

Role of computed tomography (CT) in the evaluation of acute abdomen

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Abstract

Background: The term ‘Acute Abdomen’ refers to any clinical condition characterised by severe abdominal pain that develops over a period of hours. For diagnosing the cause of ‘acute abdomen’, CT is superior to clinical evaluation basic laboratory investigations and inconclusive imaging examination regardless of duration of signs and symptoms in both traumatic and non-traumatic patients. **Aims and Objectives:** To establish the value of CT as imaging modality of choice in evaluation of acute abdomen and to triage of patients of acute abdomen and decrease of negative laprotomies. It was also aimed to establish specific diagnosis to support initial clinical examinations. **Materials and Methods:** 50 patients of suspected acute abdomen; established by clinical findings and subsequent course referred to Department of Radiodiagnosis, Patna Medical College and Hospital, Patna, for CT scan during the period of December 2013 to November 2015, comprised the material for the present study which fulfilled the inclusion criteria and do not come under the ambit of exclusion criteria. The usual CT scan protocol comprised of contiguous 5mm transaxial sections from dome of diaphragm to pubic symphysis after administration of oral and intravenous contrast media. Reconstructed images (Sagittal and Coronal) were generated from the data set. In our institute, we have used Trazograf (60%) 20 ml (Diatrizoate meglumine USP) as oral contrast medium. And for intravenous contrast medium, we used either Iopamidol Injection USP (Lek-Pamidol) or Iohexol (Omnipaque) in dose of 1-2 mg/kg body weight. Serial CT sections of abdomen was obtained in each case using fourth generation spiral CT scanner GEE Bright speed elect (16 slice). **Results and Observations:** The collective data was analysed for CT findings of traumatic as well as non-traumatic group which presented clinically as acute abdomen. The total number of cases analysed was 50. **Conclusion:** Computed tomography is an important modality in the evaluation of acute abdomen and may avoid unnecessary exploratory laprotomies. It may help in establishing specific diagnosis and grading severity in some diseases. It is also fast and cost effective.

Key Word: Computed tomography (CT), acute abdomen, traumatic, nontraumatic

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INTRODUCTION

The term ‘Acute Abdomen’ refers to any clinical condition characterised by severe abdominal pain that develops over a period of hours¹. It is in many cases a medical emergency, requiring urgent and specific diagnosis. Computed tomography has proved its value as

the imaging modality of choice in evaluation of acute abdominal trauma with contribution towards triage of patients and decrease of negative exploratory laprotomies. CT is also indicated when there is deterioration of patient condition or non-response to initial clinical therapy. Computed tomography provides an excellent means to detect a number of acute abdominal disorders and allows rapid assessment with high diagnostic accuracy. With modern scanners, CT has broadened its wings and its accuracy has increased over the years. The advent of multi detector computed tomography (MDCT), CT angiography and perfusion studies is an example of this. For diagnosing the cause of ‘acute abdomen’, CT is superior to clinical evaluation basic laboratory investigations and inconclusive imaging examination regardless of duration of signs and symptoms in both traumatic and non-traumatic patients

MATERIALS AND METHODS

50 patients of suspected acute abdomen; established by clinical findings and subsequent course referred to Department of Radiodiagnosis, Patna Medical College and Hospital, Patna, for CT scan during the period of December 2013 to November 2015, comprised the material for the present study which fulfilled the inclusion criteria and do not come under the ambit of exclusion criteria.

Inclusion criteria: Fresh and undiagnosed patient which presented in Patna Medical College and Hospital, Patna with the following criteria:

1. A patient of acute abdomen with equivocal X – ray and/or Ultrasound findings.
2. A patient with trauma and with suspicion of abdominal injury.

Exclusion criteria: A patient which presented in Patna Medical College and Hospital, Patna with the following criteria were not included in the present study:

1. A patient of acute abdomen who had already been diagnosed.
2. patients who had severe previous allergic reactions to ionic contrast media.
3. A patient who had renal insufficiency (creatinine level >2mg/dl).

