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# Comparison Between Ultrasonography and Multi-Detector Computed tomography in evaluation of Acute Abdomen

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## Abstract

*Background: Non-traumatic acute abdomen is a frequently encountered condition in emergency medicine. Both ultrasound and CT scans are essential diagnostic tools for evaluating this condition. However, there are variations in terms of cost, time, sensitivity, and accuracy between these modalities.*

*Aim: Our study aims to compare a Multidetector CT scan with Ultrasonography to detect and evaluate the cause of abdominal pain.*

*Patient and methods: This prospective interventional comparative randomized study involved 55 patients with non-traumatic Acute Abdomen. The initial examination consisted of a standardized clinical history, physical examination, and laboratory examination. An abdominal ultrasound was performed for all cases, and MDCT was performed to complement the ultrasound results.*

*Results: The study revealed that CT is more sensitive in most cases of Acute Abdomen; however, in cases with Acute cholecystitis, Ectopic pregnancy, and ovarian torsion, the Ultrasonography was enough.*

*Conclusions: Ultrasonography has played a significant role in assessing the acute abdomen due to its accessibility, affordable cost, and lack of ionizing radiation or requirement for contrast materials. On the other hand, a CT scan is a quick and reliable imaging technique that is commonly used as the initial diagnostic tool for patients experiencing acute abdominal pain. It offers high accuracy in the diagnostic evaluation of such cases.*

*Keywords:* CT; USG; Acute Abdomen

## 1. Introduction

Acute abdomen refers to a range of medical, surgical, and gynaecological conditions that can vary in severity from minor to life-threatening. These conditions require hospital admission, thorough investigations, and appropriate treatment. The causes of acute abdomen can vary widely, ranging from benign and psychogenic pain to potentially fatal aortic dissection. It is estimated that acute abdomen accounts for 7-10% of all Emergency Department visits.<sup>1</sup>

The symptoms of acute abdomen can range from a mild, dull ache to severe guarding and rigidity, often accompanied by systemic symptoms. For a surgeon treating a patient with an acute abdomen, it is crucial to have a comprehensive understanding of the various causes of this condition and to ensure prompt treatment. To aid in this process, appropriate

radiological tests should be conducted to enable a quick and definitive diagnosis.<sup>2</sup> Despite the availability of advanced radiological diagnostic tools such as ultrasound, CT scans, and MRI, a simple upright abdominal X-ray is still frequently used as the initial investigation. Once a definitive radiological diagnosis is made, appropriate treatment can be administered.<sup>3</sup>

Ultrasound (US) is commonly employed in diagnosing patients with acute abdominal pain. It is important to note that ultrasound provides real-time, dynamic imaging that can reveal the presence or absence of peristalsis and demonstrate blood flow. Furthermore, ultrasound findings can be correlated with the area of greatest tenderness. Ultrasound offers several advantages over CT, including its immediate availability in the Emergency Department, lower cost, and absence of radiation exposure.<sup>4</sup>

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Using of CT to diagnose acute abdominal pain has risen. This increase is attributed to the remarkable precision of CT scans in identifying specific conditions like appendicitis and diverticulitis.<sup>4</sup>

In cases of acute abdominal pain, a comprehensive abdominal scan is conducted following the injection of an iodinated contrast medium intravenously. While it is possible to perform an abdominal CT scan without a contrast agent, the utilization of contrast enhances accuracy and confidence in diagnosis. The administration of rectal or oral contrast can aid in distinguishing between fluid-filled bowel loops and abscesses in certain situations, but it can also significantly prolong a patient's stay in the Emergency Department.<sup>6</sup>

This study aims to compare a Multidetector CT scan with Ultrasonography to detect and evaluate the cause of abdominal pain.

## 2. Patients and methods

This research was conducted as a prospective observational study at the Department of Radiodiagnosis of Nasser Institute and El-Nil hospitals. The study involved 55 patients who presented to the emergency department with non-traumatic acute abdomen and were clinically diagnosed with acute abdomen. Before conducting the study, ethical approval was obtained from the Al-Azhar University Ethics Committee.

The study population consisted of both male and female patients, with ages ranging from 14 to greater than 82 years. The inclusion criteria for the study required patients to have abdominal pain lasting for more than 2 hours but less than five days. On the other hand, patients with traumatic conditions or those with mild and vague abdominal symptoms were excluded from the study.

The initial examination consisted of a standardized clinical history, physical examination, and laboratory tests. To complement the negative and suboptimal ultrasound results, an abdominal ultrasound was performed for all cases, followed by a multidetector row 16-slice helical CT scan. The abdominal ultrasound scanning was conducted systematically, investigating the entire abdomen for any general or organ-specific anomalies. Due to the acute presentation of the cases, the normal abdominal protocol, which includes fasting and a distended urinary bladder, was skipped. Gel was applied to the exposed abdomen, and the scanning was performed in a supine position using both longitudinal and transverse planes with the graded compression technique.

