

Role of Unenhanced CT scan of Non-Traumatic Acute Abdomen and its comparison with Ultrasonography

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Abstract: Acute abdomen range from benign self-limiting to life threatening diseases. Sonography has become the 'stethoscope for acute abdominal pain. Ultrasonography has simplicity, easy availability, portability, inexpensiveness, non-invasive nature, quickness and radiation free. The advent of helical computed tomography provided the combined advantages of speed and seamless coverage of the abdomen. The intraperitoneal or extra peritoneal fat that provided the most crucial information & would be infiltrated in acute abdominal disease. To Study the role & importance of plain CT scan in the initial assessment of non-traumatic acute abdomen and Comparison of this study with ultrasonography. The Study was conducted in our Department of Radio-diagnosis in 18 months. NCCT abdomen of 75 patients was performed after ultrasound screening of the abdomen. The maximum number of patients belongs to 18-28 years' with male preponderance. The most common identifiable causes were acute appendicitis (20%), acute urinary colic (11%), acute pancreatitis (10%), acute cholecystitis (8%) & intestinal obstructions (8%) and indeterminate (21%). Sensitivity of Sonography was 60% for appendicitis, while sensitivity of NCCT was 87%. Acute pancreatitis was diagnosed in all cases by NCCT while Sonography could diagnose 42% only. Acute cholecystitis was diagnostic in all cases by USG, while NCCT was diagnostic in 67% cases thus USG is a significant modality for Acute Cholecystitis. NCCT for Ureteric Colic was diagnostic in all patients, while sonography was able to diagnose 63% only. Etiology of Acute intestinal obstruction can be diagnosed by NCCT. Overall accuracy, sensitivity, specificity for pneumoperitoneum (bowel perforation) was found to be 100%. Ultrasonography for Tubo-ovarian masses was diagnostic, while Hiatus hernia, Diverticulitis and gossypiboma were completely overpowered by NCCT over USG, which gave 100% positive predictive value of NCCT in diagnosing these cases. We conclude that the Sonography is a very sensitive modality for Hepatobiliary, Renal, Gynecological emergencies. Nevertheless, since a sonographic examination may be unsatisfactory in a substantial proportion of instances, there should be no hesitation in resorting to an NCCT examination to demonstrate the precise cause of acute abdomen.

Keywords: Sonography, NCCT, Acute Abdomen, Appendicitis, Uretric Colic, USG, Computed Tomography, Intestinal Obstruction, Diverticulitis, pneumo-peritoneum, Gossypiboma.

INTRODUCTION

Acute abdomen are versatile and range from benign self-limiting disorders (viz. gastritis, mesenteric adenopathy) to life threatening illnesses (bowel infarction, necrotizing pancreatitis). Establishing the cause of the acute pain is the primary consideration & this has been always dealt with a combined clinical, laboratory and imaging approach [1].

Sonography has procured compliance in examining patients for acute abdominal pain and became the 'stethoscope' of the abdomen, the sonologist could often help to provide a specific diagnosis, to distinguish surgical from medical disease (Filly) [2]. Ultrasonography, given its simplicity, easy availability, portability, inexpensiveness, non-invasive nature and quickness in the diagnostic examination was

particularly valuable in patients for whom radiation exposure was a major concern. These included children, pregnant women and individual of reproductive age [3] However; ultrasonography is an operator-dependent technique with limitation in patients with obesity and a large amount of bowel gas.

The advent of helical computed tomography provided the combined advantages of speed and seamless coverage of the abdomen with an outstanding spatial resolution of tissues. Malone *et al.* in [4] first described the unenhanced CT technique that was subsequently evaluated by Lane *et al.*[5] using helical CT for diagnosing suspected acute appendicitis. No oral or IV contrast material was administered as they believed that it was the intraperitoneal or extraperitoneal fat that provided the most crucial information & would be expected to be infiltrated in most patients with an Acute abdominal disease. The rapid unenhanced computed tomography (RUC) was found to be an excellent first-line tool in these patients [6]. Previously, many of the patients admitted in ED had to undergo unnecessary and unwanted surgical procedures to get rid of the pain. Now USG and CT have proved themselves amongst the major contributing modalities to evaluate the cause of acute abdominal pain

Sonography has developed a niche in evaluating Gall bladder [4], appendix in children and reproductive age group women. In diagnosing Hepatobiliary, gynecological conditions ultrasonography is highly sensitive and specific, as it twists down the negative laparotomy rates and is always cost effective, portable and noninvasive with no side effects and requires no patient preparations.