No attempts was made to influence the referring clinicians on the preference of CT over other modalities. Most of these patients had previously undergone US. CT was performed when the X-ray / US findings were inconclusive when accurate topographic evaluation was required. The usual CT scan protocol comprised of contiguous 5mm transaxial sections from dome of diaphragm to pubic symphysis after administration of oral and intravenous contrast media. Thinner sections were taken for the pelvic region and at the region of interest. Reconstructed images (Sagittal and Coronal) were generated from the data set. The scanning completed within short time and the whole examination finished within 10-15 minutes apart from preparation time for CT scanning. Oral contrast medium was avoided only when clinically contraindicated and in patients with suspected bowel perforation or repeated vomiting. In patients who need the abdominal CT performed urgently, oral water soluble iodinated medium was given to obtain a quicker,

thorough opacification of the gastrointestinal tract. The stomach was aspirated before the contrast is given to remove air and any stomach content/debris. In our institute, we have used Trazograf (60%) 20 ml (Diatrizoate meglumine USP) as oral contrast medium. We prepared oral solution by mixing 20 ml Diatrizoate meglumine in 1.5 liter of water for upper or lower abdomen and 20 ml Diatrigoate meglumine in 2 liter of water for whole abdomen. Intravenous administration of low osmolar contrast medium was delivered rapidly in bolus; it was only avoided when there was clinical contraindication, for instance renal failure, or history of adverse reactions to iodinated contrast In our institute; we used either Iopamidol Injection USP (Lek-Pamidol) or Iohexol (Omnipaque) in dose of 1-2 mg/kg body weight. For appendiceal CT, the patient was moved on to a table and placed in the right side down decubitus position. Upto 1000 ml of a 3% meglumine diatrizoate solution (Gastrograffin) was infused through the colon via gravity-drip through IV tubing and a soft rubber rectal catheter, without use of a ballon. The patient was then placed supine, and a digital abdominal radiograph was obtained to localize caecal position and confirm caecal opacification. CT series covering approximately 15 cm of the abdominopelvic junction was performed with 5 mm collimation and 5 mm image spacing. The scan is centered about 3 cm above the caecal tip. Serial CT sections of abdomen was obtained in each case using fourth generation spiral CT scanner GEE Bright speed elect (16 slice). Through image manipulation programs, within a region of interest the mean of CT value was calculated and displayed for recording hypoattenuated vs hyperattenuated lesions. The collective data was analysed for CT findings in 50 cases of traumatic as well as non-traumatic group presented clinically as acute abdomen.

RESULTS AND OBSERVATION

The present study consists of 50 cases of acute abdomen, wherein the principal radiologic study was computed tomography, with short clinical details. Although the final diagnosis was established by post-operative evaluation in many instances effort was made to predict the diagnosis on CT characteristics.

Table 1: Age incidence of acute abdomen in present study (n=50)

Age group (in years)	Number of cases	Percentage (%)
0 -10	1	2.0
11-20	9	18.0
21-30	8	16.0
31-40	10	20.0
41-50	8	16.0
51-60	8	16.0
>60	6	12.0
Total	50	100

The majority of cases were in the range of second to fifth decade of life, with peak incidence (20%) in age group of 31-40 years, followed by age group of 11-20 years. Of all the cases studied, the youngest and oldest case were one year (female) and 78 years (male) of age.

Table 2: Sex incidence in 50 patients of acute abdomen in present study

Sex	Number of cases	Percentage (%)
Male	29	58.0
Female	21	42.0

The above table shows the sex incidence, where 58% (29 cases) were males and 42% (21 cases) were females. The ratio between male and female cases was 1.38:1 (or nearly 3:2) in the study.

Table 3: Distribution of acute abdomen cases in present studies (n=50)

Group	No of cases	Percentage (%)
Traumatic	10	20.0
Non-traumatic	40	80.0

Out of these 50 cases of acute abdomen, the non-traumatic conditions constituted largest category of 40 cases (80%) as shown in Table 3. The traumatic cases were lesser in the present study, constituting 10 cases (20%) of the total

Table 4: Abdominal organs injury detected by CT in trauma cases (n=10).

Organ maxim all traumatised	Number of cases of organ traumatized (isolated+combination)	Total number of cases (incl. combination cases)	Percentage (%)
Spleen	2+(2)	4	40.0
Liver	2+(1)	3	30.0
Kidney	1+(1)	2	20.0
Pancreas	0+(1)	1	10.0
Multiple organ (combination)	(3)		30.0

Table 4 further illustrates the distribution of cases of acute traumatic abdomen which constituted 10 cases (20%) from (Table 3). Spleen was the most common organ traumatized, accounting for 40% of the total. The other injured solid organ were liver, kidney, pancreas constituting 3,2,1 cases respectively. Combination (multi-organ) injury represented 3 cases (30%) of the total traumatic acute abdomen cases in which spleen, liver were involved in two cases, while kidney and pancreas were involved in one case.

