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Computed tomography for assessing the etiology of non-traumatic acute abdomen: a prospective, observational, single centre study

Running Title: Computed tomography in non-traumatic acute abdomen

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Abstract

Background: Acute abdomen is the most common cause for surgical admission. Computed tomography (CT) scans are increasingly used to aid early diagnosis. Considering significant

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disease burden, role of CT in evaluation of patients with non-traumatic acute abdomen needs further evaluation. Thus, the present study was performed to evaluate role of CT scan in determination of etiological spectrum in non-traumatic acute abdomen.

Materials and Methods: The present study was a prospective, observational, single centre study over a period of 2 years. Patients were initially subjected to USG abdomen. Patients with positive findings on USG and those with clinically suspected abdominal cause of acute pain were subjected to CT abdomen. The categorical and continuous variables are represented as frequency (percentage) and mean (standard deviation, SD), respectively.

Results: In the present study, majority of patients were young males. In the present study, according to the systems affected, majority of the patients had urinary tract pathology (38.75%) followed by hepatobiliary pathology (30%), and GI pathology (17.50%). Of 43 patients that were managed surgically, the surgical findings correlated with CT findings in 41 patients. Moreover, the Ultrasonography (USG) findings correlated with CT findings in 44 patients. Thus, CT scan and USG were diagnostic in 95.35% and 55% patients.

Conclusion: In the present study, non-traumatic acute abdomen mainly affected urinary tract and hepatobiliary system. In majority of patients surgical findings correlated with CT findings. Moreover, the USG findings correlated with CT findings in limited number of patients.

Key Words: *Nontraumatic acute abdomen, Computed tomography, Ultrasonography*

I. Introduction

The term acute abdomen (AA) is referred to as a condition characterized by severe pain in abdomen which develops in duration of hours and commonly explains acute abdominal pain in a group of patients who are extremely unwell and complains of rigidity and tenderness in abdomen.[1] AA accounts for 5–10% of all presentations to the emergency department (ED) and can be caused by a variety of diseases ranging from mild and self-limiting to life threatening.[2] Therefore, the clinical diagnosis of AA can be challenging, because results of physical examination, clinical presentation, and laboratory examination are often nonspecific and non-diagnostic.[1]

AA is a symptom caused by a wide variety of disorders ranging from organic to functional.[3] The majority of cases of AA may be diagnosed clinically by the presence or absence of abdominal pain, abdominal tenderness, guarding, and rigidity, while roughly a quarter of patients are left with a non-specific etiology; however, this percentage has been reduced due

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to recent radiological imaging.[4] In patients with AA, mortality rate increases when their diagnosis is not determined in the ED.[5]

The differential diagnosis for AA is broad, encompassing gynecologic, gastrointestinal, urologic, vascular, and musculoskeletal conditions.[6] Currently, use of computed tomography (CT) to help in diagnosis in patients presenting with AA has increased and is associated with a high diagnostic accuracy with a sensitivity and specificity of approximately 90–95%.[7-11] The diagnostic efficacy of plain radiography in AA is poor, especially due to insufficient sensitivity.[12] Ultrasonography (USG) has developed a satisfactory role in evaluating the gallbladder in all patients and the appendix in children and pregnant women. However, CT has become the preferred modality for evaluation of the gut, mesenteries, omentum, peritoneum, and retroperitoneum unaffected by the presence of bowel gas and fat.[13]

Considering significant disease burden, role of CT in evaluation of patients with non-traumatic AA needs further evaluation. Studies from various parts of India have evaluated the role of CT in non-traumatic AA.[14,15] However, such studies from the perspective of central India are lacking. Thus, the present study was performed to assess the role of CT in determination of etiological spectrum in non-traumatic AA, correlate CT scan findings with surgical findings, and evaluate if CT scan yields any additional finding over USG abdomen in patients with non-traumatic AA.

II. Materials and Methods

This prospective, observational, single centre study was performed in the Department of Radiodiagnosis of a tertiary care teaching hospital situated in the Central India, over a period of 2 years (October 2020 to September 2022). The study began following approval of the Institutional Ethics Committee, and obtaining written informed consent of the patients. The study included patients of all age groups, either gender with non-traumatic AA, and those referred for CT evaluation of other diseases and accidentally found to have any pathology causing AA. While, patients with traumatic AA, and pregnant women were excluded.

