Non-traumatic Acute Abdomen Evaluation# 
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ABSTRACT
The term “acute abdomen” defines a clinical syndrome characterized by the sudden onset of severe abdominal pain requiring emergency medical or surgical treatment. A prompt and accurate diagnosis is essential to minimize morbidity and mortality. The differential diagnosis includes an enormous spectrum of disorders ranging from benign self-limiting diseases to conditions that require emergency surgery. The clinical diagnosis of acute abdomen can be challenging because physical examination clinical presentation and laboratory examination are often non specific and non diagnostic. It is often difficult based on history and physical examination alone to separate these patients from those who require immediate surgery. The increased availability and use of computed tomography (CT) and Ultrasonography (US) have dramatically changed the clinical examination and treatment of patients who present with acute abdominal pain. These noninvasive imaging techniques have effectively replaced exploratory as the primary means of examining patients who present with what was formerly known as a surgical abdomen.

KEYWORDS: Acute abdomen, Appendicitis, Renal colic, Pancreatitis, Cholecystitis

INTRODUCTION
Plain radiographs through often the first mode of investigation especially in developing countries, are nonsensitive and mostly non-specific.

US does, however have certain specific advantages. US does not require ionizing radiation, which can be important in children and pregnant women[5]. US is a dynamic, noninvasive, rapid, reliable, cost-effective way of aiming. It allows precise correlation of the area of maximum tenderness or palpable mass.

Multi slice helical. CT(2)(5) is increasingly replacing plain radiography and US for the evaluation of patients with acute abdominal pain[1,3,6-8]. CT is not disturbed by gas and bone and obesity is even advantage. Most of all, Plain Radiography and CT are not operator dependent and can be reviewed by others, even at a distance.

MATERIAL AND METHODS
This present prospective study, “Radiological Evaluation of Non-traumatic Acute Abdomen” was carried out in the Department of Radio diagnosis of Santhiram Medical College and General Hospital, Nandyal, Andhra Pradesh, India.

We have also excluded hollow viscous perforation cases. The perforation itself is a major emergency condition.

Patients presenting with clinical features suggestive of acute abdomen were evaluated with full plain radiographic series[10] (erect chest, erect and supine...
This study aimed at analyzing the various imaging features on plain radiographic series, US and CT scan in detail and suggests the likely disease process based on the characteristics like age, sex epicenter of lesion, Plain radiographic features, US characteristics and CT morphology etc.

THE METHODOLOGY

Sample Size: About 200 patients attending the casualty of Santhiram Medical College and General Hospital with clinical features of non-traumatic acute abdomen, during March 2008 to April 2010.

- Brief clinical history was taken and Clinical examination findings were recorded.
- The necessary biochemical investigations were done as per the requirements of the case under study, including.
  - Haemogram, urine analysis, blood grouping, blood urea, serum electrolytes, random blood sugar, LFT etc.
  - Emphasis was on differential leukocyte count in case appendicitis and serum amylase in pancreatitis.

RESULTS AND DISCUSSION

The present study is based on evaluation of 200 patients presenting with non-traumatic acute abdomen to the casualty of Santhiram Medical College and General Hospital and their follow up during the period from March 2008 to April 2010.

The sex incidence of patients presenting with acute abdomen[4]. Males were seen to be more commonly affected (115 cases - 57.5%) than females (85 cases - 42.5%) Acute pancreatitis was seen to occur predominantly in males, alcohol intake being the commonest etiology. Acute appendicitis showed no particular sex predilection. Acute Cholecystitis however showed a marginally greater female predilection.

Majority of the cases were due to renal colic (28%). Next in the order of increased frequency, acute appendicitis (21%) and acute cholecystitis (18%). The next in order was. Acute Pancreatitits (15%). There were numerous other conditions (18% cases) most common being bowel obstruction and bowel perforation (33.33% each) cases. Acute Pyelonephritis, Empyema gall bladder, Epiploic appendagitis, Portal vein thrombosis, renal vein thrombosis and others accounted for the remaining.