CT has evolved as a premier technique for triaging [7, 8] almost all the patients. It provides useful diagnostic information for omentum, mesenteries, gut, and peritoneum etc., with insignificant effect by the bowel gas and fat [7,8]. Non-contrast computed tomography (NCCT) gained important role with high sensitivity (98%) and specificity (96% - 98%) for

detection of urinary stones [9], acute pancreatitis, hiatus hernia, pneumo peritoneum, diverticulitis, so on and so forth.

Red flags that raise suspicion of a serious pathology

Rigid abdomen associated testicular pathology, tenderness, h/o haematemesis / malena, dehydrated patient, hypotension, confused state and shock.

AIM AND OBJECTIVES

To Study the role & importance of plain CT scan in the initial assessment of non-traumatic acute abdomen and Comparison of this study with ultrasonography. To ascertain the efficacy and importance of Unenhanced CT Scan in diagnosing the cause of Non-Traumatic Acute Abdomen.

MATERIALS AND METHODS

The Study was conducted in the Department of Radio-diagnosis at Index Medical College, Hospital and Research Centre, Indore (M.P.) during the period of 18 months, from March 2015 to August 2016. NCCT abdomen of 75 patients was performed after ultrasound screening of the abdomen with detailed clinical history.

Inclusion and Exclusion criteria

Patients above 18 years presenting with Acute Abdomen without history of Trauma were included, while traumatic, pediatrics and pregnant patient were not taken in our study

STATISTICAL METHOD

Data analyses were performed using version 17.0 of the Medcalc software program. Sensitivity, Specificity, Positive and Negative likelihood ratios were calculated. P value <0.05 was considered statistically significant. (MedCalc Software bvba, Acaciaaan, Ostend, Belgium).

OBSERVATIONS AND RESULTS

This table no 1 shows appendicitis was the most common of all the diseases for acute abdomen.

Table-1: Distribution of disease based on the final diagnosis (n=75)

Disease	No. of cases	%
Acute Appendicitis	15	20
Acute Pancreatitis	07	09
Acute Cholecystitis	06	08
Acute Ureteric Colic	08	11
Non-reducible hernia	04	05
Other Abscess	02	03
Intestinal obstruction	06	08
Intestinal perforation	03	04
T.O. Mass	02	03
Diverticulitis	01	01
Gossypiboma	02	03
Hiatus hernia	03	04
Non-specific abdominal pain	16	21
Total	75	100

Table-2: Confirmatory diagnosis of Acute Appendicitis based on USG & NCCT (n = 15)

Acute Appendicitis	Confirmatory Diagnosis		Total no. of cases
	Based on USG	Based on NCCT	
Number	09	13	15
Percentage	60	87	100.00

This table elicits more efficacy of NCCT in diagnosing Appendicitis in comparison to USG (Table-2). This table reveals that NCCT had high accuracy in diagnosing cases of Acute Pancreatitis (Table-3). This table formulate low diagnostic performance of NCCT

for Acute Cholecystitis diagnosis ($P > 0.05$) and thus USG is a statistically significant Imaging modality (Table-4). This table shows 100% accuracy of NCCT in diagnosing acute Ureteric Colic (Table-5).

Table-3: Confirmatory diagnosis of Acute Pancreatitis based on USG and NCCT (n= 7)

Acute Pancreatitis	Confirmatory Diagnosis		Total no. of cases
	Based on USG	Based on NCCT	
Number	03	06	07
Percentage	43	86	100.00

Table-4: Confirmatory diagnosis of Acute Cholecystitis based on USG & NCCT (n= 06)

Acute Cholecystitis	Confirmatory Diagnosis		Total no. of cases
	Based on USG	Based on NCCT	
Number	06	04	06
Percentage	100.00	67	100.00

Table-5: Confirmatory diagnosis of Acute Ureteric colic based on USG & NCCT (n=8)

Acute Ureteric colic	Confirmatory Diagnosis		Total no. of cases
	Based on USG	Based on NCCT	
Number	05	08	08
Percentage	63	100.00	100.00

Table-6: Confirmatory diagnosis of Intestinal Obstruction based on USG & NCCT (n=06)

Intestinal Obstruction	Confirmatory Diagnosis		Total no. of cases
	Based on USG	Based on NCCT	
Number	04	05	06
Percentage	67	83	100.00

This table reveals that NCCT is slightly more efficient in diagnosing Bowel Obstruction (Table-6). This table shows NCCT is statistically better than USG

for the diagnosis of Intestinal perforation ($P < 0.05$) (Table-7).

