium examination revealed duodeno-jejunal flexure to the right of vertebral column and at lower than normal level of L1-L2.On ultrasonography color Doppler superior mesenteric vein was found to be left to superior mesenteric artery and whirlpool sign due to clockwise spiraling of mesentery and superior mesenteric vein around superior mesenteric artery seen suggestive of midgut volvulus with malrotation. CT of the same patient showed large gas-filled loop without haustral markings, forming a closed-loop obstruction and whirl sign (twisting of the mesentery and mesenteric vessels).Our findings were consistent with other study [15]. Thus our study concluded that CT is a better modality than any other imaging modality.

Conclusion

Radiological investigations play a key role in diagnosis and in many cases treatment of atraumatic cases of acute abdomen. CT however proved to be a better imaging modality with high sensitivity and specificity in diagnosis than conventional imaging.

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