Acute Appendicitis On plain radiography[9], Fluid levels localized to the caecum and /or terminal ileum was the most common feature (14.28% of cases). Localized ileum with gas in the caecum / ascending colon and /or terminal ileum was seen in (9.25% of cases) while increased soft tissue density of the right lower quadrant was noted in 4.76% of cases.

On US, wall thickening (target sign), was the most common feature (71.42%). Lumen diameter greater than 6mm was seen in 76.19% cases while a positive sonographic. McBureny’s sign was noted in 66.67% of the cases. All cases in our study had a raised differential leukocyte count with neutrophil predominance.

The corresponding CT scans reveled mural enhancement in all the cases (100%) and wall thickening in most of them. Lumen diameter greater than 6mm was the next most common finding (80.95%) and fat stranding was helpful whenever present (71.42%). After the IV administration of iodinated contrast material, either a homogenous or mural or a stratified configuration target appearance of mural enhancement is seen in the wall of the appendix. The wall of the appendix is often mildly thickened.

The arrowhead sign was reported to be present to be present in 30% of 56 patients with appendicitis and it was not present in patients without appendicitis. The sign is clinically useful but it is not specific because other processes may cause spasticity and focal thickening at the tip of the cecum including cecal diverticulities, typhilitis and cecal carcinoma.
Appendicolith was observed in only 11.90% of the acute appendicitis cases in our study. Complications in the form of perforation and abscess formation were observed in another 18% of the cases. Abnormality suspected on US could detect the abnormality, confirmation of the diagnosis on CT scans and per operative. In a review of 22 patients with perforation of appendix, the signs of perforation were (1) If the symptoms are present for more than 72 hours and (2) if a right lower quadrant mass is palpated. The sonogram demonstrates findings that suggest a phlegmon, pericecal inflammation or an abscess. CT is done to distinguish a periappendiceal phlegmon from a liquefied abscess, it can better define the extent of an abscess and it can be used to guide interventional drainage procedures, including percutaneous catheter placement.

In our study, the efficacy of Plain radiography in diagnosing acute appendicitis is 28.57% and that of US is 76.19% while that of CT is 90.47%. In out study, the ‘Indeterminate’ cases were taken as negative on both plain radiograph and US. This included cases needing further workup with CT or other investigation and those needing further confirmation. US could not diagnose four cases of Appendicular abscess, which probably contributed to the higher false negative rate.

The characteristic features of acute pancreatitis that were commonly used arrive at the diagnosis on plain radiography. The Colon cut off sign was used to diagnosis acute pancreatitis in (13.33%) of cases and the sentinel loop sign in (10%) of cases of our study.

On ultrasound altered (hypoechoic) echotexture was used to diagnosis acute pancreatitis in majority of cases (66.67%) of our study, along with an enlarged edematous gland in 63.33% of cases. These findings were correlated with raised serum amylase to further the diagnosis. All thirty patients in this study had biochemical evidence of acute pancreatitis.

The pancreas may appear normal in acute edematous pancreatitis. The interstitial edema that characterizes edematous pancreatitis, however, results in a diffusely enlarged hypo echoic gland. In our experience, this may occur in only about one third of patients with acute edematous pancreatitis. Although the intra pancreatic changes in size, echogenicity and ductal dilatation are often reliable evidence of acute pancreatitis, they were not invariably present. Moreover, Poor sonographic window due to overlying bowel gases or the non-fasting patient in the emergency scenario lower the sensitivity of US.

In higher grades of pancreatitis fluid collections are seen -20% of our cases, most commonly in the lesser sac (3 cases) anterior pararenal space (2 cases) and the interfascial planes (1 cases). The most common extra pancreatic sites of involvement included the lesser sac, anterior pararenal space, transverse mesocolon and pararenal space.