Table-7: Confirmatory Diagnosis of Intestinal Perforation

Intestinal Perforation	Confirmatory Diagnosis		Total no. of cases
	Based on USG	Based on NCCT	
Number	01	03	03
Percentage	33	100.00	100.00

Table-8: Less Frequent Diseases and their Imaging Evaluation

Disease Modality		Confirmatory Diagnoses		Total no. of cases
		Based on USG	Based on NCCT	
T-O Mass	Number	02	00	02
	Percentage	100.00	0.00	100.00
Abscess	Number	01	01	02
	Percentage	50.00	50.00	100.00
Non reducible Hernia	Number	04	01	04
	Percentage	100.00	25.00	100.00
Hiatus Hernia	Number	00	03	03
	Percentage	0.00	100.00	100.00
Gossypiboma	Number	00	02	02
	Percentage	0.00	100.00	100.00
Diverticulitis	Number	00	01	01
	Percentage	0.00	100.00	100.00

This table shows overall sensitivity and efficacy of NCCT statistically analyzed was

significantly better than USG in cases of hiatus hernia, gossypiboma and diverticulitis (Table-8).

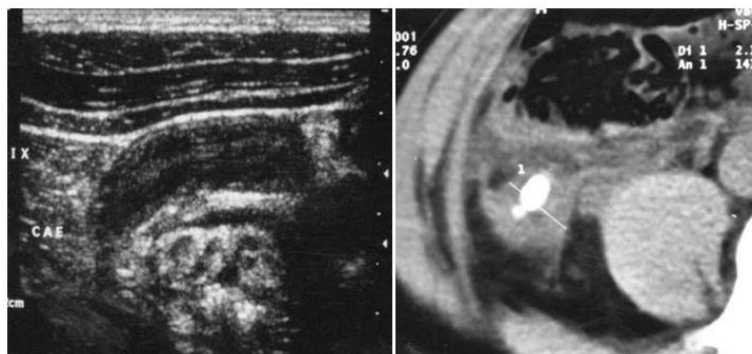


Fig-1 A and B: USG image showing inflamed dilated blind ending tubular Appendix. CT scan image depicting inflamed appendix (2.1cm) with surrounding fat stranding, right Psoas sign and Appendicolith

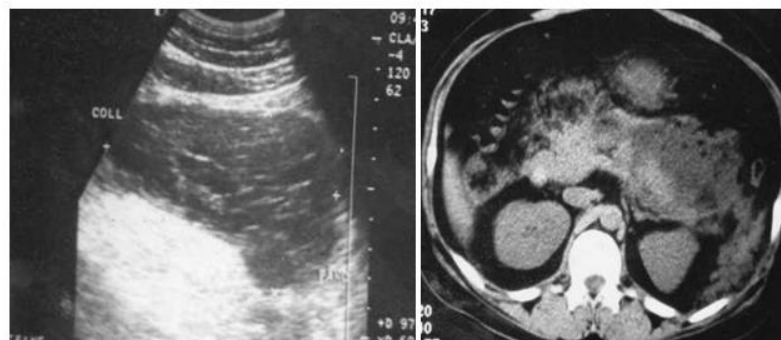


Fig-2 A & B : USG image shows hypoechoic septated collection in lesser sac with non- visualization of Pancreas. CT Scan image eliciting collection in Left anterior pararenal space and bulky tail of Pancreas with adjacent fat stranding