Table 5: Distribution of Non-traumatic acute abdomen cases in present study based on etiology (n=40)

Etiology	Number of cases	Percentage (%)
1)Inflammatory/infective		
a) Acute Pancreatitis	10	25.0
b) Gall bladder and CBD related entity	5	12.5
c) Appendicitis	2	5.0
d) Diverticulitis	1	2.5
2)Perforation		
Perforation of hollow viscus	2	5.0
3)Obstruction		
a) urinary system	4	10.0
b) hollow viscus (bowel)	5	12.5
4)Vascular causes	5	12.5
5)Post.-op. complication	2	5.0
6)Others	4	10.0

Among 40 cases of non-traumatic acute abdomen, 10 cases (25%) were of acute pancreatitis. Obstruction cases were next in order, constituting nine cases. Out of these nine cases, obstruction of hollow viscus (bowel) were 5 cases and constituted 12.5% of total nontraumatic acute abdomen cases. Gall bladder and CBD related inflammatory/infective pathologic entity accounted 5 cases (12.5%). Vascular causes also accounted for 5 cases.

Table 6: CT based injury severity for Spleen trauma (n=4).

Grade	Number of cases	Percentage (%)
I	-	-
II	-	-
III	3	75.0
IV	1	25.0

Table 6 shows that grade III injury was seen in most cases of splenic trauma, accounting for 3 out of 4 cases (75.0%)

Grade IV injury was seen in one case. No case was seen of grade I or II injury.

Table 7: Hepatic trauma classification on CT features in present study (n=3).

Class	Number of cases	Percentage (%)
I	-	-
II	1	33.3
III	2	66.6
IV	-	-
V	-	-

Most of the patients had class III hepatic injury (Parenchymal hematoma > 3 cm and fractures extending to porta). Grade III injury was seen in 66.6% of the hepatic trauma cases.

Table 8: Age and sex incidence of acute pancreatitis in the present study (n=10)

Age group (in years)	Sex		No. of cases
	Male	Female	
0-10	0	0	0
11-20	0	0	0
21-30	2	0	2
31-40	1	0	1
41-50	2	1	3
51-60	1	1	2
>60	1	1	2

Table 8 shows a male predominance in the acute pancreatitis cases studied. Out of the total 10 cases studied, there were 7 male patients in various age group while 3 females patients had acute pancreatitis who underwent CT scanning. The maximum acute pancreatitis cases were from age group of (41-50) years. All the female cases were aged more than 40 years, while male cases were of different age group. No cases of acute pancreatitis were reported in first and second decade.

Table 9: Distribution of cases of acute pancreatitis based on Modified CT severity index (CTSI) (n=10).

Modified CTSI score	Number of cases	Percentage (%)
0-2	0	0.0
4-6	2	20.0
8-10	8	80.0

Out of 10 cases of acute pancreatitis, the majority of cases (80%) were having modified CTSI score of 8-10 (severe pancreatitis). Two case of pancreatitis were noted having modified CTSI score of 4-6.

DISCUSSION

CT scanning of the abdomen and pelvis is often the preferred imaging test for evaluating acute abdomen, especially with modern scanners, CT offers clear anatomic delineation, better demonstrates retroperitoneal pathologies, and has fewer limitations especially in acute abdomen. The use of intravenous contrast provides