Peripancreatic fat stranding/inflammatory changes were present in 93.33% of the cases on CT imaging. The gland was edematous, enlarged in 86.67% patients. The difference was because, in subtle cases of pancreatitis, the gland per se was not enlarged but fat stranding was noted. CT helps in grading the severity of pancreatitis, as most patients with severe pancreatitis exhibit one or several fluid collections. Non-enhancing necrotic areas were seen in 73.33% patients. In our study CT was 100% sensitive and specific in detecting necrosis, which has a prognostic significance for acute pancreatitis. There were no false positive or false negatives CT is used in assessing acute attacks and complications of acute pancreatitis.

In our study, Plain radiography was 26.67% US was 66.67% efficacious as compared to CT imaging which showed 93.33% accuracy for diagnosing acute pancreatitis hence making CT the gold standard for this entity.

Acute cholecystitis: Plain radiography US and CT in evaluating acute cholecystitis. The most commonly used parameter used in assessment on plain radiography, US and CT were opacities over gall bladder Calculi, a positive sonographic Murphy’s sign and gallbladder wall (GB) thickening (19.44% was
distended in majority (>4 mm, Calculi were observed in 72.22% of the cases - suggesting the most prevalent etiology. The most sensitive criteria are gallstones in association with focal gallbladder tenderness (Sonographic Murphy’s sign) (2).

In the experience of Ralls et al. there is a positive predictive value of 92% for acute cholecystitis when cholelithiasis and a positive sonographic. Murphy’s sign are present. Also highly predictive for acute cholecystitis is a stone impacted in the gall bladder neck or cystic duct, Diffuse gallbladder thickening is present in approximately 50-75% of patients who have acute cholecystitis; this finding is found in approximately 50-75% of patients with chronic cholecystitis. Only four cases, in which no calculi were found (12.5%)-Suggesting acalculous cholecystitis. However, no etiology was noted for these Acalculous cholecystitis occurs in approximately 5-10% of patients with acute cholecystitis.

Comparison of accuracy of C.T. diagnosis of Bennett and et al. and our study

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<th>Study</th>
<th>Accuracy of CT diagnosis acute cholecystitis</th>
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<td>Bennett et al.[11]</td>
<td>94.3%</td>
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<tr>
<td>Our Study</td>
<td>86.11%</td>
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In the accuracy of CT diagnosis of Acute cholecystitis, in our study is 86%. It is slightly less than Bennett et al. study.

In two cases (11%) complications in the form of GB perforation had occurred. Both could not be detected on plain radiography. US was done. One could not be detected on US, however in the other, a diagnosis was suggested, though CT confirmation was needed. The former showed GB calculi. While the latter had large calculi in the terminal ilum-gallstone ileus. Gallbladder perforation, which is reported in 5% to 10% of patients with acute cholecystitis has a morality of 19-24%. The majority of perforations occur at the fundus, the area with the sparsest blood supply.

CT detected wall thickening and mural enhancement in 86.11% of the cases and calculi in 72.22%. In this prospective study. Plain radiography was done followed by US and then by CT. Hence a targeted approach was taken using thin 3 mm slices in the suspected/positive cases. However, this introduced an observer bias and a dedicated gall bladder study, due to which a true sensitivity could not be observer bias and a dedicated gall bladder study, due to which a true sensitivity could not be evaluated. However, once suspected, the specificity is comparable to plain radiography and US.

At CT, findings with the highest specificity for gangrenous cholecystitis[11] are gas in the wall or lumen (100%) intraluminal membranes (99.5%) irregular or absent wall (97.6%) and abscesses (96.6%) (139). In difficult cases, CT is most sensitive for confirming gas in the gall bladder wall or lumen It also allows distinction between gas and wall calcification, as is seen with porcelain gall bladder. CT should also be performed in patients with acute right upper quadrant pain in whom the gall bladder is not definitely identified at sonography because a gas-filled gallbladder may be mistaken for gas-filled bowel with dire consequences.