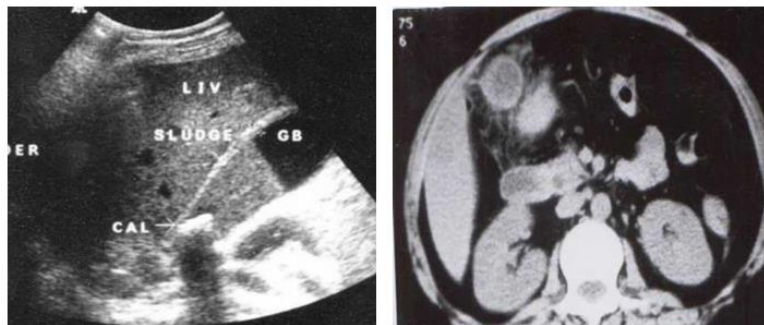


Fig-3 A & B : Sonography showing hyperechoic sludge & calculus in GB, suggesting Cholelithiasis. NCCT image showing pericholecystic fat stranding in a case of Cholelithiasis

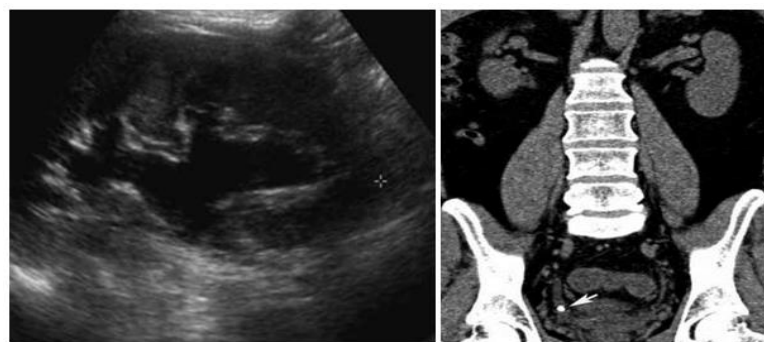


Fig-4 A & B : USG scan showing Right side Hydronephroureterosis NCCT reveals Right UVJ calculus in same patient



Fig-5 A & B : USG showing Fluid filled, dilated small bowel loops suggesting Obstruction CT Scan image shows concentric thickening of caecum with perilesional fat stranding suggesting cause of Bowel obstruction



Fig-6: NCCT image showing presence of ascites with small amount of free air suggesting Perforation Peritonitis

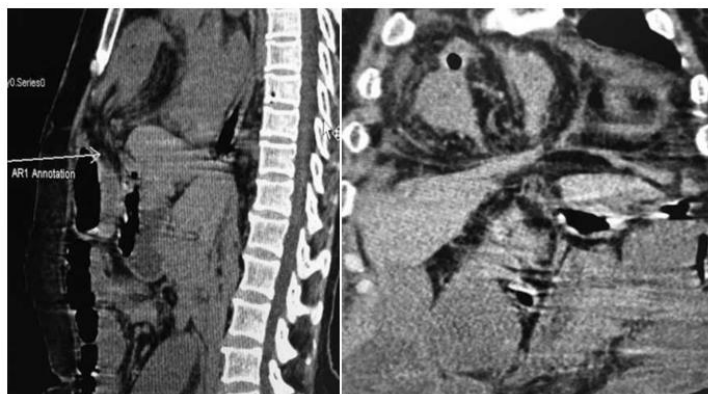


Fig-7 A & B : Saggital & Coronal NCCT images reveal herniation of bowel sac into the thoracic cavity through a defect, suggesting Non-reducible Hernia



Fig-8 A & B : USG of the pelvis showing echogenic bright streak posterior to the uterus (*) having Posterior Acoustic Enhancement. Contrast CT shows periphery enhancing round to oval shaped soft tissue lesion having central hypodense areas & gas bubbles

DISCUSSION

A total of 75 patients with acute abdominal pain were included in this study. The maximum number (40%) patients belonged to 18-28 years' (Younger age group) with male preponderance. The most common identifiable causes were acute appendicitis (20%), acute urinary colic (11%), acute pancreatitis (10%), acute cholecystitis (8%) & intestinal obstructions (8%). The cause was indeterminate (non-specific) in as many as 21% of these patients, who showed no abnormality on any investigation or follow up. Brewer *et al.* [10] also reported a similar incidence for causes of acute abdominal pain. Sonography was diagnostic in 36 (61%) cases out of the 59 evaluated cases, and supportive in 10/59 cases (17%). NCCT, on the other hand, was diagnostic in 48 (81%) cases and supportive in 4/59 (7%) cases.