For the abdominal CT scans, a multidetector row 16-slice helical CT scanner was used. The

model CT scan protocol involved a scan with an effective A level of 165, 120kV, collimation of 2.5mm, slice width of 3mm, and a rotation time of 0.5s. Intravenous contrast (125ml.ultravist) and oral and rectal contrast agents were administered when necessary.

The findings of both the CT and ultrasound examinations of acute pain abdomen cases were analyzed to assess their effectiveness as diagnostic tools and their contribution to patient management. The Ultrasonography and computed tomography results were compared and correlated with each other, as well as with the clinical outcome and operative findings, if applicable.

## 3. Results

The research encompassed a total of 55 individuals who were patients at the radiology department of Nasser Institute and El-Nil hospitals. The average age of the patients was 37, ranging from a minimum of 14 years old to a maximum of 82 years old. The age group with the highest representation was 15-30 years, accounting for 41.8% of the sample, followed by the 31-40 age group at 25.5%. Out of the total sample, 37 were male and 18 were female.

Ureteric calculi were the most common cause of acute abdomen, accounting for 22% of total cases. The second most common cause of acute abdomen was acute cholecystitis and acute appendicitis (16%). This was followed by intestinal obstruction and perforation (7%), iliopsoas abscess, pancreatitis (5.5%), splenic infarctions, ectopic pregnancy, and diverticulitis (3.5%). Lesser common diagnoses were liver abscess, ovarian torsion, incarcerated hernia, and leaking AAA.

Table 1. Diagnosis

DIAGNOSIS	MALES	FEMALES	TOTAL	PERCENTAGE
URETERIC CALCULUS	9	3	12	21.8%
ACUTE CHOLECYSTITIS	2	7	9	16.3%
ACUTE APPENDICITIS	7	2	9	16.3%
I/O	4	0	4	7.2%
PERFORATION	4	0	4	7.2%
ILIOPSOAS ABSCESS	2	1	3	5.5%
ACUTE PANCREATITIS	2	1	3	5.5%
SPLenic INFARCTS	2	0	2	3.5%
ECTOPIC PREGNANCY	-	2	2	3.5%
DIVERTICULITIS	2	0	2	3.5%
OVARIAN TORSION	-	1	1	1.8%
LEAKING AAA	1	0	1	1.8%
LIVER ABSCESS	1	0	1	1.8%
INCARCERATED HERNIA	1	0	1	1.8%
ABDOMINAL MALIGNANCY	0	1	1	1.8%

Fifty-five individuals underwent ultrasonography (US) and the findings of USG examination were validated by the final

diagnosis. Within our research, USG diagnosis concurred with the final diagnosis in 67.3% of cases (37 individuals). Multi-detector computed tomography (MDCT) was performed on 43 patients, excluding those with acute cholecystitis and gynecological conditions.

In our study, a total of 12 cases of ureteric calculus were observed, with five of them being accurately identified through using of ultrasound (US). Among these cases, three involved stones located lower ureter, while one case exhibited a stone in the upper ureter and another case presented a mid-ureteric stone. USG also can assess hydronephrosis.

The sensitivity of USG and CT in the detection of ureteric calculi was 41.6% and 100% respectively.

Nine cases of acute cholecystitis were observed. Ultrasonographic characteristics of acute cholecystitis encompassed the identification of stones in seven cases and the presence of mud in two cases. Additionally, increased wall thickening was observed in eight cases, fluid collection in two cases, and an enlargement in both the width and length of the gall bladder in four cases. Notably, the sensitivity of ultrasonography in diagnosing acute cholecystitis was determined to be 100%.

Among the 9 cases of appendicitis, only 2 cases were not accurately diagnosed by USG. The remaining 7 cases were correctly identified as appendicitis by CT. USG features of acute appendicitis included non-compressibility, an increase in appendicular diameter and wall thickness, hyperechoic peri-appendiceal fat, fluid collections, appendicolith with a characteristic target sign on the transverse scan, and an appendicular mass.

The sensitivity of USG in diagnosing acute appendicitis was 77.7%, while CT had a sensitivity of 100%.

There were 4 cases of small bowel obstruction, with 3 of them was diagnosed by USG with findings like dilated fluid-filled intestinal loops and free fluid between the loops. However, 1 case was not correctly diagnosed through USG, due to Marked gas. This particular case was accurately diagnosed through CT.

The sensitivity of USG in diagnosing bowel obstruction was 75%, while CT had a sensitivity of 100%.

Out of the 4 cases of gastrointestinal tract (GIT) perforation, only 1 case was correctly diagnosed through USG. In the remaining 3 cases, ascites were observed through USG, which later turned out to be indicative of perforation through CT.