At the time of enrolment, following parameters were noted in all the patients. Demographic characteristics included age, and gender. Clinical characteristics included presenting complaints, duration of pain, comorbidities, adverse habits, complications at presentation, treatment, and surgical/histopathological findings. Radiological characteristics included findings on USG abdomen and contrast-enhanced or non-contrast CT abdomen.

Based on the hospital data, a total of 85 patients presenting with AA were referred from inpatient wards and outpatient departments. These patients were initially screened for the study and were explained the study procedure in their native language. Of these, 3 patients

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did not give consent, and 2 had a history of trauma to abdomen. Excluding these 5 patients, those who were willing to participate and signed the informed consent document were enrolled in the study. A total of 80 patients were evaluated.

Following enrollment, a thorough history was taken, and demographics details were recorded. Parameters relevant to the study, including presenting complaints, duration of pain, comorbidities, adverse habits, complications at presentation, were noted in a specifically designed case report form. Patients were initially subjected to USG abdomen. Patients with positive findings on USG and those with clinically suspected abdominal cause of acute pain were subjected to NCCT/CECT abdomen.

CT scans were performed with Siemens Somatom Emotions 16 slice MDCT scanner. Serial axial section of abdomen and pelvis were taken from diaphragm to inferior border of symphysis pubis with a collimation of 5 - 7 mm and pitch of 1 to 1.5 depending on the length of coverage. Multi-planar reconstruction was done at intervals of 3-7 mm. Axial and coronal/sagittal reformatted images were studied. Appropriate, maximum intensity projection, minimum intensity projection and volume rendering techniques were also analyzed. Initially plain CT abdomen and pelvis axial sections were taken, followed by contrast study. lodinated IV contrast was routinely used except in patients suffering from medical renal disease and known anaphylaxis to medications. Serum creatinine was noted, and contrast was administrated only when serum creatinine was normal. Oral and rectal contrasts were used wherever necessary. The IV Contrast IOHEXOL (Omnipaque) 350 mg iodine/ml used at a dose of 1.75 ml/kg (Average 90 to 100 ml) by using power injector through IV cannula (18 Gauge) at a rate of 2ml/sec. To avoid bias in imaging recordings, two separate experienced radiologists interpreted the USG and CT findings.

Based on the findings, patients were managed either conservatively or surgically. The pathological findings were noted during surgical procedure and resected samples were sent for histopathological examination (HPE). Finally, the surgical or HPE findings were correlated with CT findings, and CT findings were correlated with USG findings.

Statistical analyses

Data was collected and descriptive statistics were used. The categorical and continuous variables are represented as frequency (percentage) and mean (standard deviation, SD), respectively.

III. Results

Majority of the patients were males (61.25%, male-to-female ratio of 1.58), and belonged to the age group of 21 – 30 years (23.75%). The mean age of the study population was 38.08 ±

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18.48 years (range: 5 to 72 years). The patients predominantly presented with abdominal pain (100%) followed by nausea/vomiting (52.50%), and fever (32.50%). Most of the patients had abdominal pain for < 3 days (57.50%), and the mean duration of pain was 2.9 ± 1.81 days (range: 1 to 10 days). Of 80 patients, 14 (17.50%) had diabetes mellitus, nine (11.25%) had hypertension, and five (6.25%) had malignancy. Moreover, 18 (22.50%) patients had adverse habits of alcohol and 11 (13.75%) had adverse habits of smoking (Table 1).

On CT evaluation, majority of the patients had urinary tract pathology (38.75%) followed by hepatobiliary pathology (30%), GI pathology (17.50%), and pancreatic pathology (13.75%). The most frequent urinary tract, hepatobiliary, GI, and pancreatic pathologies were renal calculi (48.39%), cholelithiasis / cholecystitis (62.50%), acute appendicitis (57.14%), and acute pancreatitis (100%), respectively (Table 2). Six patients presented with complications, with two (33.33%) patients each having acidosis and peritonitis (Table 3).

Majority of the patients were managed surgically (53.75%), while remaining required pharmacotherapy (46.25%). Surgically, most of the patients underwent laparoscopic cholecystectomy and percutaneous nephrolithotomy (each 11.25%; Table 4).