In our study, plain radiography has an accuracy of 19.44% US has an accuracy of 91.67% for diagnosing acute cholecystitis and CT shows 86.11% accuracy. According to our study, US is a better modality than CT for acute cholecystitis. A study by Gupta et al., Ultrasound was 100% accurate in diagnosing acute cholecystitis.

US is also superior to computed tomography (CT) as the initial imaging investigation for assessment of biliary disease causing acute right upper quadrant pain. This view is supported by a study by Harvey et al. where CT was the initial imaging study in 57 patients and CT findings resulted in under diagnosis. Follow-up US performed within 48 hours of the CT, suggested the correct diagnosis and provided additional clinical information in seven of these eight patients.
Non-traumatic Acute Abdomen Evaluation

US is also superior to plain radiography as the initial imaging investigation for assessment of biliary disease causing acute right upper quadrant pain. This view is supported by a study by Gupta et al. in 13 cases of acute cholecystitis, plain X ray abdomen was positive in 1 case only which showed multiple radiopaque shadows in were observed as thickened gall bladder wall (more than 3 mm) with wall oedema in all cases, Cholelithiasis in 12 cases, sonographic Murphy’s sign in seven cases, sludge in three cases, Pericholecystic collection in three cases. CBD stone in one case. Thus diagnostic accuracy of 100% was found in gall bladder pathology on ultrasound.

A plain radiography shows an incidence of 10-15% radioopaque stones. Thus a negative plain radiography presents to be little value in excluding gall stones on a simple abdominal rdiograph In our study gall bladder stones were present in 3 (7.5%) out of 40 cases.

Renal Colic: Radiography, US and CT for renal colic patients. A calculus/calculi were detected on plain radiography in 66.70% on US in 89.28% and on CT in 100% of the cases. On US, Hydronephrosis was observed in 71.42% patients. However, where no calculus was detected (often due to poor window over the ureters) hydronephrosis was used as an ancillary sign to further workup for a calculus.

In our study, as compared to plain radiography (66.07% accurate) and US (89.28% accurate) CT detected all calculi (100% specificity) and hydronephrosis in 71.42% of the cases. In our study CT gave better results. Here again, thin 5 mm thin slices were used in the suspected cases.

Carpenter et al. in a study of 112 patients showed that radiography of the kidneys, ureters and bladder (KUB) has a sensitivity of 84% specificity of only 64% and an accuracy of 74%, when unenhanced helical CT was used as the standard of reference.

In a study with 69 patients, the mean diameter of ureteral calculi that underwent spontaneous passage was approximately 2.9 ± 2.0 mm. where the mean diameter of ureteral calculi for which conservative therapy failed was 7.9 ± 3.3 mm. this difference was statistically significant.

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<th>Study</th>
<th>Accuracy of CT in renal/ureteric calculi</th>
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<td>Smith et al.</td>
<td>94%</td>
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<tr>
<td>Our study</td>
<td>100%</td>
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In diagnosing urinary calculi we achieved 100 % accuracy and findings are comparable with Smith et al. Pitfall is the false negative CT study. False-negative results have been reported with rates ranging from 2-7%. This result has been attributed to a probable combination of volume averaging (Small stone size relative to collimation) and stone composition.

The remainder of the cases was categorized as miscellaneous. Majority were perforation and bowel obstructions. Intussusception being the most common. In our study there were two ileocolic intussusceptions. Another was colo-colic intussusceptions with a lipomatous lead point. There were two cases of ileo-ileal intussusceptions with pedunculated ileal polyp was lead point. A case of obstructed right femoral hernia was also documented.

Four cases of intestinal obstruction due to adhesions were documented preoperatively plain radiography was 100% diagnostic in GIT perforation and bowel obstruction.