The sensitivity of USG in diagnosing GIT perforation was 25%, while CT had a sensitivity of 100%.

Among the 3 cases of iliopsoas abscess, only 2 cases were diagnosed by USG. One case was identified as a psoas abscess, while the other was an iliacus abscess. The third case, an iliopsoas abscess, was missed through USG, possibly due to the presence of multiple air loculi within the abscess. However, this case was accurately diagnosed through CT.

The sensitivity of USG in diagnosing iliopsoas abscess was 66.6%, while CT had a sensitivity of 100%.

Out of the three cases of pancreatitis, one case corresponded to the final diagnosis, while the other two cases posed challenges. In one case, the pancreas was obscured, and in the other case, the pancreas appeared normal in the ultrasound (US) examination.

The sensitivity of USG and computed tomography (CT) in diagnosing acute pancreatitis was 33.3% and 100% respectively.

There were two cases of splenic infarctions, all of which were accurately diagnosed using USG and confirmed through CT.

Cases with gynecological causes were correctly identified using USG and confirmed through laboratory results and operative findings.

The two cases of diverticulitis were not detected in USG examination. One case exhibited significant colonic gaseous distension, while the other case showed normal results in USG. Both cases were diagnosed using CT.

In the case of a leaking abdominal aortic aneurysm (AAA), ultrasonography successfully diagnosed the aneurysm with an intra-mural thrombus, but it failed to detect the retroperitoneal hematoma, which was diagnosed using CT.

There was one case of abdominal malignancy, where USG revealed pelvic masses and dilated bowel loops. This case was accurately diagnosed using CT.

Additionally, there was one case of a liver abscess where USG scan displayed reverberation artifacts within the liver. This case was correctly diagnosed using CT.

Lastly, one case of an incarcerated hernia was missed by USG examination due to edema in the skin and subcutaneous tissue. However, this case was correctly diagnosed using CT.

*Table 2. Sensitivity of USG and CT in diagnosis of acute abdomen*

DIAGNOSIS	NUMBER	US%	CT%
URETERIC CALCULI	12	41.6%	100%
ACUTE CHOLECYSTITIS	9	100%	-
ACUTE APPENDICITIS	9	77.7%	100%
SBO	4	75%	100%
PERFORATION	4	25%	100%
ILIOPSOAS ABSCESS	3	66.6%	100%
ACUTE PANCREATITIS	3	33.3%	100%
SPLENIC INFARCTS	2	100%	100%
ACUTE DIVERTICULITIS	2	0%	100%
ECTOPIC PREGNANCY	2	100%	-
OVARIAN TORSION	1	100%	-
LEAKING AAA	1	0%	100%
LIVER ABSCESS	1	0%	100%
INCARCERATED HERNIA	1	0%	100%
ABDOMINAL MALIGNANCY	1	0%	100%

#### 4. Discussion

Acute abdomen presents a crucial surgical spectrum that encompasses a wide array of conditions, ranging from mild and self-limiting ailments to urgent surgical emergencies. Nevertheless, it is important to highlight that only a quarter of individuals diagnosed with acute abdomen undergo surgical intervention. Hence, the clinical dilemma lies in ascertaining the necessity of surgical treatment for patients and identifying the precise cases where immediate surgical intervention becomes indispensable.<sup>7</sup>

Acute abdominal pain is a common occurrence in the Surgical Emergency Department (ED) and poses a considerable challenge for healthcare providers in terms of diagnosis. This condition is marked by the abrupt onset of intense abdominal pain, requiring urgent medical or surgical intervention. The majority of patients with acute abdomen experience a variety of symptoms, with abdominal pain being the most commonly reported. Depending on the underlying cause, patients may also present with additional symptoms such as nausea, vomiting, fever, and constipation.<sup>8</sup>

Ultrasound (US) is the preferred imaging modality for children, pregnant women, and young patients primarily because it does not involve ionizing radiation. Nevertheless, the emergence of CT has led certain medical practitioners to contemplate using MDCT as the preferred technique for assessing patients experiencing right iliac fossa pain.<sup>9</sup>

This investigation aimed to elucidate the role of multidetector CT in comparison to Ultrasonography in assessing non-traumatic acute abdomen. Furthermore, the study sought to evaluate the impact of initial ultrasonography examination on the management of acute abdominal pain, compare the findings of MDCT and USG in patients with acute abdomen, and

compare the results of MDCT and USG with operative findings and clinical outcomes of patients.

Although the primary focus of this study was on acute abdominal pain in general, it also explored several commonly encountered urgent diagnoses in patients with this condition, such as appendicitis, diverticulitis, cholecystitis, bowel obstruction, and perforated viscus.