additional information on pathologic identification (FL Chan, K.S. Tai, 1998). Multi detector computed tomography (MDCT), CT angiography and perfusion studies with modern scanners have further added wings to its dimensions. Acute abdomen can be divided into two broad categories Traumatic acute abdomen Trauma causes an estimated 10% worldwide deaths and is third commonest cause of death after malignancy and cardiovascular disease². The sensitivity and specificity of CT for detecting bowel and mesenteric injury are approximately 80%, while for solid organ injuries eg. Spleen, liver, pancreas, approach 100%³. Non Traumatic acute abdomen Non-traumatic acute abdomen can be divided into four broad categories Inflammatory/infective pathologies Inflammation of appendix, pancreas, gall bladder, diverticulitis, pelvic inflammatory disease Acute epiploic appendagitis is an uncommon cause of abdominal pain whose diagnosis is primarily based on computed tomography findings (Vikram S. Dogra and Shwetta Bhatt,2009).⁴ Perforation of hollow viscus organ Obstruction to pancreaticobiliary tree, urinary system, bowel Vascular causes: Gastrointestinal bleeding and acute mesenteric ischemia are conditions that generally require urgent and accurate diagnosis. In this setting multi detector CT plays an important role. (Seung Soo Lee, Seung Ho Park,2013).⁵ The present study consisted of 50 cases of ‘acute abdomen’, wherein principal radiologic study was computed tomography, with short clinical details. Although the final diagnosis was established by post operative evaluation in many instances, an effort was made to predict the diagnosis on CT characteristics. The findings of the study is summarized below The majority of cases were in second to fifth decade of life , with peak incidence (20%) in age group of 31-40 years, followed by age group of 11-20 years. The number of males were more than females in ratio of approximately 1.38:1(nearly 3:2) in present study. Out of these 50 cases of acute abdomen incidently 80% patients were having nontraumatic entities and 20% patients were of traumatic conditions The nontraumatic entities of acute abdomen constituted predominant category, out of which acute pancreatitis were largest group forming 25% of the total 40 non-traumatic acute abdomen cases. Obstruction cases were next in order, constituting 9 cases .Out of 9 cases, obstruction of hollow viscus (bowel) were 5 cases and constituted 12.5% of total nontraumatic acute abdomen cases. Gall bladder and CBD related inflammatory/infective pathologic entity accounted 5 cases (12.5%).Vascular causes also accounted for 5 cases. The trauma resultant acute abdomen constituted 10 cases (20% of total acute abdomen cases).Out of which, the maximally injured organ was the spleen constituting 4 cases (40%). The other injured solid organ were liver,

kidney, pancreas which constituted^{3,2,1} cases respectively. The spleen was the most commonly injured abdominal organ in 40% cases. In CT based trauma classification³ out of 4 patients (75%) had grade-3 splenic injury. The liver was the next frequently injured solid organ in present study after splenic injury. Grade III was the most common CT grade based on CT findings, constituting 66.6% of all traumatic hepatic injury cases. Multi-organ (combination) injuries were also common in trauma resultant acute abdomen cases. 3 cases (30%) had injury in multiple organ. CT protocols were custom-tailored to optimally show all of the suspected injuries, or rule them out. In addition, the CT images were more carefully and systematically scrutinized so as not to miss additional injuries after the first or most prominent injury has been detected. CT today is considered by far the most sensitive imaging modality and has become the procedure of choice in the evaluation of patients suspected of having acute pancreatitis. Its role in the initial diagnosis staging prognostic evaluation of complications and follow-up is significantly established. Out of 40 cases of non-traumatic acute abdomen, the entity of acute pancreatitis constituted largest category of 25%. In most cases the entire pancreas was diffusely enlarged its contour turned irregular and the parenchyma appeared heterogeneous due to varying degree of necrosis. The peripancreatic fat showed haziness with a slight increased in density and often mild thickening of the adjacent facial planes, alongwith peripancreatic collection. With the seriousness of pancreatitis and the difficulty in predicting the outcome, staging of acute pancreatitis is a method for predicting the outcome of patients. In the present study, staging of acute pancreatitis was based on modified CT severity index (CTSI) score in present study (n=10). Out of 10 cases of acute pancreatitis, the majority of cases (80%) were having modified CTSI score of 8-10(severe

acute pancreatitis).The other entities like acute cholecystitis, acute appendicitis and operative fluid/pus collections were also encountered as presenting 'acute abdomen' and these cases were examined by CT regardless to the duration of clinical course.

CONCLUSION

For evaluation of 'acute abdomen', the computed tomography (CT) with standard protocols has been adjudged superior, to clinical evaluation and conventional imaging investigations, regardless of the duration of signs and symptoms or any pre-existing abdominal disease. The major impact in application of CT is the high confidence of this imaging modality in excluding abnormalities in a single study. It has not only avoided un-necessary exploratory laprotomy in patients with acute abdomen but has enabled triage of these patients rapidly and safely. The trend towards availability of CT in emergency department and likelihood of utilizing quick survey scanning are expected to make use of sensitivity and specificity of 'computed-tomography' to rationalize the overall cost of patient care.

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