There were 5% cases of Acute Pyelonephritis both could be diagnosed with CT but negative on plain radiography and missed on ultrasound.

During this study, we also came across two cases of Epiploic appendagitis, both of which presented with right/left lower quadrant abdominal pain[1] and clinically suspected appendicitis. However, plain radiograph was negative but US revealed an oval hyperechoic non compressible mass <3 cm in size at the pints of tenderness just under the anterior abdominal wall. Further work up with CT was confirmatory of Epiploic appendagitis with the characteristic hyper attenuating rim and the central dot sign.
Portal vein thrombosis and renal vein thrombosis on US were characterized by lack of blood flow in the respective veins and in the presence of a clear window echogenic debris filling the lumen may be visualized. CT may give a complete picture by showing the prominent vein with non-enhancing Hypodense thrombus with/without peripheral rim enhancement but plain radiographs were non contributory. There were two cases of splenic infarct, which were negative on plain radiograph and missed on US, CT however, showed a peripheral wedge shaped perfusion defect. This goes to show that the sensitivity and specificity of US is operator dependent.

Histopathological correlation was available in two of the cases in our study. One was a jejunal adenocarcinoma causing acute bowel obstruction at the duodeno-jejunal flesure. The other was benign right paraovarian cyst adhering to pericolonic fat causing acute bowel obstruction.

In our study overall accuracies of plain radiography, US and CT in the evaluation of patients with non-traumatic acute abdomen were 42.59, 77.54 and 93.98% respectively. In study by Mac Kersie et al. the accuracies of plain radiography and CT were 56% and 95.6% respectively.

Our findings are comparable with Mac Kersie et al. study in CT in non-traumatic acute abdomen cases where as radiography findings are slightly less accurate.

A study by Gupta et al., ultrasound was highly accurate in diagnosing the exact cause of acute abdomen with high overall predictive accuracy of 98.3%. In our study the overall accuracy of US in the evaluation of patients with non-traumatic acute abdomen was 77.54%.

There were thirty cases that were clinically suspected acute appendicitis/Acute pancreatitis/Acute cholecystitis/renal colic but were found to be negative on plain radiography. US and CT. Patients did not return with pain on follow up. They constituted the true negatives of the study.

SUMMARY AND CONCLUSIONS

US and CT findings were carefully recorded in each case:

1. No particular age bracket was noted for patients presenting with acute abdomen.
2. We observed a greater male distribution (57.5% of the study population). This may be due to the exclusion of gynecological cases, which constitute significant female case burden.
3. Acute pancreatitis was more often seen in males, especially in alcoholics, while acute cholecystitis showed a higher incidence in fatty females. The other conditions had no distinct age or gender distribution.
4. Single most common cause of non-traumatic acute abdomen was renal colic and accounted for 28% of the cases. Second commonest being acute appendicitis (21%) followed by acute cholecystitis (18%).
5. The characteristic target sign and a dilated tubular non-compressible, non-peristaltic structure in the right iliac fossa most commonly aids in the diagnosis of acute appendicitis on US.
6. US is more sensitive and specific for acute cholecystitis, with the advantage of more interactive scanning with patient guidance over the site of

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<th>Study</th>
<th>Overall accuracy of plain radiography in non-traumatic acute abdomen</th>
<th>Overall accuracy of CT in non-traumatic acute abdomen</th>
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<tr>
<td>Mac Kersie et al.</td>
<td>6%</td>
<td>95.6%</td>
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<tr>
<td>Our study</td>
<td>42.59%</td>
<td>93.98%</td>
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maximal tenderness. The same principle also comes of aid in acute appendicitis.

7. Plain radiography can diagnose the acute pancreatitis by revealing colon "colon cut off sign" and "sentinel loop sign" but has limited role. US can diagnose acute pancreatitis, limitation being poor sonographic window and the nil per oral status of the patient CT is than an advantage and is more sensitive and specific.

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REFERENCES