To conduct this prospective observational study, the research was carried out at the Department of Radio-diagnosis of Nasser Institute and El-nil Hospitals. A total of 55 patients with non-traumatic acute abdomen who had been clinically diagnosed with acute abdomen were included in the study. These patients underwent evaluation using both Ultrasonography and computed tomography. Ultrasonography was performed initially, followed by computed tomography in symptomatic patients with negative USG scans and patients with suboptimal scan results.

The findings of the current study revealed that the mean age of the participants was 37.4 years, ranging from 14 to 82 years. The most prevalent age group was 15-30 years, accounting for 41.8% of the participants. This was followed by the age groups of 31-40 years and 41-60 years, each constituting 25.5%. The age group of individuals older than 60 years comprised 7.2% of the participants, with a male-to-female ratio of 2:1

A study was conducted to compare the efficacy of USG and CT in diagnosing acute abdomen, and the mean age of the patients was 49.2.

On the other hand, Ghimire et al. conducted a study to evaluate the significance of Ultrasonography in diagnosing individuals who experience non-traumatic acute abdominal pain. Their findings revealed a higher prevalence of females, with a male-to-female ratio of 1:1.8.<sup>10</sup> This difference is understandable as there are different geographic distributions and epidemiologic factors.

In our investigation, fifty-five patients underwent Ultrasonography (US), and USG findings agreed with the final diagnosis in 67.3% (37 patients) of the cases out of the total 55 patients. This result aligns with the findings of a previous study conducted by Rupinder et al., which reported a concordance rate of 70% (35 patients) between USG diagnosis and the final diagnosis in their study involving 50 patients.<sup>11</sup>

In our investigation, MDCT was performed on a total of 43 patients, excluding cases of cholecystitis and gynaecological conditions. The diagnostic results obtained from MDCT were found to agree with the final diagnosis in all 43 patients, indicating a remarkable accuracy rate of 100% for MDCT in our current study. Conversely, a study conducted by Rupinder et al. in 2019

reported that MDCT showed concordance with the final diagnosis in 47 patients, yielding an accuracy rate of 94% for MDCT.

In the study population, ureteric calculi emerged as the predominant factor contributing to the acute abdomen, accounting for 22% of all cases. Acute cholecystitis and acute appendicitis followed closely behind as the second most common causes, representing 16% of the cases. Subsequently, intestinal obstruction and perforation accounted for 7% of the cases, while iliopsoas abscess, pancreatitis, splenic infarctions, ectopic pregnancy, and diverticulitis constituted 5.5% each. The least frequently observed diagnoses included liver abscess, ovarian torsion, incarcerated hernia, and leaking abdominal aortic aneurysm, with a prevalence of 1.8%. In contrast, Kumar and Badhan's study identified acute appendicitis as the primary cause of acute abdomen.<sup>12</sup> Furthermore, according to the study conducted by Malviya et al., acute appendicitis was identified as the most prevalent acute non-traumatic abdominal emergency, accounting for 61.71% of all patients. Acute intestinal obstruction was observed in 10.79% of the cases, while hollow viscus perforation and acute cholecystitis accounted for 8.57% and 8.28% of the patients, respectively. The remaining cases consisted of acute pancreatitis (3.99%), liver abscess (3.25%), and Meckel's diverticulitis (1.40%).<sup>13</sup>

In their study, Panigrahi et al. (2021) discovered that peptic perforation accounted for the highest proportion of acute abdomen cases at 14%. Following closely behind, acute appendicitis was identified as the second most prevalent cause, with a prevalence rate of 12.9%. Conversely, the incidence of ureteric colic was found to be the lowest among the reported cases, constituting only 2.9% of the total cases (Panigrahi et al., 2021). Additionally, Mandhane and Mariyappa's previous investigation revealed that hollow viscus perforation was the most frequent cause of acute abdomen. Acute appendicitis ranked second, while acute calculus cholecystitis was identified as the third most common cause of acute abdomen.<sup>14</sup>

The variations in these occurrences could potentially be attributed to variances in demographic, ethnic, and dietary practices among the populations under investigation.

#### 4. Conclusion

USG has played a significant role in assessing the acute abdomen due to its availability, cost-effectiveness, lack of ionizing radiation, and need for contrast materials. On the other hand, CT is a fast and accurate imaging technique that is commonly used as a first-line diagnostic tool for patients with acute abdominal pain. In particular,

multidetector CT has been found to have a higher sensitivity in differentiating various causes of acute abdomen. One of the key advantages of CT is its ability to propose alternative diagnoses when the initial clinical diagnosis is uncertain, which is crucial given the wide range of diseases that can cause acute abdominal pain.

#### Disclosure

The authors have no financial interest to declare in relation to the content of this article.

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All authors have a substantial contribution to the article

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