Of 43 patients managed surgically, the surgical findings correlated with CT findings in 41 (95.35%) patients. One patient each diagnosed as having acute appendicitis and cholelithiasis/cholecystitis on CT examination were found to have intussusception and cholangiocarcinoma, respectively on histopathological examination (Table 5). Moreover, the USG findings correlated with CT findings in 44 (55%) patients (Table 6).

IV. Discussion

The present study evaluated the role of CT scan in determining the etiological spectrum in non-traumatic AA. Moreover, the CT scan findings were correlated with the surgical findings and those observed in USG abdomen.

In the present study, according to the systems affected, majority of the patients had urinary tract pathology (38.75%). Moreover, renal calculus and cholelithiasis/cholecystitis (each 18.75%) were the most common causes of abdominal pain. Similar to the present study, Agrawal et al.[16] found that urinary tract pathologies (32%) were most frequent, while others included pathologies of hepatobiliary system (26%), GI system (26%), and pancreas (16%). Moreover, acute pancreatitis (16%), ureteric calculus (14%), and cholelithiasis/cholecystitis (14%) were the most frequent causes of AA. Further, Chanana et al.[17] reported that the most frequent causes of acute abdominal pain were ureteric colic (16.29%), urinary tract infection (12.50%), acute pancreatitis (10.98%), and acute appendicitis (10.61%). However, other studies have reported varying causes of non-traumatic AA. In their study, Jain et al.[18] found

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that perforative peritonitis (39.7%) followed by acute appendicitis (37.7%), and intestinal obstruction (14.2%) were most common causes of AA. Similarly, in a study done by Ray et al.,[19] perforative peritonitis was the most common cause for surgical intervention in patients with AA. The variation in the findings could be attributed to variation in the study population, while the predominance of ureteric calculi observed in the present study could be attributed to the topography and warm climate of central India.

In the present study, of 43 patients that were managed surgically, the surgical findings correlated with CT findings in 41 patients. One patient each diagnosed as having acute appendicitis and cholelithiasis/cholecystitis on CT scan were found to have intussusception and cholangiocarcinoma, respectively on HPE. Moreover, the USG findings correlated with CT findings in 44 patients. Thus, CT scan and USG were diagnostic in 95.35% and 55% patients. Similar to the present study, Julka et al.[14] observed that CT and USG were diagnostic in 81% and 61% patients, respectively.

In patients with acute appendicitis, USG was diagnostic in 2/7 (28.57%) patients, while CT diagnosed all patients with acute appendicitis. In their study, Julka et al.[14] reported that USG was diagnostic in 9/15 (60%) cases and CT, on the other hand, was diagnostic in 13/15 (87%) cases. NCCT missed 2 cases of acute appendicitis in thin patients with lack of intraperitoneal fat, as fat stranding was not seen in these cases. Our CT findings were in concordance with the findings reported by Malone,[20] and Lane and Mindelzun.[21] They also reported a sensitivity of 96%, specificity of 99%, and accuracy of 97% for the diagnosis of acute appendicitis on unenhanced helical CT. Sonography missed 3 cases of acute appendicitis due to the location of the appendix (retrocecal) which were seen in CT.

In patients with acute pancreatitis, USG was diagnostic in 5/11 (45.45%) patients, while CT diagnosed all the patients. Similar to the present study, Julka et al.[14] reported that definitive diagnosis was made by NCCT in all of the 7 presenting cases. Similar findings were reported by Siegel et al.,[22] as compared to USG, which could only diagnose 3 cases (42%), while it was supportive in 2 cases (30%).

In patients with acute cholecystitis, USG was diagnostic in 14/15 (93.33%) patients, while CT diagnosed all the patients. Contrarily, Julka et al.[14] reported that USG was diagnostic in all of the presenting cases, while CT was diagnostic in 4/6 (67%) cases and gave supportive evidence in the rest of the cases, thus ensuring USG as a significant modality for diagnosing acute cholecystitis as a cause for AA.

In patients with acute cholecystitis, CT was diagnostic in all the patients, while USG was able to diagnose only 7/11 patients. Similarly, Julka et al.[14] reported that USG was diagnostic in

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5/8 (63%) cases, while CT scan diagnosed all the cases. Nimkin et al.[23] reported similar sensitivity of USG (77%). NCCT could pick up calculi and proximal hydroureter in patient with normal USG findings.