Acute Appendicitis

Sonography was diagnostic in 9/15 (60%) cases and supportive in 2/15 (13%) cases with a sensitivity of 60%. Similar findings were reported by Jeffrey RB Jr, *et al.*[11]. NCCT, on the other hand, was diagnostic in 13/15 (87%) cases with 87% sensitivity. 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 findings were in concordance with the findings reported by Malone[4], and Lane and Mindelzun[12]. 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 NCCT. Thus, NCCT was statistically significant than USG for Acute Appendicitis diagnosis ($P < 0.05$).

Acute Pancreatitis

Definitive diagnosis was made by NCCT in all of the 7 presenting cases (Similar findings were reported by Berger *et al.* [13]), as compared to Sonography, which could only diagnose 3 cases (42%), while it was supportive in 2 cases (30 %). These observed findings of our study are related to the findings of Husband *et al.*[14] who concluded in his study the supportive evidence percentage of USG to be 40 %. The sensitivity quotient for USG & NCCT was evaluated to be 43% & 100 % respectively in our study. Which statistically signify difference between USG & NCCT for diagnosing Pancreatitis (P value - 0.034).

Acute cholecystitis

Sonography was diagnostic in all of the presenting cases, while NCCT 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 Acute Abdomen. The findings elaborated in our present study

are in concordance with the findings reported by Cooperber *et al.* [15]. Which was statistically insignificant for NCCT with P - value of 0.114?

Ureteric Colic: NCCT was diagnostic in all 8 patients, while sonography was able to diagnose only 5 (63%) and supporting evidence in 1 case (12%). Nimkin *et al.*[16] reported similar sensitivity of USG (77%) NCCT could pick up calculi and proximal hydro-ureter in patient with normal usg findings. An overall positive predictive value and accuracy of NCCT in the presence of ureteric calculus was 100%. Our observations were similar to those by Dalrymple *et al.*[17] with sensitivity of 96%, specificity of 98% The P- value (0.040) obtained in our study also proves the statistical significance of NCCT over USG for diagnosing Ureteric Colic.

Acute intestinal obstruction

Sonography was diagnostic in 4/6 (67%) cases and had 50% accuracy in determining the etiology & site of obstruction. Meiser and Meissner [18] and Suri *et al.*[19] reported similar findings in their studies, except for the identification of the etiology of obstruction for which they reported values as low as 20% and 23% respectively. NCCT was diagnostic in 5/6 (83%) cases. Similar observations were reported by Suri *et al.*[7, 6] for the CT diagnosis of bowel obstruction and etiology.

Bowel perforation

Sonography was able to pick-up free air in one of the cases. Statistical analysis calculated the sensitivity of USG to be 33%. On NCCT, evidence of pneumoperitoneum was seen in all the 3 cases (100%). So an overall accuracy, sensitivity, specificity for pneumoperitoneum (bowel perforation) was found to be 100%. Which is statically significant? Similar findings were also reported by Stapakin and Thickman[20].

Tubo-ovarian masses

Ultrasonography was diagnostic in all 2/2 (100 %) cases, while NCCT was only supportive in these instances as we could not evaluate a definitive mass on NCCT, while Hiatus hernia, Diverticulitis and gossypiboma was completely overpowered by NCCT over USG, which gave 100% positive predictive value of NCCT in diagnosing these cases

CONCLUSION

We conclude that the Sonography is a very sensitive modality when there is an adequate visualization of abdominal structures and it should remain the initial investigation modality for Hepatobiliary, Renal, Gynecological emergencies and thin built patients. Nevertheless, since a sonographic examination may be unsatisfactory (observer dependent, presence of bowel gases, obesity) in a substantial proportion of instances, there should be no

hesitation in resorting to an NCCT examination to demonstrate the precise cause of acute abdomen.

This protocol as we feel will result in a cost-effective means of finding the cause of acute abdomen by pulling in an accurate, proper and timely diagnosis and prospectively reducing the undue surgical interventions and henceforth reducing the psychological & financial pressure and delineating the unwanted duration of stay in the hospital. Single shot NCCT screening has a low radiation exposure as compared to multiple, continuous scans done in case of contrast administered CT scans, and also it limits the patient from undergoing a series of plain X-ray projections that eventually overpower the radiation exposure of NCCT.

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