In patients with acute intestinal obstruction, CT was diagnostic in all the patients, while USG was able to diagnose only 2/5 (40%) patients. Similarly, Julka et al.[14] observed that USG was diagnostic in 4/6 (67%) cases and had 50% accuracy in determining the etiology and site of obstruction. While, CT was diagnostic in 5/6 (83%) cases. Meiser and Meissner[24] reported similar findings in their study, except for the identification of the etiology of obstruction for which they reported USG values as low as 20% and 23%, respectively.

The study had certain limitations, including a relatively small number of patients admitted in a single centre, so that future studies of larger sample size are required to confirm the findings; severity of pain was not evaluated; and length of hospital stay, and outcome were not assessed.

V. Conclusion

To conclude, non-traumatic AA mainly affected urinary tract and hepatobiliary system. Renal calculus and cholelithiasis/cholecystitis followed by ureteric calculus, acute pancreatitis, liver abscess, and acute appendicitis were mainly implicated in AA. In majority of patients, surgical findings correlated with CT findings. Moreover, the USG findings correlated with CT findings in limited number of patients. Thus, CT scan and USG were diagnostic in 95.35% and 55% patients, respectively.

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Competing interest:

There is no Competing interest.

Authors contribution:

All authors in our study contributed to the data collection of the patients.

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Table 1. Demographics and clinical characteristics

Characteristics	N (=80)	%
Age groups (years)		
0 – 10	5	6.25
11 – 20	11	13.75
21 – 30	19	23.75
31 – 40	7	8.75
41 – 50	15	18.75
51 – 60	9	11.25
> 60	14	17.50
Gender		
Male	49	61.25
Female	31	31.75
Presenting complaints		
Abdominal pain	80	100.00
Nausea/Vomiting	42	52.50
Fever	26	32.50
Dysuria/Hematuria	18	22.50
Constipation	6	7.50
Duration of pain		
< 3 days	46	57.50
≥ 3 days	34	42.50
Comorbidities		
Diabetes mellitus	14	17.50
Hypertension	9	11.25
Malignancy	5	6.25
Adverse habits		
Alcohol	18	22.50
Smoking	11	13.75

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Table 2. Causes of non-traumatic acute abdomen

Causes	**N (=80)**	**%**
Systems affected		
Urinary tract pathology	31	38.75
Hepatobiliary pathology	24	30.00
GI pathology	14	17.50
Pancreatic pathology	11	13.75
Urinary tract pathologies	**N (=31)**	**%**
Renal calculus	15	48.39
Ureteric calculus	11	35.48
Vesical calculus	5	16.13
Hepatobiliary pathologies	**N (=24)**	**%**
Cholelithiasis / Cholecystitis	15	62.50
Liver abscess	9	37.50
GI pathologies	**N (=14)**	**%**
Acute appendicitis	8	57.14
Intestinal obstruction	5	35.71
Intestinal perforation	1	7.14
Pancreatic pathologies	**N (=11)**	**%**
Acute pancreatitis	11	100

Table 3. Complications at presentation

Complications	**N (=80)**	**%**
Acidosis	2	2.5
Peritonitis	2	2.5
Sepsis	1	1.25
Pancreatic pseudocyst	1	1.25

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Table 4. Treatment received

Treatment	N (=80)	%
Pharmacotherapy	37	46.25
Laparoscopic cholecystectomy	9	11.25
Percutaneous nephrolithotomy	9	11.25
Appendectomy	8	10.00
Shock wave lithotripsy	5	6.25
Transurethral endoscopic lithotripsy	5	6.25
Flexible ureteroscopy	3	3.75
Pharmacotherapy + Surgical drainage	2	2.50
Exploratory laparotomy	1	1.25
Surgical resection + anastomosis	1	1.25

Table 5. Correlation between CT and surgical findings

Correlation	CT findings	Surgical findings	Total
N	41	43	43
%	95.35	100	100

Table 6. Correlation between USG and CT findings

Correlation	USG findings	CT findings	Total
N	44	78	80
%	55.00	97.50	100